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Sustainability Indicators for the Army Installation Management Command

Chris C. Rewerts, Michelle J. Hanson, David A. Krooks,
Gary G. Gerdes, Michael R. Kemme, and William T. Brown

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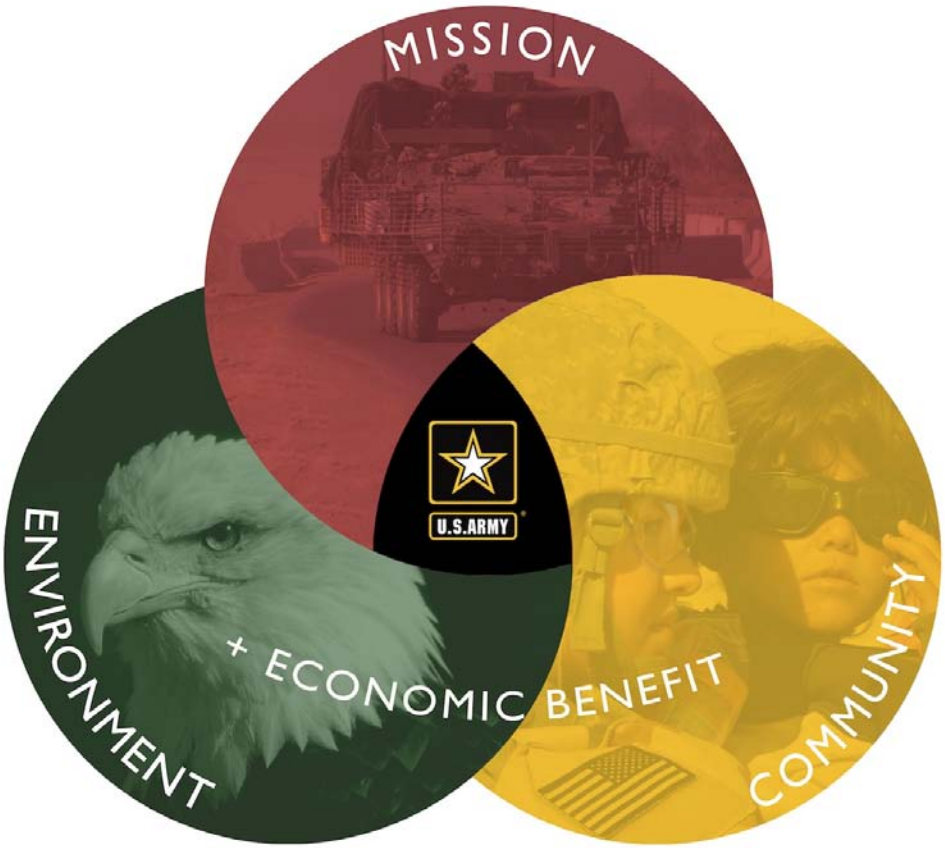

Construction Engineering
Research Laboratory

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Abstract: This study addresses indicators of sustainability. Such indicators differ from both sustainability goals and plans, and even from the implementation of actions that are believed likely to enhance sustainability. The indicators developed during this study are intended as direct measures of sustainability. The attributes of ideal indicators of sustainability are discussed. A set of indicators is defined that satisfy the criteria represented by those attributes. This ideal set of indicators is then confronted with Army data that might be used to derive values for the indicators. A set of six indicators and data sources is proposed for use by both the installations that are part of the U.S. Army's Installation Management Command (IMCOM) and by the Command itself.

Executive Summary

The United States Army Installation Management Command Headquarters (HQ IMCOM) tasked the Center for Advancement of Sustainability Innovations (CASI) with the creation of a set of indicators that would reveal the level of sustainability at each of its installations. The approach taken by CASI to develop this set of indicators involved the steps given here:

1. Determine the attributes of ideal indicators.
2. Define a set of indicators that had the desired attributes.
3. Compare the indicators with the metrics and goals developed by other efforts and refine the list as necessary.
4. Delineate the sources of data to be used to generate the indicator's value.

The ideal indicators were determined to have the attributes listed here, and a list of preliminary indicators was developed that meet these criteria.

- Indicators must measure sustainability, rather than merely quantify practices or actions that might be implemented as means of attaining sustainability.
- Indicators should represent elements directly related to mission.
- Indicators should report sustainability as a rate.
- Indicators should be independent of possible fluctuations in operations tempo (OPTEMPO), such as units deploying.
- Indicators should be applicable to any IMCOM installation.
- Indicators need to encompass the entire installation, fence line to fence line.
- Indicators should be easy to understand and should show status simply and clearly.
- Data must be readily available from which to derive the indicator's value.

In order to expose any deficiencies, those preliminary indicators were compared to metrics included in other approaches. The intention was to establish whether other approaches addressed a topic or topics important enough to require us to substitute it for one or more members of our set of

possible indicators. Appendix A reproduces tables that exhibit the comparisons between our approach and the following five other approaches.

- The Tri-Services Sustainable Communities Scorecard
- The SERDP-funded report by Alan Atkinson, David Berry, and Lee Hatcher (2009) entitled *Sustainability Assessment of a Military Installation: A Template for Developing a Mission Sustainability Frame-work, Goals, Metrics, and Reporting System*
- The College Sustainability Report Card
- Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, 5 October 2009
- The Army Sustainability Campaign Plan

The major outcome from comparisons between these documents and the preliminary set of installation sustainability indicators was the addition of an indicator (waste) that captures efforts toward the sustainable management of material resources. A proposed metric focused on infrastructure was deleted. What made the deletion of the infrastructure metric possible is the premise that any positive changes that an installation makes in the management of its infrastructure will result in improved performance against the water, energy, land, and waste indicators.

Ultimately, six installation sustainability indicators were selected, as defined here.

1. **Water:** water needed compared to water available
2. **Energy:** fossil fuel energy used per person
3. **Waste:** total cost per person of waste going to final disposal
4. **Land:** ratio of area of training land needed to accomplish the mission to area of training land available
5. **Economic Impact:** installation payroll compared to regional gross domestic product
6. **Well-Being:** installation's overall score from the dashboard developed by the Well-Being Division in Army G1 (Personnel).[1]

The indicators are designed to give each IMCOM installation a view of its own sustainability that is as straightforward as possible. The indicators are designed to allow HQ IMCOM to make informed decisions regarding sustainability efforts. This handful of indicators is intended to give as clear a

[1] The Well-Being indicator has not been finalized, pending G1 efforts to develop metrics in this area.

picture of sustainability as possible and to reveal trends at the installation, region, and enterprise levels.

The indicators offer a unique approach to monitoring sustainability. Many sustainability approaches merely aim at inspiring frugality. Others prescribe arbitrary numerical goals that are assumed (but not necessarily demonstrated) to result in improved sustainability. Still others merely tabulate a group of steps that might lead to enhanced sustainability.

The indicators proposed here are intended instead as direct measures of sustainability, such that an improvement in a given indicator's value over time actually demonstrates an improvement in sustainability. In short, this approach is unique because it sets out to answer the questions, "How sustainable are we?" and "Which way are we trending?" For example, a decrease in fossil fuel use shows an improvement in an installation's sustainability by directly correlating to a decrease in consumption of a finite and critical resource and a decrease in greenhouse gas emissions.

Furthermore, the set of indicators is broad-based and intended to address the sustainability issues vital to enduring Army mission success. The individual indicators also are easily understood and communicated, even by laypersons whose interest in sustainability might range from moderate to nonexistent. Perhaps most importantly, the indicators do not dictate what choices installations must make on their journey to improved sustainability. Instead, an installation is free to implement those actions most appropriate to its unique natural, economic, and cultural environments. The simplicity and breadth of the indicators provides the freedom to encourage systems thinking that is creative and crosses traditional domains.

Data that support many of the installation sustainability indicators are found in Installation Status Report – Natural Infrastructure (ISR-NI), Army Energy and Water Reporting System (AEWRS), and Solid Waste Annual Reporting (SWAR) system. It is expected that these data (and more) will be available in the Army's Strategic Management System (SMS). It is therefore expected that SMS will be the home for the installation sustainability indicators so that they ultimately can be of use not only to IMCOM and its installations, but also to the Army as a whole.

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Preface

This study was conducted for the U.S. Army Installation Management Command (IMCOM) under Project Number BK4914, "Analysis of Installation Sustainability Program Goals for IMCOM Futures Strategies". The IMCOM technical monitor was Mr. Matthew Barden, Program Analyst, IMCOM Strategic Planning Division.

The work was performed by the Land and Heritage Conservation Branch (CN-C) of the Installations Division (CN) at the Engineer Research and Development Center–Construction Engineering Research Laboratory (ERDC-CERL). Dr. Christopher M. White was Chief, CEERD-CN-C; Dr. John Bandy was Chief, CEERD-CN; and Mr. William D. Goran was Technical Director for Sustainable Programs and Director of the Center for Advancement of Sustainability Innovations (CASI). The Deputy Director of ERDC-CERL was Dr. Kirankumar V. Topudurti and the Director was Dr. Ilker R. Adiguzel.

The Commander and Executive Director of ERDC was COL Kevin J. Wilson, and the Director of ERDC was Dr. Jeffery P. Holland.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
British thermal units (International Table)	1,055.056	joules
gallons (U.S. liquid)	3.785412 E-03	cubic meters
pounds (mass)	0.45359237	kilograms

1 Introduction

1.1 Background

The U.S. Army is a leader and innovator in sustainability. About 2000, the Army Forces Command (FORSCOM) began the Installation Strategic and Sustainability Planning (ISSP) effort. This effort engaged installations and their surrounding stakeholder communities in identifying a range of goals and objectives to advance sustainability within the Army. The initial efforts of installations in strategic sustainability planning were affirmed and strengthened as Army leadership presented a sustainability vision in 2004 with the *Army Strategy for the Environment*,[2] which introduced the concept of the "Triple Bottom Line: Mission, Environment, and Community." In 2008, the first annual, Army-wide sustainability report was published.[3] None of these efforts were required by policy or regulation; instead, the Army saw sustainability as something important enough to its mission to take the initiative.

The Army continues to seek innovations on its path to sustainability while learning from its previous efforts. For instance, over 30 installations have implemented ISSPs. Unfortunately, this bottom-up approach has created a situation in which installations have established various sets of noble though possibly unattainable goals.[4] Army Installation Management Command (IMCOM) must now determine how to implement sustainability practices and infrastructure at installations and how to enhance sustainability within the Army.

To enhance Army sustainability, IMCOM needed the capability to determine how its available resources could best be used. To do this, IMCOM decided on an approach that would use a small set of carefully chosen indicators as a management tool to quantify installation sustainability and

[2] U.S. Army, 2004. Available at http://www.asaie.army.mil/Public/ESOH/doc/ArmyEnvStrategy.pdf (last accessed 19 September 2010)

[3] U.S. Army, 2007. "Sustainability Report 2007", Available at http://www.aepi.army.mil/docs/FINALArmySustainabilityReport2007.pdf (last accessed 19 September 2010)

[4] Lachman, B., E. Pint, G. Cecchine, and K. Collaton. 2009. "Developing Headquarters Guidance for Army Installation Sustainability Plans in 2007". RAND Corporation Report. http://www.rand.org/pubs/monographs/MG837/ (last accessed 8 February 2010).

begin to answer the question, "How sustainable are we?" Unlike ISSP goals that were defined independently at the installation level and were not comparable across installations, the installation-level set of indicators would be designed to allow the comparison of relative sustainability states and priorities across the IMCOM organization. The installation-level indicators could also roll up to the Army level to provide a more informed reporting of trends in the Army's annual sustainability report, while better informing installation-level ISSP goal setting.

1.2 Objective

The objective of this work was to develop a set of five to seven sustainability indicators for IMCOM's use at both the enterprise and installation levels. The indicators would measure progress toward sustainability that was due to the implementation of policy and other initiatives. While it may not be possible yet to quantify sustainability completely, the indicators are to be used as a relative or comparative measure of sustainability. Using available data, this initial set of indicators allows an organization to begin to answer the question, "How sustainable are we?"

1.3 Approach

Our development of a set of installation sustainability indicators has followed the path outlined here.

1. Define the attributes of ideal indicators. Given the small number, the set of indicators needs to cover the spectrum of sustainability and generate a big picture.
2. Prepare a list of ideal indicators that have the desired attributes.
3. Compare the indicators with other lists of sustainability metrics.
4. Discover and document sources of data that have the greatest ability to generate the indicators' value.
5. Negotiate between the ideal indicators and available data sources to determine practical indicators closest to the ideal.

1.4 Mode of technology transfer

This report will be made accessible through the World Wide Web (WWW) at URL: http://libweb.wes.army.mil/uhtbin/hyperion/CERL-TR-11-11.pdf.

2 Ideal Indicator Attributes

To accomplish the objective, the set of installation-level sustainability indicators should simply and broadly answer the question, "How sustainable are IMCOM installations?" in the areas of greatest importance to fulfilling the Army mission. To do that, ideally each indicator should have the attributes listed below.

- Indicators must measure true sustainability rather than quantify a practice or action used to enhance sustainability. Indicators need to focus on the ends (true sustainability), not the means to achieve those ends.
- Indicators should represent elements directly related to mission.
- Indicators should report sustainability as a rate.
- Indicators should be minimally influenced by fluctuations in operational tempo (OPTEMPO), such as units deploying.
- Indicators should be applicable to any IMCOM installation, making it possible to compare sustainability among all installations and combine indicators to look at the trends across the enterprise.
- Indicators need to encompass the entire installation, fence line to fence line; thus, the indicators should represent aspects of sustainability that can be affected by installation and IMCOM decisions and actions.
- Indicators should be easy to understand and should show sustainability status and trends simply and clearly.
- Indicators' values should be derived from data that is readily available.

To further elaborate on the first bullet point above, an indicator should not single out specific efforts that improve sustainability. Rather, an indicator should measure an aspect of sustainability that can be improved by the implementation of sustainable actions or practices. For example, it is better to monitor fossil fuel usage than the amount of renewable energy used. Using renewable energy is one of many options that could reduce dependency on fossil fuel. Monitoring sustainability rather than a single action or practice allows the installation freedom to implement measures appropriate to its location. Such implementation creativity and innovation will be best promoted by allowing flexibility whenever possible at the installation level.

The attributes of good indicators suggest that an indicator should be a ratio that represents a specific sustainability domain (energy, water, etc.) and then relates that domain to a common point of reference (per person, per square foot, etc.). When properly defined, each indicator is a metric that measures sustainability across installations and is independent of installation size or OPTEMPO.

For some indicators, the best resource usage rate is "per person." The per-person denominator addresses the impact of all who live and/or work on the installation. We recommend that the total population served, as reported in the Army Stationing and Installation Planning (ASIP) database, be used as the denominator to obtain a "per person" measure.

Another valuable resource ratio is to compare the amount of a resource that will always be available versus the amount of that resource an installation needs to sustain its mission. In this case, the level of sustainability improves as the value of this ratio becomes larger.

An indicator should be easy to understand. It should be like the gas gauge on an automobile dashboard that does not need to tell the driver the chemistry of combustion or the mechanics of using it for propulsion, but simply how much fuel is available. The driver easily knows what to do with the information.

To date, many sustainability efforts have focused on goals such as reduction of energy or water use. Without knowing the state of sustainability; such goals are only attempts at inspiring frugality. Sustainability means operating within our means. So-called sustainability goals often imply or state a prescriptive means to obtain them. In contrast, the design of the indicators outlined here may better empower Army personnel to employ systems thinking that will develop innovative processes and methods to support the mission.

An indicator must be based on information that is currently reported. Large amounts of information and data are already available to IMCOM via the Installation Status Report (ISR), the Army Energy and Water Reporting System (AEWRS), and other systems. The derivation and updating of the indicator values should require only a small amount of effort on the part of IMCOM personnel. Ideally, there will be no new reporting requirements placed on the installations in order to measure sustainability.

There is a tendency to focus on environmental compliance when establishing metrics for sustainability. Sustainability is about the stewardship of natural and human resources. While environmental compliance is certainly a tool of proper stewardship, it is not a measure of sustainability, nor is it the focus of any of the indicators developed as part of this effort.

3 Indicators

Our concise group of indicators has been defined in such a way that the attributes discussed in Chapter 2 affected the indicators' definitions as closely as possible. Those definitions with brief explanations are below.

1. **Water:** water needed/water available (maximum amount needed by the installation versus the amount available)
2. **Energy:** fossil fuel energy (BTU)/person (fossil fuel energy used per person)
3. **Waste:** total cost of waste going to final disposal per person (cost of solid waste + hazardous waste + construction and demolition waste disposal per person)
4. **Land:** area of training land available/area of land needed (acres available versus acres required to accomplish the installation's mission)
5. **Economic Impact:** installation payroll ($)/regional GDP (ratio of installation payroll to economic metric of the local community)
6. **Well-Being:** overall score from dashboard developed by the Well-Being Division in Army G1, Personnel.

The value of each indicator is not meaningful in isolation; it becomes meaningful when used in comparison to previous values and/or in comparison to other installations. The following sections discuss each of the above indictors in detail.

3.1 Water indicator

Water is critical to the Army's operations and mission because it is essential for human survival. Each installation must have a sustainable source of water and an appropriate infrastructure to deliver water where it is needed. The ideal indicator for water sustainability should take into consideration water availability and water usage. Most importantly, the amount of water that is available must always be greater than the amount of water that is needed if the installation is to be considered sustainable.

Globally, water is not a limited resource; two-thirds of Earth is covered with it. However, water is often a resource that is limited at the installation level. Thus the sustainability aspect of water is not a function of water being a finite resource, as it is for fossil fuel, but rather it is related to the

economics of obtaining water from the nearest source and then treating it. For instance, seawater is Earth's most plentiful source of water, but treating and transporting it long distances is usually not considered a viable option because of the high cost to do so. As a result, likely sources of water are normally surface fresh water or groundwater, both of which are limited in volume and of varying quality. As the cost of water goes up, alternative sources such as treated wastewater and collected stormwater become economically viable. However, these alternative sources do not actually become available until the necessary delivery infrastructure is in place. In order to evaluate the utility of alternate sources, IMCOM needs an indicator that will capture the notion of "available water."

The research team considered using the installation's cost of water as the sustainability indicator for water. The underlying assumption was that the availability of water would be reflected in its cost. The cost of water per person could then be used by IMCOM to determine where water conservation measures are most appropriate across the Army. A disadvantage to using cost as an indicator is that it tends to reflect current availability, but might not reflect long-term availability particularly well. Also, the cost for water currently is not reported to IMCOM, thus undermining using cost as an indicator. Since cost is not an effective indicator, indicators that measured availability were evaluated.

Measuring the availability of water is complex. Surface waters are limited by weather cycles, and groundwater is limited by recharge rates. Population growth also limits the long-term availability of water.

