

ANNEX 1. CLIMATE AND TERRAIN ANALYSIS

1.1 Introduction

TABS addressed the climate and terrain area comments stated within Department of Defense Selection Criterion #2, which identifies the availability and condition of land throughout a diversity of climate and terrain as a key military value criterion.

"The availability and condition of land, facilities and associated airspace (including **training areas suitable for maneuver** by ground, naval, or air forces **throughout a diversity of climate and terrain areas** and staging areas for the use of the Armed Forces in homeland defense missions) at both existing and potential receiving locations."

TABS identified installation coverage across different climate and terrain regimes and compared this coverage to Army maneuver land capability, since the capability to maneuver is the Army capability most influenced by land type. Other Army capabilities (e.g., industrial, admin, depot, etc.) are not as restricted by regime.

1.2 Definitions

Maneuver / Training Areas – lands that provide space for the movement of combat forces and equipment under simulated battlefield conditions for training purposes in order to improve combat readiness.

Terrestrial Habitats (Regimes) – areas that share similar environmental conditions, habitat structure, and patterns of biodiversity. A total of 14 major habitat types exist, ranging from forests to deserts. The 14 major habitat types include the full extent of continental topographic relief. Army installations reside within nine of these 14 habitats.

1.3 Approach

TABS followed these steps:

1. Identified the major habitat types within the 50 United States and Puerto Rico where Army installations reside.
2. Identified U.S. Army installations with maneuver areas greater than 10,000 acres.
3. Determined which habitat these installations were located within.

TABS used certified data to conduct the analysis and geographic information systems (GIS) to map the habitat regions and the 87 Army installations studied within BRAC 2005.¹ GIS provided a visual representation of the major habitat types and their relation to Army installations.

¹ Ten leases within Army BRAC 2005 analysis are not considered here because the leases are admin buildings and do not include potential training lands.

Step 1: Identifying Habitat Types

A broad terrestrial view, including unique combinations of temperature, precipitation, topographic relief, and vegetative structure, provides a complete representation of climate and terrain for this analysis. TABS utilized the Global 200 ranking of the Earth's habitats, which is a science-based global ranking of the Earth's terrestrial, freshwater, and marine habitats. Developed by the World Wildlife Fund, Global 200 represents a comparative analysis of every major habitat type. Habitats range from the wettest of forest types to the driest and hottest desert conditions; they include the full extent of continental topographic relief:

- **Tropical & Subtropical Moist Broadleaf Forests** – low variability in annual temperature and high level of rainfall, dominated by semi-evergreen and evergreen deciduous trees
- **Tropical & Subtropical Dry Broadleaf Forests** – similar to above but subject to long dry seasons which can last several months
- **Temperate Broadleaf and Mixed Forests** – wide range of variability in temperature and precipitation
- **Temperate Coniferous Forests** – evergreen forests common in coastal areas with mild winters and heavy rainfall, or inland in drier mountainous areas
- **Boreal Forests / Taiga** – low annual temperatures in northerly latitudes; precipitation falls mainly as snow
- **Tropical & Subtropical Grasslands, Savannas and Shrublands** – large expanses of land in the tropics that do not receive enough precipitation to support extensive tree cover
- **Temperate Grasslands, Savannas and Shrublands** – similar to above, but have a much broader annual temperature regime, known as prairies in North America
- **Deserts and Xeric Shrubs** – receive less than 10 inches of precipitation annually with wide temperature extremes
- **Mediterranean Forest, Woodlands** – hot dry summers, cool and moist winters

Step 2: Identifying Maneuver Areas

Army BRAC 2005 objectives include:

“...providing Army units and activities with sufficient, sustainable maneuver and training space in a wide variety of geographic, topographic, and climatic conditions in support of Joint training, testing, and experimentation and Homeland Defense.”

In order to meet this objective, and satisfy Criterion #2, TABS identified and maintained those installations with sustainable maneuver land in each of the habitats where the Army currently has maneuver lands. Maneuver land requirements for a “company” size unit are approximately 10,000 acres; therefore TABS identified installations with 10,000 maneuver acres or more within each habitat. For company level training, 10,000 acres is sufficient, but, in the interest of looking at the sensitivity of our results to this acreage requirement, we also considered installations with 5,000 maneuver acres.

Step 3: Creating a Thematic Map of Army Installations and Habitat Types

The data from the previous steps were brought into a GIS software package and used to create a thematic map depicting Army installations and the habitats where they are located. The GIS software enabled us to query the data sets and produce results based on the aforementioned criteria.

1.4 Analysis

Tabs mapped Army installations and differentiated between those with available maneuver areas and those without across the nine major habitat types Army installations reside in. Figure 1 depicts the location of each installation within its respective habitat.

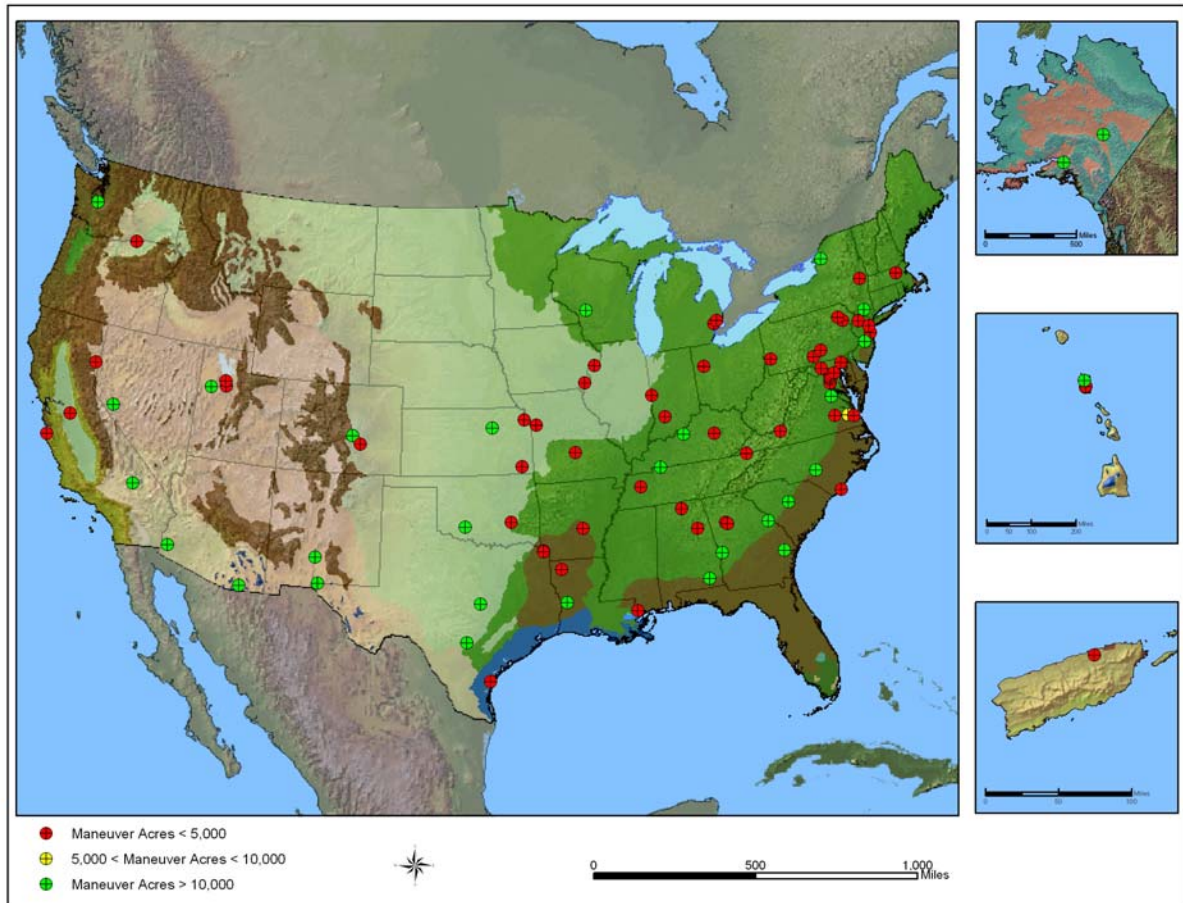


Figure 1. Installations and Habitat Types

Green symbols in Figure 1 represent installations with more than 10K maneuver acres. One additional installation is considered when we relax the 10K requirement to 5K (yellow).

Table 1 summarizes the habitat type and the number of installations within the habitat that meet the required level of maneuver lands. TABS concentrated on the gray column; three habitats currently have no maneuver capable installations located within them.

#	HABITAT TYPE	TOTAL # OF INSTALLATIONS	# WITH >10,000 MANEUVER ACRES	# WITH >5,000 MANEUVER ACRES
1	Temperate Broadleaf & Mixed Forests	42	9	9
2	Temperate Coniferous Forests	13	6	7
3	Temperate Grasslands, Savannas & Shrub lands	13	5	5
4	Deserts & Xeric Shrub lands	11	7	7
5	Boreal Forests / Taiga	2 (Ft. Wainwright) (Ft. Richardson)	2 (Ft. Wainwright) (Ft. Richardson)	2 (Ft. Wainwright) (Ft. Richardson)
6	Tropical and Subtropical Moist Broadleaf Forests	2 (Ft. Buchanan) (Schofield Barracks)	1 (Schofield Barracks)	1 (Schofield Barracks)
7	Tropical & Subtropical Dry Broadleaf Forests	2 (Tripler Army Medical Center) (Ft. Shafter)	0	0
8	Tropical & Subtropical Grasslands, Savannas & Shrub Lands	1 (Corpus Christi Army Depot)	0	0
9	Mediterranean Forests, Woodlands & Scrub	1 (Presidio of Monterey)	0	0

Table 1. Installations by Habitat Type

Table 1 shows that 42 of the Army installations are in the Temperate Broadleaf & Mixed Forest Habitat and that 9 of these installations have more than 10,000 acres of maneuver lands. TABS ensured that the Army maintained at least one of these nine installations resided within the Temperate Broadleaf habitat. The same thought process holds for habitats 2-4. For example, TABS ensured the Army retained an installation in the Deserts & Xeric Shrub lands habitat (currently there are seven), and kept Schofield Barracks and at least one of either Fort Wainwright or Fort Richardson within the Tropical & Subtropical Moist Broadleaf Forest and Boreal Forest/Taiga habitats, respectively.

1.5 Summary

TABS identified installation coverage across different climate and terrain habitats; compared habitat coverage to Army maneuver land capability; and determined the necessary climate and terrain restrictions on Army portfolio analysis. Using climate and terrain characteristics, TABS addressed the requirement stated within Department of Defense Selection Criterion #2:

"The availability and condition of land, facilities and associated airspace (including **training areas suitable for maneuver** by ground, naval, or air forces **throughout a diversity of climate and terrain areas** and staging areas for the use of the Armed Forces in homeland defense missions) at both existing and potential receiving locations."

TABS identified installations with more than 10,000 acres of maneuver areas in each habitat because, in the Army, climate and terrain types mostly influence maneuver land quality and training diversity. The analysis illustrates that three of the nine habitats do not contain installations that the Army considers maneuver capable. Of the remaining six habitats, Boreal Forests/Taiga and Tropical & Subtropical Moist Broadleaf Forests are limited in the number of installations they support and are considered influential in the overall analytical result.

Appendix

Installation List by Habitat Type:

Temperate Broadleaf & Mixed Forests (42)		
Aberdeen Proving Ground	Fort Gillem	Milan AAP
Anniston Army Depot	<i>Fort Gordon (a)</i>	Naval Weapons Support Center Crane
Blue Grass Army Depot	Fort Hamilton	Newport Chemical Depot
Carlisle Barracks	<i>Fort Knox (a)</i>	Picatinny Arsenal
Charles E. Kelly Support Facility	Fort Lee	Radford AAP
Detroit Arsenal	Fort Leonard Wood	Redstone Arsenal
<i>Fort A.P. Hill (a)</i>	<i>Fort McCoy (a)</i>	Scranton AAP
Fort Belvoir	Fort McNair	Soldier Systems Center (Natick)
<i>Fort Benning (a)</i>	Fort McPherson	Tobyhanna Army Depot
<i>Fort Campbell (a)</i>	Fort Monmouth Main Post	US Army Garrison Selfridge
Fort Detrick	Fort Myer	USA Adelphi Laboratory Ctr
<i>Fort Dix (a)</i>	Holston AAP	Walter Reed Army Medical Center
<i>Fort Drum (a)</i>	Letterkenny Army Depot	Watervliet Arsenal
Fort George G Meade	Lima Army Tank PLT	<i>West Point Military Reservation (a)</i>
Temperate Coniferous Forests (13)		
<i>Fort Bragg (a)</i>	<i>Fort Polk (a)</i>	Mississippi AAP
<i>Fort Eustis (b)</i>	<i>Fort Rucker (a)</i>	Pine Bluff Arsenal
<i>Fort Jackson (a)</i>	<i>Fort Stewart (a)</i>	Red River Army Depot
<i>Fort Lewis (a)</i>	Lone Star AAP	
Fort Monroe	Military Ocean Terminal Sunny Point	
Temperate Grasslands, Savannas & Shrub lands (13)		
<i>Fort Carson (a)</i>	<i>Fort Sill (a)</i>	Pueblo Chemical Depot
<i>Fort Hood (a)</i>	Iowa AAP	Riverbank AAP
Fort Leavenworth	Kansas AAP	Rock Island Arsenal
<i>Fort Riley (a)</i>	Lake City AAP	
<i>Fort Sam Houston (a)</i>	McAlester AAP	
Deserts & Xeric Shrub lands (11)		
Deseret Chemical Depot	<i>Hawthorne Army Depot (a)</i>	Umatilla Chemical Depot
<i>Dugway Proving Ground (a)</i>	National Training Center and Fort Irwin	<i>White Sands Missile Range (a)</i>
<i>Fort Bliss (a)</i>	Sierra Army Depot	<i>Yuma Proving Ground (a)</i>
<i>Fort Huachuca (a)</i>	Tooele Army Depot	
Boreal Forests / Taiga (2)		
<i>Fort Richardson (a)</i>	<i>Fort Wainwright (a)</i>	
Tropical and Subtropical Moist Broadleaf Forests (2)		
Fort Buchanan	<i>Schofield Barracks (a)</i>	
Tropical and Subtropical Dry Broadleaf Forests (2)		
Fort Shafter	Tripler Army Medical Center	
Tropical & Subtropical Grasslands, Savannas & Shrub lands (1)		
Naval Air Station Corpus Christi		
Mediterranean Forests, Woodlands & Scrub (1)		
Presidio of Monterey		

(a) Greater than 10,000 maneuver acres

(b) Greater than 5,000 maneuver acres

ANNEX 3: MVA Attribute Data Certifications

This annex provides a listing of the certification sources for the forty attributes used to assess installation military value. Attributes 1-6, 9, 10, 12, 19-24, 32, 35, 36 were certified either by installation data call or by other government sources e.g., U.S Census Bureau. A hard copy of the certification letters acquired by means other than data call and government sources is provided herein.