The Installation Status Report—Natural Infrastructure (ISR-NI) has standards that address the amount of water available versus the amount of water being used at an installation. From this, we can derive the installation sustainability indicator for water as the ratio of peak water usage to minimum water available. Chapter 4 discusses in detail the use of ISR-NI data for water availability.

Many installations are in areas where the water resources are already limited and require local or regional management. The water indicator will clearly reveal where use is relatively unsustainable, so that IMCOM can direct its sustainability efforts where they are most needed. The water indicator also allows an installation the flexibility to implement recycling, conservation, and other measures appropriate to its specific context.

As the value of this indicator increases, water sustainability decreases. And of course as the value decreases, water sustainability increases. The numerical value of the water indicator must be kept below 1.0 in order for water to be a sustainable commodity (i.e., water usage must not exceed water availability.

3.2 Energy indicator

By itself, energy use is not a sustainability issue. Similar to its total water resources, the Earth is awash in sustainable energy sources that are yet to be fully exploited. However, the currently used primary sources of energy are not sustainable.

Fossil fuel consumption is the most unsustainable current use of energy. Fossil fuel is a finite world resource and also is the most significant source of greenhouse gas emissions on Army installations. For these reasons, the energy indicator is defined as: energy (measured in BTUs) as derived from the amount of fossil fuel used per person.

By defining the energy indicator in this way, the installation is free to reduce fossil fuel consumption in a number of ways, such as through increased efficiency and/or use of various types of renewable energy. The installation can choose the approach that is most cost-effective and suitable for its infrastructure. This definition does not constrain the installation to the implementation of specific technologies.

Additionally, the quantity of fossil fuel use is essentially an indicator of CO_2 emissions. Thus, much of the data required for reporting greenhouse gas emissions can be used to calculate the energy indicator's value.

Military training and operations currently are dependent on energy derived from fossil fuels; thus, the energy indictor is directly related to mission fulfillment. Its critical nature is further supported by the existence of Army doctrine that addresses the logistics of providing liquid fossil fuel to support operations.[5] Because fossil fuel is a finite world resource, monitoring its use and reducing dependency on it are essential to making the Army's mission sustainable.

[5] Army field manuals do not specifically address any other material resource except water.

Reporting energy use is often limited to the amounts used in infrastructure and is normally reported as "per square foot." However, this measure does not represent total fossil fuel use that includes fossil fuel consumption by civilian fleet and tactical vehicles. An adequate indicator must include all fossil fuel use.

Even measuring total fossil fuel use would not offer an adequate indicator. Deployments have a significant impact on total energy use by dramatically decreasing the installation's resident population. If the indicator were to measure only total energy used without reference to population, or if it were to measure energy used per square foot, then it would falsely appear that significant improvement in energy efficiency had occurred, when it was caused merely by a temporary reduction in population. This false positive likely will not occur when the value of the energy indicator is calculated per person.

As the value of the indicator increases, the energy sustainability of the installation decreases. As the value of the indicator decreases, energy sustainability improves.

Data on Army energy use must be collected from several sources. Utility fossil fuel energy data can be collected from AEWRS, federal civilian vehicle fleet fossil fuel usage from the General Services Administration's (GSA) Federal Automotive Statistical Tool (FAST), and tactical vehicle fuel consumption from the Operating and Support Management Information System (OSMIS) relational database system.

3.3 Waste indicator

The waste indicator is defined as the cost per person to dispose of waste. The indicator's value will be the sum of final disposal costs for hazardous and non-hazardous wastes. That sum would also include costs to dispose of ash from incinerators and the disposal of construction and demolition waste.

When developing the waste indicator, two alternatives were considered for the numerator: cost and weight. Using weight as the measure tends to give a much greater importance to the minimization of non-hazardous waste disposal versus hazardous waste disposal. The per-pound cost to dispose of hazardous waste is normally much higher than the cost to dispose of non-hazardous waste, yet the total amount of hazardous waste generated

is much smaller than the amount of non-hazardous waste. It was assumed that the incentives to limit the disposal of hazardous and non-hazardous wastes should be as near equal as possible. Therefore, total cost was chosen as the numerator for this indicator because its use tends to equalize the incentive to minimize the disposal of both hazardous and non-hazardous wastes.

As with energy, the value of the waste indicator is not meaningful except for the purpose of comparisons to previous values and to other installations. Obviously, the goal will be to minimize the cost per person to dispose of waste at an installation. Minimizing cost encourages an installation to implement cost-effective measures to reduce its waste by methods such as recycling, reuse, reduction of packaging, energy recovery, product substitution, and composting. Because the indicator uses installation population as the denominator, its value is independent of population changes due to deployments.

Non-hazardous solid waste disposal cost data is being reported currently on the "Comprehensive Report" in the Solid Waste Annual Reporting (SWAR) system. Hazardous waste disposal costs can be obtained through a Defense Logistics Agency (DLA) Disposition Services database tool called the Environmental Reporting System (ERS).

3.4 Land indicator

An Army installation must have enough land available so that the training necessary to develop and maintain mission capabilities can be conducted. However, training land is often restricted by encroachment from nearby commercial and residential developments and by habitat requirements for threatened and endangered species. The Army Compatible Use Buffer (ACUB) system has been helpful in maintaining the availability of land on many installations.

The land indicator is defined as the ratio of the area of land needed to accomplish mission to the area of land actually available. Ideally, "land needed" would include all uses whether for maneuver training, structures, or industrial purposes. However, the amount of land supporting administrative and industrial use is trivial compared to the amount used for ranges. Thus, the land indicator can be limited to range land needed for maneuver training and weapons use. For the purpose of this indicator,

"land needed" is defined as the area of range land necessary to accomplish all required training by the tactical units dependent on that land.

"Land available" takes into consideration any land lost due to range management requirements (e.g., controls related to habitat, noise or dust), and any land lost due to outside-the-fence influences (e.g., encroachment). When the ratio of land needed to land available has a value of 1.0 or less, an installation has at least as much land as it needs. A ratio greater than 1.0 indicates the installation cannot fully accomplish its training mission because it needs more land than it has available.

3.5 Economic impact indicator

The economic impact indicator is included to represent the elements of community and economics that are reflected in the Army's concept of Triple Bottom Line – Plus (Mission, Environment, Community, Economy), as given in the *Army Sustainability Report* (2007). An installation interacts with the local community in many ways, not the least of which is the direct economic impact the installation has on the local economy by providing jobs to civilians and payroll to soldiers who live in the community. In return, the community normally provides retail, entertainment, and professional services; infrastructure to access those services; and utility services for use by the installation's military and civilian populations. The natural financial and social interactions between the installation and the local community often generate more formal interactions between installation command and local governments. Communities also may become involved in cooperative efforts to provide services used by installation personnel.

An ideal economic impact indicator would measure the relative health of the overall relationship between an installation and its local community. Unfortunately, there are presently no metrics that objectively measure that relationship. For instance, good will and cooperation are important but not easily quantifiable. Economic impact, however, is more easily quantifiable.

An installation's economic impact on the surrounding community includes: (a) jobs created inside and outside the fence line, (b) dollars inserted into the local economy through local acquisition, and (c) taxes generated for local governments. The installation has the most control over the amount of money inserted into the local economy, through purchases

and contracts with local vendors and through wages paid to military and civilian personnel at the installation. Quantifying local purchases might be a good measure of economic impact, were it not for Department of Defense (DoD) and Army policies that tend to centralize procurement, even of office supplies, for example. But for such policies, quantifying local purchases also would emphasize the sustainability principle of buying goods and services locally. Unfortunately, the amount of installation funding going toward the local economy does not appear to be reported or tracked.

Another possibility for an economic indicator is the effect wages paid to the military members and civilians have on the local economy. This effect can be measured by the ratio of total annual payroll to the regional gross domestic product (GDP). The economic indicator is then defined as: installation payroll (total population)/regional GDP. That ratio, or percentage, will tell HQ IMCOM the relative impact each installation has on the respective local economy. It also will indicate to HQ IMCOM the relative affect changes in mission or OPTEMPO have on the surrounding community. Using this measurement, the relative impact the installation has on the local economy, the greater the value of its economic indicator.

Data are available to support this indicator from two sources. The Bureau of Economic Analysis (BEA) provides data regarding regional GDP, and the human resources group within the Directorate of Resource Management should be able to provide payroll data.

3.6 Well-being indicator

> ...I sometimes feel like I live in a parallel universe. I sit through these briefings at the Pentagon, where I learn all about these great things that the Department of Defense is doing when it comes to family programs. But when I visit a base or a post and actually talk to military families, I sometimes hear a different story. (SECDEF Robert E. Gates[6])

The Army Mission is not sustainable without people. First and foremost is the well-being of soldiers and their families, plus that of Army civilians on the installation. Including well-being as an installation-level sustainability metric thus is important not only for the mission dimension of sustainabil-

[6] Town Hall Meeting at Fort Riley, Kansas, on 8 May 2010. Available at: http://www.defense.gov/Transcripts/Transcript.aspx?TranscriptID=4622

ity, but also for the community dimension. There is a continuum of possible indicators that starts with standard of living, moves through quality of life, and continues through well-being. First, "standard of living" normally includes measures such as income per person relative to poverty rates, and the access and quality of health care, education, services, and goods. Secondly, "quality of life" generally takes into account the material components in the standard of living but also considers less tangible life factors such as environmental quality, health, leisure, culture, and social life. Third on the continuum of indicators is "well-being" which is less involved with the outward aspects of people's lives and focuses on more inward and personal aspects such as physical, mental, and spiritual health.

Well-being, as defined by Army Command Policy:[7]

> Army Well-being is the personal—physical, material, mental, and spiritual—state of the Army Family, including Soldiers (active, reserve, and guard), retirees, veterans, DA civilians, and all their Families, that contributes to their preparedness to perform and support the Army's mission. The focus of Army Well-being is to take care of our Army Family before, during, and after deployments.

It makes intuitive sense that promoting well-being on the installation will benefit the sustainability of the Army mission. Reduced stress would improve safety, workers would be more productive, soldier retention would be higher, and there would be benefits to the surrounding community that likely would result in increasing support of the Army installation as a neighbor. The difficulty, in terms of indicator development, is how to quantify and measure well-being.

A number of possible sources were considered for well-being metrics within the Army. There are many programs that focus on soldiers and/or families; however, few result in quantifiable data.

[7] US Army. 18 March 2008. Army Regulation 600-20, Chapter 3, Section 3-2, p 20. Available at http://www.apd.army.mil/pdffiles/r600_20.pdf

3.6.1 Family, Morale, Welfare, and Recreation

The Family, Morale, Welfare, and Recreation (FMWR) function at installations is a well-being program that supports readiness by providing a variety of community, soldier, and family support programs, activities, and services. This variety includes social, fitness, recreational, educational, and other programs and activities that enhance installation life, foster soldier and unit readiness, promote physical and mental fitness, and provide a working and living environment that attracts and retains quality soldiers. The Army Regulation for FMWR, AR 215-1,[8] states, "programs are prioritized based on their impact on readiness." Unfortunately, we have yet to find any metrics that quantify this impact.

3.6.2 Climate surveys

A potential source for well-being metrics could be organizational climate surveys, such as those conducted on behalf of the Army Deputy Chief of Staff, G-1;[9] or by the Army Research Institute for Behavioral and Social Sciences (ARI).[10] What is not known is how well such climate survey results might reflect the effect that the installation has on the morale and well being of the soldiers and civilians, and how any connections to well-being can be made obvious. Furthermore, both groups conduct climate surveys only by authorized requests and do not release the results of the surveys except to the commander who requested them. Therefore, these surveys are not a potential source for well-being metrics that can be used across all installations.

3.6.3 The Army Family Covenant

The Army Family Covenant: Keeping the Promise[11] was introduced Army-wide in October 2007. It provides a compilation of information reported across the following areas of interest:

[8] http://www.army.mil/usapa/epubs/215_Series_Collection_1.html (last accessed 6 July 2010)

[9] For example, http://www.deocs.net/public/index.cfm (last accessed 6 July 2010)

[10] http://www.hqda.army.mil/ari/about/index.shtml, specifically, see http://www.hqda.army.mil/ari/pdf/surveysandtransformation.pdf (last accessed 6 July 2010)

[11] A brochure is available for download at the Army Family Covenant homepage (accessed July 2010)

- family programs and services
- health care
- soldier and family housing
- child, youth, and school services
- education, careers, and libraries
- recreation, travel, and BOSS (Better Opportunities for Single Soldiers)
- communities and marketplace

Although it does address topics of interest from the perspective of well-being, it is a compilation of success stories intended to articulate what the Army has done under each of the topic headings above. It is not a report against a specific plan or a specific program that establishes clearly defined measures of success.

3.6.4 Superior Quality Of Life Awards

In December 2010, the Office of the Secretary of the Army sought submissions for the third annual Superior Quality of Life Awards to installations. There are three awards, one each for a small, a medium, and a large installation. It was thought that the criteria used in selecting the winners of these awards might provide insight into an effective well-being indicator. While the criteria do include a category called "measurement of impact," the installation submitting its application must develop its own measurement method. Measurement methods are not provided by the submission website.[12] Therefore, the award selection criteria were not helpful in defining the well-being indicator.

3.6.5 Army recruitment and retention rates

Both Army recruitment and retention are considered as possible indicators for quality of life or well-being, since the trending of either rate could reflect a relative change in perceived well-being. We found recruitment to be an Army-wide issue and one that is not reported at the installation level. Similarly, retention is not an issue over which the installation can exercise control. Even if a causal link between well-being and recruitment or retention could be argued, the lack of reporting or influence at the installation level makes them poor choices as metrics.

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http://www.myarmyonesource.com/CommunitiesandMarketplace/ArmyFamilyCovenant/default.aspx

[12] www.acsim.army.mil

3.6.6 The Installation Management Campaign Plan and Quality of Life

The Installation Management Campaign Plan (IMCP)[13] contains a number of references that might suggest metrics useful to quantifying well-being. For example, in the section entitled, "Soldier, Family and Civilian Well-Being," we find the statement saying, "The Army Comprehensive Soldier Fitness (CSF) initiative focuses on sustaining resilience in our Soldiers, Families and Civilians through individual assessment and planning across emotional, social, spiritual, family, and physical domains. It provides one tool to measure the effectiveness of the AFC [Army Family Covenant]." The keystone of the CSF is the global assessment tool (GAT), which allows the Soldier to assess him-/herself "on the dimensions of emotional, spiritual, social, and family fitness."

The GAT[14] is a survey that takes about 10-20 minutes to complete and, at the end, presents the taker with a rapid estimate of his/her individual fitness in the following four dimensions: emotional, spiritual, social, and family fitness. The same GAT website's welcome page indicates that the Soldier will be able to see individual performance in response to training, experience, and maturity. The website continues:

> Additionally, beginning in FY 2010, the results will automatically develop an individualized profile to guide you through self-development training modules most appropriate for your stage and current level of performance in each dimension. The self-development training modules will provide you with real-time and interactive multi-media training... A complete transcript and record of the courses you complete will be stored in a database that allows you to display your training as a component of the Army Career Tracker.

According to ACSIM's website, [15] the program is intended to:

> ...develop and institute a holistic fitness program for Soldiers, families and Army civilians to enhance performance and build resilience [the ability to grow and thrive in the face of challenges and to bounce back from adversity]. As a result we will have an Army of balanced, healthy, self-confident

[13] References to IMCP are to the Version 1.0 Draft, date March 2010. Version 2.0 (Installation Management Community Campaign Plan 2010–2017) was released October 2010.

[14] See https://www.sft.army.mil/Protected/Secured/Welcome.aspx

[15] See http://www.acsim.army.mil/readyarmy/ra_csf.htm

> people whose resilience and total fitness enables them to excel in an era of high operational tempo and persistent conflict.

The same website also indicates, "Soldiers will take the GAT every two years or 120 days following contingency operation deployments. The reserve-component Soldiers are also able to take the GAT every two years, and within 180 days following contingency operation deployments." The opportunity to participate in the GAT survey recently has been made available to Soldiers' family members and to DA civilians.

Although it does appear that the Army expects to roll up GAT scores to the Army level, it is unclear whether or not it would be possible to use any such results as a metric at the installation level. Additionally, none of the CSF sources we have reviewed (and referred to in this report) indicate anything more than that changes in scores over time will be available to individuals. Thus, we do not see any possibility for adding information from CSF to the IMCOM installation sustainability indicators.

The IMCOM Campaign Plan also mentions the following:

- a metric defined as percentage change in the Military Family Life Counselor contacts and referrals;
- a summary report prepared by the Suicide Prevention Task Force to which garrisons submit data; and
- an ISR standard for alcohol-related incidents.

It is likely that these metrics would only weakly support an installation-level well-being indicator. Section 4.6 below contains the recommended course of action for developing a well-being indicator.

4 Recommendations for Data Sources

Chapter 3 of this report introduces the concept of sustainability and explores possible ways to measure it in the Army. The process of refining the recommended sustainability indicators starts with exploring the data that might support them. The goal of that exploration is to find data that matches as closely as possible to the ideal indicator metrics, and, whenever possible, was collected by the Army itself. For purposes of trending the various indicators, it is imperative that these data sources also have a long life expectancy.

When considering sources of data that might support indicators, it is important to remember the data's original purpose was to measure something other than sustainability. The goal is to find the closest fit possible between the desired characteristics of the sustainability indicators and the available data. This will be an iterative process because first, an ideal indicator definition may change to fit better with available data and secondly, over time the use of indicators may demonstrate a need for new data or other parties may suggest data that previously was not found in the course of preparing this report. The sections below describe information sources for each of the indicators. Example data are included whenever possible.

As a general rule, all the data used in calculating the value of a given indicator must be taken from the same range of dates. For example, if data from 2008 were used to calculate the water indicator value, all data used to develop that indicator value must come from 2008. On the other hand, it is possible (but not significant) that the data ranges for individual indicators may vary. That is, if the most recent data for the water indicator come from 2008, it is not critical (and may not be possible) that the data underlying the energy indicator also come from 2008.

4.1 Water indicator

Data for the water indicator can be obtained from the Natural Infrastructure section of the ISR database system. The Natural Infrastructure section has a subcategory for Mission Support – Water – Potable Water and this subcategory includes eleven standards. One of these standards, MS310-3, reports the percentage of available potable water used (based on peak daily demand) versus its lowest availability in the previous three years. This

measure is acceptable as the data source for this indicator for immediate use. However, the definition of "Total Available Water Supply" should be modified to consider long-term availability of water from its source. Other recommendations to correct the way water data are defined for input into ISR-NI series MS310 are in the Note below.

Calculating the water indicator will use the two data inputs for MS310-3: "Total Available Potable Water Supply" and "Total Water Used (Peak)." The water indicator will be a ratio of those two inputs. Table 1 (using notional data) shows an example of the water indicator values for four example installations.

Table 1. Water indicator example data as it would have been extracted from the Installation Status Report - Natural Infrastructure.

	Installation			
	Fort X	Fort Z	Camp A	Camp B
Total Water Used Peak (GPD)	8,060,000	9,000,000	5,400,000	5,500,000
Available Potable Water Supply (GPD)	16,050,000	23,300,000	6,000,000	14,000,000
Water Indicator	0.50	0.39	0.90	0.39

As seen in the above hypothetical example, Camp A is using the highest percentage of its available water supply. It would be concluded that IMCOM might consider prioritizing actions to improve water sustainability at such an installation.

As the value of this indicator increases, water sustainability decreases and as the value decreases, water sustainability increases. Water is a sustainable commodity when the numerical value of the ratio of the amount of water needed to the amount of water available is always kept below 1.0. A maximum acceptable value for this ratio of 0.5 has been set in the ISR-NI in order for an installation to achieve a "Green" rating.

Note: The input for "Total Available Potable Water Supply (Gallons)" is not meaningful as defined in the ISR-NI worksheet. Water stored in water towers should not be included in the quantity reported. The purpose of water towers is to provide a large volume of water for emergency purposes (e.g., fire fighting), and at some locations, to maintain a constant line pressure. Water stored in water towers is not used to meet average daily water

demand. If is recommended that the definition of available potable water be corrected in the series of ISR-NI indicators for potable water. Further, "Total Available Water Supply" should be reported in gallons per day (GPD), so that the units of measure for that input match the units for "Total Water Used." Making these corrections to the definitions used in the ISR-NI Potable Water Standards will result in changes to the installation inputs, and possible result in changes to ratings.

4.2 Energy indicator

Energy consumption on an installation can be broken down into electrical energy usage, fossil fuel combustion for utility purposes (e.g., distributed and central heating/cooling), fossil fuel combustion for military mobile sources, and fossil fuel combustion for federal civilian mobile sources. AEWRS contains information about both electrical energy consumption and fuel usage for utility purposes. FAST tracks vehicle fleet inventory, acquisition and disposal expenses, vehicle cost, miles driven, and fuel consumption. Tactical vehicle fuel consumption information can be found in OSMIS. The sections below will describe how energy information is collected for these categories by presenting example data for FY08 provided by Fort Hood, Texas.

4.2.1 Utility energy

Energy consumed at Fort Hood for utility purposes is shown in Table 2. The first section of the Utilities by Product report shows electrical energy consumption, and the second section shows natural gas consumption. No other fuels were reported in AEWERS for Fort Hood. AEWRS does not include renewable energy when utility energy consumptions are entered; thus, increased use of purchased or on-base renewable energy will lead to a reduction of the energy consumption values shown in Table 2. The report indicates 1,136,165 MMBTU of electrical energy and 891,988 MMBTU of natural gas were consumed by Fort Hood in FY08.

Table 2. FY08 Utilities by product report for Fort Hood, Texas (data source: AEWERS).

UTILITIES BY PRODUCT							
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48255 FORT HOOD							
Units Are: MMBTUs							
Prod Code	FY	Month	Building Consumed	Industrial Consumed	F. Housing Consumed	MSE Consumed	Total Consumed
ELC	2008	Oct-07	86,521	0	0	7,332	93,854
		Nov-07	76,064	0	0	7,315	83,379
		Dec-07	78,616	0	0	6,937	85,552
		Jan-08	81,612	0	0	0	81,612
		Feb-08	75,937	0	0	0	75,937
		Mar-08	88,395	0	0	0	88,395
		Apr-08	86,542	0	0	0	86,542
		May-08	102,831	0	0	0	102,831
		Jun-08	117,380	0	0	0	117,380
		Jul-08	118,676	0	0	0	118,676
		Aug-08	116,636	0	0	0	116,636
		Sep-08	85,372	0	0	0	85,372
			----------	----------	----------	----------	----------
		Total	1,114,581	0	0	21,584	1,136,165
NAG	2008	Oct-07	39,959	0	0	528	40,487
		Nov-07	83,125	0	0	752	83,877
		Dec-07	153,324	0	0	973	154,297
		Jan-08	201,858	0	0	0	201,858
		Feb-08	118,993	0	0	0	118,993
		Mar-08	111,493	0	0	0	111,493
		Apr-08	53,911	0	0	0	53,911
		May-08	35,083	0	0	0	35,083
		Jun-08	25,493	0	0	0	25,493
		Jul-08	21,812	0	0	0	21,812
		Aug-08	20,799	0	0	0	20,799
		Sep-08	23,884	0	0	0	23,884
			----------	----------	----------	----------	----------
		Total	889,735	0	0	2,253	891,988

Electrical energy purchased from the distribution grid in the United States will include different mixtures of renewable and non-renewable energy. One way to account for this is through the U.S. Environmental Protection Agency's (USEPA) Emissions & Generation Resource Integrated Database (eGRID) that contains unique CO_2, CH_4, and N_2O emission factors for 26 different geographic subregions in the United States. Figure 1 shows the eGRID subregions on a US map. The emission factors shown relate mass of greenhouse gas (GHG) emissions to purchased electrical energy and are based on the mixture of renewable and non-renewable electrical energy generation within the subregions. The eGRID subregions can be determined by zip code and the eGRID subregion for Fort Hood is ERCT. Information for ERCT obtained from the eGRIDWeb application[16] indicates that 86.5421 % of the electrical energy generation is from fossil fuel combustion. If this percentage is applied to the AEWRS electrical energy consumption of 1,136,165 MMBTU (Table 2), then 980,000 MMBTU of electrical energy consumption at Fort Hood is attributable to fossil fuel combustion.

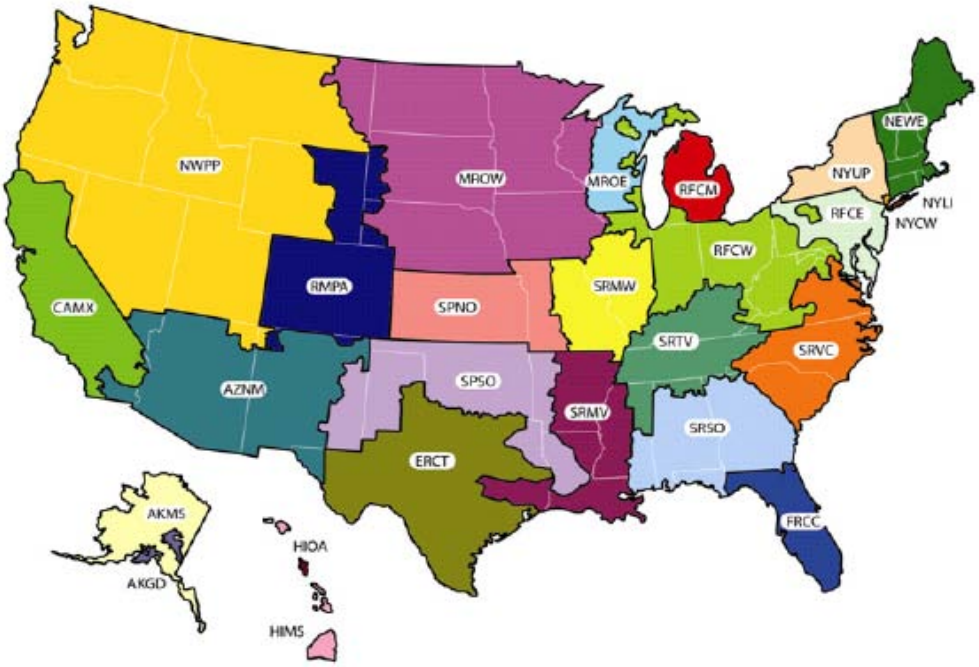

Figure 1. USEPA eGRID subregions.[17]

[16] See http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

[17] Image from USEPA Clean Energy eGRID website http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2007_eGRID_subregions.jpg

4.2.2 Army civilian fleet vehicle fuel consumption

As mentioned in Chapter 3, federal fleet fuel consumption information can be obtained from the GSA's FAST. FAST provides fuel consumption and fuel type data for each fleet vehicle. For Fort Hood, we obtained FY08 GSA FAST fleet data from the Directorate of Logistics Transportation motor pool and the Directorate of Public Works, which are the main two fleet vehicle organizations on the installation. Each fuel consumption record was converted to MMBTU and summed for the installation. This results in total energy consumption of 105,000 MMBTU by non-tactical fleet vehicles at Fort Hood during FY08.

4.2.3 Army tactical vehicle fuel consumption

As also explained in Chapter 3, tactical vehicle fuel consumption information can be obtained from OSMIS. OSMIS can generate reports that provide total fuel costs and fuel price information for tactical vehicles and weapon systems that fall into commodity groups. The commodity groups are Aviation, Combat, Electronic, Missile, Engineering, Armament, Medical, Tactical Vehicles, and Wheeled Combat. To generate the fuel consumption information for an installation, a report must be generated for each fuel type used by each commodity group. These reports are exported into spreadsheets through the OSMIS export feature. Each report will include a record for each of the weapon system and tactical vehicle types found on an installation. Fuel consumption information is calculated by dividing the total fuel cost for each weapon system by the price of the fuel. The fuel consumption must then be converted to MMBTUs. This is illustrated in Table 3, which contains a few of the records and a subset of columns from the Aviation Commodity Group report.

Summing the fuel consumption across all weapon systems in all commodity groups for Fort Hood for FY08 yielded a grand total of 4,807,000 MMBTU of energy consumed by tactical vehicles.

Table 3. Fuel consumption calculation example information from the OSMIS Aviation Commodity Group for Fort Hood during FY08.

MDS	MDS NAME	Fuel Type	Fuel Price ($/gallon)	Total Pol Cost ($)	Gallons	Energy Conversion (MMBTU/gal)	MMBTU
UH-60A	BLACKHAWK	JP4	2.24	219,409.34	97950.6	0.127	12439.726
UH-1H	HUEY	JP4	2.24	7,539.84	3366	0.127	427.482
UH-60L	BLACKHAWK	JP4	2.24	2,215,707.65	989155.2	0.127	125622.71
CH-47D	CHINOOK	JP4	2.24	1,454,435.14	649301.4	0.127	82461.278
AH-64D	APACHE	JP4	2.24	2,864,845.28	1278948.8	0.127	162426.5
UH-60A	BLACKHAWK	JP4	2.24	72,885.12	32538	0.127	4132.326
UH-1H	HUEY	JP4	2.24	9,767.52	4360.5	0.127	553.7835
UH-60L	BLACKHAWK	JP4	2.24	1,156,611.46	516344.4	0.127	65575.739
CH-47D	CHINOOK	JP4	2.24	1,149,825.60	513315	0.127	65191.005

4.2.4 Energy indicator calculation

Table 4 shows all reported energy consumed at Fort Hood from fossil fuel combustion during FY08. Tactical vehicle energy consumption dominated at Fort Hood, which is likely related to the installation's large training mission. ASIP records show that Fort Hood contained a total population of 70,812 (53,758 military and 17,054 civilian) in FY08. The calculated FY08 energy indicator for Fort Hood is therefore 6,784,000 MMBTU divided by 70,812 people or 95.4 MMBTU/person.

Table 4. Energy consumption from fossil fuel use at Fort Hood during FY08.

Energy Category	Energy Consumption from Fossil Fuel Use (MMBTU)
Utility Fuel Combustion	892,000
Utility Electrical Energy	980,000
Civilian Fleet Vehicles	105,000
Tactical Vehicle	4,807,000
Total	**6,784,000**

The value of this indicator is not meaningful except when used in comparison to previous values, and/or in comparison to other installations. As the value of the indicator increases, the energy sustainability of the installation

decreases. As the value of the indicator decreases, energy sustainability improves.

4.3 Waste indicator

4.3.1 Hazardous waste

Hazardous waste data can be obtained from a Defense Logistics Agency (DLA) Disposition Services[18] database tool called the Environmental Reporting System (ERS). ERS is the data warehouse[19] for the Base Operations Supply System (BOSS) that manages Hazardous Contracting, Finance, and Manifest Tracking data for all Defense Reutilization Marketing Offices (DRMOs).

ERS data come from two main areas of BOSS - the Hazardous Line Item and the Manifest Line Item. Data are extracted by DLA on a daily basis from BOSS and updated in ERS. Data are stored in an ORACLE database and DISCOVERER VIEWER formatted reports are set up to run against the database. Once the report has been run, users have the option of exporting data to make it available for use in reports, charts, or for loading into another database.

The DISCOVERER VIEWER opening page presents a list of reports that have been developed for BOSS data. The Generator DoDAAC/HIN, Pickup DoDAAC Summary report provides information on the weight of hazardous waste disposed and the cost associated with the disposal. The report can be queried by a range of delivery order issue dates, the DRMO contract number, and the installation's Generator Department of Defense Activity Address Code (DoDAAC). The Generator DoDAAC/HIN, Pickup DoDAAC Summary report generates a list of all the Generator DODAACs related to the query parameters.

Table 5 shows the column headings and their association with BOSS data.

[18] DLA Disposition Services disposes of excess property received from military services. For more information, see www.drms.dla.mil .

[19] Information about ERS can be found at: http://www.drms.dla.mil/newenv/hazardousreports.shtml.

Table 5. AE – Generator DoDAAC/HIN, Pickup DoDAAC Summary Report column descriptions.

Column Label	Associated Field
Generator DODAAC	Generator DoD Activity Address Code
Pickup DoDAAC	Pickup DoD Activity Address Code
Pickup Name	Name associated with the Pickup DoDAAC
HIN	Hazardous item number
Description	HIN description
Quantity	Sum of obligated quantity for the HIN
UM	Unit of measure for the HIN
COST	Sum of all obligated costs for the HIN

To create a report for a specific installation, the Generator DoDAAC/HIN, Pickup DoDAAC Summary report can be queried by providing the installation's Generator DoDAAC and a range of dates. For example, Table 6 shows the report results for FY09 at Fort Lewis. The report shows the quantity and costs for each of the HINs during FY09. The HINs include disposal costs for hazardous waste categories, hazardous waste equipment costs, and hazardous waste service costs. In this example the hazardous waste cost component of the waste indicator would be $695,055.

Table 6. Generator DoDAAC/HIN, Pickup DoDAAC Summary Report for FY09 at Fort Lewis.

HIN	Description	Quantity	UM	Cost
0812AB	Small cylinder, engine start cartridges	23	EA	$1,723
087200	Cylinder- small	7	EA	$831
632100	Provide and prepare lab packs, consisting of small quantity items (55 gal)	132	EA	$29,615
632300	Provide and prepare lab packs, consisting of small quantity items (5-15 gal)	4	EA	$542
633200	Expedited removal - 7 Days	1	EA	$283
633400	Expedited removal - 3 Days	2	EA	$1,153
635000	Tank cleaning/services - (above ground) mobilization cost	3	EA	$5,617
635600	Tank cleaning/services - additional mobilization cost for confined entry	3	EA	$605

HIN	Description	Quantity	UM	Cost
636000	Personnel for cleaning/servicing of tanks, totes, oil/water separators (team leader)	16	EA	$1,197
636100	Personnel for cleaning/servicing of tanks, totes, oil/water separators (technician)	24	EA	$1,133
637200	Provide storage container (20 Cyl)	2	EA	$1,844
637500	Provide storage container (40 Cyl)	4	EA	$3,804
638500	Rental - storage containers (40 Cyl)	1	EA	$483
6400AB	Prepare Waste Profile form	31	EA	$3,573
6400TS	Perform unknown analysis (two-step) and prepare waste profile form.	1	EA	$732
641800	Provide incineration and stabilization of lab packs, non-lab packed waste, non-regulated waste, and soil samples (in accordance with 40 CFR 268 Appendix IV and for solid wastes not subject to regulations under 40 CFR 261).	21,260	EA	$12,300
6500MM	Surcharge for disposal of high level mercury	315	LB	$1,571
650200	Perform management services	24	HR	$1,492
6502ZD	Management services	357	EA	$20,467
701400	Small capacitors 500-4999 ppm Pcb	66	LB	$97
7014AA	Small capacitors 500 ppm & over Pcb (w/ballasts)	643	LB	$582
702800	Debris (example: rags, cans, drums, wood) Pcb contaminated	77	LB	$42
910100	Ignitable - small containers	6,849	LB	$4,035
910200	Ignitable - containerized liquids/multi-phase	31,360	LB	$11,547
9102RR	Ignitable - containerized liquids/multi-phase -- mandatory recycling/fuels blending	12,952	LB	$4,137
910400	Ignitable - containerized solids	17,966	LB	$13,958
910600	Ignitable - bulk liquids (pumpable)	160,040	LB	$55,795
9106RR	Ignitable - bulk liquids (pumpable) -- mandatory recycling	44,435	LB	$12,442
9108CD	CDE Kits - liquid and/or solid	751	LB	$1,187
920100	Corrosive - small containers	1,514	LB	$785

HIN	Description	Quantity	UM	Cost
920200	Corrosive - containerized liquids/multi-phase	7,653	LB	$2,907
920400	Corrosive - containerized solids	31	LB	$15
9204LA	Corrosive - containerized solids	64	LB	$20
9204NC	Corrosive - containerized solids	1,186	LB	$969
9204NH	Containerized solids	1,117	LB	$916
920600	Corrosive - bulk liquids (pumpable)	3,790	LB	$1,251
9208CD	CDE Kits liquid and/or solid	63	LB	$106
930100	Reactive - small containers	729	LB	$1,092
930400	Reactive - containerized solids	351	LB	$608
9304LL	Reactive - containerized solids	16,926	LB	$38,023
930500	Reactive – aerosols	21,782	LB	$20,160
9308CD	CDE Kits - liquid and/or solid	10	LB	$35
940100	Toxicity - small containers	798	LB	$462
9401MM	Toxicity - small containers with mercury/mercury compounds	691	LB	$3,752
940200	Toxicity - containerized liquids/multi-phase	21,009	LB	$7,749
940400	Toxicity - containerized solids	14,910	LB	$5,751
9404FT	Toxicity - containerized solids fluorescent tubes	16,366	LB	$15,150
9404MB	Toxicity - containerized solids	6	LB	$23
9404MG	Toxicity - containerized solids	32	LB	$42
9404NC	Toxicity - containerized solids	6,674	LB	$5,531
940700	Toxicity - bulk solids	7,840	LB	$2,744
9407DB	Toxicity - bulk solids	794	LB	$667
9407PL	Bulk solids packed in large (>119 gal) boxes by generator	1,090	LB	$545
9408CD	CDE Kits liquid and/or solid	3,293	LB	$5,455
950100	Solvent - small containers	586	LB	$305
950200	Solvent - containerized liquids/multi-phase	9,850	LB	$3,422
950400	Solvent - containerized solids	4,259	LB	$3,186
970100	P-Listed - small containers	22,776	LB	$37,261
9708CD	CDE Kits liquid and/or solid	4	LB	$7
975100	U-Listed - small containers	421	LB	$280

HIN	Description	Quantity	UM	Cost
975200	U-Listed - containerized liquids/multi-phase	153	LB	$65
975400	U-Listed - containerized solids	376	LB	$355
980100	State Reg - small containers	11,641	LB	$5,000
980200	State Reg - containerized liquids/multi-phase	99,708	LB	$33,711
980400	State Reg - containerized solids	87,246	LB	$80,861
980600	State Reg - bulk liquids (pumpable)	283,885	LB	$65,294
980700	State Reg - bulk solids	55,190	LB	$25,387
9808CD	CDE Kits liquid and/or solid	253	LB	$418
990100	Non Reg - small containers	16,764	LB	$6,357
990200	Non-Reg - containerized liquids/multi-phase	35,364	LB	$10,382
9902AF	Non-Reg - containerized liquids/multi-phase	4,943	LB	$1,675
9902FA	Non-Reg - containerized liquids/multi-phase	35,669	LB	$10,990
9902RR	Containerized liquids/multi-phase, fuels blending	9,730	LB	$2,822
990400	Non-Reg - containerized solids	142,100	LB	$46,586
9904AB	Non-Reg - containerized solids	8,525	LB	$6,698
9904CZ	Non-Reg - containerized solids	347	LB	$273
9904LA	Record created by rehost conversion	276	LB	$88
990500	Non-Reg - aerosols	122	LB	$113
990600	Non-Reg bulk liquids (pumpable)	18,320	LB	$4,030
990700	Non-Reg - Bulk Solids	121,060	LB	$29,054
9907PL	Non-Reg - Bulk Solids	13,867	LB	$3,328
9908CD	CDE Kits Liquid and/or Solid	5,701	LB	$9,566
	Sub-Total:	**1,415,204**		**$695,055**

4.3.2 Non-hazardous waste

For nonhazardous waste, data can be obtained from the Solid Waste Annual Reporting (SWAR) system. The SWARWeb system is a data management system designed to facilitate tracking and reporting of solid waste and recycling data at DoD facilities. Army installations are required to report their nonhazardous solid waste generation and cost information using this system.