Attribute	Source¹	Certification Source
1. Direct Fire Capability	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
2. Indirect fire Capability	DC1, DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
3. MOUT Capabilities	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
4. Heavy Maneuver Area	DC1, DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
5. Light Maneuver Area	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
6. Joint Airspace	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
7. General Instructional Facilities	HQRPLAN S, ISR	Certified by ACSIM IAW Addendum 1 of TABS ICP.
8. Applied Instructional Facilities	HQRPLAN S, ISR	Certified by ACSIM IAW Addendum 1 of TABS ICP.
9. Air Quality	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
10. Noise Contours	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
11. Soil Resiliency	ATTACC model	Derived data from Army Training and Testing Area Carrying Capacity model certified by HQDA principal.
12. Water quantity	DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
13. Mobilization History	G-3, FORSCOM	Certified by G3 and Commander, FORSCOM IAW TABS ICP.
14. Force Deployment	DC1, MSDDCTE A	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP. Military Surface Deployment and Distribution Command Transportation Engineering Agency data certified by OSD or HQDA principal.

¹ DC1, DC2=Data Call #1, Data Call #2

15. Materiel Deployment	DC1, MSDDCTE A	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP. Military Surface Deployment and Distribution Command Transportation Engineering Agency data certified by OSD or HQDA principal.
16. Ops/Admin Facilities	HQRPLAN S, ISR	Certified by ACSIM IAW Addendum 1 of TABS ICP.
17. Accessibility	CAA report	Data certified by CAA.
18. Connectivity	Army G- 6/ISEC	Certified by G6 IAW TABS ICP.
19. RDT&E Mission diversity	DC1, DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
20. Test Range Capacity	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
21. Munitions Production	DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
22. Ammunition Storage Cap.	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
23. Joint Workload	DC1, DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
24. Maintenance/Manufacturing	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
25. Supply & Storage Capacity	HQRPLAN S, ISR	Certified by ACSIM IAW Addendum 1 of TABS ICP.
26. Crime Index	UCR	Certified as to source IAW TABS ICP.
27. Employment Opportunities	Census Bureau, Bureau of Labor Statistics, DC 2	Certified as to source IAW TABS ICP. Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
28. Housing Availability	Housing Market Analysis	Certified by ACSIM IAW TABS ICP.
29. Medical Care Availability	Census Bureau American Hospital Association Database	Certified as to the source IAW TABS ICP. American Hospital Association Database, Office of the Surgeon General data certified by OTSG.
30. In-state Tuition Policies	DoD In- State website	Certified as to the source IAW TABS ICP.

31. Workforce Availability	Department of Labor; Bureau of Labor Statistics; Census Bureau	Certified as to the source IAW TABS ICP.
32. Joint Facilities	DC 2	Certified by Senior Mission Commander IAW Addendum 2 TABS ICP.
33. Area Cost Factor	DoD Facilities Pricing Guide	Certified by ODUSD-IE IAW TABS ICP.
34. C2 Facilities	HQRPLANS	Certified by ACSIM IAW Addendum 1 of TABS ICP.
35. Variable Cost Factor	DC2	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
36. Buildable Acres	DC1	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP.
37. Brigade Capacity	RPLANS	Certified by ACSIM IAW Addendum 1 of TABS ICP.
38. Environmental Elasticity	DC1, DC2, ISR, AEPI	Certified by Senior Mission Commander IAW Addendum 2 of TABS ICP. Certified by ACSIM IAW Addendum 1 of TABS ICP. Derived data from Army Environmental Policy Institute certified by Army Environmental Policy Institute.
39. Urban Sprawl	U. S. Army Corps of Engineers Research Labs (CERL)	Certified by Chief of Engineers IAW TABS ICP.
40. Critical Infrastructure. Proximity	U. S. Bureau of Labor, GIS	Certified as to the source IAW TABS ICP. Geographic Information System data certified by Center for Army Analysis.



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

AUG 17 2004

MEMORANDUM FOR CHAIRMAN, MEDICAL JOINT CROSS-SERVICE GROUP

SUBJECT: Use of Medical Commercial Data Sources

You requested permission to use the following commercial data sources during the BRAC 2005 process:

- American Medical Association, Physician's Professional record (AMA-PPD), December 31, 2003
- American Dental Association Database, copyright 2003
- Health Forum, LLC, an affiliate of the American Hospital Association (AHA), Annual Survey Database, Fiscal Year 2002
- U.S. Census Bureau population data

Using these commercial data sources in the BRAC 2005 process as described in your memorandum is acceptable. I understand that the Office of the Assistant Secretary (Health Affairs) used these same data sources to support the data call efforts of the Joint Process Action Team for Criterion 7.

A handwritten signature in black ink, appearing to read "Michael W. Wynne".

Michael W. Wynne
Acting USD (Acquisition, Technology & Logistics)
Chairman, Infrastructure Steering Group

cc: Assistant Secretary of Defense (Health Affairs)
MilDep BRAC DASs
Chairmen JCSG



Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The data requested for the installation military value attribute "Urban Sprawl", and maintained in the 1992 National Land Cover Data (NLCD), are certified as to the source. The data requested, and maintained in the National Imagery and Mapping Agency's IKONOS database are certified as accurate and complete to the best of the certifier's knowledge and belief. Attached is the requested information.

Robert C. Jegan / SP IV
Name/Grade


2 JUN 04
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The data requested for the installation military value attribute "Accessibility", and maintained in the 2003 DoD Base Structure Report, the Federal Aviation Administration's 2002 Air Carrier Activity Information system, the Sustainable Installations Regional Resource Assessment database, and the ArcGIS 8.3 (ESRI Inc.) are certified as to the source. Attached is the requested information.



Name/Grade

Ewing, Paul C.


3 June 04
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The data requested for the installation military value attribute "Critical Infrastructure Proximity", and maintained in the 2003 U.S. Nuclear Regulatory Commission Information Digest, Appendix A; the U.S. Army Corps of Engineers National Inventory of Dams; the Federal Reserve Board of Governors website; the National Geospatial Intelligence Agency's U.S. Port Protection Graphic, Version 1, Top 25 Most Dangerous Chemical Facilities, Version 2, and U.S. Crude oil Pipelines and Refineries, Version 2, are certified as to the source. Attached is the requested information.

 0-4
Name/Grade
Ewing, Paul L.

3 Jun 04
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA

MEMORANDUM FOR RECORD

2 Aug 2004

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE ANALYSIS (DASA (IA)

SUBJECT: Data Certification, Soil Resiliency Attribute for TABS Military Value Analysis (MVA)

1. TABS requested Soil HEL (Highly Erodible Land) classification data on 88 Army installations and an additional 8 Air Force and Navy installation. I collected the data, and in some cases, derived the HEL classification for the requested installations as described below. I am providing the data as an attachment to this memorandum.

a. Thirty Seven of the 96 installations have no training acreage reported, so no HEL classification was required. One installation (Blue Grass Army Depot) had the HEL class already determined.

b. Fifty Four (54) have the classification completed.

c. Five of the Navy and Air Force installations are still to be developed (Cannon AFB, Hill AFB, Luke AFB, Fallon NAS, and Camp Pendleton).

d. Two installations lack adequate spatial data, and I'm still attempting to acquire usable spatial data. This applies to Ft McPherson and Tobyhanna Army Depot.

2. The data used in the Soil Resiliency attribute for MVA was collected from a variety of certifiable sources. The equations used and actual data will be provided in a related report.

a. When available, HEL classification was taken from the NRCS (National Resources Conservation Service) NASIS (National Soil Information System) database. Information on NASIS can be found at <http://nasis.nrcs.usda.gov/>. Attribute data can be downloaded on a soil survey area basis from the NRCS Soil Data Mart at <http://soildatamart.nrcs.usda.gov/>.

b. Spatial data was taken from NRCS maps. In most cases, this consisted of SSURGO certified digital maps. SSURGO certification specifies that the digital data meets all requirements in the NRCS National Soil Survey Handbook (NSSH). SSURGO certified data can be downloaded from the NRCS Soil Data Mart at <http://soildatamart.nrcs.usda.gov/>. In some cases, I used STATSGO maps (less detail). STATSGO data can be downloaded from NRCS National Cartography and Geospatial Center found at <http://www.ncgc.nrcs.usda.gov/branch/ssb/products/statsgo/>. Where digital maps were not available, NRCS hard copy maps were used.

c. When required for deriving HEL classification, equation values were used from the following sources:

(1) Slope. LS factor from (Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook No. 703.

(2) Climate. R factor from Agricultural Handbook No. 703.

SUBJECT: Data Certification, Soil Resiliency Attribute for TABS Military Value Analysis (MVA)

- (3) Erosivity. K factor from NASIS.
- (4) Water, Wind. T factor from NASIS;
- (5) C factor (wind) from interactive C-value map at NRCS National Cartography and Geospatial Center found at <http://nm6.ftw.nrcs.usda.gov/website/>.

3. The data taken directly from the open sources listed above, and not changed from the sources, are certified as to the sources. The data derived from data taken from the above listed open data sources are certified as accurate and correct to the best of my knowledge.

4. POC is the undersigned at (410) 436-1561.

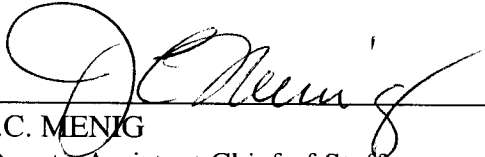


Enclosure

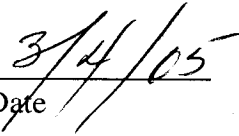
George E. Teachman
Soil Scientist,
NRCS/USAEC

Data Certification

The data requested, and maintained in the 2003 Army Real Property Planning and Analysis System (RPLANS) and Army Stationing and Installation Plan (ASIP) databases are certified as accurate and complete to the best of the certifier's knowledge and belief.



J.C. MENIG
Deputy Assistant Chief of Staff
for Installation Management



Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Enclosure 1.

Data Certification

The data requested and maintained in the Mobilization Product contained within GCCS-A are certified as accurate and complete to the best of the certifier's knowledge and belief. Attached is the requested information.


Name/Grade LTC (P) 40

6 Jul 04
Date

MICHAEL BOSMA, LTC (P)
Acting Chief, Plans Division
HQ, FORSCOM G-3

Draft deliberative document-For discussion purposes only-Do not release under FOIA

MEMORANDUM FOR RECORD

24 August 2004

SUBJECT: TABS Internal MV Attribute Data Certification – AMA-PPD, ADAD, AHA, US Census Bureau

1. ATTRIBUTE: Primary/Specialty Care Providers
2. DESCRIPTION: Indicates the ability of civilian primary and specialty care providers to accommodate the population adjacent to the military installation.
3. CERTIFIED VALUES: see attached Memorandum, 17 August 2004.
4. DATA SOURCES: Database with consolidated data from AMA-PPD, ADAD, AHA, and US Census Bureau.
5. I certify that the Medical Commercial Data Sources information supplied is certified as to the source and that the information is accurate and complete to the best of my knowledge and belief.



Dale Grossett

SGM, USA

TABS Military Value Analyst

Enclosure

Memorandum, Use of Medical Commercial Data Sources,
17 August 2004



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

AUG 17 2004

MEMORANDUM FOR CHAIRMAN, MEDICAL JOINT CROSS-SERVICE GROUP

SUBJECT: Use of Medical Commercial Data Sources

You requested permission to use the following commercial data sources during the BRAC 2005 process:

- American Medical Association, Physician's Professional record (AMA-PPD), December 31, 2003
- American Dental Association Database, copyright 2003
- Health Forum, LLC, an affiliate of the American Hospital Association (AHA), Annual Survey Database, Fiscal Year 2002
- U.S. Census Bureau population data

Using these commercial data sources in the BRAC 2005 process as described in your memorandum is acceptable. I understand that the Office of the Assistant Secretary (Health Affairs) used these same data sources to support the data call efforts of the Joint Process Action Team for Criterion 7.

A handwritten signature in black ink, appearing to read "Michael W. Wynne".

Michael W. Wynne
Acting USD (Acquisition, Technology & Logistics)
Chairman, Infrastructure Steering Group

cc: Assistant Secretary of Defense (Health Affairs)
MilDep BRAC DASS
Chairmen JCSG





REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT AGENCY
2511 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VA 22202-3926

SFIM-PL-Q

AUG 09 2004

8/1/04

MEMORANDUM THRU Assistant Chief of Staff for Installation Management (ACSIM),
600 Army Pentagon, Room 1E677, Washington, DC 20310-0600

FOR Deputy Assistant Secretary of the Army (Installation Analysis), 1400 Key Blvd,
Suite 200, Arlington, VA 22209

SUBJECT: Certification of 2003 Installation Status Report (ISR) Infrastructure Data

1. This responds to your request for a copy of correspondence from installation garrison commanders certifying the 2003 ISR Infrastructure data for their installation.
2. Enclosures include copies of the certifications for all ISR Infrastructure reporting CONUS installations.
3. POC for this action is Mr. Ron Knowles, SFIM-PL-Q, (703) 602-4398.