SWARWeb is located on the Army Knowledge Online (AKO) Installation Management Applications Resource Center (IMARC) page.[20] SWARWeb is a web-based program, allowing access via User ID and password from any Internet-connected computer. The IMARC portal contains other Assistant Chief of Staff for Installation Management (ACSIM) systems.[21]

Cost and revenue information about Army installations' non-hazardous solid waste management program can be extracted from the *Comprehensive Report* that SWARWeb provides. The report is based on an installation's data input for solid waste disposal and diversion. The information tracks both costs for disposal and treatment along with any revenue from the installation's recycling programs. Section 8 of the report summarizes solid waste management information. Figure 2 shows this section for Fort Lewis's FY09 information. The bottom of the report contains a cost figure labeled ADC that is used in calculating cost avoidance information. The ADC cost reflects all non-hazardous waste disposal costs, program costs, and revenues/costs from the recycling program. In the case of Fort Lewis in FY09 this cost was $1,730,337.76.

[20] Accessible to registered users at https://imcom-it.apgea.army.mil/imarc/web/access/login

[21] https://www.us.army.mil/suite/page/550262

Comprehensive Report
WA215220506 - FORT LEWIS
FY2009 (From 10/01/2008 to 09/30/2009)

SECTION 8. INSTALLATION INTEGRATED SOLID WASTE MANAGEMENT SUMMARY

DOD MOM:

Overall Diversion Rate: 77.47%

Integrated SW Management Cost Avoidance($): 1,971,729.96

Breakout of other Totals and Diversion rates:

	Generation (US)	Disposal (US)	Diversion (US)	Diversion (%)
Total	59,180.9998	13,331.2368	45,849.7630	77.47
C&D	10,749.5065	18.6800	10,730.8265	99.83
Non C&D	48,431.4933	13,312.5568	35,118.9365	72.51
WCF	0.0000	0.0000	0.0000	N/A
Non WCF	59,180.9998	13,331.2368	45,849.7630	77.47
Without C&D and WCF	48,431.4933	13,312.5568	35,118.9365	72.51
Without Composting	59,180.9998	13,331.2368	45,849.7630	77.47
Without C&D and Composting	48,431.4933	13,312.5568	35,118.9365	72.51
QRP			0.0000	
Non-QRP			36,541.7915	
Daily Per Capita MSW (lbs/person/day)	5.2043	1.4305	3.7738	

(Cost)/Revenue Summary:

	Generation ($)	Disposal ($)	Diversion ($)
C&D	(220.64)	0.00	(220.64)
WCF	0.00	0.00	0.00
Without C&D and WCF	(1,730,117.12)	(1,563,802.76)	(166,314.35)
QRP			0.00
Non-QRP			(77,013.67)
DRMO			(89,521.32)
Daily Per Capita ($/person/day)	(0.09)	(0.08)	(0.01)

Breakout of Cost Avoidance:

	PDC ($)	ADC ($)	Cost Avoidance ($)
Total	3,702,067.72	1,730,337.76	1,971,729.96

Figure 2. Section 8 of Fort Lewis's SWARWeb comprehensive report for FY09.

4.3.3 Waste indicator

The waste indicator is the sum of hazardous waste costs and non-hazardous solid waste costs divided by the installation population. For Fort Lewis in FY09, the hazardous waste costs were $695,055 and the non-hazardous waste costs were $1,730,338 (total $2,425,393). ASIP shows that the Fort Lewis total population for FY09 was 44,239 (34,036 military and 10,203 civilian personnel). The FY09 waste indicator for Fort Lewis was therefore $2,425,393 divided by 44,239 people or $54.82 per person.

As with energy, the value of this indicator is not meaningful except for comparisons to previous values and to other installations. Obviously, the sustainability goal would be to minimize the installation's cost per person to dispose of waste.

4.4 Land indicator

The land indicator is defined as a ratio of the amount of land needed to accomplish maneuver training to the total amount of land that is available. Land use is measured in acre-days (e.g., one acre of land used for training one day equals one acre-day). If 10 acres were used all year, the land use calculation would be 10 acres x 365 days = 3,650 acre-days. The total acre-days of training land available is reported on ISR-NI sheet MS101-2 in the column titled "Available Acre-Days Remaining" (although it would seem that this column should be titled "Available Acre-Days"). This entry takes into consideration days when maneuver areas are not available. MS101-2 shows entries for "Heavy Maneuver" and "Light Maneuver." Normally, all acres available for heavy maneuver training also are available for light maneuver training. Therefore, the "Available Acre-Days Remaining for Light Maneuver" entry is used as the value for the total acre-days available for maneuver training at an installation.

The number of acre-days required by each Army Unit using maneuver training land at an installation is reported in ISR-NI sheet MS101-3 "Training Acre-Day Requirements." Then, the total acre-days needed for maneuver training is the sum of all entries in the "Training Acre-Day Requirements" column. The value of the land indicator is then the sum of the entries for "Training Acre-Day Requirements" divided by the "Available Acres-Days Remaining for Light Maneuver."

Table 7 shows a hypothetical example for the fictional "Camp Swampy." At Camp Swampy, there are four heavy maneuver units of varying types and training requirements. Camp Swampy has a total of 25,000,000 training acre-days available during a calendar year after all restrictions on training land use have been accounted for.

Table 7. Example hypothetical training schedule.

Training Type	Unit	Training Acre-Day Requirement	Available Acre-Days Remaining
Heavy Maneuver	01231	4,500,000	20,500,000
Heavy Maneuver	01232	6,000,000	14,500,000
Heavy Maneuver	01233	1,500,000	13,000,000
Heavy Maneuver	01234	5,000,000	8,000,000
	Total Required	17,000,000	

The land indicator is reported as a percentage. In this simplistic example, 17,000,000 acre-days of annual training capacity are needed of the 35,000,000 acre-days available. Thus the land indicator for Camp Swampy would have a value of 17,000,000/25,000,000, or 68%. When the value is less than 100%, the installation has enough maneuver area available. If the value is more than 100%, there is not enough maneuver area available at the installation.

NOTE: There seems to be a problem with ISR-NI sheet MS 101 report design. The apparent purpose of ISR-NI sheet MS101-3 is to determine whether there is enough land available for maneuver training. However, it appears that this sheet is designed incorrectly; it calculates whether there is land capacity for each individual unit, but not does not calculate whether there is land capacity to satisfy the land requirements for all of the units combined. Furthermore, some of the data entered into the system seems to be incorrect (for example, at Fort Carson all of the units report doing maneuver training 365 days a year). It is recommended that HQ IMCOM correct the calculation function used to report the status of Maneuver Land Capacity. IMCOM should consider a general quality assessment of ISR-NI regarding how data elements are defined and reported.

4.5 Economic impact indicator

The indicator for economic impact is defined as the ratio of the total personal income for the military and civilian personnel at an installation ver-

sus the gross domestic product (GDP) for the regional Metropolitan Statistical Area (MSA) that includes the installation. The GDP for the regional MSAs is readily available for many of the IMCOM installations through the Bureau of Economic Analysis (BEA) website. [22] The difficulty with using the MSA data from BEA is that the most recent data may be for statistics two years previous to the date of the search; thus, data for this indicator may lag behind data for the other sustainability indicators.

Table 8 shows installations found within the borders of regional and micro MSAs. (Our search of BEA statistics has not yet located a good representation of regional GDP outside MSAs.)

Installations often use figures from the personal income of military and civilian personnel (payroll) for various purposes. That data is undoubtedly available to IMCOM from the Human Resources groups within the Directorate of Resource Management (DRM) at both the installation and headquarters (HQ) IMCOM level.

As the value of the economic indicator increases, the relative impact the installation has on the local economy increases.

Table 8. Army installations with the borders of regional and micro MSAs.

MSA	Installation
Alexandria (Polk), LA	Fort Polk
Las Cruces or Alamogordo, NM	White Sands Missile Range
Baltimore, MD	Aberdeen Proving Grounds
Clarksville, TN	Fort Campbell
Colorado Springs, CO	Fort Carson
Dothan, AL	Fort Rucker
El Paso, TX	Fort Bliss
Fayetteville, NC	Fort Bragg
Harrisburg, PA	Fort Indiantown Gap
Hinesville, GA	Fort Stewart

[22] The Bureau of Economic Analysis website is available at www.bea.gov/regional/bearfacts.

MSA	Installation
Honolulu, HI	Schofield Barracks; Fort Shafter
Killeen, TX	Fort Hood
Olympia, WA	Fort Lewis
Richmond, VA	Fort Lee; Fort A.P. Hill
San Antonio), TX	Fort Sam Houston
Tucson, AZ	Fort Huachuca
Washington, DC	Numerous installations
Watertown, NY	Fort Drum
Yuma, AZ	Yuma Proving Grounds

4.6 Well-being indicator

The Army cannot exist without its soldiers and civilians, and thus its sustainability depends on their well-being. As can be seen in the well-being section of Chapter 3, aspects such as well-being or quality of life are intangible and thus difficult to measure and quantify, especially compared to other sustainability elements like water, land, or energy. It has been difficult, therefore, to find installation-level indicators to represent this essential component of Army sustainability. The recommendation is to look to a relatively new effort at the Well-Being Division of the Army Office of the Deputy Chief of Staff, G-1, Human Resources Policy Directorate (HRPD). On their public website,[23] they describe themselves on the "About Us" page:

[23] http://www.armywell-being.org (last accessed 20 August 2010) They also have a website at http://www.armyg1.army.mil/hr/wellBeing.asp (last accessed 17 September 2010).

> The Army Well Being Division provides a central source of compiled human dimension data (both objective and subjective) with the commensurate analytical capability to inform Human Capital Strategy, policy and program decisions and to provide assessments of issues related to the well-being of the force. In short, we are a key measurement tool for senior Army leadership.
>
> We provide the capability to use metric analyses and assessments to inform Strategy, policy, Core Enterprise Activities, Task Force operations and Army Staff Action Plans.
>
> We provide knowledgeable and trained Subject Matter Experts in support of G-1/HRPD Human Capital Strategy, Human Dimension, Well-Being of the Force and Health of the Force requirements for information, recommendations and assessments.

It is clear that the Army Well-Being Division is a compelling potential source for an installation-level sustainability indicator for well-being. The Division is initiating the development of a well-being dashboard that is organized around five domains of well-being:[24]

1. standard of living
2. career
3. health
4. personal life
5. community

The Division's current efforts at quantifying well-being have two main dashboards: "Soldier, Civilian, and Family Indicators" and "Violent Crimes." Both include a number of subtopics populated from many internal Army sources that provide a spectrum of metrics and indicators.

Our recommendation for an installation-level sustainability indicator for well-being is that IMCOM coordinate efforts with the Well-Being Division. They clearly have both a mission and a strategy that align well to serve the purposes of the well-being indicator. However, they are only in the beginning stages of standing up their dashboards. Currently their dashboard

[24] The information herein has been compiled from notes from several telephone conversations with Mr. David White, Chief of the Well-Being Division HRPD, that took place July–August 2010.

provides data and analysis at the Army-wide level, but does not yet have the ability to drill down to the installation or unit level. Also, they provide a dashboard of many indicators, not a single indicator. They do have a notional strategy to create such a single indicator, however, through the development of an algorithm and weighting scheme.

4.7 Army Strategic Management System

The data that support many of the installation sustainability indicators are found in ISR-NI, AEWRS, and SWAR systems. These data (and more) are expected to be available in the Army's Strategic Management System (SMS). It is therefore our hope that SMS will be the home for the installation sustainability indicators so that they can ultimately be of use not only to IMCOM and its installations, but also to the Army as a whole.

5 Comparison of Approaches for Capturing the Level of an Organization's Sustainability

Our work proposes to IMCOM a set of brief, concrete measures that will give a straightforward indication of whether (and if so, how) an installation is progressing towards becoming more sustainable. That set of installation sustainability indicators must also allow a roll-up of installation-level facts such that the parent command can understand how it, too, is progressing as a whole. In order to expose any deficiencies in our approach to designing that set of indicators, we compared our proposed indicators to other approaches that also could be potentially applicable to an Army installation context. Our intention was to establish whether other approaches addressed a topic (or topics) important enough to require us to substitute it for one or more members of our set of proposed indicators.

This chapter describes the approaches we reviewed and some advantages of each. Included is information about the relative complexity of the approach and whether its indicators are quantitative, qualitative, or simple "yes/no" type. Appendix A reproduces the tables that instantiate the comparisons.

5.1 Approaches reviewed

We reviewed and agreed to look further at the following approaches to capturing an organization's relative degree of sustainability:

- *The Tri-Services Sustainable Communities Scorecard*[25] from The Tri-Service Sustainable Communities, a collaboration led by the Air Force Center for Environmental Excellence (AFCEE).
- *The Atkinson Group's SERDP-funded 2009 report*, "Sustainability Assessment of a Military Installation: A Template for Developing a Mission Sustainability Framework, Goals, Metrics, and Reporting System."[26] Authors Alan Atkinson, David Berry, and Lee Hatcher provide a

[25] This evaluation was based on Version 9 (6-Nov-09) of the working draft of the Tri-Services Sustainable Communities Credit Table. The POC for the coordination of the Tri-Services Sustainable Communities group at AFCEE is Christopher Kruzel (Christopher.Kruzel@brooks.af.mil; 210 536-8951).

[26] Available at http://www.serdp.org/Research/upload/SustainAssessMili.pdf (accessed 22-Jan-10).

prototype system to be used by an installation to establish sustainability metrics.

- *The College Sustainability Report Card*[27] which is designed to collect metrics on hundreds of colleges from publically available data and surveys. The report card's design makes comparisons between colleges possible.
- *Executive Order (EO) 13514*, October 5, 2009[28] was included in our review since it (and the implementation guidance that will ultimately follow it) will shape much of the U.S. Government's future sustainability-related activities. This EO represents the most comprehensive set of federal sustainability policies and goals to date. The EO is not analogous, however, to the other scorecards and metrics in this comparison, especially since it is not optional. Compliance with EO 13514 also will not answer the question, "How sustainable is IMCOM?"
- *The Army Sustainability Campaign Plan (ASCP)* because it also will serve as a touchstone for much of the Army's future activity.

We also considered two other approaches but decided *not* to include them in our comparison, as explained below:

- *Installation Strategic and Sustainability Planning*. The ISSP process was one of the early appearances of the concept of sustainability in the Army. It can be seen as a bottom-up approach that has created an awareness of sustainability concepts across installation communities. A review of the available ISSP documents[29] did not provide a consistent set of goals or metrics that could be compiled for a comparison such as this. The ISSP template[30] includes a step for establishing baseline data for the suggested groupings such as utilities, infrastructure, transportation, procurement, environmental, regional, operations and training, and military community. However, upon examination, the goals from the ISSP processes of a number of installations exhibit little or no overt connection to baselines in the goal statements or to how the goal would be tracked against trends in the data. A report prepared for the Army[31]

[27] Available at http://www.greenreportcard.org/ (last accessed 22-Jan-10).

[28] Available at http://edocket.access.gpo.gov/2009/pdf/E9-24518.pdf (last accessed 22-Jan-10).

[29] Appendix B provides a summary of ISSP goals and status for 22 installations.

[30] For instance, see the Installation Sustainability Planning Guide at http://www.sustainability.army.mil/tools/programtools_guide.cfm (last accessed 8-Feb-10).

[31] Lachman, B., E. Pint, G. Cecchine, and K. Collaton. 2009. "Developing Headquarters Guidance for Army Installation Sustainability Plans in 2007". RAND Corporation Report available at http://www.rand.org/pubs/monographs/MG837/ (last accessed 8-Feb-10).

looked at the ISSP process, initial outcomes, and provided recommendations for future improvements. In that report, Lachman et al. noted that the ISSP process has no requirements or follow-through to identify the most important, strategic, or pressing sustainability issue.[32] Perhaps this may have led to what they also observed by writing, "so far most installations tend to place too much emphasis on easier sustainability approaches, such as technology adoption and issues internal to the installation, and not enough emphasis on assessing and considering regional trends, relationships, and effects that can be important for long-term installation sustainability."[33] Thus, while the ISSP process could perhaps be better informed by a set of installation sustainability indicators, that process does not provide ready examples of what those indicators might look like.