Encls

STEVE T. WILBERGER
COL, QM
Chief of Staff



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY ASSISTANT SECRETARY OF THE ARMY
(INFRASTRUCTURE ANALYSIS)
1400 KEY BLVD
ARLINGTON, VA 22209

SAIE-IA

8 November 2004

MEMORANDUM FOR Headquarters and Support Joint Cross Service Group

SUBJECT: Army Real Property Planning and Analysis System (RPLANS) Data

1. The information you have been provided on Army FACs has been obtained from the TABS RPLANS database. This database is based on the FY03 lock of HQRPLANS, and has been certified by the appropriate certification authority, in accordance with our Internal Control Plan.
2. Please let my Data Support Team know if you have any additional questions. You can reach Larry Wright at (703) 696-9588 or Kathy Manners at (703) 696-9786.

Craig E. College
Deputy Assistant Secretary of the Army
Infrastructure Analysis

Encl

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Data Certification

The data requested, and maintained in SDDCTEA Port Throughput Analysis Data records are certified as accurate and complete to the best of the certifier's knowledge and belief. The data requested, and maintained in the Fairplay Venson Distance Tables and the Joint Flow and Analysis System for Transportation (JFAST) Air Distance Calculator are certified as to the source. Attached is the requested information.

William J. Cooper / SES-4
Name/Grade

23 Jun 04
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA


MEMORANDUM FOR RECORD

24 May 2004

SUBJECT: TABS Internal MV Attribute Data Certification - Open Source

1. ATTRIBUTE: Crime Index
2. DESCRIPTION: The level of violent and property crimes, as measured by the FBI's Uniform Crime Reporting (UCR) Program, for the Metropolitan Statistical Areas (MSA), county(s) or cities containing BRAC Study group military installations.
3. CERTIFIED VALUES: See attached webpage extract.
4. DATA SOURCE: UCR, Section II, http://www.fbi.gov/ucr/cius_02/pdf/2sectiontwo.pdf.
5. I certify that the information supplied is certified as to the source to the best of my knowledge and belief.

Enclosure


DALE L CROSSETT
SGM, USA
TABS Military Value Analyst

MEMORANDUM FOR RECORD

24 May 2004

SUBJECT: TABS Internal MV Attribute Data Certification –DoD Source

1. ATTRIBUTE: In-State Tuition
2. DESCRIPTION: Measures the eligibility of soldiers and family members to receive in-state tuition educational benefits.
3. CERTIFIED VALUES: See attached webpage extract.
4. DATA SOURCES: DoD (Army) Education website,
<https://www.armyeducation.army.mil/InState/index.HTM>.
5. I certify that the Census Bureau information supplied is certified as to the source and that the DFAS information is accurate and complete to the best of my knowledge and belief.

Enclosure



Dale Crossett

SGM, USA
TABS Military Value Analyst


MEMORANDUM FOR RECORD

24 May 2004

SUBJECT: TABS Internal MV Attribute Data Certification - Open Source

1. ATTRIBUTE: Employment Opportunity
2. DESCRIPTION: Unemployment rates and median incomes for the Metropolitan Statistical Areas (MSA)/MHA (Military Housing Area)/County containing BRAC Study group military installations.
3. CERTIFIED VALUES: See attached webpage extract.
4. DATA SOURCE: .
 - a. Bureau of Labor Statistics, <http://www.bls.gov/data/home.htm>
 - b. US Bureau of Census: Line QT-P32
http://factfinder.census.gov/servlet/QTGeoSearchByListServlet?ds_name=DEC_2000_SF3_U&lang=en&ts=101649370327
5. I certify that the information supplied is certified as to the source to the best of my knowledge and belief.

Enclosure


DALE L. CROSSETT
SGM, USA
TABS Military Value Analyst

MEMORANDUM FOR RECORD

24 May 2004

SUBJECT: TABS Internal MV Attribute Data Certification – DoD and Open Source

1. ATTRIBUTE: Housing
2. DESCRIPTION: A combination of the number of available rental vacancies and the Basic Allowance for Housing (BAH) Rates, for the Metropolitan Statistical Areas (MSA)/MHA (Military Housing Area/County containing BRAC Study group military installations.
3. CERTIFIED VALUES: See attached webpage extract.
4. DATA SOURCES:
 - a. Defense Finance and Accounting Service (DFAS)(2004 BAH Rates)
<http://www.dtic.mil/perdiem/bah.html>
 - b. US Bureau of Census, Summary file 3 (Rental Vacancies)
http://factfinder.census.gov/servlet/DatasetMainPageServlet?_ds_name=DEC_2000_SF3_U&_program=DEC&_lang=en or US Bureau of Census:
<http://quickfacts.census.gov/qfd/>
5. I certify that the Census Bureau information supplied is certified as to the source and that the DFAS information is accurate and complete to the best of my knowledge and belief.

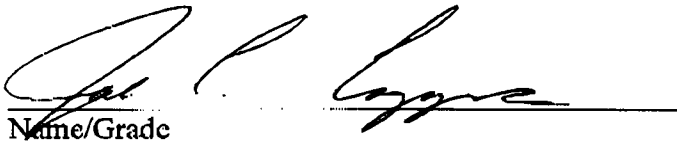
Enclosures


DALE L. CROSSETT
SGM, USA
TABS Military Value Analyst

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The data requested, and maintained in Enterprise Systems Technology Activity circuit database reflecting post fiber wide area network connectivity are certified as accurate and complete to the best of the certifier's knowledge and belief. The data requested on post GSM/WPS cellular coverage, and maintained by Enterprise Systems Technology Activity are certified as accurate and complete to the best of the certifier's knowledge and belief. The data requested, and maintained by Information Systems Engineering Command (Ft Detrick) records on the Army's Installation Information Infrastructure Modernization Program are certified as accurate to the source. The data requested, and maintained in The Federal Communication Commission's "Eighth Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services"; the proprietary vendor CONUS fiber path maps from Level3, Sprint, Qwest, MCI, AT&T, and Broadwing; and the Joint Spectrum Center's "Government Master File" of all government frequency assignments are certified as to the source. Attached is the requested information.


Name/Grade

11 Aug 04
Date

Joe C. Capps, SES
Director, Enterprise Systems Technology Activity

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The proprietary vendor CONUS fiber path maps obtained from the Defense Information Systems Agency (Level3, Quest, AT&T, and Broadwing), and those obtained directly from the vendors (Sprint, MCI) are certified as to the source.

Mark V. Flasch, MAJ
Name/Grade

23 Jun 04
Date


Mark V. Flasch, MAJ
HQDA CIO/G-6

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The data requested on the Installation Information Infrastructure Modernization Program, and maintained by Information Systems Engineering Command-Fort Detrick Engineering Directorate, are certified as accurate and complete to the best of the certifier's knowledge and belief. The data requested, maintained in The Federal Communication Commission's "Eighth Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services" are certified as to the source. Attached is the requested information.



CONNIE L. SLYE
Chief, Infrastructure Division
GS-14

23 Jul 04
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA



DEPARTMENT OF THE ARMY
ARMY SPECTRUM MANAGEMENT OFFICE
ENTERPRISE SYSTEMS TECHNOLOGY ACTIVITY
USA NETWORK ENTERPRISE TECHNOLOGY COMMAND
2461 EISENHOWER AVE
ALEXANDRIA, VA 22331-2200

NETC-EST-V

14 July 2004

MEMORANDUM FOR: USA BASE REALIGNMENT AND CLOSURE OFFICE (BRAC)

SUBJECT: Spectrum Analysis Report In Support Of BRAC Activities

1. Reference email from Maj Flasch, Information Infrastructure Modernization, CIO/G-6, SAB, dated 15 April 2004.
2. Per the request of Maj Mark Flasch, CIO/G6, the Army Spectrum Management Office provides the Army BRAC office with spectrum usage data for ninety-four locations within CONUS.
3. We certify that the data contained in this report is accurate as of the date the data sheets were compiled (the dates are shown at the top of each page). The standard spectrum management analysis tool, Spectrum XXI, was used to retrieve all relevant information from the government-controlled databases, Government Master File (GMF), and the Frequency Record Recourse System (FRRS). The specific methods of analysis to meet BRAC requirements are discussed elsewhere in the report.

Encls

//SIGNED//
CLINTON L. BURRELL, II
LTC, SC
Acting Director

Draft Deliberative Document

For Discussion Purposes Only

Do Not release Under FOIA

IT Connectivity Assessment										
Installation	ISMP	Cellular			Long Haul			Spectrum		Connectivity Value (High - Better)
	SCORE	CELLULAR SCORE	# Providers (FOC Data)	GSM/WPS	Long Haul Score	Fiber In Place	# Providers	Score	Risk %	
Aberdeen PG	0	10	6	Y	10	Y	6	10	1.23%	9
Adelphi Labs	0	10	8	Y	7	N	6	10	0.42%	8.1
Annapolis AD	10	10	7	Y	10	Y	6	10	0.13%	10
AP Hill	0	7	4	N	7	N	6	10	0.02%	8.9
Belvoir*	10	10	6	Y	10	Y	6	10	0.57%	10
Bennings*	10	10	7	Y	7	N	2	6	4.52%	8.3
Bliss*	10	10	6	Y	7	N	6	10	1.97%	9.1
Bluegrass AD	0	10	5	Y	7	N	2	10	0.30%	8.1
Bragg*	10	10	6	Y	10	Y	4	8	3.18%	9.2
Buchanan	0	7	6	N	0	N	0	10	1.10%	4.6
Campbell*	10	10	4	Y	7	N	4	10	1.01%	9.1
Carlsie	0	10	6	Y	7	N	5	10	0.22%	8.1
Carson*	10	10	6	Y	7	N	6	10	0.88%	9.1
Charles Kelley Support Activity	0	10	6	Y	7	N	6	10	0.03%	8.1
Corpus Christi ADA	0	7	6	N	7	N	4	10	2.40%	6.9
Crane AD	0	5	2	Y	7	N	5	10	0.01%	6.1
Deseret Chem Plant	0	2	2	N	7	N	6	10	0.18%	4.9
Detrick*	10	10	8	Y	10	Y	6	10	0.22%	10
Detroit Arsenal	10	10	6	Y	7	N	6	10	0.01%	8.1
Obot	10	7	6	N	7	N	6	2	9.61%	6.3
Drum*	10	7	6	N	0	N	0	8	4.86%	5
Dugway PG	0	10	5	Y	7	N	5	10	1.66%	8.1
Eutaw*	10	10	8	Y	10	Y	4	8	4.14%	9.2
Gilham	10	10	7	Y	10	Y	6	10	0.03%	10
Gordon*	10	10	7	Y	10	Y	4	10	1.54%	10
Hamilton	0	7	6	N	7	N	6	10	0.03%	6.9
Hawthorne AD	0	2	2	N	0	N	0	10	0.19%	2.8
Holston AAP	0	7	6	N	7	N	4	10	0.07%	6.9
Hood*	10	10	6	Y	10	Y	6	2	12.58%	8.4
Huechua*	10	10	3	Y	10	Y	3	10	2.90%	10
Iowa AAP	0	7	3	N	5	N	1	10	0.16%	6.3
Irwin	10	7	6	N	7	N	4	2	10.24%	6.3
Jackson	10	10	6	Y	7	N	4	10	1.00%	9.1
Kansas AAP	0	2	2	N	7	N	4	10	0.76%	4.9
Knox	10	5	2	Y	7	N	5	10	1.11%	7.1
Lake City AAP	0	7	5	N	7	N	6	10	0.00%	6.9
Leavenworth	0	10	5	Y	7	N	6	10	1.66%	8.1
Lee	10	10	6	Y	7	N	6	10	0.95%	9.1
Leonard Wood	10	5	2	Y	7	N	3	8	5.80%	6.3
Letterkenny AD	0	10	4	Y	7	N	5	10	0.10%	8.1
Lewis*	10	10	7	Y	10	Y	6	8	4.72%	9.2
Lima Tank Plant	0	7	3	N	7	N	6	10	0.05%	6.9
Lone Star AAP	0	7	4	N	7	N	3	10	0.01%	6.9
Louisiana AAP	0	7	5	N	7	N	3	10	0.06%	6.9
McAlester AAP	0	7	3	N	0	N	0	10	0.50%	4.8
McCoy	10	7	3	N	10	Y	4	10	0.96%	8.8
McNair	10	7	6	N	7	N	6	10	0.13%	7.9
McPherson*	10	10	7	Y	10	Y	8	8	3.35%	9.2
Meade*	10	10	6	Y	10	Y	6	10	1.26%	10
Milan AAP	0	7	6	N	7	N	3	10	0.17%	6.9
Mississippi AAP	0	7	7	N	7	N	5	10	0.61%	6.9
Monmouth	10	10	8	Y	10	Y	6	10	2.03%	10
Monroe	10	10	6	Y	7	N	4	10	0.17%	9.1
MOT Sunny Point	10	10	4	Y	5	N	1	10	0.01%	8.5
Myer	10	7	6	N	7	N	6	10	0.27%	7.9
Newport Chem Depot	0	7	3	N	7	N	5	10	1.04%	6.9
Picatinny Arsenal	0	10	8	Y	7	N	6	10	0.33%	8.1
Pine Bluff Arsenal	0	10	5	Y	10	Y	5	10	0.78%	9
Polk*	10	10	3	Y	7	N	3	2	10.55%	7.5
Presidio Of Monterey	0	7	5	N	7	N	6	10	0.06%	6.9
Pueblo Chem Depot	0	7	6	N	7	N	6	10	1.49%	6.9
Radford AAP	0	7	5	N	10	Y	4	10	0.13%	7.8
Red River AD	0	7	4	N	7	N	3	10	0.00%	6.9
Redstone Arsenal	10	10	6	Y	10	Y	5	6	6.46%	9.2
Richardson*	10	7	3	N	0	N	0	2	9.21%	4.2
Rileys	10	10	4	Y	10	Y	5	10	1.28%	10
Riverbank AAP	0	7	7	N	7	N	6	10	0.01%	6.9
Rock Island Arsenal	10	10	6	Y	7	N	2	10	1.87%	9.1
Rucker	10	10	6	Y	7	N	4	6	3.35%	8.3
San Houston*	10	10	6	Y	10	Y	6	10	0.42%	10
Schofield Barracks*	10	10	5	Y	0	N	0	10	0.52%	7
Scranton AAP	0	10	4	Y	7	N	3	10	0.47%	8.1
Shafter	10	10	5	Y	0	N	0	6	3.43%	6.2
Sierra AD	0	7	3	N	7	N	3	10	0.47%	6.9
SIH*	10	10	3	Y	7	N	3	8	3.92%	6.3
Soldier System Center (Natick)	0	10	6	Y	10	Y	6	10	0.00%	9
Stewart	10	10	7	Y	7	N	5	8	3.25%	8.8
Tobyhanna AD	10	7	4	N	10	Y	3	10	1.36%	8.8
Tooele AD	0	7	5	N	7	N	6	10	0.18%	6.9
Tripler AMC	0	10	5	Y	0	N	0	10	0.06%	6
Umatilla Chem Depot	0	7	3	N	7	N	2	10	0.10%	6.9
USAG Settridge	0	10	8	Y	7	N	6	10	1.34%	8.1
Wainwright*	10	9	2	N	0	N	0	10	1.30%	3.8
Water Reed AMC	0	10	5	Y	7	N	6	10	0.62%	8.1
Watervliet Arsenal	0	10	5	Y	7	N	6	10	0.42%	8.1
West Point	10	10	6	Y	7	N	6	10	1.56%	9.1
White Sands MR*	10	10	5	Y	10	Y	5	10	1.23%	10
Yuma PG	10	7	6	N	7	N	4	6	4.61%	7.1