- *The Global Reporting Initiative (GRI).*[34] The GRI sustainability performance indicators are the outcome of an international, consensus-based process that engaged a wide range of stakeholder groups in the development of a tool that would support public reporting of organization-specific information on sustainability. It represents an extensive catalog of topics connected to sustainability that was agreed upon as part of that international effort. The extent to which the GRI performance indicators are used in an organization's public reporting on its sustainability is left entirely to the discretion of the individual reporting organization. GRI's 79 performance indicators are grouped under the following headings: Economic (9), Environmental (30), and Social (40). Obviously, each of these topics embraces quite a large number of indicators (none of which is explicitly motivated); therefore, its utility in working toward a concise set of sustainability indicators is limited. GRI's indicators are not amenable to roll up, i.e., there is no way to take a subset of GRI indicators and combine them to arrive at a good summary of how sustainable an organization is. Indeed, GRI is not so much a list of indicators as a list of potential concerns that a company or consumer may have when thinking about sustainability. While it

[32] Lachman, B., E. Pint, G. Cecchine, and K. Collaton. 2009. "Developing Headquarters Guidance for Army Installation Sustainability Plans in 2007". RAND Corporation Report. http://www.rand.org/pubs/monographs/MG837/ (last accessed 8-Feb-10), p. 64.

[33] Ibid.

[34] For a detailed discussion of the GRI as it is used for Army Sustainability Reporting see Foltz, S., G. Gerdes, M. Hanson, D. Krooks, and C. Rewerts, "Public Reporting and a More Sustainable Army". Technical Report, 14 Apr 09, ERDC-CERL, Champaign, IL, Report No ERDC/CERL TR-09-11. http://www.cecer.army.mil/techreports/ERDC-CERL_TR-09-11/ERDC-CERL_TR-09-11.pdf (last accessed 7-Feb-10).

may have value as a framework for public reporting, the tool's level of complexity makes it an unlikely candidate for building a set of sustainability indicators.

5.2 Review comments

5.2.1 The Tri-Services Sustainable Communities Scorecard

The Tri-Services Scorecard is focused on compliance with requirements and on giving an installation credit for its attempts to become more sustainable across a wide range of possibilities. One striking feature is its rather narrow emphasis only on keeping required plans updated. Plans are all well and good, but the measure of an organization's sustainability is going to come not from having an updated plan but from making that plan a good one and then executing it well.

The Tri-Services group is seeking to build a scorecard that will be a comprehensive, installation-based sustainability rating system using an approach similar to LEED® (Leadership in Energy and Environmental Design). Installation personnel will use the scorecard as a checklist of their accomplishments, to obtain an overall rating. The current version of the Sustainable Communities Scorecard is a rating system that uses a combination of "Requirements" and "Credits" to show compliance with federal requirements (Requirements) and to document best practices (Credits). The rating system is comprised of 10 categories: Community Design and Development; Energy and Greenhouse Gases; Water Efficiency; Built Infrastructure; Natural Infrastructure; Materials and Waste Management; Transportation; Human Health, Development, and Productivity; Community Engagement; and Innovation & Regional. Each category is defined by the credits and requirements within it. Scoring for a category cannot begin without the requirements having been accomplished, while credits allow an installation optional ways to increase their score. There has been discussion of an added mechanism to provide the incorporation of life-cycle cost effectiveness as part of the prioritization of actions.

There are a number of benefits to the Tri-Services approach. It is relatively simple and does not mandate that installations do more than what is already required. It also streamlines the tracking of installation compliance with the requirements in a more centralized, enterprise process. Assuming that the types of optional credits can evolve to capture a wide spectrum of the equivalent of best management practices for sustainability, this ap-

proach could prove to be as useful to installations as LEED has been to buildings. However, compliance is not necessarily equal to sustainability, and this system will not inform installations as to whether or not they are becoming more sustainable.

5.2.2 The SERDP Atkinson Report

The Atkinson, Inc., SERDP final report is titled "Sustainability Assessment of a Military Installation: A Template for Developing a Mission Sustainability Framework, Goals, Metrics, and Reporting System."[35] The expressed need for this SERDP report is the premise that existing sustainability metrics and management frameworks are not adequate due to the complexity of military installations. However, the report makes no argument as to why this premise is true. Nor does the report compare the sustainability management needs of the military with other metrics-based systems, such as GRI. The report does express a somewhat unique definition of installation sustainability: "Capacity for continuous operations in the long term coupled with resilience for maintaining operations in the case of short-term shocks and disturbances." (p. 8)

The study developed a Mission Sustainability Framework (MSF) consisting of six metric categories: mission, installation management, neighbors and stakeholders, operations and maintenance, environment, and quality of life. Each of these categories was subdivided into varying numbers of what are called "issues and elements." Issues and elements were subdivided again into specific metrics.

The last step of the study's methodology was to "Develop a conceptual Sustainability Reporting Template that can be used as a 'dashboard' to monitor ... sustainability metrics ... in each MSF category..." (p. 7). However, that dashboard is never specifically discussed anywhere else in the report. The template suggests 86 conceptual metrics from which an installation may choose when developing its reporting system. The template does not provide a specific group of metrics that could be used as a dashboard in the vein of the set of installation sustainability indicators described herein. The 86 conceptual metrics listed are either too specific, do not actually measure an aspect of sustainability, or are not metrics at all. Many of the metrics measure the existence or magnitude of sustainability efforts, or

[35] This report is available at http://handle.dtic.mil/100.2/ADA512929 (last accessed 3 Mar 2010)

generally declare the existence of good intentions on the part of an installation.

5.2.3 The College Sustainability Report Card

The College Sustainability Report Card is a method of measuring the relative sustainability of college campuses. This measurement is carried out via a college's self-assessment by using a protocol developed for that purpose.

There are similarities between military installations and college campuses. Both operate with a focus on transient populations. In general, the buildings, housing, utilities, and other facilities of a campus and a cantonment area are analogous.

The protocol has nine categories under which there are a total of 48 indicators. Each indicator has a value, and the sum of those values under each category is used to score that category. The maximum score for a category is 100 points. Each of the nine categories is given a grade (A, B, C, D, or E) based on the number of points earned by addressing the indicators. The category grades are then averaged, and a score for the institution is awarded.

There are very few quantitative metrics for determining the grade of a category. Most of the indicators are Yes/No type, meaning either something has been done or it hasn't. There are also extra credit points available if the something has been done really well, but awarding those seems to be subjective.

Setting goals and awarding points for achieving goals are not part of the protocol. Basically colleges are graded on the intensity of their good intentions. Because of the lack of quantifiable metrics, this grading system does not have indicators that the Army could use as indicators of sustainability.

5.2.4 Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, 5 October 2009

EO 13514 contains broad policy directives and some quite specific goals for Federal agencies. These goals can be arranged within the following eight category topics.

1. Reduction in Green House Gas Emissions (3 goals)

2. Reduction in Water Consumption (4 goals)
3. Pollution Prevention (P2) and Waste Elimination (10 goals)
4. Regional and Local Planning (5 goals)
5. Green Buildings (7 goals)
6. Sustainable Acquisition (1 goal)
7. Electronics Stewardship (5 goals)
8. Environmental Management (2 goals)

Metrics are specified for some of the goals listed under topics 1–5. The specified metrics may include, for example, a percentage reduction in resource consumption, in pollutant emissions, or an increase in waste diversion rates. A large number of the goals,[36] however, simply require the federal agency to show some progress in a particular area from year to year.

With respect to our proposed indicators, we noticed no critical gaps except to note that our original set did not include any metric that addressed P2 and waste reduction. Our energy and water indicators will capture categories 1 and 2, respectively, while our waste indicator will capture categories 3 and 7. Infrastructure improvements, such as those that will result from an emphasis on green buildings, will be manifest in our energy and water indicators. Improvements brought about by sustainable acquisition policies and enhanced environmental management programs will also be taken into account under the indicators we propose.

5.2.5 Army Sustainability Campaign Plan

The ASCP is written at such a high level of abstraction that it will likely be easy to align any set of sustainability metrics or indicators with it. We do not see it as either harmful or helpful in developing a set of sustainability indicators, but it must be considered in all Army efforts because the Army intends it to be a capstone that embraces and unifies all the organization's efforts at becoming more sustainable.

5.3 Consequences of the comparisons

The major outcome of the several individual comparisons in this chapter was our decision to include an indicator (waste) that captures attempts at minimization, recycling, and pollution prevention. In order to be able to include it, an earlier proposed metric that focused on infrastructure was

[36] The number of goals that require showing only some progress is 25 of 37 (68%).

deleted. In order to improve sustainability as measured by the water, energy, land, and waste indicators, an installation will necessarily make positive changes in the management of its infrastructure.

6 Conclusions and Recommendations

The US Army is a leader in embracing sustainability as a goal. Over the years, the Army has continued to evolve its collective vision and its approaches to operationalize that vision. By initiating this report, IMCOM has embraced an approach that is not only unique, but also highly practical and resulted in a set of indicators designed to answer the question, "How sustainable are we?" This indicator set can serve to complement other existing approaches to sustainability by providing information that has rarely, if ever, been brought to bear in analysis and decision making.

The approach taken in the development of the indicators described in this report began with a team that was well acquainted with the Army's many sustainability efforts, and that approach then was broadened with a review of other organizations' approaches to capturing information about their sustainability. A set of criteria for the desired characteristics of indicators was developed; then an idealized list of potential indicators was proposed. Next, the ideal indicators were balanced against the available data that could be used to support them. A few indicators, such as the land indicator, proved straightforward to design; others, such as the well-being indicator, presented greater challenges.

At the same time this effort began to develop, IMCOM had been developing the Installation Management Campaign Plan (IMCP) that provides the Commander's vision and intent, an outline of tasks, and the metrics it will use to track those tasks. The installation sustainability indicators proposed in this report were designed to complement and reinforce the vision and intent of the IMCP. The IMCP will use the Army's Strategic Management System (SMS) to manage tasks and their metrics. SMS is the Army's enterprise, web-based system that provides a framework and methodology to enable Army leaders at all levels to manage performance. A majority of the data sources for the installation sustainability indicators are advertised as being incorporated in SMS. It is therefore logical that the way forward is to ensure that the installation sustainability indicators proposed herein are built into the SMS.

The application of the installation sustainability indicators in practice will need to be an iterative process. While some indicators can be readily im-

plemented in SMS and sourced with data that are already there, others (e.g., well-being) will need some coordination to better mature the related data source.

It is also possible that IMCOM leadership may want to change the way some indicators are sourced or expressed. This discussion and evolution was anticipated and is the rationale for some of the extra content of this report that records the background research connected with each indicator. Thus, as the installation sustainability indicators are automated in the SMS, they can also be refined. When they are vetted and gain acceptance, the indicators can be institutionalized and used across the Army to ground more informed, relevant, and prioritized ISSP goals, and to produce an annual Army Sustainability Report that tracks efforts against trends in achieving sustainability.

It also is possible that the number of indicators may grow over time. IMCOM's initial vision for this project was to start with a small, manageable number of indicators because a manageable number of indicators would allow their utility to be demonstrated. Later, more indicators can be developed, especially as we learn about other available data that can support them.

In addition to the recommendations in Chapter 4 for sources for data to support the IMCOM indicators and the recommendation that SMS become the home for the indicators, it is recommended that IMCOM partner with The Well-Being Division of Army G1, Personnel, in the development of an installation sustainability indicator for well-being.

Appendix A: Approaches Compared

In researching this report, we first determined attributes for ideal installation sustainability indicators and then prepared a list of preliminary indicators. In order to expose any deficiencies, those preliminary indicators were compared to metrics included in other approaches. The intention was to establish whether other approaches addressed a topic or topics important enough to require us to substitute it for one or more members of our set of possible indicators. Table A-1–Table A-5 exhibit the comparisons between our approach and the five alternative approaches listed here:

- The Tri-Services Sustainable Communities Scorecard (Table A-1)
- The SERDP-funded report by Alan Atkinson, David Berry, and Lee Hatcher (2009) entitled Sustainability Assessment of a Military Installation: A Template for Developing a Mission Sustainability Framework, Goals, Metrics, and Reporting System (Table A-2)
- The College Sustainability Report Card (Table A-3)
- Executive Order (EO) 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," 5 October 2009 (Table A-4)
- The Army Sustainability Campaign Plan (Table A-5)

Comparison with Tri-Services Sustainable Communities Scorecard

Table A-1. The Tri-Services Sustainable Communities Scorecard credit table.[37]

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Community Design and Development (CDD)			
Environmental Management Systems (EMS) conformance	Req 1		EMS must conform to requirements set forth by ISO 14001; must also identify and show compliance with all applicable regulatory permits
Asset management plan	Req 2		Establishment and maintenance of a current plan in accordance with EO 13327; components of the plan are defined by EO and by example

[37] *Note: highlighted text indicates requirements (reproduced as presented in original draft).*

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Installation planning profile	Req 3		Installation Master Plan must be current, thoroughly examined, revised, and amended when necessary; identify aspects that the plan must include.
Sustainable design standards	Credit 1		Plan which includes: goal of LEED Silver for all construction; use of sustainable materials; cool roof/high albedo roof specifications; water-efficient plumbing fixtures; advanced meters; facility energy goals; use of WaterSense Irrigation Contractor.
Effective land use	Credit 2	Land	Change in acres of improved land, semi-improved land, and unimproved land
Development near existing infrastructure	Credit 3		Consists of two parts: (a) New development does not require extension of new roads and utility transmission lines into previously undeveloped land (increase in real property records); (b) show a net decrease in roads/utility transmission lines
Choices for getting around	Credit 4		Must meet (a) identification of public transportation to the installation; (b) identification of on-base public transportation which connects to the external public transportation
Shared-use pathway network	Credit 5		(a) Establish a comprehensive pathway network plan; (b) percentage execution of the plan
Brownfield redevelopment	Credit 6		(a) Identify the percentage of brownfields remediated (no further actions required) and/or (b) percentage of eligible brownfields remediated using sustainable remediation techniques.

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Demolition	Credit 7		Square footage of facilities demolished
Heat island effect: installation	Credit 8		Using thermal images as a baseline and identifying strategies to reduce overall heat island effect for roofs and non-roofs
Light pollution: installation	Credit 9	Energy	Use night-time lighting images/models to establish a baseline and then show a decrease in illumination (graduated scale); use strategies such as full cut-off lighting or lighting curfew.
Energy and Greenhouse Gases (EG)			
GHG emissions benchmarking and tracking	Req 1	Energy (partially)	Provide baseline and annual inventory of Scope 1, 2, and 3 GHG emissions
Energy conservation: installation	Req 2	Energy	Graduated scale based on a 2003 baseline which exceeds 3% per year through 2015 (or 20% total): 2% in 2009; 5% in 2010; 8% in 2011; 11% in 2012; 14% in 2013; 17% in 2014; 20% in 2015.
Renewable energy: installation	Req 3	Energy	Document that installation has met renewable energy requirements: 3% for FY07-09; 5% for FY10–12; 7.5% for FY13 and thereafter with half coming from new renewable energy sources.
Refrigerant management	Req 4		Phase out program of ozone depleting chemicals (ODCs) for refrigerants OR maintenance program to ensure proper charge levels are maintained in all HVAC equipment
Energy management	Req 5	Energy	Does the installation have an Energy Management Control System (EMCS) and is it benchmarking collected meter readings?

Credit Title	ID	Topically Relevant CERL Indicator	Metric
GHG Emissions Reduction	Credit 1	Energy (partially)	Graduated scale of reductions at 2% increments based on benchmark; can be achieved either for total GHG emissions or under any individual scope.
Increased Energy Conservation, Installation	Credit 2	Energy	Graduated scale based on a 2003 baseline which exceeds 3% per year through 2015 (or 20% total): > 2% in 2009; > 5% in 2010; > 8% in 2011; > 11% in 2012; > 14% in 2013; >17% in 2014; > 20% in 2015, by 2% increments.
Increased renewable energy, installation	Credit 3	Energy	Document that the installation has exceeded renewable energy requirements by 2% increments: 3% for FY07-09; 5% for FY10-12; 7.5% for FY13 and thereafter with one-half from new renewable energy sources.
Carbon neutral installation	Credit 4		Calculation showing annual GHG emissions/energy consumption is offset by carbon sequestration, renewable energy sources, and carbon-neutral energy sources. Points awarded on a graduated scale ranging from 75%–100% by 5% increments.
Advanced metering	Credit 5	Energy	Have meters been installed IAW AF metering policy?
Electrical load / demand efficiency	Credit 6	Energy	To be determined
Water Efficiency (WE)			
Water use reduction	Req 1	Water	2% water reduction per year (2007 as baseline year); or 26% by 2020; additional points given to exceeding the requirement.

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Drinking water quality management	Req 2	Water	Show no primary drinking water standards were exceeded in the reporting year based on the consumer confidence report and any agency data call/report.
New construction storm water management	Req 3	Water	Document that all new construction projects must comply with this policy [to preserve the pre-development hydrology to the maximum extent possible on all new construction projects (EISA07, 438)] to the maximum extent technically feasible.
Wastewater management and reuse	Credit 1	Water	Reuse 50% of the installation's wastewater OR treat 50% of the installation's wastewater to tertiary standards.
Stormwater management and reuse	Credit 2	Water	The installation must prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 95th percentile rainfall event.
Water infrastructure	Credit 3	Water	The installation must have an N-1 or better rating in the annual Natural Infrastructure Assessment for each of the specified categories.
Water rights documentation	Credit 4	Water	A completed water rights documentation index has been prepared as required by AF 2009 policy.
Minimize potable water for landscaping	Credit 5	Water	Graduated scale: <50%; <25%; no potable water
Minimize potable water for golf course irrigation	Credit 6	Water	Graduated scale: <50%; <25%; no potable water
Process water / grey water management and reuse	Credit 7	Water	Process waters and grey water is reused at 50% or more of the facilities where these process waters exist.

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Materials and Waste Management (MW)			
Hazardous waste management	Req 1	Waste	Installation must have a HazWaste Management Plan as required; the plan must be reviewed and updated regularly.
Integrated solid waste management plan	Req 2	Waste	Plan must have all aspects as required; plan must be reviewed and updated annually.
Electronics stewardship	Req 3	Waste	Policy must include guidance on purchasing sustainable electronics (e.g. Energy Star, EPEAT, etc.).
Sustainable procurement plan	Req 4	Waste	Plan must identify environmentally preferable products, biobased products, rapidly renewable, recycled content, and low VOC.
Solid waste reduction	Req 5	Waste	Divert 50% on non-hazwaste and divert 50% of construction/demolition debris.
Hazmat reduction or elimination	Credit 1	Waste	Percentage reduction in total hazardous materials
Solid waste reduction: above threshold	Credit 2	Waste	Graduated scale of percentage above the federal requirement
Recycled Building Materials	Credit 3	Waste	Graduated scale of cubic yards of materials used
Natural Infrastructure (NI)			
Installation Natural Resource Management Plan (INRMP)	Req 1		The Sikes Act (16 U.S.C. 670) and DoD policy require all installations with natural resources to maintain an INRMP, and to keep the INRMP current by review and update that includes coordination with the United States Fish and Wildlife Service (USFWS), state fish and wildlife management agency, and installation commander no less often than every 5 years.