Installation	I3MP SCORE	Cellular				Long Haul		Spectrum Score	Connect why Value (High = Better)
		CELLULAR SCORE	# Providers (FCC Data)	GSM/WPS	Wireless Advisor	Long Haul Score	Fiber in Place		
Army JAG Agency - lease		10	6	Y	6	10	Y		7
Army JAG School - lease		10	6	Y	6	10	Y		7
Army Research Office - lease		10	6	Y	6	10	Y		7
ARPERCEN - lease		10	6	Y	6	10	Y		7
Bailey's Crossroads - lease		10	6	Y	6	10	Y		7
Ballston Complex - lease		10	6	Y	6	10	Y		7
Crystal City Complex - lease		10	6	Y	6	10	Y		7
Hortman Complex - lease		10	6	Y	6	10	Y		7
HQ ATEC - lease		10	6	Y	6	10	Y		7
PEO STRICOM - lease		10	8	Y	6	10	Y		7
Rosslyn Complex - lease		10	6	Y	6	10	Y		7

Flasch, Mark V MAJ CIO/G6

From: Jackson, Katrina M Ms ESTA**Sent:** Tuesday, August 03, 2004 11:21 AM**To:** Flasch, Mark V MAJ CIO/G6

NETC-EST-T

03 AUG 04

MEMORANDUM FOR: USA BASE REAIGNMENT AND CLOSURE OFFICE**Subject: Fiber Connectivity and Wireless Coverage Reports in Support of BRAC Activities**

1. Reference email from MAJ Flasch, Information Infrastructure Modernization, CIO/G-6, SAB.
2. Per the request of MAJ Flasch, CIO/G6, the Army Telecommunication Directorate provides the Army BRAC office with a report on Army CONUS locations with fiber connectivity and a report of Army CONUS locations with GSM wireless antenna coverage.
3. We certify that the data contained in these reports are accurate as of the date the reports were compiled.

//Signed//

Katrina M. Jackson
Director, Army Telecomm
Directorate

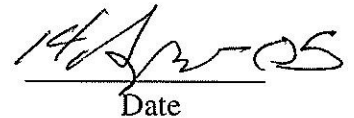
08/03/2004

Data Review Certification

The attached responses to TABS request for data on Installations not in the ISR are certified as accurate and complete to the best of the certifier's knowledge and belief.



DARYL H. POWELL
DAC
Chief, AMC Stationing Office


Date



DEPARTMENT OF THE ARMY
CENTER FOR ARMY ANALYSIS
Wilbur B. Payne Hall
6001 Goethals Road, Suite 102
Fort Belvoir, Virginia 22060-5230

REPLY TO
ATTENTION OF: CSCA-RA

31 March 2004

MEMORANDUM FOR RECORD

**FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA))**

**SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute**

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Accessibility
 - b. Critical Infrastructure Proximity
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at 703-806-5391.

Encl (*dated attribute narratives*)

David J. Russo
DAVID J. RUSSO
GS-15, DAC
Division Chief, Resource Analysis



DEPARTMENT OF THE ARMY
U.S. ARMY TRAINING SUPPORT CENTER
FORT EUSTIS, VIRGINIA 23604-5166

REPLY TO
ATTENTION OF:

ATIC-ATML-LM (350)

07 MAY 2004

MEMORANDUM FOR HQDA (DAMO-TRS), 450 Army Pentagon, Washington,
D.C. 20310-0450

SUBJECT: Certification of the Army Training and Testing Area
Carrying Capacity (ATTACC) Methodology

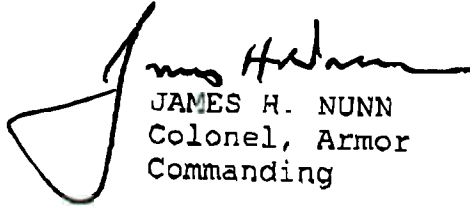
1. Purpose. This memorandum summarizes and certifies the ATTACC methodology.
2. General. As the Army G3's Executive Agent for Training Land and Ranges, the Army Training Modernization Directorate developed the ATTACC methodology in 1995. It is used at HQDA MACOMs and installations in estimating training land carrying capacity and resiliency. ATTACC is used in support of Transformation Environmental Impact Statements.
3. ATTACC Components.
 - a. Training Impacts. ATTACC estimates training impacts by combining vehicle characteristics (ex., vehicle weight, severity of ground disturbance), unit training events, unit vehicle densities, and miles driven in training. These characteristics are combined into a standard measure referred to as Maneuver Impact Miles (MIMs).
 - b. Land Condition. The ATTACC Land Condition is the ecological state of the land measured in terms of erosion using the Revised Universal Soil Loss Equation (RUSLE). This equation includes soil loss, rainfall and runoff, soil resiliency and erodibility (K factor), slope, vegetative cover, and mitigation practices.
4. ATTACC Methodology.
 - a. ATTACC relates the training load (MIMs) of units stationed at an installation and the training land condition (RUSLE) to determine the amount of training a specific parcel of land can accommodate in a sustainable manner.

ATIC-ATML-LM

SUBJECT: Certification of the Army Training and Testing Area
Carrying Capacity (ATTACC) Methodology

b. The Army Range and Training Land Program Requirements Model (ARRM) will include annual MIMs by unit and installation. Land condition data is available either at an installation or the Sustainable Range Program Regional Support Centers.

5. Point of contact for this action is Mr. Chenkin,
DSN 826-3090.



JAMES H. NUNN
Colonel, Armor
Commanding



DEPARTMENT OF THE ARMY
U.S. ARMY TRAINING SUPPORT CENTER
FORT EUSTIS, VIRGINIA 23604-5166

REPLY TO
ATTENTION OF:

ATIC-ATML-LM 350)

27 APR 2004

MEMORANDUM FOR HQDA (DAMO-TRS), 450 Army Pentagon, Washington,
D.C. 20310-0450

SUBJECT: Certification of the Army Ranges and Training Land
Program (RTLTP) Requirements Model (ARRM)

1. Purpose. This memorandum summarizes and certifies the ARRM and the ARRM process.

2. General. As the Army G3's Executive Agent for Training Land and Ranges, the Army Training Modernization Directorate (ATMD) developed the ARRM Model in 1997 to identify and analyze Army installation live-training requirements and capabilities.

3. ARRM Components.

a. Assets. ARRM uses the live-training assets data (training land and training ranges) provided by the Jul 00 - Dec 02 Active and Inactive (A&I) Range Inventory. The asset descriptions are in accordance with DA Pam 415-28, Guide to Army Real Property Category Codes.

b. Requirements. Requirements are generated from the most current versions of the Army Stationing Installation Plan (ASIP); DA Pam 350-38, Standards in Weapons Training; and Training Circulars 25-1, Training Land, and 25-8, Training Ranges.

4. ARRM Process

a. Using the A&I inventory and ASIP ARRM places the live-training assets and Army units at the correct installation locations. Using the current Army training doctrine identified in para 3b, ARRM identifies the type, frequency, and required training asset of Army unit live-training events. The ARRM Model is then able to calculate each of its installation's training capacity and requirements.

ATIC-ATML-LM

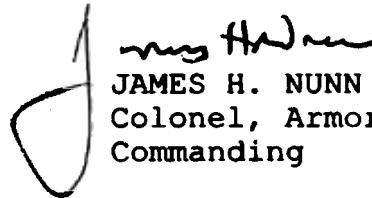
SUBJECT: Certification of the Army Ranges and Training Land
Program (RTLP) Requirements Model (ARRM)

b. Live-training asset throughput capacity and requirements are measured in kilometer squared days (km² x days) for training land (TC 25-1) and in range days for training ranges (TC 25-8).

c. The ARRM source documents, data and process are reviewed annually and updated as required.

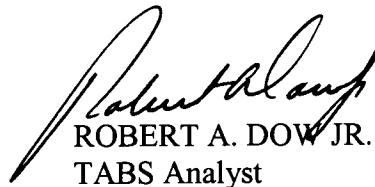
5. Data storage, documentation, and archived information are maintained under the control of ATMD.

6. Point of contact for this action is Mr. Chenkin,
DSN 826-3090.


JAMES H. NUNN
Colonel, Armor
Commanding

SUBJECT: TABS Internal MV Attribute Data Certification

1. ATTRIBUTE: Area Cost Factor (ACF)
2. DESCRIPTION: The ACF is developed for selected cities, states and countries (222 locations total) by DoD. The ACFs are developed based on the construction market condition of local costs for a market basket of 8 labor crafts, 17 construction materials, and 4 equipment items used to construct most military facilities.
3. CERTIFIED VALUES: See attached spreadsheet.
4. DATA SOURCE: DoD Facilities Pricing Guide, Version 6, Table B.
 - a. DATE LAST UPDATED: March 2004
 - b. DATE OF NEXT UPDATE: March 2005
5. METHODOLOGY: N/A
6. I certify that the information supplied is accurate and complete to the best of my knowledge and belief.


ROBERT A. DOW JR.
TABS Analyst

7/8/2004

Area Cost Factors (2004 DoD Facilities Pricing Guide)

<u>Area Cost Factors</u>	<u>State</u>	<u>ACF</u>	<u>Remarks</u>
FORT WAINWRIGHT	AK	2.04	
TRIPLER ARMY MEDICAL CENTER	HI	1.69	
FORT RICHARDSON	AK	1.68	
SCHOFIELD BARRACKS	HI	1.67	
FORT SHAFTER	HI	1.66	
FORT HAMILTON	NY	1.49	ACF is for New York City
U S MILITARY ACADEMY	NY	1.40	
FORT BUCHANAN	PR	1.36	
YUMA PROVING GROUND	AZ	1.30	
SIERRA ARMY DEPOT	CA	1.29	
FORT IRWIN	CA	1.27	
PRESIDIO OF MONTEREY	CA	1.21	ACF is for Monterey Area & Ft Ord
PICATINNY ARSENAL	NJ	1.20	
UMATILLA ARMY DEPOT	OR	1.19	
RIVERBANK ARMY AMMO PLANT	CA	1.17	
FORT MONMOUTH	NJ	1.16	
HAWTHORNE ARMY AMMO PLANT	NV	1.16	
FORT MCCOY	WI	1.16	
DETROIT ARSENAL	MI	1.15	
FORT DIX	NJ	1.15	
FORT LEONARD WOOD	MO	1.13	
FORT DRUM	NY	1.13	
SOLDIER SUPPORT CENTER	MA	1.12	ACF is for the State of Massachusetts
USAG SELFRIDGE	MI	1.12	ACF is for State of Michigan
FORT HUACHUCA	AZ	1.11	
FORT CARSON	CO	1.11	
IOWA ARMY AMMO PLANT	IA	1.10	
FORT RILEY	KS	1.08	
TOBYHANNA ARMY DEPOT	PA	1.07	
FORT LEWIS	WA	1.06	
CRANE ARMY DEPOT	IN	1.05	ACF is for NWSC of which Crane AD is a sub-installation
FORT LEAVENWORTH	KS	1.05	
FORT CAMPBELL	KY	1.05	
FORT KNOX	KY	1.05	
CHARLES E. KELLEY SUPPORT CENTER	PA	1.05	ACF is for State of Pennsylvania
SCRANTON ARMY AMMUNITION PLANT	PA	1.05	ACF is for State of Pennsylvania
DUGWAY PROVING GROUND	UT	1.05	
TOOELE ARMY DEPOT	UT	1.05	
LAKE CITY ARMY AMMO PLNT	MO	1.03	
FORT MCNAIR	DC	1.02	
WALTER REED ARMY MEDICAL CENTER	DC	1.02	
ROCK ISLAND ARSENAL	IL	1.02	
ADELPHI LABS	MD	1.02	ACF is for "Harry Diamond Labs"
FORT DETRICK	MD	1.02	
FORT MEADE	MD	1.02	
WATERVLIET ARSENAL	NY	1.02	
FORT BELVOIR	VA	1.02	
FORT MYER	VA	1.02	
KANSAS ARMY AMMO PLANT	KS	1.01	
DESERET CHEMICAL PLANT	UT	1.01	ACF is for State of Utah
WHITE SANDS MR	NM	1.00	
LETTERKENNY ARMY DEPOT	PA	0.99	
NEWPORT CHEMICAL DEPOT	IN	0.98	ACF is for State of Indiana
LIMA TANK PLANT	OH	0.98	