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Installation Cultural Resources Management Plan (ICRMP)	Req 2		The National Historical Preservation Act (NHPA) (16 U.S.C. 470 et seq.) Section 110 and DOD policy require the installation commander to develop, update, and use the ICRMP to define the cultural resources program, plan for contingencies, and comply with federal laws and DoD policy to protect and manage cultural resources.
Integrated Pest Management Plan (IPMP)	Req 3		DODI 4150.07 and AFI 32-1053 require an IPMP to be updated annually and completely revised and coordinated every five years. The Plan describes an integrated pest management approach by which the installation will prevent pests and disease vectors in accordance with federal, state, and local laws.
Natural Infrastructure Assessment (NIA)	Credit 1		The installation is rated as N=0 or N=1
Impact on the installation mission: threatened and endangered (T&E) species	Credit 2.1		Graduated scale of acreage of associated critical habitat declined.
Impact on the installation mission: wildfire management	Credit 2.2		The installation's wildland areas meet the requirements of an approved strategy for reduction in wildland fuels and wildfire risk mitigation.
Impact on the installation mission: exotic and invasive species	Credit 2.3		Graduated scale of acreage of associated habitat declined
Impact on the installation mission: bird/wildlife aircraft strike hazard (BASH) reduction	Credit 2.4		Graduated scale of reduction in BASH incidents

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Recovery of species at risk	Credit 3		Any species on the installation is either delisted or downlisted on the T& E list due to actions by the installation.
Sustainable forest management	Credit 4		The installation's forests meet the requirements of the Forest Stewardship Council (FSC) or other sustainable forest management practices.
Effective urban forestry	Credit 5		The installation achieves the National Arbor Day criteria to receive "Tree City USA" certification.
Sustainable agriculture management	Credit 6		The installation's agricultural areas/leases are managed in accordance with sustainability standards; document compliance.
Built Infrastructure (BI)			
High-performance sustainable buildings (HPSB)	Req 1	Energy	Percentage of buildings (or square footage) of facilities that meet the requirements of HPSB; Building centric aspects: day lighting, lighting controls, thermal comfort/ventilation, metering, commissioning (including verifying the facility energy model meets operational consumption).
Vertical Construction			
HPSB: above threshold	Credit 1		Graduated scale: 3% by FY11; 6% by FY12; 9% by FY14; 15% by FY15
Certified green buildings	Credit 2		Number of construction projects receiving any certification of LEED Gold or higher (NC or CI)
Heat island effect: roof	Credit 3		Percentage of roof area on the installation that meets LEED requirements for low heat island effect (i.e., minimizing the thermal gradient caused by development, namely roof reflectivity).

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Horizontal Construction			
Heat island effect: non-roof	Credit 4		Percentage of pavement that meets the LEED requirements for low heat island effect
Pavements: airfields	Credit 5.1		Graduated scale of cumulative dollar value of recycled content
Pavements: roads	Credit 5.2		Graduated scale of long feet of road created or replaced with asphalt or concrete meeting a defined threshold of re-cycled content
Pavements: parking	Credit 5.3		Graduated scale of square footage / yardage of parking created or replaced with asphalt or concrete that meets a defined threshold of recycled content AND/OR amount of open grid / porous pavement used
Pavements: walks and paths	Credit 5.4		Graduated scale of long feet of walks / paths created or replaced with asphalt, concrete, or other material meeting a defined threshold of recycled content AND/OR amount of open grid / porous pavement used
Docks, bridges, and other structures	Credit 5.5		**Placeholder**
Lighting			
Exterior lighting efficiency	Credit 6	Energy	Percentage of exterior lighting meeting a specified lighting efficiency (e.g., LED) –AND must not exceed IESNA/OSHA lighting density/levels
Exterior lighting controls	Credit 7	Energy	Percentage of exterior lighting with daylight controls AND must be on a recurring commissioning/inspection program
Space Optimization			
Space management plan	Credit 8		Having an approved and up-to-date plan

Credit Title	ID	Topically Relevant CERL Indicator	Metric
Adaptive reuse and consolidation	Credit 9		Percentage of facilities using adaptive reuse or consolidation
Operations and Maintenance (O&M)			
Certified green existing buildings, operations and maintenance (EBOM)	Credit 10	Energy	Percentage or number of facilities receiving certification for LEED EBOM
Water fixture replacement program	Credit 11	Energy	O&M program for replacement of old fixtures with high-efficiency ones
Light fixture replacement program	Credit 12	Energy	O&M program for replacement of old lighting fixtures with new, high-efficiency ones (both interior and exterior)
Sustainable building operations and maintenance plan	Credit 13		Plan establishes goals for energy, water, materials, recycling, and indoor environmental quality; assesses facilities and identifies areas for improvement; identifies avenues for occupant feedback on workplace conditions/satisfaction; identifies applicable AFIs/ETLs/fed reqs; requires process water reductions to be considered in life-cycle cost analysis.
Transportation (T)			
(no information)			
Human Health, Development, and Productivity (HDP)			
No-smoking policy	Req 1	Well-Being	Document policy
Community Engagement (CE)			
Invasive Species Plan	Credit 1		Development of the plan
Innovation and Regional (IR)			
Notices of Violation (NOVs)	Credit 1		Number of concurrent years since last NOV (resets after an NOV is received)

Comparison with Atkinson SERDP-funded report

According to page 13 of this report, "'Conceptual Metrics,'... are ideas for appropriate measures to assess the status and trend for a specific Issue or Element. Conceptual Metrics are topical rough drafts; they must be refined by analyzing available data, testing user comprehension, and other actions. Often, in practice, the envisioned metric must be replaced by indirect proxy measures that have better data or which communicate more effectively with the end-user or stakeholder." Fundamentally, then, it would seem that the metrics that are actually to be used against these conceptual ones are still to be determined.

Table A-2. Conceptual metrics from Atkinson SERDP report.

Mission (MS)	Reference	Topically Relevant CERL Indicator	Specified Metric
Mission (MS)			
CB Ops	MS1		
Port Ops	MS2		
Air Ops	MS3		
Ops Support	MS4		
Fleet and family readiness	MS5		
Facility support	MS6		
Environmental	MS7	Water Energy Land Waste	
Safety	MS8	Well-Being	
Command and Staff	MS9		
Anti-Terrorism and Force Protection	MS10		
Emergency Preparedness	MS11		
Personnel	MS12	Well-Being	
Equipment	MS13		
Supply	MS14		
Training	MS15		
Ordnance	MS16		

Mission (MS)	Reference	Topically Relevant CERL Indicator	Specified Metric
Facilities	MS17		
Installation Management (MG)			
Billeting adequacy	MG1		
Civilian employment	MG2	Well-Being	
Safety performance	MG3		
Staffing levels	MG4		
Disaster preparedness rating	MG5		
Disaster readiness	MG6		
Directives and instructions effectiveness	MG7		
Buildings certified as sustainable	MG8		
Base master plan implementation	MG9		
Basic facility sufficiency	MG10		
Management tools effectiveness	MG11		
Management tool integration across base	MG12		
Neighbors and Stakeholders (NS)			
“Walkable” on-base community design	NS1		
Alternative transportation utilization	NS2		
Average commute time for off-base personnel	NS3	Energy Well-Being	
Alternative transportation performance	NS4		
AICUZ effectiveness	NS5		
Encroachment index	NS6	Land	
Enforcement actions against installation	NS7	Water Energy Land	
Land use planning	NS8	Land	

Mission (MS)	Reference	Topically Relevant CERL Indicator	Specified Metric
Relationship with local/regional zoning authority	NS9	Economy	
Community economic impact of NBVC	NS10	Economy	
Community perception of NBVC	NS11	Economy	
Direct impact on local and regional business	NS12	Economy	
Operations and Maintenance (OM)			
Building maintenance cost	OM1		
Maintenance backlog	OM2		
Facilities performance condition	OM3		
Sustainability retrofit status	OM4		
Organic (natural) water source capacity	OM5	Water	
Water conservation implementation	OM6	Water	
Surface and groundwater status	OM7	Water	
Regional water availability	OM8	Water	
Water consumption	OM9	Water	
Base electrical generation cost	OM10	Energy	
Base energy density	OM11	Energy	
Power reliability	OM12	Energy	
Renewable energy	OM13	Energy	
Landscape maintenance costs	OM14		
Solid waste streams	OM15	Waste	
On-base wastewater treatment capacity	OM16		
Wastewater volume	OM17		

Mission (MS)	Reference	Topically Relevant CERL Indicator	Specified Metric
On-base water reclamation and reuse	OM18	Water	
Environment (EN)			
Greenhouse gas emissions on-base	EN1	Energy (partially)	
Greenhouse gas emissions off-base	EN2	Energy (partially)	
Air pollution non-attainment days	EN3		
Toxic emissions to air, water, land	EN4		
Hazardous material usage	EN5	Waste	
Habitat and species protection	EN6		
Endangered species population recovery	EN7		
Water consumption	EN8	Water	
Wastewater flow	EN9	Water	
Non-point source pollution	EN10	Water	
Surface water quality	EN11	Water	
Regional watershed condition	EN12	Water	
Quality of Life (QL)			
Local community school quality	QL1	Well-being	
School adequacy	QL2	Well-being	
Travel to schools	QL3	Well-being	
Housing accessibility on-base and off-base	QL4	Well-being	
Off-base housing affordability index	QL5	Well-being	
Housing satisfaction on-base and off-base	QL6	Well-being	

Mission (MS)	Reference	Topically Relevant CERL Indicator	Specified Metric
Housing sufficiency on-base and off-base	QL7	Well-being	
On-base housing availability	QL8	Well-being	
Health care responsiveness	QL9	Well-being	
Health care satisfaction	QL10	Well-being	
Public transportation to health care facilities	QL11	Well-being	
Travel to health care facilities	QL12	Well-being	
Child care accessibility	QL13	Well-being	
Child care satisfaction	QL14	Well-being	
Quality, availability, and accessibility of child care	QL15	Well-being	

Comparison with College Sustainability Report Card

The College Sustainability Report Card[38] has nine categories under which there are a total of 48 indicators. Each indicator is given a value, and the sum of those values under each category is 100. Each of the nine categories is given a grade (A, B, C, D, or E) based on the number of points earned from addressing the indicators. The grades for the nine categories are then averaged and a score for the institution is awarded.

There are very few quantitative metrics for determining the grade of a category. Most of the indicators are of the "yes/no" type, meaning either something has been done or it hasn't. There are also extra-credit points available if a particular "something" has been done really well, but awarding extra-credit points appears subjective.

[38] http://www.greenreportcard.org/

One thing that stands out due to its omission is a requirement to set goals and reward progress toward achieving them. Basically, colleges are graded on the intensity of their good intentions.

Table A-3. Comparison with College Sustainability Report Card.

Category/Indicator	Topically Relevant CERL Indicator	Specified Metric
Administration		
Sustainability policies		Formal policy; adopt plans from higher levels
Advisory council		Stakeholder advisory council; accept student input
Sustainability staff		Designated staff; provide them adequate funding
Office or department		Focused on achieving campus goals
Website		Community involvement; campus involvement.
Green purchasing		Formal policy
Climate Change and Energy		
GHG emissions inventory	Energy (partially)	Initiate and update
Commitment to GHG emissions reduction	Energy (partially)	Formal commitment
Realized GHG emissions reduction	Energy (partially)	Achieving a reduction (per sq. ft. and per student)
Energy efficiency	Energy	Use efficient systems; upgrade existing systems
Energy conservation	Energy	Provide incentives to reduce
Renewable energy generation	Energy	Install renewable sources
Renewable energy purchase	Energy	Purchase renewable power/credits; buy renewable non-electric

Category/Indicator	Topically Relevant CERL Indicator	Specified Metric
On-site combustion	Energy	Heating/cooling from renewable sources
Food & Recycling		
Locally grown and produced food	Economy	Acquire food from <150 miles
Organic and sustainably produced food		Purchase sustainably produced food; offer vegan meals
Fair trade products		Purchase fair trade products
Dishware and eco-friendly incentives	Waste	Reusable dining hall dishware; brown-bag incentives; eco-friendly take-out containers
Food composting and waste diversion	Energy Waste	Compost food waste; donate excess food; trayless dining; recycle cooking oil
Recycling of traditional materials	Waste	Administer recycling program
Recycling of electronic waste	Waste	Provide recycling opportunity
Composting (aside from dining facilities)	Waste	Compost landscaping waste; provide receptacles for students
Source reduction	Waste	Programs to reuse items; end of semester clothing / furniture swaps
Green Building		
Green building policy		Construction and demolition policies
Green building standards	Water Energy	Seek LEED certification
Renovation and retrofits	Water Energy	Renovate to LEED-EB, Energy Star; retrofit with energy / water conservation devices

Category/Indicator	Topically Relevant CERL Indicator	Specified Metric
Student Involvement		
Residential communities		Offer sustainably themed options
New student orientation		Integrate sustainability in orientation
Internships/outreach opportunities		Offer internship, student position opportunities
Student organizations		Active student orgs that prioritize campus efforts; student efforts advance campus sustainability
Sustainability challenges and competitions		Campus sustainability competitions at least once per year
Transportation		
Campus motor fleet	Energy	Fleet uses clean fuel; minimize GHG on per-passenger-mile-basis
Local transportation alternatives	Energy	Offer incentives to carpool, use public transportation; provide access to pub. trans.
Bicycle program	Energy	Offer bike rental, sharing program, repair service
Car-sharing program	Energy	Partner with a car-sharing program
Planning	Energy	Implement policies for pedestrian, bike-friendly campus; parking policies that encourage alt. transportation; achieve low percentage of single-person vehicles
Endowment Transparency		
Investment holdings		
Proxy voting record		
Accessibility		

Category/Indicator	Topically Relevant CERL Indicator	Specified Metric
Investment Priorities		
Renewable energy and sustainable investments		
Community investment	Economy	Invest in community development loan funds, etc.
On-campus sustainability projects		
Donor fund option		
Optimizing investment return		
Shareholder Engagement		
Proxy vote decisions		
Stakeholder involvement		Incorporate shareholders into investment advisory process; include faculty, student, and alumni on adv. committee
School community input		Encourage community to provide input via forums or website
Sustainability voting record		

Comparison with EO 13514

Table A-4. Comparison with EO 13514.[39]

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Broad Policy Directives			
Increase energy efficiency.	1	Energy	
Measure, report, and reduce greenhouse gas emissions from direct and indirect activities.	1	Energy (partially)	
Conserve and protect water resources through efficiency, reuse, and stormwater management.	1	Water	
Eliminate waste, recycle, and prevent pollution.	1	Waste	
Leverage agency acquisitions to foster markets for sustainable technologies and environmentally preferable materials, products, and services.	1	Economy Waste	
Design, construct, maintain, and operate high performance sustainable buildings in sustainable locations.	1	Energy Waste	
Strengthen the vitality and livability of the communities in which federal facilities are located.	1	Economy Well-being	
Inform federal employees about and involve them in the achievement of these goals.	1		
Prioritize actions based on a full accounting of both economic and social benefits and costs.	1		

[39] Executive Order 13514 "Federal Leadership in Environmental, Energy, and Economic Performance", signed 5 October 2009. http://www.fedcenter.gov/programs/eo13514/

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Drive continuous improvement by annually evaluating performance, extending or expanding projects that have net benefits and reassessing or discontinuing underperforming projects.	1		
Be transparent and disclose results associated with the actions taken pursuant to this order on publicly available federal websites.	1		
Goals for agencies: GHG			
Establish and report a percentage reduction target for agency-wide reductions of Scope 1 and 2 greenhouse gas emissions in absolute terms by FY 2020, relative to a FY 2008 baseline of the agency's Scope 1 and 2 greenhouse gas emissions.	2a	Energy (partially)	Percentage reductions versus FY 2008 baseline
Establish and report a percentage reduction target for reducing agency-wide Scope 3 greenhouse gas emissions in absolute terms by fiscal year 2020, relative to a fiscal year 2008 baseline of agency Scope 3 emissions.	2b	Energy (partially)	Percentage reductions vs. FY2008 baseline
Establish and report a comprehensive inventory of absolute greenhouse gas emissions, including Scope 1, Scope 2, and specified Scope 3 emissions (i) within 15 months of the date of this order for FY 2010, and (ii) thereafter, annually at the end of January, for the preceding fiscal year.	2c	Energy (partially)	Inventory complete within 15 mo of 5 OCT 09 for 2010; annually thereafter

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Goals for agencies: Water			
Reduce potable water consumption intensity by 2% annually through FY 2020, or 26% by the end of FY 2020, relative to a baseline of the agency's water consumption in FY 2007, by implementing water management strategies including water-efficient and low-flow fixtures and efficient cooling towers.	2d	Water	2% consumption reduction annually through 2020 or 26% by the end of FY2020 relative to FY2007 baseline
Reduce agency industrial, landscaping, and agricultural water consumption by 2% annually or 20% by the end of FY 2020 relative to a baseline of the agency's industrial, landscaping, and agricultural water consumption in FY 2010.	2d	Water	2% consumption reduction annually through 2020 or 26% by the end of FY2020 relative to FY07 baseline
Identify, promote, and implement water reuse strategies that reduce potable water consumption.	2d	Water	None - show progress
Implement and achieve the objectives identified in the storm water management guidance referenced in Section 14 of this order.	2d and 14	Water	None - show progress
Goals for Agencies: P2 / Waste Elimination			
Minimize the generation of waste and pollutants through source reduction.	2e	Waste	None - show progress
Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by the end of FY 2015.	2e	Waste	At least 50% diversion by the end of FY2015

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Divert at least 50% of construction and demolition materials and debris by the end of FY 2015.	2e	Waste	At least 50% diversion by the end of FY2015
Reduce printing paper use and acquiring uncoated printing and writing paper containing at least 30% postconsumer fiber.	2e	Waste	None - show progress
Reduce and minimize the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed.	2e	Waste	None – show progress
Increase diversion of compostable and organic material from the waste stream.	2e	Waste	None – show progress
Implement integrated pest management and other appropriate landscape management practices.	2e		None – show progress
Increase use of acceptable alternative chemicals and processes in keeping with the agency's procurement policies.	2e	Waste	None – show progress
Decrease use of chemicals where such decrease will assist the agency in achieving greenhouse gas emission reduction targets.	2e	Waste	None – show progress
Report in accordance with EPCRA.	2e		None – show progress

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Goals for Agencies: Regional / Local Planning			
Participate in regional transportation planning and recognizing existing community transportation infrastructure	2f	Energy	None - show progress
Align federal policies to increase the effectiveness of local planning for energy choices such as locally generated renewable energy	2f	Energy	None - show progress
Ensure that planning for new federal facilities or new leases includes consideration of sites that are pedestrian friendly, near existing employment centers, and accessible to public transit, and emphasizes existing central cities and, in rural communities, existing or planned town centers	2f	Energy Well-being	None - show progress
Identify and analyze impacts from energy usage and alternative energy sources in all Environmental Impact Statements and Environmental Assessments for proposals for new or expanded Federal facilities	2f	Energy	None - show progress
Coordinate with regional programs for federal, state, tribal, and local ecosystem, watershed, and environmental management	2f		None - show progress