7/8/2004

Area Cost Factors (2004 DoD Facilities Pricing Guide)

FORT A. P. HILL	VA	0.98	
PUEBLO ARMY DEPOT	CO	0.96	
BLUE GRASS AD	KY	0.95	
FORT EUSTIS	VA	0.94	ACF is for State of Ohio
FORT LEE	VA	0.94	
FORT MONROE	VA	0.94	
RADFORD ARMY AMMO PLANT	VA	0.94	
FORT GILLEM	GA	0.93	
FORT MCPHERSON	GA	0.93	
FORT POLK	LA	0.93	
CARLISLE BARRACKS	PA	0.93	
FORT SILL	OK	0.92	
FORT BLISS	TX	0.92	ACF is for Puerto Rico
PINE BLUFF ARSENAL	AR	0.90	
CORPUS CHRISTI ARMY DEPOT	TX	0.90	ACF is for State of Tennessee
FORT SAM HOUSTON	TX	0.90	ACF is for State of Tennessee
LOUISIANA ARMY AMMO PLANT	LA	0.89	
LONE STAR ARMY AMMO PLANT	TX	0.89	
RED RIVER ARMY DEPOT	TX	0.89	
ABERDEEN PROVING GROUND	MD	0.88	ACF is for "Corpus Christi Area"
FORT BRAGG	NC	0.88	
SUNNY POINT	NC	0.87	
HOLSTON ARMY AMMUNITION PLANT	TN	0.87	
MILAN ARMY AMMUNITION PLANT	TN	0.87	
REDSTONE ARSENAL	AL	0.85	
FORT HOOD	TX	0.85	FT STORY=0.94
FORT GORDON	GA	0.84	
FORT STEWART	GA	0.84	
MISSISSIPPI ARMY AMMUNITION PLANT	MS	0.84	ACF is for State of Mississippi.
MCALISTER ARMY AMMO PLANT	OK	0.84	
FORT JACKSON	SC	0.83	
FORT BENNING	GA	0.80	
FORT RUCKER	AL	0.77	YAKIMA FIRING RANGE=1.08
ANNISTON ARMY DEPOT	AL	0.74	
<u>Leased Facilities</u>			
PEO STRICOM		0.85	Used ACF for the Orlando Area
Army Research Office		0.87	Used ACF for the State of North Carolina
ARPERCEN		1.09	Used ACF for St Louis Army Ammo Plant
Army JAG Agency		1.02	Used ACF for Fort Belvoir
Army JAG School		0.92	Used ACF for the State of Virginia
Bailey's Crossroads		1.02	Used ACF for Fort Belvoir
Ballston Complex		1.02	Used ACF for Fort Belvoir
Crystal City Complex		1.02	Used ACF for Fort Belvoir
Hoffman Complex		1.02	Used ACF for Fort Belvoir
Rosslyn Complex		1.02	Used ACF for Fort Belvoir
HQ, ATEC		1.02	Used ACF for Fort Belvoir
<u>FAST Installations</u>			
MCMAGTFTC 29 Palms	CA	1.32	
MCB Camp Pendleton	CA	1.17	
NAS Fallon	NV	1.12	
MCB Camp Lejeune	NC	0.96	
Hill AFB	UT	1.00	
Eglin AFB	FL	0.80	
Luke AFB	AZ	1.00	
Cannon AFB	NM	1.04	

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Data Certification

The data requested for the installation military value attribute "Urban Sprawl", and maintained in the 1992 National Land Cover Data (NLCD), are certified as to the source. The data requested, and maintained in the National Imagery and Mapping Agency's IKONOS database are certified as accurate and complete to the best of the certifier's knowledge and belief. Attached is the requested information.

Robert C. Jagan / SP IV
Name/Grade


2 JUN 04
Date

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Data Certification

The data requested for the installation military value attribute "Accessibility", and maintained in the 2003 DoD Base Structure Report, the Federal Aviation Administration's 2002 Air Carrier Activity Information system, the Sustainable Installations Regional Resource Assessment database, and the ArcGIS 8.3 (ESRI Inc.) are certified as to the source. Attached is the requested information.



Name/Grade

Ewing, Paul C.


3 June 04
Date

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Data Certification

The data requested for the installation military value attribute "Critical Infrastructure Proximity", and maintained in the 2003 U.S. Nuclear Regulatory Commission Information Digest, Appendix A; the U.S. Army Corps of Engineers National Inventory of Dams; the Federal Reserve Board of Governors website; the National Geospatial Intelligence Agency's U.S. Port Protection Graphic, Version 1, Top 25 Most Dangerous Chemical Facilities, Version 2, and U.S. Crude oil Pipelines and Refineries, Version 2, are certified as to the source. Attached is the requested information.

 0-4
Name/Grade
Ewing, Paul L.

3 Jun 04
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Draft deliberative document-For discussion purposes only-Do not release under FOIA

Data Certification

The data requested for the installation military value attribute "Workforce Availability", and maintained in the Geolytics, 2000 Census, and Missouri Economic Research and Information Center (MERIC) databases are certified as to the source. Attached is the requested information.

Erin J. Smith, Col
Name/Grade

3 June 2004
Date

Draft deliberative document-For discussion purposes only-Do not release under FOIA

ANNEX 4: MVI Technical Document

4.1 Purpose

This Appendix outlines the elements of multi-attribute preference theory that the TABS analysis team used to develop the Military Value Installation (MVI) model. In addition to the general discussion, this Appendix provides basic notation, a technical description of the value functions, the associated scaling constants known as weights, and the assessment process the team used to determine these MVI elements. Throughout the paper, we use MVI results and data to illustrate the approach.

4.2 Notation and Definitions¹

Attributes are characteristics of an installation that distinguish the alternatives. In MVI, attributes are signified by $X = (X_1, X_2, \dots, X_{40})$, where X_i represents an individual attribute and x_i represents an individual score for attribute X_i . The function $v(x)$ is a *value function* if it is true that $v(x^a) > v(x^b)$ if and only if $x^a > x^b$, where x^a and x^b are specific scores of X . For a single attribute, $v_i(x_i)$ is referred to as the single-dimensional or single-attribute value function. Because the MVI contains multiple attributes, a *weight* or scaling factor w_i is introduced to reflect the Senior Review Group's (SRG) relative preference for a particular X_i .

Preferential Independence (PI): Suppose that Y and Z are a partition of the set of MVI attributes X . Then Y exhibits PI of Z if the rank ordering of alternatives (installations in the MVI) that have common levels for all attributes in Z does not depend on these common levels. When PI holds, the indifference curves over Y , for fixed levels of Z , will be the same regardless of the level of Z . Bunn (1984) provides the following example where PI may *not* hold.

Consider a decision where the outcomes affect both the place where you live and the automobile that you drive. Let x_1 be an outcome variable that could be either Los Angeles or an African Farm. Let x_2 be an outcome variable for a Cadillac or an SUV. The value of x_1 may affect your preference for x_2 . Therefore, x_2 is not PI of x_1 . However if we consider the reverse: regardless of the car, you prefer LA to an African farm, then this is a PI case. This example illustrates a case that is not *Mutual Preferential Independent* (MPI) because it is not PI in both evaluations.

Mutual Preferential Independence (MPI): A set of attributes X , displays MPI if Y exhibits PI of Z for every partition, $\{Y, Z\}$, of the set X . In theory, determining MPI using the 40 attributes for the MVI model would be prohibitive because of the large number of possible combinations of levels required for the assessment. Fortunately, Keeney and Raiffa (1976) derive a theorem that shows MPI can be shown to hold by testing for PI of $n-1$ pairs of attributes. *Pairwise Preferential Independence* says that if PI holds for the specified pairs of attributes, then MPI must hold. In addition, we paid careful attention to the decomposability property of the objective hierarchy when the MVI was designed, so MPI is a reasonable

¹ For the definitions in this section, we used Kirkwood's (1997) interpretation of the original definitions found in Keeney and Raiffa (1976).

assumption, and as illustrated in the next section, MPI is a necessary condition for the value functions we use in the MVI.

The above PI definition does not allow TABS to analyze *differences* in value between two outcomes, e.g., we can only draw conclusions based on “\$2 million is preferred to \$1 million.” By applying the appropriate positive monotonic transformation, we can convert the difference in value, $v(x_1) - v(x_2)$ between any two outcomes x_1 and x_2 into any number that is desired, as long as the transformed value has the same sign as $v(x_1) - v(x_2)$. For us to determine the optimal portfolio based on MV, we must use a *measurable* value function.

Dyer and Sarin (1979) defined *Difference Consistency* (DC) as the condition that the preference of the different levels of an attribute, X_i , can be ranked by comparing the value differences between each level and the least desirable level. Dyer and Sarin state that this condition can be assumed to hold in most practical applications without testing. The second condition defined by Dyer and Sarin, *Difference Independence* (DI) is stronger; it states that the value difference between two levels of an attribute does not depend on the levels of the other attributes. The importance of this result is shown in the next section.

4.3 Value Functions

The value function helps answer the question “How much is enough?” for each of the value measures. This section describes the types of value functions used by the analysis team that are used to measure the returns to scale on the value measures, and describes the assessment process the analysis team used to determine the specific value function.

For the multi-attribute case, Keeney and Raiffa (1976) prove a value function $v(x_1, x_2, \dots, x_n)$ is *additive* if $\{X_1, X_2, \dots, X_n\}$ are MPI (for $n > 3$). They demonstrate that MPI is a necessary condition for a valid additive value function of more than two dimensions. MPI implies that the overall value function can be separated into entities that represent different attributes. Furthermore, if the additive value function is difference consistent and X_i is difference independent of the remaining attributes, then the Military Value (MV) for an installation, $v(x)$, can be written as an *Additive Measurable Value Function* with the form:

$$v(x) = \sum_{i=1}^{40} w_i v_i(x_i), \quad \text{where } \sum_{i=1}^{40} w_i = 1. \quad (\text{eq. 1})$$

When the conditions for the Additive Measurable Value Function hold, then it is possible to assess the value function using the “value difference approach.”² The MVI is assessed using the following four steps:

- Step 1.** Determine the attributes that best support the objectives of the qualitative MVI model.
- Step 2.** Confirm that the attributes obey MPI, are DC, and test for DI.
- Step 3.** Assess the individual value functions for each of the 40 attributes using the value increment approach.
- Step 4.** Determine the weights using a swing weight approach.

We address the attribute and weight assessments in the following sections.

4.4 Attributes

The MVI uses two types of attributes to support its primary objective of determining an installation’s military value. The first type of attribute contains an evaluation measure that requires a *single-dimension scale*. The *direct* scale for the corresponding value function is either a *natural* scale, e.g., square feet or dollars, or a *proxy* scale, e.g., square feet – quality, where quality represents the condition of the building. The model contains some single-dimension attributes, which require that a scale be *constructed* to represent a specific evaluation measure, e.g., the number of production processes an installation currently conducts.

The second type of attribute combines multiple evaluation measures, which we refer to as a *multi-dimensional scale*, and is also a constructed scale. For this type of attribute, we develop a constructed scale for an attribute that must capture the value dependence between several measures, or it must capture qualitative and quantitative measures in one attribute.

The MVI uses 40 attributes; 26 of the attributes are the single-dimension type, and 14 are the more complex multi-dimensional type.

² Kirkwood, pg. 243-244.

4.5 Single Dimension Attribute Assessment

Keeney and Raiffa (1976) present two methods that are used to assess value functions based on natural scales: the *Lock-Step Procedure* and the *Mid-value Splitting Technique*³, with the latter being the most used in practice. The mid-value of a range is defined to be the level, x_i^m , such that the difference in value between the lowest score in the range and the mid-value is the same as the difference in value between the mid-value and the highest score in the range.

Kirkwood and Sarin (1980) extend the Mid-value Splitting Technique to include some useful analytic forms when they meet specified conditions. We implement an assessment approach based on the Mid-value Splitting Technique, which is a built-in LDW assessment function that is referred to as the *Mid-Level Splitting Approach*.⁴ Kirkwood (1997) shows that the following exponential form is often reasonable for monotonically increasing preferences of X_i :

$$v_i(x_i) = \begin{cases} \frac{1 - \exp[-(x_i - x_i^L) / \rho_i]}{1 - \exp[-(x_i^H - x_i^L) / \rho_i]}, & \rho_i \neq \infty \\ \frac{x_i - x_i^L}{x_i^H - x_i^L}, & \text{otherwise} \end{cases} \quad (\text{eq. 2})$$

or for monotonically decreasing preferences of X_i :

$$v_i(x_i) = \begin{cases} \frac{1 - \exp[-(x_i^H - x_i) / \rho_i]}{1 - \exp[-(x_i^H - x_i^L) / \rho_i]}, & \rho_i \neq \infty \\ \frac{x_i^H - x_i}{x_i^H - x_i^L}, & \text{otherwise.} \end{cases} \quad (\text{eq. 3})$$

where x_i^L (and x_i^H) are the lowest (and highest) level of interest of x_i and ρ_i is the single dimensional value function exponential constant. The value function shown above is scaled so $v_i(x_i)$ varies between 0 and 1. However, other scales are permissible, and we scale the $v_i(x_i)$ for the MVI value functions to vary between 0 and 10. The value of ρ_i defines the shape of the exponential curve. A closed-form solution for eq's 2 and 3 does not exist; however, LDW determines the value for ρ_i numerically.

In the following example, we implement the Mid-Level Splitting Approach by using the attribute, *Interservice and Partnering with Industry*. Interservice workload includes work

³ Keeney and Raiffa, pg. 91 to 96.

⁴ LDW, pg. 9-15 to 9-19.

being performed in support of another Service and/or work being performed for a combatant command. Partnered workload is any work being performed in support of a commercial or private sector customer under one or more of the specific authorities. The proxy measure of Direct Labor Hours (DLHs) is used to measure an installation's ability to perform inter-service workload and partnered workload for maintenance and manufacturing operations (less munitions). The range of scores (in 1000s of DLHs) varies from 0 to 1313 DLH as shown in Figure 1.

Please set Score B so that the change from Score A to Score B
has the same Importance as the change from B to C

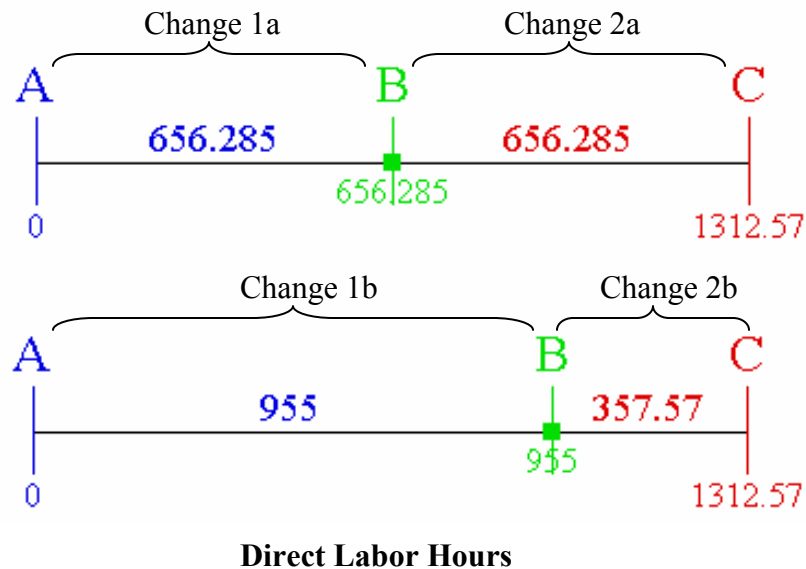


Figure 1. Mid-level Splitting Assessment Technique Example

To assess the Subject Matter Expert's (SME's) preference, we ask the following question; "Which change in DLHs is more important for an installation to perform the required mission, Change 1a or Change 2a?" The SME answers that Change 2a is more important than Change 1a. We continue asking a series of questions about the relative importance between the differences between A-B and B-C. Through this series of questions and answers, we find that the SME is indifferent between Change 1b and Change 2b. Using equation's 2 or 3, LDW is able to calculate the value for ρ_i and generate the value function shown in Figure 2.

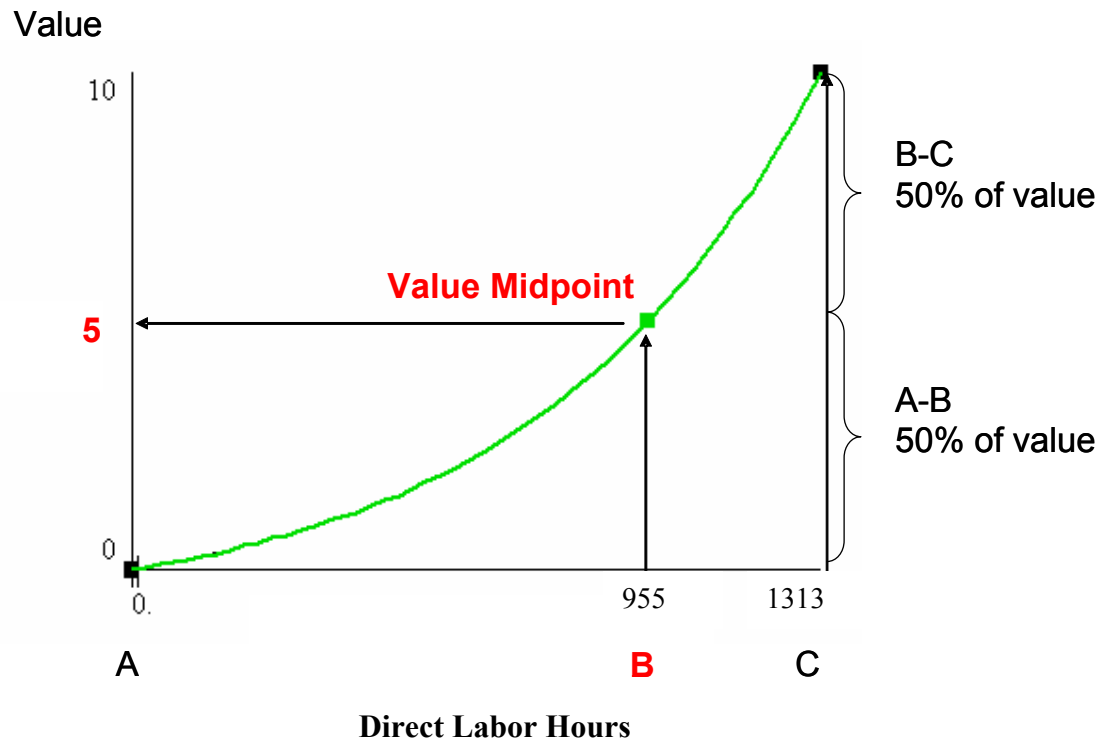


Figure 2. Interservice and Partnering with Industry Value Function Example

We assess the single-dimensional constructed scales the same way as the natural scales. We assume that the scale is linear unless the SME offers a compelling argument as to why the value function should be non-linear. As an illustration, we use the *General Instructional Facilities* attribute, which measures the existing capability of the installation to conduct training with general-purpose facilities used for general instruction.

The attribute is multi-dimensional in nature because we use a quantitative measure (square feet) as well as a qualitative measure (quality factors). By using the weighted sum (by quality condition: Green, Amber, and Red) of the square footage of general instructional facilities (GIF) on an installation, we transform the two dimensions into a single-dimensional constructed scale through the following linear transformation:

GIF Score = $G \cdot (1.0) + A \cdot (0.71) + R \cdot (0.36)$, where G, A, and R equal available square feet of Green, Amber, and Red general instructional space, respectively. Analogous to the example shown in Figure 2, the GIF score (x-axis) is then converted to a *value* (y-axis), normalized on a scale of zero to ten based on the curvature of the value function.

Through the linear transformation, we are able to bypass some of the problems associated with using multi-dimensional constructed scales as illustrated in our example in Figure 3.

	DEFINITION	SCORE
Label 1	Current capability allows for High capacity with Green quality	10
Label 2	Current capability allows for High capacity with Amber quality	8
Label 3	Current capability allows for Med capacity with Green quality	7
Label 4	Current capability allows for Med capacity with Amber quality	4
Label 5	Current capability allows for High capacity with conversion OR Low capacity with Green quality	3
Label 6	Current capability allows for Med capacity with Conversion OR Low capacity with Amber quality	2
Label 7	Current capability allows for Low capacity with Conversion	1
Label 8	No Capacity or Conversion available	0

Figure 3. Traditional Multi-Dimensional Constructed Scale Example

The linear transformational form of the constructed scale uses the natural measure of square feet and a proxy for quality. For the traditional constructed scale, we must spend time developing the scale definition and determine the subdivisions of the evaluation considerations corresponding to the Labels in Figure 3. Unfortunately in practice, it is difficult to find a mathematical transformation like the one we just demonstrated leading to final evaluation measures that may interact. This is the topic for the next section.

4.6 Multiple Dimension Attribute Assessment

Kirkwood (1997) describes several studies, discusses issues associated with using constructed scales, and shows a small example on assessing two constructed scales using a piecewise linear approach. However, the literature on constructed scales is not as mature with regards to the development and assessment of multidimensional constructed scales. Because our problem required constructed scales to account for the interactions between measures, and in some cases combined qualitative and quantitative measures, we developed a visual representation to assist within the multi-measure attribute development with SMEs and assessment with senior leaders.

The labels that describe the constructed scale must pass the *clairvoyance test*.⁵ For each constructed scale we ask, “Would a clairvoyant be able to assign a score to the outcome from each installation in the MVI?” This test requires labels that are well defined and ensures that all subdivisions of the evaluation measures include all possible outcomes for our installations. For most of our multi-dimensional attributes, definition of the individual labels

⁵ Kirkwood pg. 28

is straightforward because we use natural scales, e.g., square feet and/or acres to describe the measure. Only in the cases where we must use qualitative measures is the definition difficult, e.g., environmental elasticity or MOUT.⁶

To select the sub-divisions of the evaluation measures, we linked the attribute's measure to a specific capability that the attribute describes. For example, Figure 4 shows the visual representation of the multi-dimensional constructed scale for the *Heavy Maneuver Area* attribute, which directly supports the *Maneuver Land* sub-capability, and indirectly supports the *Support Army and Joint Training Transformation* capability. This attribute determines an installation's ability to support training and maneuvering of mechanized forces.

	TOTAL HVY MVR AREA (1000s ACRES)			
Largest Contiguous Area (1000s)				
	<=10	>10 and <=50	>50 and <= 100	>100
< = 10	Label 1	Label 2	Label 3	Label 4
>10 and < = 50	X	Label 5	Label 6	Label 7
>50 and < = 100	X	X	Label 8	Label 9
>100	X	X	X	Label 10

Figure 4. Multi-Dimensional Constructed Scale for Heavy Maneuver Area

The Heavy Maneuver attribute has two evaluation measures: total heavy maneuver area and the largest contiguous area of an installation. We initially chose the *Bins* (evaluation measure subdivisions) based on the SME's determination of how much utility a mechanized infantry brigade would receive. The labels shown in Figure 4 allow for easy identification of the Bins. For example, if an installation contains more than 100,000 acres, but only has 50,000 acres of contiguous maneuver area, then the installation would receive a value associated with label 7.

Before we assess the constructed attributes, we analyze the data from the first MVI data call to ensure that a distribution across the scale exists. For example, Figure 5 shows that four installations contain between 5,000 and 10,000 and two have between 500,000 and 2 million acres of heavy maneuver area.

⁶ Additional information for the attributes Environmental Elasticity and MOUT is contained in Annex 14 of the MV Supporting Document.

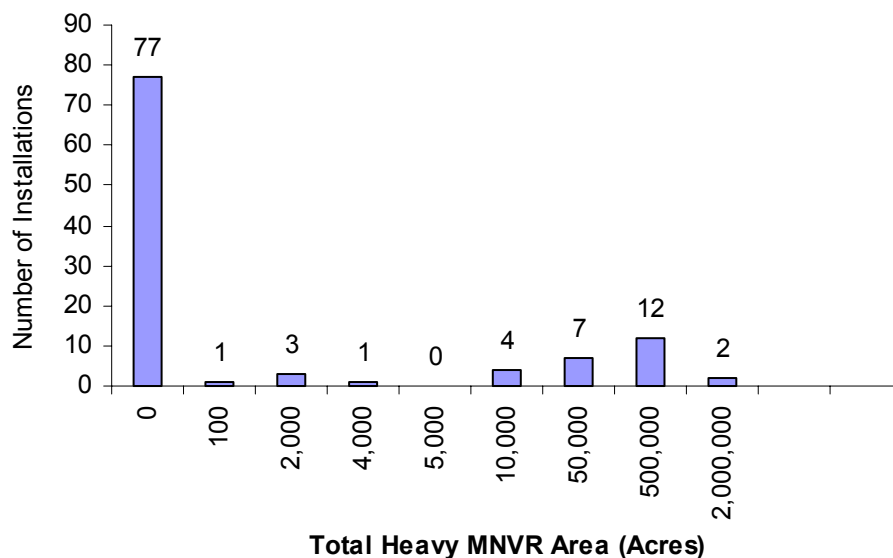


Figure 5. Frequency Chart for Total Heavy Maneuver Area

Information about the quality of the maneuver area is captured by including the evaluation measure of Largest Contiguous Area. By representing the attribute visually, we are able to discuss with the SME and decision-makers in detail how the attribute should be assessed.

Once we establish the bins for the multi-dimensional constructed scales, we use the following three-step process:

1. Arrange the bins in order by increasing value from left to right and top to bottom. Assuming that a higher score is better than a lower score, place the lowest score in top left-hand corner of matrix and highest possible score bottom right-hand corner of matrix. If a zero score exists, it is given “Label 0” and is not placed on the matrix.
2. Make a holistic assessment based on value increments for each Label, e.g., the increment from moving from label 2 (1) to label 5 (2), and from label 2 (1) to label 3 (2) (assessment values in Figure 6).

	TOTAL HVY MVR AREA (1000s ACRES)			
Largest Contiguous Area (1000s)	<=10	>10 and <=50	>50 and <=100	>100
< = 10	0.5	1	2	3
>10 and < = 50	X	2	4	6
>50 and < = 100	X	X	6	8
>100	X	X	X	10

Figure 6. Holistic Assessment to Establish Value Function Scores for the Multi-Dimensional Value Function

3. Use a pairwise comparison tool to assess the value function. For this analysis, we found the Adjusted Analytical Hierarchy Process (AHP) was adequate. The AHP (Saaty, 1982) relies on the method of pairwise comparisons where label of the attribute is compared one pair at a time. MVA Report, Book 1: Approach describes this assessment process in detail. Figure 7 shows the final values for the multi-dimensional scale.