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Goals for Agencies: Buildings			
Ensure that all new federal buildings that enter the planning process are designed to achieve zero-net-energy by 2030	2g	Energy	Starting with buildings that enter planning process in 2020, zero-net-energy by 2030
Ensure that all new construction, major renovation, or repair and alteration of Federal buildings complies with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings, (Guiding Principles)	2g	Energy Waste	100% compliance of all new construction, major renovation, or repair and alteration
Ensure that at least 15% of the agency's existing buildings (above 5,000 gross sq ft) and building leases (above 5,000 gross sq ft) meet the Guiding Principles by fiscal year 2015 and that the agency makes annual progress toward 100% conformance with the Guiding Principles for its building inventory	2g	Energy	15% of existing buildings meet Guiding Principles by 2015; annual progress toward 100% conformance with the Guiding Principles for its building inventory
Pursue cost-effective, innovative strategies, such as highly reflective and vegetated roofs, to minimize consumption of energy, water, and materials	2g	Energy Water Waste	None - show progress
Manage existing building systems to reduce the consumption of energy, water, and materials, and identifying alternatives to renovation that reduce existing assets' deferred maintenance costs	2g	Energy Water Waste	None - show progress

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Identify opportunities to consolidate and dispose of existing assets, optimize the performance of the agency's real-property portfolio, and reduce associated environmental impacts, when adding assets to the agency's real property inventory	2g	Energy Land	None - show progress
Ensure that rehabilitation of federally owned historic buildings utilizes best practices and technologies in retrofitting to promote long-term viability of the buildings	2g	Energy Waste	None - show progress
Goals for Agencies: Sustainable Acquisition			
Ensure that 95 percent of new contract actions (including task and delivery orders) for products and services with the exception of acquisition of weapon systems, are energy-efficient (Energy Star or Federal Energy Management Program (FEMP) designated), water-efficient, biobased, environmentally preferable (e.g., Electronic Product Environmental Assessment Tool [EPEAT] certified), non-ozone depleting, contain recycled content, or are non-toxic or less toxic alternatives, where such products and services meet agency performance requirements	2h	Water Energy Waste	95% of new contract actions (including task and delivery orders) for products and services with the exception of acquisition of weapon systems, are energy-efficient
Goals for Agencies: Electronics Stewardship			
Ensure procurement preference for EPEAT-registered electronic products;	2i	Waste	None - Show Progress

EO Requirement	EO Section	Topically Relevant CERL Indicator	Specified Metric
Establish and implement policies to enable power management, duplex printing, and other energy-efficient or environmentally preferable features on all eligible agency electronic products.	2i	Energy Waste	None - Show Progress
Employ environmentally sound practices with respect to the agency's disposition of all agency excess or surplus electronic products	2i	Waste	None - Show Progress
Ensure the procurement of Energy Star and FEMP designated electronic equipment	2i	Energy	None - Show Progress
Implement best management practices for energy-efficient management of servers and Federal data centers	2i	Energy	None - Show Progress
Goals for Agencies: Environmental Management			
Continue implementation of formal environmental management systems at all appropriate organizational levels	2j		None - Show Progress
Ensure these formal systems are appropriately implemented and maintained to achieve the performance necessary to meet the goals of this order.	2j		None - Show Progress

Comparison with Army Sustainability Campaign Plan

Table A-5. Army Sustainability Campaign Plan
(Concurrence Draft of 1 OCT 09).

Area of Coordination and Execution	ASCP Reference	Topically Relevant CERL Indicator	Specified Metric
Energy	3(g)(2)(a)	Energy	
Water	3(g)(2)(b)	Water Land	
Planning and Conservation	3(g)(3)	Water Land	
Waste	3(g)(4)	Waste	
Air	3(g)(5)	Energy (partially)	
Interagency, Intergovernmental, Public, and Private Cooperation	3(g)(6)	Economy	
Contingency Operations	3(g)(7)	Water Energy Land Waste	
Acquisition and Procurement	3(g)(8)	Water Energy Land	
Lines of Operation			
Materiel	3(d)(2)	Energy Land Well-being Waste	
Readiness	3(d)(3)	Land	
Human Capital	3(d)(4)	Well-being	
Services and Infrastructure	3(d)(5)	Water Land Well-being	
Soldier Health	3(d)(6)	Well-being	

Area of Coordination and Execution	ASCP Reference	Topically Relevant CERL Indicator	Specified Metric
Outcomes			
Doctrine	3(c)(2)		
Sustainable Services and Infrastructure	3(c)(3)	Water Land Well-being Waste	
Improved utilization of resources	3(c)(4)	Water Energy Land Well-being Waste	
Continued access	3(c)(5)	Water Land	
Enhanced operational capability	3(c)(6)	Water Energy Land Well-being Waste	
Enhanced well-being	3(c)(7)	6	
Continued protection of human health and environment	3(c)(8)	Water Energy Land Well-being	
Compliance and adaptability	3(c)(9)	Water Energy Land Well-being Waste	

Appendix B: Installation Strategic Sustainability Planning (ISSP) Summary

The Installation Strategic Sustainability Planning (ISSP) process represents an important investment, and while it began as an installation-level effort, it has done much to improve sustainability throughout the Army. The following pages summarize the ISSP goals of 22 installations, along with any available information of how the installation revisits, updates, or measures progress toward their goals.

INSTALLATION	Anniston Army Depot				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2008	GOALS LAST UPDATED	Update scheduled Dec 2010
Currently decentralized – Goal Champions responsible for all tracking and reporting. To be revised with integration into Strategic Plan.					

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
INDUSTRIAL GOALS: • Integrated production equipment operation and maintenance • Integrate sustainable practices using best achievable technology (BAT) • A Sustainability Culture Throughout the ANAD Community **COMPETITIVE EDGE GOALS:** • Expand ANAD's relationship with the community to foster economic growth and stability. Participate in local resource planning to optimize resource availability for all stakeholders • Sustain FY07 sales by diversifying our mission capabilities through partnerships to sustain existing workforce and developing innovative (non-traditional) business relationships with industry **INFRASTRUCTURE GOALS:** • Zero production line down time due to delay in parts delivery through improved intra-depot movement of supplies, services, and increased delivery efficiency • Flexible and adaptable facilities: provide the right buildings at the right time in the right location to support current and future missions • Become capable of 100% self-sufficient utility production over 2010 baseline (produced on depot or purchased within the local community). Utilities include water and energy (facility and mobility) • Procurement and Contracting GOALS: • Life-Cycle Sustainability - Change procurement strategy to... - Influence weapons systems design and development (DMWR) - Use performance based contracting to apply sustainability criteria to the acquisition of Goods, products, and materials; Equipment and processes (i.e., how we clean parts); Services and utilities • Generate zero waste	Measure progress at the objective level – measure not provided.

INSTALLATION	USAG Baumholder				
GOALS IN USE (YES/NO):	Yes	**GOALS DEVELOPED**	2008	**GOALS LAST UPDATED**	Sept 2009
CURRENT SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
• Well-zoned Community with Modern, Integrated, and Maintainable Facilities • Zero-Footprint Baumholder (ZFB) • Innovative, Sustainable, and Effective Services			• Energy consumption • Water consumption • Petroleum use • Progress in developing specific plans for land use and new construction • Lean Six Sigma cost savings		

INSTALLATION	Fort Benning				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2005	LAST UPDATED	March 2009

The 5-year sustainability plan is integrated with the Garrison Strategic Plan; both plans are on a one year review cycle. http://www.benning.army.mil/garrison/sustainability/

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
REGIONAL INTERACTION • Goal #1 A Chattahoochee Valley community that sustains the Fort Benning mission, enhances quality of life, and protects and restores the environment will better serve the overall objectives. **MILITARY TRAINING** • Goal #1: Increase Training Space (air, land, water, and bandwidth) by 50%. • Goal #2: Fort Benning becomes the Army Live-Virtual-Constructive (LVC) Center of Excellence for Joint and Combined Arms Operations. • Goal #3: Establish world's most innovative Maneuver Center of Excellence **INSTALLATION MANAGEMENT** • Goal #1: Achieve procurement of 100% sustainable goods and services by establishing an effective procurement network that minimizes life cycle costs, maximizes acquisition options, reduces delays, and establishes system-wide accountability and ownership • Goal #2: Fort Benning leads DoD in the provision of Soldier and Family Support Services • Goal #3: Capture full economic potential for energy efficiency through the use of innovative and sustainable approaches to energy acquisition, management and consumption • Goal #4: Implement sustainable water acquisition, use, and management practices that support the mission of Fort Benning • Goal #5: Facilities at Fort Benning meet sustainability objectives. **POWER PROJECTION** • Goal #1: Increase deployment capacity and decrease deployment time for brigade elements by 2030 to 25% of FORSCOM standards. • Goal #2: Eliminate frustrated cargo and de-	Progress measured at the objective level: **COMMUNITY** • Acres Under Conservation/Non-development Easement • Degree of designated lands in compatible use. Acres in various compatible land uses. • Programs for Skills Management and Lifelong Learning (Percent target completion for LEAN Six Sigma Training) **MISSION** • High Performance (SPIRIT and LEED) Base Realignment and Closure Construction Expenditure ($ millions) • Solider Training Load (total number of Soldiers) • Interactive Customer Evaluation Measures of Effectiveness (%) • Interactive Customer Evaluation Response Rate (%) • Strategic Sustainability Actions (Percent ongoing or completed) • Number of usable live fire/maneuver acres • Number of usable multi-purpose live fire ranges • Number of UXO acres • Number of degraded acres rehabilitated • Throughput and range utilization rate • Training capacity for riverine and airborne operations • Availability rate - percent of live fire/maneuver acres in suitable condition for scheduling/use • Utilization rate – percent use of scheduled resources • Amount of resource "down time" • Range and training area throughput rates • Amount of space converted or restored to training use (e.g. redesignated or restored land) • Range Readiness Review System data (share point document system) • Incorporate use of sustainable technologies in all Initial Capabilities Documents (ICDs) and Capabilities Development Documents (CDDs).

crease deployment time through reduction and improved management of HAZMAT on the installation and during deployment	• Percent of acres of multi-use training areas without restrictions • Number of Soldiers trained to standard • Percent of fossil fuel use • Air emissions • Percent use of green munitions • Percent use of short range munitions • Percent use of non-dud producing munitions • Number of pieces of equipment and personnel for movement of supplies, numbers of trucks, aircraft, and railcars. Space and storage facilities on the ground to stage/store equipment (e.g. mile by-pass). Time-Phased Force Deployment Data to establish timelines • Simultaneous air and land deployment capability **ENVIRONMENT** • Overall energy consumption (MMBTU/KSF) • Energy Savings from Conservation and Efficiency Improvement (% energy cost) • Renewable Energy Use (% of overall energy consumption) • Existing buildings smart metered for energy use (%) • Water Withdrawal by Source (million gallons) • Long Leaf Restoration (Number of acres planted) • Red Cockaded Woodpecker Population Monitoring (Number of potential breeding groups) • Total Solid Waste Diversion (% non-C&D) • Percent of contracts with sustainable purchasing content • Percentage of proposed projects that include return on investment/lifecycle considerations. Fully integrated reporting process in place • Vehicle Fossil fuel consumption level; non-fossil fuel consumption; conversion rates of fleets to non-fossil-fuel capable • Amount of fossil fuel based energy used for facility operations; amount/percentage of facilities energy from non-fossil sources. Number of energy related LEED credits achieved • Volume of water reused, Water use per person, Categories of water reused, Water use classifications, number of LEED credits achieved • Contaminant levels in surface waters, Acres of bare ground • ISR-1 Infrastructure, ISR-2 Environment

INSTALLATION	Fort Bragg				
GOALS IN USE (YES/NO):	Yes (Goal 1 of Strategic Plan)	**GOALS DEVELOPED**	2000	**LAST UPDATED**	Annually, Sept 2010
Sustainability goals are linked to Goal 1 of the Garrison Strategic Plan. Strategic Plan Goal 1 managed by sustainability management council, reported to Senior Management Board. Objectives and projects under sustainability goals managed through EQCC and DPW.					
CURRENT SUSTAINABILITY GOALS:		**CURRENT MEASUREMENTS FOR GOALS:**			
1.1 Land Use: Create and enhance sustainable training and urban areas to ensure military readiness and promote compatible growth of the surrounding communities. 1.2 Facilities: To become the model sustainable military community of the world by using sustainable principles throughout the life cycle of all facilities and supporting infrastructure (FSI). 1.3 Materials/Commodities: Achieve zero waste through acquisition and management of materials and commodities, which, throughout their lifecycle, creates no additional waste nor requires resources for disposal. 1.4 Utilities: Supply reliable utility services and infrastructure with no negative impact while aggressively reducing overall demand. Utilities include energy, water, and information technology. 1.5 Transportation: Build a sustainable world-class ground transportation network providing seamless transition between multiple modes of travel while reducing harmful emissions.		Some have gross indicators of progress. 1.2 – number of high performance buildings on post 1.3 – normalized waste generation rates 1.4 – normalized energy use and cost of energy Others measured at the objective level			

INSTALLATION	Fort Campbell				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2003	LAST UPDATED	2010
Managed through Strategic Plan. Progress reported through the Installation Planning Board to the Senior Executive Leadership Committee. The review cycle is 2x per fiscal year, with the metrics set up for quarterly reporting. The specific initiatives within Objective P2 are managed through SIMS (EMS + sustainability management system)					

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
C2.4 Obtain Training Maneuver Area per Range Training Land Program-Development Plan P2.1 Implement Sustainable Installation Management -ISO 14001 P2.2 Implement Sustainable Facilities P2.3 Expand Use of Renewable Energy P2.4 Execute Encroachment Prevention Strategy P2.5 Sustainable Technology Demonstration Projects P2.6 Initiate Affirmative Procurement Program (APP) (Green Procurement)	Measures are at Objective or Initiative level: • Evaluate available land vs. DPTMS requirements • Conformance with International Organization for Standardization (ISO) 14001 • Potable water usage • Projects (New Construction) implemented to meet 2 points for LEED to support reduction of impact on Municipal Separate Storm Sewer System (MS4) • Percent of Stream Bank Restoration projects completed • Percent of Construction and Demolition (C&D) Waste diverted from landfill • Percent of Municipal Solid Waste (MSW) diverted from landfill • Percent reduction in hazardous waste generation • Number of tons removed annually (Clean up training ranges) • Percent of Military Construction (MILCON) buildings constructed annually with LEED "Silver" rating or better • Percent of other (non-MILCON) buildings constructed annually having LEED "Silver" or better rating • Number new transportation projects identified and funded by non-FTC sources • Percent reduction in energy intensity (mbtu/ksf) • Percent increase in renewable energy use • Funding Received for Army Compatible Use Buffer (ACUB) program annually • Percent of designated “High-priority” (Zone 1) ACUB areas protected (6K acres around airfields) • Percent of JLUS recommendations implemented by surrounding jurisdictions • Percent of incompatible land use (urban encroachment) within designated high noise zones/APZs • Number of FTC projects in planning, execution, or completed in current FY using other people's money • Percent of directorates having established green procurement procedures that comply with EO13423

INSTALLATION	Fort Carson				
GOALS IN USE (YES/NO):	Yes	GOAS DEVELOPED	2002	LAST UPDATED	May 2010
Sustainability is overseen through the Sustainability Management System which applies an EMS-like framework to installation-wide sustainability					

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
Zero Waste: Total weight of solid and hazardous waste disposed of is reduced to zero by 2027, and every year thereafter. Sustainable Transportation: Reduce automobile dependency and provide balanced land use and transportation systems. Sustainable Training Lands: Training ranges; maneuver lands; and associated air space capable of supporting current and future military training to standard while maintaining and sustaining training resources. Energy and Water Resources: Sustain all facility and mobility systems from renewable sources and reduce total water purchased from outside sources by 75% by 2027. Sustainable Development: Create a community that encourages social, civic, and physical activity while protecting the environment.	• Normalized solid waste disposal • Hazardous waste disposal • Percent of facility electricity and heat from renewable sources • Percent energy use per square foot reduction • Amount of potable water purchased from outside sources • Amount of potable water consumed per capita (to include housing) • Permanent loss of training land • Percent of proposed buffer area permanently protected by open space or compatible land uses. • Percent of available training lands maintained in a sustainable condition for military training. • Number of LEED Buildings • Building Density and pathways • Low Impact Development Designs Installed • Carbon Dioxide Equivalents (tons of CO2e) • Total Hazardous Air Pollutants and Criteria Pollutants (tons) • Greenhouse gas emissions – buildings, non-tactical vehicle fleets, electricity, 3rd party • Number of single occupant vehicles compared to total number of vehicles per capita annual average entering Fort Carson gates and on Fort Carson roadways • Percent annual improvement in DoL's GSA fleet vehicle fuel economy; *actual fuel usage not yet available.* • Percent non-tactical fleet alternative fuel capable

INSTALLATION	Fort Drum				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2008	LAST UPDATED	Jun 2009. Currently under review to incorporate IMCP V2

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
We have been thru the ISSP Process (Jan 09) and each of our goals in our Strategic Plan has Sustainability embedded in them. We do not have separate Sustainability Goals. We are currently incorporating the IMCP V2 as the Base for our Strategic Plan, which will involve retaining some of our previous objectives that do not crosswalk to the IMCP, as Supporting Strategic Actions to the re-written Strategic Plan. **Current Strategic Goals:** GOAL 1: A high performing, well-led, affordable workforce of the proper size that is technically competent, agile, motivated, knowledgeable, and postured to meet the challenges of today's and tomorrow's missions. GOAL 2: Realistic training capabilities that optimize installation and regional resources (land, airspace, water and facilities) for current and future missions GOAL 3: Infrastructure self-sufficiency, including on-post renewable sources of energy GOAL 4: Optimal infrastructure growth through community partnerships, use of emerging construction and reclamation technologies, and sustainable natural resources utilization GOAL 5: An installation organized and structured with adequate manning, equipment and facilities to sustain the transformed tactical force with the capability to anticipate future force requirements and the ability to rapidly adapt to emerging technologies and changes to force structure and doctrine. GOAL 6: Fort Drum and region's quality of life makes it the installation of choice GOAL 7: Efficient, effective, and responsive business practices that optimize changing resources for current and future missions.	Measure progress at the objective level *Currently under review to incorporate IMCP V2*

INSTALLATION	Fort Eustis				
GOALS IN USE (YES/NO):	Yes – installation is transitioning to a Joint Base run by the Air Force	GOALS DEVELOPED	2004	LAST UPDATED	2007
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
• Achieve zero waste disposal; • Reduce dependency on fossil fuels; • Develop and maintain a viable range complex; • Build a sustainable infrastructure; • Build energy efficient facilities; • Build forward-looking information technology infrastructure.			Integrated into the installation strategic plan in 2007. Sustainability goals became objectives. Track progress in accomplishing specific projects but not goals/objectives overall. Have begun some gross monitoring for specific resources (water and power consumption)		

INSTALLATION	USAG Grafenwohr				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED	2010	LAST UPDATED	2010
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
Goal 1: Maintain enduring interactive partnerships or forums with Host Nation authorities to ensure pro-active communication, education, and planning to enhance strategic multinational force readiness and the environment with Host Nation support. Goal 2: Build and sustain world class facilities to support deploy, redeploy and reset activities in support of multinational full spectrum missions. Goal 3: Provide multifunctional, state-of-the-art training facilities and capabilities in support of multinational training to prepare and sustain the force in any operational environment, while preserving our natural resources. Goal 4: Meet Leadership in Environmental and Energy Design (LEED) platinum standard for all new construction and when renovating existing structures. Goal 5: Acquire and manage resources and maximize processes optimizing sustainability (Mission, Environment and Community) Goal 6: Provide a safe and secure living and working environment through best practice programs and processes; use Best Available Technologies (BAT); ensure interoperability with Host Nation systems; maintain and improve Host Nation partnerships and promote a sustainable safe and secure culture; cultivate enterprise relationships between JMTC, Garrison, and Host Nation organizations to leverage resources and avoid duplication of efforts. Goal 7: Provide proactive, adaptive, results-focused well-being services resulting in an empowered and resilient community. Goal 8: Develop a flexible/adaptable workforce that gives us the Right People, with the Right Skills at the Right Time.			• Average time to fill supervisory vacancies (IMCP: LW1-2) New employees with college degree in Career Programs/Career Field 29 (IMCP: LW1-3) • Supervisory mobility and retention rate • Post-Training utilization rate • ICE satisfaction • Training area utilization and availability • Percent classroom utilization • Lean Six Sigma cost savings • Percent of facilities that meet the ISR infrastructure quality standard • Percent of facilities that meet the ISR infrastructure quantity standard • Percent all new building construction certified to LEED Silver with measurements and verifications upon completion of construction • Percent of building renovations certified LEED Silver with measurements and verifications upon completion; • Percent of GHG emissions reduction against 2008 baseline • Percent reduction in energy consumption per square foot; • Percent reduction in water consumption per square foot; • Satisfaction score (participants, managers, partners) for programs launched with strategic partners;		

INSTALLATION	Fort Greely				
GOALS IN USE (YES/NO):	NO	GOALS DEVELOPED	2009	LAST UPDATED	March 2010
CURRENT SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
Goal 1: Comprehensive life cycle management of Ft. Greely's workforce needs that address recruitment, retention, and professional development of human resources. Goal 2: Our strategic planning will be the benchmark for integrated garrison planning and programming which meets the needs of current and future users. Goal 3: Arctic benchmark for modernized infrastructure and utilities that provide for current and future mission requirements to attain energy efficiency and self-sufficiency while ensuring environmental stewardship. Goal 4: Agile and state-of-the-art Logistics capabilities that support today's Mission, contingencies, Fort Greely After-next; while reducing vulnerabilities, impacts, and constraints. Goal 5: Progressive planning that embraces unified partnerships capturing a future focused on optimizing resources through accurate communication and sustainable technology.			Goal 1: Retention Percent Goal 2: N/A Goal 3: Number of buildings being updated for best energy efficiency divided by total Number of buildings on the Garrison. Goal 4: N/A Goal 5: N/A *Comment: Unfortunately Fort Greely has had issues keeping up on our goals and measurements. While many of the "right" things are being done in each area and those "right" things fall into sustainability goals and strategic plans, not all of the goals are being measured on a recurring basis.*		

INSTALLATION	USAG Hohenfels				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED	March 2010	LAST UPDATED	March 2010
CURRENT SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
• USAG Hohenfels is a "Net Zero Bootprint" Installation in terms of energy, water, materials, transportation, and waste/emissions • High performance, optimally-placed infrastructure that best supports the mission and community, while maximizing resources and adapting to change: - Plan/program - Strategic Master Plan (zoning, development, time-phased execution strategy, investment strategy) - Marketing/resource acquisition - Design/construct: High performing, resource efficient, sustainable building design - Operate/maintain - Adapt • Maximize socialization opportunities through vibrant programming in modern and high-performing facilities. • Ensure the Hohenfels community is safe and secure in a fluid environment by embracing technology and host nation relationships - Technology (deterrence, detection, surveillance) - Consolidated Incident Response Center (CIRC) - Training Center (incident response, fire protection, law enforcement, safety) • Develop sustainable community to support future missions by bringing family housing closer to installation, improving two-way communication between U.S. and HN communities, consolidating on-post retail services and enhancing medical care. • Develop a Human Capital System that maximizes the intellectual capacity of the workforce, leverages resources to ensure sustainment of qualified employees, and transforms the culture of USAG-H into a model people-focused organization.			Strategic Plan recently completed – just beginning implementation and working to integrate IMCP measures into their measurement scheme		

INSTALLATION	Fort Hood				
GOALS IN USE (YES/NO):	Yes on regional goals. Garrison Goals are in Transition to Strategic Plan	**GOALS DEVELOPED**	2002	**LAST UPDATED**	Regional Goals 2010
CURRENT (Active) SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
Sustainability being integrated into EMS. Currently working on Regional sustainability goals: **Quality of Life:** Visionary progressive leaders, government and citizens that are change-oriented and embrace the needs and values of the community making Central Texas the most desirable region. **Sustainable Development/Land Use**: Central Texas will maintain the ability of Fort Hood to train, deploy and sustain its mission by promoting sustainable development of the Fort Hood region through mixed-use development, intermodal transportation networks, open space, and economic development. **Materials and Resources:** Maximize efficient use of resources, including regional materials, renewable energy, water, and recycling programs to benefit our environment & economy for present and future generations. **Sustainable Transportation Solutions:** Central Texas will have a sustainable multi-modal transportation network. **Education and Outreach:** Central Texas is Educated for Sustainability.			Regional sustainability goals are evaluated by each community at the objective level. Program started in January 2010 and has not matured to measurement yet.		

INSTALLATION	USAG Hawaii				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED	2007	LAST UPDATED	August 2009
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
• Sustain a predictable posture to generate trained and ready forces in support of all mission requirements. • Mission accomplished now and in the future while minimizing resource consumption, maximizing output through cost saving efficiencies, and increasing use of sustainable/renewable/ alternative resources, products and services. • The QOL OPB will meet soldier and family needs by providing oversight, guidance, direction, and prioritization to ensure sustainable, quality services, facilities, infrastructure, and information technology in support of the Garrison's mission. • A safe and secure installation with effective security operations that allow for a non-emergency, pre-911 environment.			Measure progress at the objective level – measure not provided.		

INSTALLATION	Fort Jackson				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED	Established in 2006, not revised since	LAST UPDATED	Objectives and targets are reviewed and revised annually
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
Military Training: Goal 1: Increase training efficiency and capacity. Goal 2: Develop an effective system of indicators to track quality of life for the Ft Jackson community. Goal 3: Establish an efficient, sustainable, and comprehensive installation planning process that is commensurate with the current operating environment (COE) and future installation requirements. Goal 4: Ensure optimal utilization of all existing Fort Jackson lands for training purposes. **Transportation:** Goal 1: Use renewable energy sources for all mobility systems to provide efficient transportation of materials and personnel. Goal 2: Access-friendly and secure installation. **Procurement:** Goal 1: Enhance current policies and procedures to ensure a flexible and sustainable procurement process to work towards achieving zero waste. Goal 2: A logistics system that ensures optimum utilization of available re-			Measure progress at the objective level – measure not provided.		

sources. **Infrastructure:** Goal 1: Operate an integrated, sustainable water system. Goal 2: Achieve 100% energy self-sufficiency. **Regional Interaction:** Goal 1: Achieve sustainable, long-term economic development in the Fort Jackson region. Goal 2: Integrated compatible regional land use. Goal 3: An active regional recreational partnership with facilities/activities that maximize community and military participation, well-being, revenue, fitness and promote active living.	

INSTALLATION	USAG Kaiserslautern				
GOALS IN USE (YES/NO):	Currently on hold to cross-walk with IMCP	GOALS DEVELOPED	2008	LAST UPDATED	2008
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
Establish an integrated and cooperative relationship between the American and HN populations Support transformation by maintaining and improving quality of life and mission support services to existing and incoming customers. (Efficient and effective infrastructure & transportation systems that support current and future missions.) Provide seamless, expandable power projection platform and re-integration services that support an expeditionary force. Leadership/ Workforce Development Objectives and Actions: • Establish and refine systems and business processes; • Provide a healthy, safe and efficient workplace; • Retain a high performing, diverse workforce • Train and develop workforce			Not measuring – awaiting guidance on how to integrate IMCP LOEs into strategic plans		

INSTALLATION	Letterkenny Army Depot				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2008	LAST UPDATED	2010
Goals managed through the Depot Commander-chaired EQCC. Progress reviewed quarterly with Commander and Senior Staff. Progress reported and reviewed monthly within DPW.					

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
Goal 1: Water Conservation: Establish a baseline for all water systems to include usage of potable water, waste water and storm water runoff by 2010 Conserve and reduce water usage for potable and non-potable water to include recycling of water for reuse **Goal 2: Energy Conservation** Develop and implement an energy conservation and reduction program to achieve energy sustainability Supply all energy for depot operations from renewable resources by 2033 **Goal 3: Pollution Reduction:** Achieve 100% diversion of solid waste (to include hazardous waste) from landfills or incinerators by 2033 No Title V Air Quality permit needed by 2018	Goal 1: • Overall water use from reservoir • Wastewater discharge from the IWTP per direct man-hour • Storm water flow and pollutants Goal 2: • Net energy consumption per direct labor hour • Number and level of LEED Certified facilities • Percentage of energy purchased from Green Sources Goal 3: • Percentage of wood diverted from landfills • Amount of hazardous waste generated per direct labor hour • Air pollutants from painting operations • Air pollutants from OB/OD operations

INSTALLATION	Fort Leonard Wood				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2010	LAST UPDATED	2010
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
Goal 1: Enduring communities supported by enhanced infrastructure and efficient utilities Goal 2: Forecasting and Resourcing Goal 3: Organize and construct FLW with adequate manning, equipment, technology, and facilities to sustain mission services in support of the training and deployment missions. Goal 4: Full and Effective Community Engagement Goal 5: Service Members, Families and Civilians Resilient in Mind, Body and Spirit. Goal 6: FLW community utilizes employment services and educational opportunities Goal 7: Modern, adaptable and high performance training facilities, ranges and land.			Under development		

INSTALLATION	Fort Lewis				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED	2002	LAST UPDATED	2007
CURRENT SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
Goal 1 - Air Quality: Reduce installation stationary source and non-tactical motor vehicle air emissions 85% by 2025 Goals 2&3 - Energy: - Reduce total energy consumption by 30% by 2015 - Sustain all activities on post using renewable energy sources and generate all electricity on post by 2025 Goal 4 - Sustainable Community: Create sustainable neighborhoods for a livable Fort Lewis community that enhances the Puget Sound Region Goal 5 - Products and Materials: Cycle all material use to achieve zero net waste by 2025 Goals 6&7 - Sustainable Training Lands: - Maintain the ability of Fort Lewis to meet its current and future military missions without compromising the integrity of natural and cultural resources, both on the installation and regionally. - Recover all listed and candidate federal species in the South Puget Sound Region Goal 8 - Water Resources: Treat all wastewaters to Class A reclaim standards by 2025 to conserve water resources and improve Puget Sound water quality			Goal 1 – Metric: - Stationary source emissions Goals 2&3 – Metrics: - Mega BTU/ K square feet of facilities space (reduction to target) - Percent of Renewable Energy Used Goal 4 – Metrics: - Percent Neighborhood attainment of sustainable design principles - Percent Attainment of sustainable design principles per project Goal 5 – Metrics: - Percentage of total potential customers that use the Hazardous Material Control Center (includes military units and civilian activities); Delivery Sites: Deliver to 398 locations - Percent Waste disposal to waste diversion - Percent Waste generation, disposal and diversion Goals 6&7 – Metric: - Training usage and management actions for training and natural resources - Percent Acre-days available Goal 8 - Metrics: - Biological Oxygen Demand Loading to Puget Sound Annual Average (tons) - Potable Water Production (Mgal)		

INSTALLATION	Fort Riley				
GOALS IN USE (YES/NO):	YES	GOALS DEVELOPED	2009	LAST UPDATED	2010
CURRENT SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
• Ensure Ft. Riley's ability to meet its mission; maintain the integrity of natural, cultural and economic resources; and cooperate with neighboring communities in and around the Flint Hills Region. • Fort Riley and the surrounding Flint Hills Region is a community of choice for Soldiers, Families, Retirees, and civilians – an enduring, welcoming, Family-oriented community that consists of interconnected services: o High quality jobs, o Affordable housing, o State of the art healthcare, o Quality education, o Affordable childcare, and o Diverse recreational opportunities • Recognized as the DoD Installation of Logistics Excellence for its regional partnerships resulting in efficient transportation and maintenance systems, responsive supply chain, and zero waste. • Provide sustainable facilities, infrastructure and land development to support the mission while enhancing quality of life. o Eliminate energy waste in existing facilities o Increase energy efficiency in new construction and renovations o Eliminate dependence on fossil fuels o Conserve water resources to achieve a sustainable level o Improve energy security o Development that addresses land use patterns, transportation, utility infrastructure, and regional collaboration o Maintain historic value of Fort Riley o Design, build, commission, maintain, decommission sustainable facilities			Progress on Methods (Tasks/initiatives) is reported weekly to the Senior Commander via email and a VTC is conducted every 6 weeks for face-to-face reporting. Measures not provided.		

INSTALLATION	Fort Rucker				
GOALS IN USE (YES/NO):	(Oct 2010) Still in development of first version of plan and integration with IMCOM campaign plan	GOALS DEVELOPED	2009	LAST UPDATED	Goals updated April 2010. Action plans under development

The Installation Planning Board (IPB), chaired by the senior commander and facilitated by the Garrison Commander, is the venue by which the installation's common operating picture is presented to installation senior leaders. The board is comprised of primary tenant activity commanders, school commandants and their sergeants major. The board serves as the principal forum by which senior leaders communicate with installation stakeholders and planners to:

- Present the broad continuum of results and decisions of numerous planning activities
- Demonstrate how installation activities interrelate and contribute to the spectrum of support for the Mission and our Soldiers and Families
- Communicate the Senior Commander's priorities
- Provide a final opportunity to ensure all significant inputs have been considered and synchronized

Stakeholders, both internal and external, working in concert with the U.S. Army Aviation Center of Excellence and the Garrison, participate in functional boards and workgroups, such as the Real Property Planning Board, Safety, Well-being, Environmental, Anti-terrorism/Force Protection, Training/Readiness Support and the Installation Planning Board Steering Committee. These planning forums validate alignment of their functional products and initiatives with the senior commander's installation priorities and strategic plan. Updates on initiatives are presented semi-annually to the IPB, which in turn provides feedback and guidance on the installation's strategic direction.

CURRENT SUSTAINABILITY GOALS:	CURRENT MEASUREMENTS FOR GOALS:
Goal 1: Enhance support to ARFORGEN and mission training Goal 2: Sustain, Transform & Modernize the Installation Goal 3: Enhance Well-Being of the Military Community Goal 4: Recruit, Develop and Sustain a Service-Oriented, Mission-Focused and Capable Workforce Goal 5: Transform Business Processes to Optimize Resources	To be developed around IMCOM Campaign Plan LOE Metrics

INSTALLATION	USAG Vicenza				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED	2010	LAST UPDATED	2010
CURRENT SUSTAINABILITY GOALS:			CURRENT MEASUREMENTS FOR GOALS:		
• Soldiers, Families and Civilians are able to meet the challenges of deployment and the ARFORGEN process through proper training, responsive services, and communities of excellence. • Soldiers, Families, and Civilians are confident that they are being cared for; and their physical, emotional, and spiritual needs are enriched by quality programs, infrastructure, and support. • A multi-skilled workforce comprising Military and Civilian leaders and personnel with the knowledge, capabilities, skills, and opportunities to successfully and innovatively accomplish the installation management mission. • Installations are platforms of readiness supporting current and future requirements through regular modernization and new construction of facilities and infrastructure to maintain efficient and sustainable operations and to enable the provision of effective services to Soldiers, Families and Civilians. • All Soldiers, Families, and Civilians consciously employ risk reduction measures to foster a safe working and living environment, instilling a sense of safety both on- and off-duty while promoting leader and individual accountability. • Maintain energy and water efficient installations by holding users accountable, modernizing facilities, installing new technologies, and leveraging partnerships that will provide an increased level of energy security leading to sustainable and resilient infrastructure and mission assurance.			Goals are the same as the IMCP LOE. Currently implementing strategic objectives and integrating IMCP measurement.		

INSTALLATION	Yakima Training Center				
GOALS IN USE (YES/NO):	Yes	GOALS DEVELOPED		LAST UPDATED	2007
CURRENT SUSTAINABILITY GOALS:			**CURRENT MEASUREMENTS FOR GOALS:**		
ENERGY: Supply all activities on YTC with renewable energy sources by 2030 PRODUCTS AND MATERIALS: Recycle/reuse all waste material to achieve ZERO net waste by 2030 AIR QUALITY: Minimize air emissions on YTC and maintain emission levels below thresholds for becoming a major source WATER RESOURCES: Reduce potable and irrigation water use as much as feasible SUSTAINABLE TRAINING LANDS: - Maintain the ability of YTC to meet its current and future military missions while protecting the integrity of natural and cultural resources, both on the installation and regionally - Provide shrub steppe ecosystem processes and functions that ensure ecosystem integrity - Protect the aesthetic and cultural landscape of YTC			Energy produced and/or "renewable credits" purchased – Energy consumed > 0. Total waste generated – recycled/reused material = 0. Maintain emissions below 100 tons/year for each priority pollutant and minimize dust emissions. Maintain soil and water resources and habitat for T&E species and management indicator species as defined by the YTC INRMP and as measured by natural resource assessments.		

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14. ABSTRACT
This study addresses the nature of indicators of sustainability. Such indicators differ from both sustainability goals and plans, and even from the implementation of actions that are believed likely to enhance sustainability. The indicators developed during this study are intended as direct measures of sustainability. The attributes of ideal indicators of sustainability are discussed. A set of indicators is defined that satisfy the criteria represented by the attributes. This ideal set of indicators is then confronted with Army data that might be used to derive values for the indicators. A set of six indicators and data sources is proposed for use both by installations that are part of the U.S. Army's Installation Management Command (IMCOM) and by the Command itself.

15. SUBJECT TERMS
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