	TOTAL HVY MVR AREA (1000s ACRES)			
Largest Contiguous Area (1000s)				
	<=10	>10 and <=50	>50 and <= 100	>100
< = 10	0.1	0.2	1.4	2.0
>10 and < = 50	X	3.2	4.3	5.2
>50 and < = 100	X	X	6.1	7.6
>100	X	X	X	10

Figure 7. Assessed Multi-Dimensional Constructed Scale

Once the assessments for constructed attributes are complete, we analyze the frequency of occurrence for the constructed scales. Figure 8 shows the number of installations contained within a given label. For this example, we see that approximately 65 installations get no value for heavy maneuver area, and that no installations lay inside the Label 3 or 6 Bins. We use this variation of the range of the scale information to help determine an attribute's *weight*.

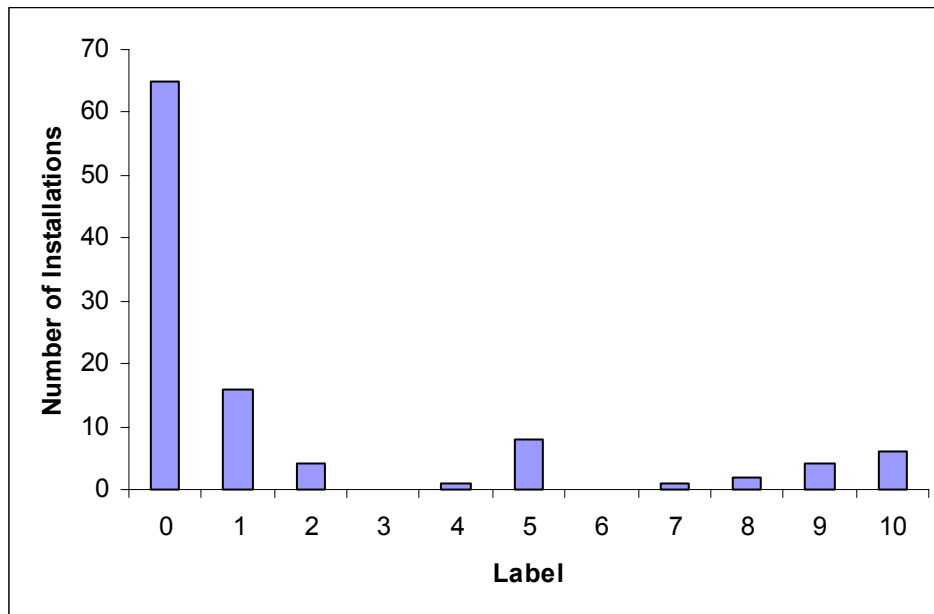


Figure 8. Frequency Chart for Heavy Maneuver Area Attribute

4.7 Weights

To properly assess weights, we account for the decision-makers' preferences (relative importance of the attribute), and for the variation or range of data within the measure.⁷ The weight process is subjective by nature; decision-makers, stakeholders, and SMEs involved in the process provide their inherent preferences. Sometimes, reaching consensus on the weight assessment with a group of decision-makers with varied interests is difficult. That said, we considered four common weight-assessment approaches for a multiple-objective decision analysis (MODA) problem

1. **Importance ratios** – comparisons are made between selected attributes. This approach may assess attributes in a global manner, or in a local manner (one pair of attributes at a time). Examples of this approach are implemented in LDW as the SMART, AHP, and pair-wise weight ratio methods.
2. **Order of importance** – attributes are ordered by level of importance. The SMARTER method uses this approach and is easy to implement. However, as the number of attributes increase, the less accurate this method becomes in assessing weights.
3. **Tradeoffs** – tradeoffs made between two alternatives imply the weight.
4. **Direct Entry** – weights are directly assigned to the attributes.

The analysis team initially selected the Simple Multi-Attribute Rating Technique using Swings (SMARTS) method because it is a global assessment method and is based on measurable value theory. Figure 9 shows a screen shot of the LDW's graphical implementation of SMARTS (referred to as SMART in LDW), but due to the large number of attributes, we determined that the SMARTS method is too difficult to implement. It can be seen from Figure 9, that it would be difficult to lead the senior leadership through the weighting process and gain consensus using the traditional SMARTS method.

⁷ Keeney and Raiffa (1976), pgs. 271 and 272.

Please enter the swing weights for Determine Military Value of Army Installation

Swing weights must be between 0 and 100. One swing should equal 100.

Swings indicate importance of going from least to most preferred level

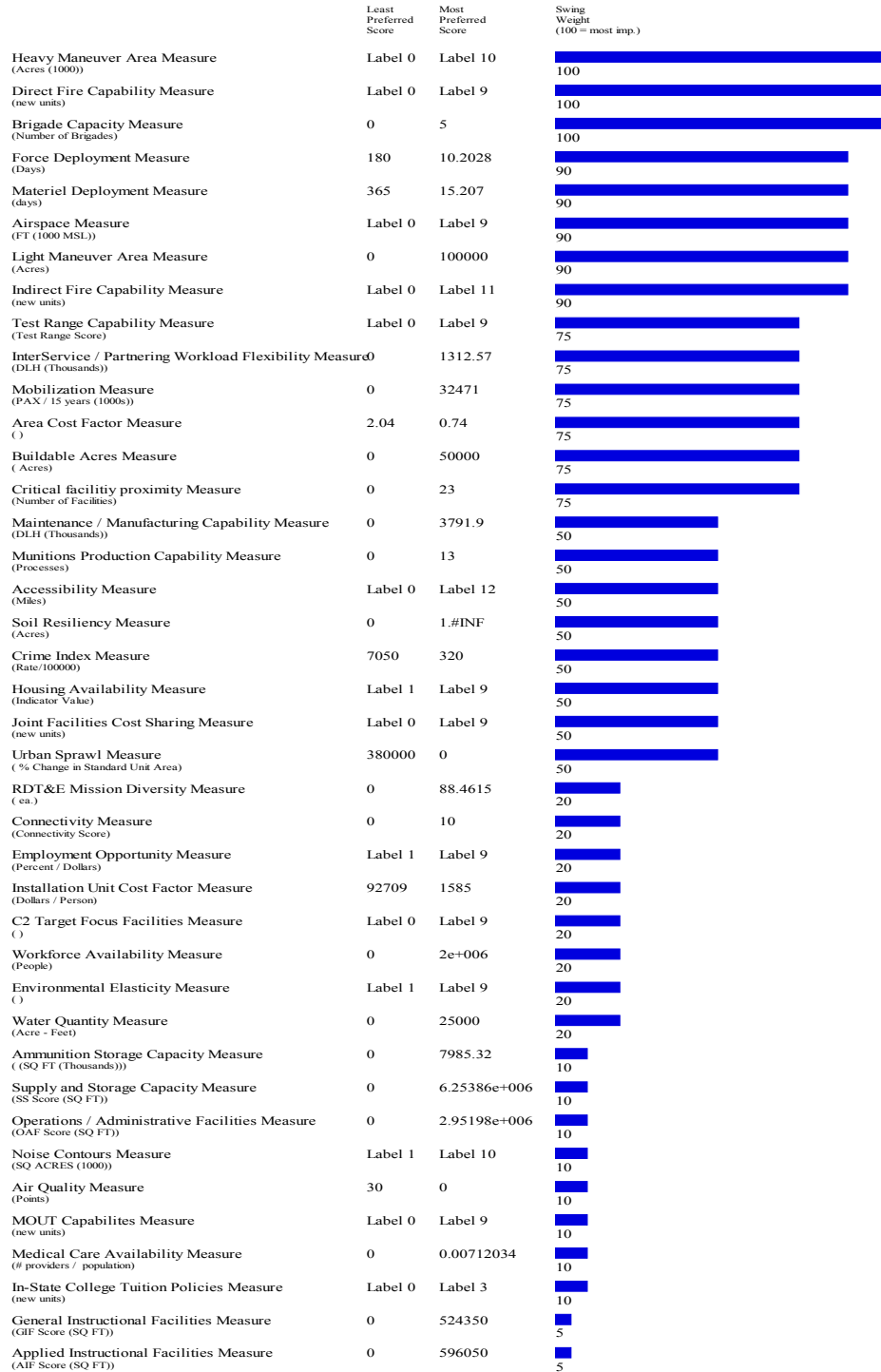


Figure 9. LDW Screenshot of the SMART Weighting Technique

Our success with applying a visual matrix approach to the multi-dimensional constructed scales led to the development of a visual representation of the Swing Weight Matrix Method. This method is applied in four steps:

1. Apply the two overarching weight criteria to the matrix. For military value, the relative importance of an attribute depends on the Army's ability to change an installation's attribute level. For example, an installation cannot simply expand its acreage, but it could expand its administrative space. The ability to change is represented in the columns, and the second criterion, the variability of range, is in the rows. Figure 10 shows the matrix with increasing ability to change from left to right and decreasing variation in range from top to bottom.

Ability to Change						
	Mission Immutable (Very difficult to change) <small>High Flexibility Low Flexibility</small>		Mission Support (Difficult to change without External support) <small>National/State Local</small>		Mission Enablers (Can Change with Dollars) <small>High \$ Low \$</small>	
Variation of Scale	LARGE					
	MODERATE					
	SMALL					

The diagram illustrates the relationship between the variation of scale and the ability to change. It features a grid with three rows representing different scales: LARGE, MODERATE, and SMALL. The columns represent different mission types: Mission Immutable, Mission Support, and Mission Enablers. A red arrow points from the MODERATE row to the LARGE row, indicating an increasing ability to change. A green arrow points from the MODERATE row to the SMALL row, indicating a decreasing variation. A green box labeled 'Importance' is positioned between the MODERATE and SMALL rows.

Figure 10. Swing Weight Matrix Development

2. Once the matrix is defined, the attributes are added. Figure 11 shows an example where the X_i 's represent the MVI attributes. The color bands represent the importance level corresponding to an attribute. This color scheme is used to facilitate the discussion and gain concurrence on the attribute weights. Once presented to the decision makers, the discussion no longer centers on the number, but on what importance level and variation the attribute is assigned.
3. After the leadership approves the placement of the attributes on the matrix, we assign the matrix swing weight, f_{jk} (j = row, k = column), to all of the cells of the matrix. We place the highest swing weight, $f_{11} = 100$, in the upper left corner of the matrix. Because of the large number of attributes in the model, we ensure at least two orders of magnitude between the highest and lowest matrix weight. The lowest matrix swing weight, $f_{3,6} = 1$, in the lower right corner of the matrix. The remaining matrix swing weights are placed in the matrix according to the importance level and variation. The completed matrix with the appropriate matrix weights are shown in Figure 12.

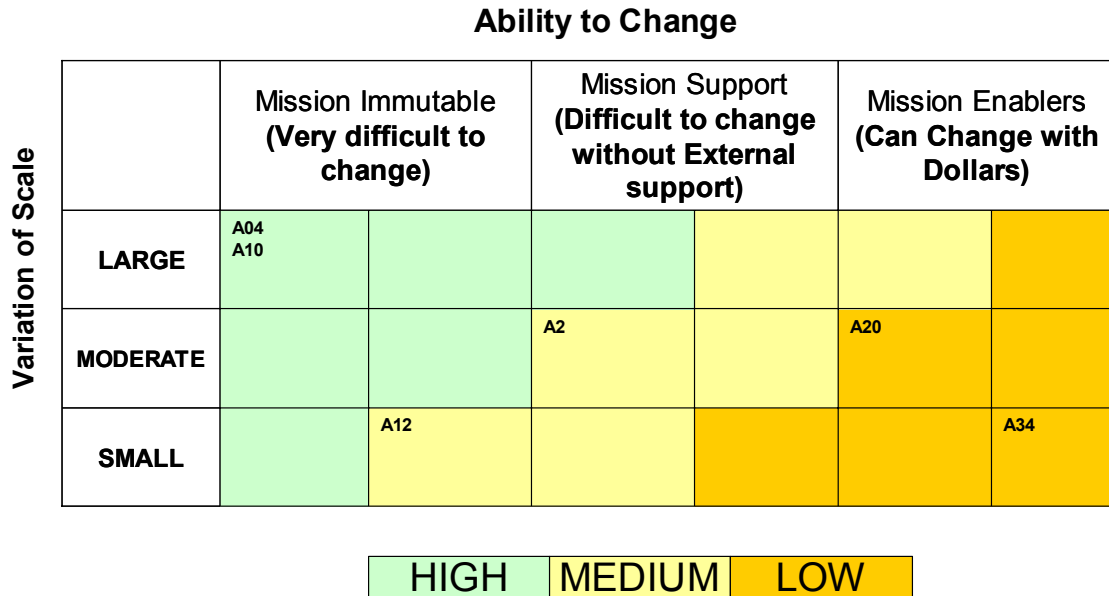


Figure 11. Complete Swing Weight Matrix

4. The normalized global weights, w_i , used in the additive value function in equation 1, is found with the following equation:

$$w_i = \frac{F_i}{\sum_{i=1}^{40} F_i}, \text{ where } F_i = \text{matrix weight, } f_{j,k}, \text{ corresponding to attribute } i. \quad (\text{eq. 3})$$

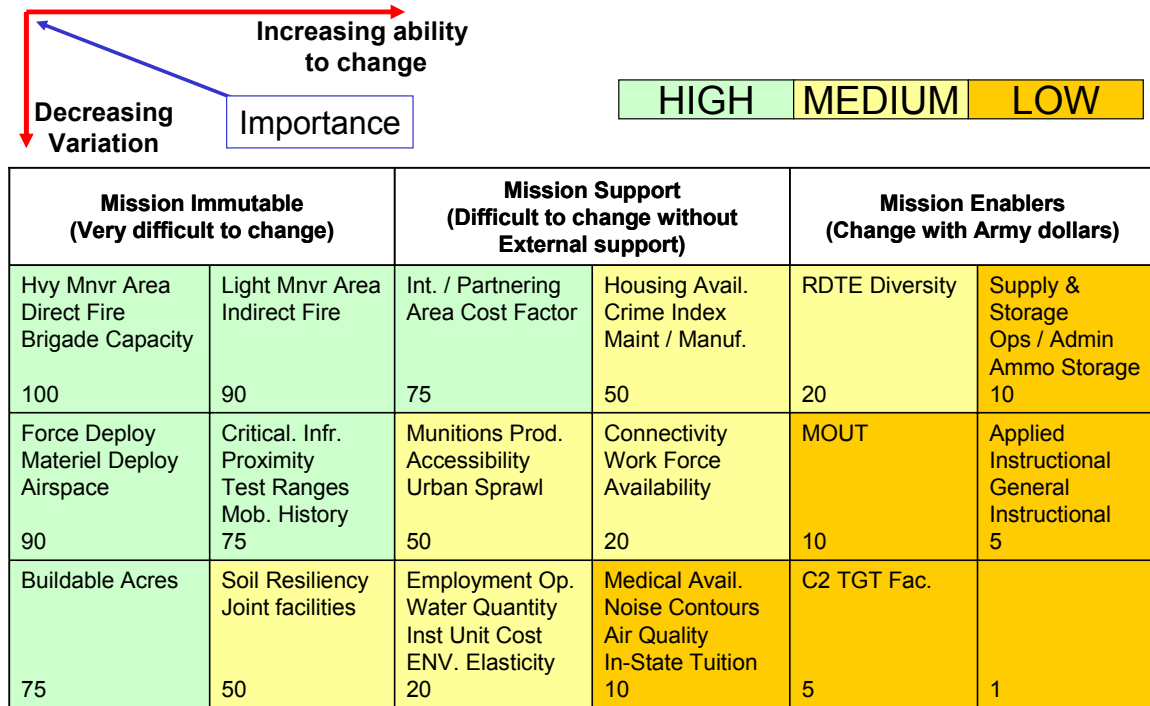


Figure 12. Completed Swing Weight Matrix

The above approach provided an efficient and effective means to brief, explain, and debate different attributes and their placement in the overall scheme. The matrix in Figure 12 represents the final approved matrix with associated weights.

4.8 Summary

This paper outlines the elements of multi-attribute preference theory that the TABS analyst team used to develop the Military Value Installation (MVI) model and the model's individual components. With this technical background, the model, and installation data, the reader can recreate the Army's 2005 military value for installations evaluation.

References

Bunn, D. *Applied Decision Analysis*, New York, McGraw-Hill, 1984.

Dyer, J.S. and Sarin, R.K. "Measurable Multiattribute Value Functions," *Operations Research*, 27, pp. 810-822, 1979.

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Kirkwood, C. W. and Sarin, R. K. "Preference Conditions for Multiattribute Value Functions", *Operations Research*, 28, pp. 225-232, 1980.

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ANNEX 5: MVA Attribute Listing-SME Certifications

This annex lists the names of subject matter experts consulted by TABS to develop military value attributes. Hard copies of the signed memorandum from each of the SMEs is provided herein for review.

Train

1. Direct Fire Capability-James B. Gunlicks, Deputy Director of Training
2. Indirect Fire Capability-James B. Gunlicks, Deputy Director of Training
3. MOUT Capabilities-James B. Gunlicks, Deputy Director of Training
4. Heavy Maneuver Area-James B. Gunlicks, Deputy Director of Training
5. Light Maneuver Area-James B. Gunlicks, Deputy Director of Training
6. Joint Airspace-James B. Gunlicks, Deputy Director of Training
7. General Instructional Fac. -James B. Gunlicks, Deputy Director of Training
8. Applied Instructional Fac.-James B. Gunlicks, Deputy Director of Training
9. Air Quality-Martin G. Elliot, Env. Program Manager, Office of the Director of Army Env. Programs
10. Noise Contours- William A. Russell, Acting Program Manager Env. Noise
11. Soil Resiliency- Dr. Vic Diersing, Conservation Action Officer
12. Water Quantity-Martin G. Elliot, Env. Program Manager, Office of the Director of Army Env. Programs

Project Power

13. Mobilization History- COL Michael P. Ryan, Chief, Mobilization Division
14. Force Deployment-Michael K. Williams, Chief, Deployment Division
15. Materiel Deployment- Michael K. Williams, Chief, Deployment Division
16. Ops/Admin Facilities-COL Peter F. Porcelli, Chief, Plans and Operations Division
17. Accessibility-David J. Russo Division Chief, Resource Analysis
18. Connectivity-COL Mark F. Barnette, Chief, Information Infrastructure Modernization

Materiel and Logistics

19. RDT&E Mission diversity-Michael G. Vogt, Deputy Chief of Staff for Eng. Logistics & Env.
20. Test Range Capacity-Michael G. Vogt, Deputy Chief of Staff for Eng. Logistics & Env.
21. Munitions Production-David Shaffer, Director, U.S. Army Material Command
22. Ammunition Storage Cap. -David Shaffer, Director, U.S. Army Material Command
23. Interservice & Partnering with Industry Flexibility-David Shaffer, Director, U.S. Army Material Command
24. Maintenance/Manufacturing-David Shaffer, Director, U.S. Army Material Command
25. Supply & Storage Capacity-COL Randall Bockenstedt, Chief, Maintenance Policy Division

Well Being

26. Crime Index-COL Michael F. Pfenning, ARMY-G-1
27. Employment Opportunities-COL Michael F. Pfenning, ARMY-G-1
28. Housing Availability-COL Michael F. Pfenning, ARMY-G-1
29. Medical Care Availability-COL Michael F. Pfenning, ARMY-G-1
30. In-state Tuition Policies-COL Michael F. Pfenning, ARMY-G-1

Cost Efficient

31. Workforce Availability-COL E. Casey Wardynski, Director, Office of Economic & Manpower Analysis
32. Joint Facilities-Stephen G. Barth, Division Chief, Installation Costing
33. Area Cost Factor-COL Peter F. Porcelli, Chief, Plans and Operations Division
34. C2 for Focus Facilities-COL Peter F. Porcelli, Chief, Plans & Operations Division
35. Installation Unit Cost Factor-Stephen G. Barth, Division Chief, Installation Costing

Mission Expansion

- 36. Buildable Acres-Richard L. Schneider Project Manager/Research Architect
- 37. Brigade Capacity-COL Wesley L. McClellan, Chief, Force Management Initiative Division
- 38. Environmental Elasticity-Michael L. Cain, Director
- 39. Urban Sprawl-Robert C. Lozar, Principal Investigator
- 40. Critical Infrastructure Proximity-David J. Russo Division Chief, Resource Analysis

23 March 2004

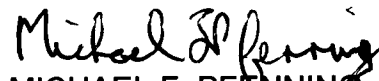
MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Attribute #1- Housing
 - b. Attribute #2- Medical
 - c. Attribute #3- Education
 - d. Attribute #4- Crime
 - e. Attribute #5- Employment Opportunity
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at 703-696-5290

Encl *Attribute Narratives* (5)


MICHAEL F. PFENNIG
COL, EN
Army G-1, HR

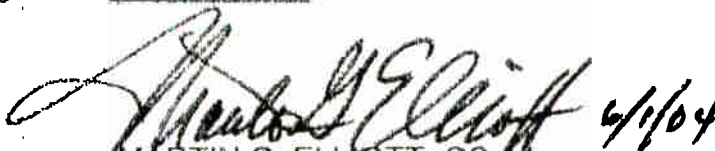
1 June 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Air Quality
 - b. Water Quantity
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at 703/601-1584.

Encl (dated attribute narratives)

A handwritten signature in black ink, appearing to read "Martin G. Elliott", followed by the date "6/1/04".

MARTIN G. ELLIOTT, GS-14
Environmental Program Manager
Office of the Director,
Army Environmental Programs



5 May 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. URBAN SPRAWL
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required supporting the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at 217 352 6511 Ext 6367.

Encl URBAN SPRAWL



Robert C. Lozar
USACE ERDC-CNN
Principal Investigator



DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF, G-3
400 ARMY PENTAGON
WASHINGTON, DC 20310-0400

REPLY TO
ATTENTION OF

DAMO-TR

26 March 2004

**MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR
INFRASTRUCTURE ANALYSIS (DASA (IA))**

**SUBJECT: Concurrence with 2005 Base Realignment and Closure (BRAC) Military
Value (MV) Model Attribute**

1. I have reviewed and concur with the following eight BRAC 05 MV attributes as defined: Applied Instructional Facilities; General Instructional Facilities; Joint Airspace; Heavy Maneuver; Light Maneuver; MOUT; Indirect Fire; and, Direct Fire.
2. The DAMO-TR Point of Contact is Mr. Robert Harrison, (703) 695-1680.


JAMES B. GUNLICKS
Deputy Director of Training

#1-8

31 August 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the BRAC 05 MV attribute "Supply and Storage Capacity".
2. This concurrence signifies that, for the above listed attribute:
 - a. The attribute, as defined, is an effective installation military value measure for its stated purpose and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at (703) 614-0715.


RANDALY J. BOCKENSTEDT
COL, GS
Chief, Maintenance Policy Division

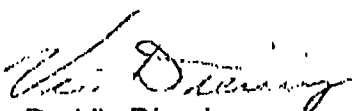
13 July 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the BRAC 05 MV attribute for Soil Resiliency.
2. This concurrence signifies that, for the above listed attribute:
 - a. The attribute, as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required supporting the model is available either within existing Army databases or from open sources.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at (703) 601-1963.

End



Dr. Vic Diersing

GS-14

Conservation Action Officer

15 March 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:

- a. RDTE Mission Diversity
- b. Test Range Capacity

2. This concurrence signifies that, for the above listed attributes:

*(Subject to
Comments provided)*

- a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
- b. That the methodology supports the purpose.
- c. That the data required supporting the model is available either within existing Army databases or from the installations.
- d. That any weights applied within the equation are valid.
- e. That the curve of the value function is consistent with the military value of the attribute.

3. POC for this action is the undersigned at

Michael G. Vogt

Encl (dated attribute narratives)

Michael G. Vogt

Name (Title Case)

Rank, Branch of Service

Title

*HQ ATEC**Deputy Ch. of Staff**for ENGINEERING, Logistics
& the Environment*

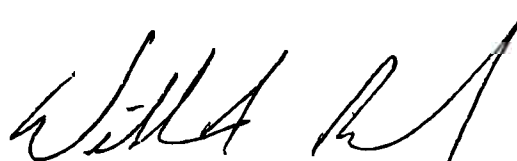
29 April 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Noise Contours
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at COM 410-436-3829 or DSN 584-3829.

Encl



WILLIAM A. RUSSELL, Sc.D.
Acting Program Manager
Environmental Noise

DAMO-ODM

17 March 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attribute:

Attribute #1: Mobilization

2. This concurrence signifies that, for the above listed attribute:

- a. The attribute, as defined, is an effective installation military value measure for its stated purpose and the DOD criteria.
- b. That the methodology supports the purpose.
- c. That the data required to support the model is available either within existing Army databases or from the installations.
- d. That any weights applied within the equation are valid.
- e. That the curve of the value function is consistent with the military value of the attribute.

3. POC for this action is the undersigned at (703) 614-4919.

Encl Mobilization Military Value Attribute,
16MAR 2004
MICHAEL P. RYAN
COL, USAR
Chief, Mobilization Division

26 March 2004


MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV) Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attribute: Joint Facilities.
2. This concurrence signifies that, for the above listed attribute:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. Recommended Changes Attached
4. POC for this action is Robert Conley, (703)692-7392.

Encl


Stephen G. Barth
GS-15, Army
Division Chief, Installation Costing
(SAFM-CES)

30 March 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attribute: Installation Unit Cost Factor.
2. This concurrence signifies that, for the above listed attribute:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. Recommended Changes Attached.
4. POC for this action is Robert Conley at (703)692-7399.

Encl



Stephen G. Barth
GS-15, Army
Division Chief, Installation Costing
(SAFM-CES)

29 March 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Attribute #1: Force Deployment
 - b. Attribute #2: Materiel Deployment
2. This concurrence signifies that, for the above listed attributes:
 - a. The attributes, as defined, are an effective installation military value measure for their stated purposes and the DOD criteria.
 - b. The methodology supports the purpose.
 - c. The data required to support the model are available either within existing Army databases or from the installations.
 - d. The curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at SDDCTEA.

Encl (*dated attribute narratives*)

E-Signed by Michael K. Williams
VERIFY authenticity with ApproveIt

Michael K. Williams
GS-15, US Army
Chief, Deployability Division



DEPARTMENT OF THE ARMY
ARMY ENVIRONMENTAL POLICY INSTITUTE
1550 CRYSTAL DRIVE, SUITE 1301
ARLINGTON, VIRGINIA 22202-4136

July 22, 2004

**MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR
INFRASTRUCTURE ANALYSIS (DASA (IA))**

**SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute**

I have reviewed and concur with the BRAC 05 MV attribute on "Environmental Elasticity".

This concurrence signifies that, for the above listed attribute:

- a. The attribute, as defined, is an effective installation military value measure for its stated purpose and the DoD criteria.
- b. That the methodology supports the purpose.
- c. That the data required supporting the model is available either within existing Army databases or from the installations.
- d. That any weights applied within the equation is valid.
- e. That the curve of the value function is consistent with the military value of the attribute.

The point of contact for this action is Mr. John Fittipaldi at (703) 604-2307.

A handwritten signature in black ink, appearing to read "Michael L. Cain", is positioned above the printed name and title.

Michael L. Cain
Director

cf:
DASA-ESOH
(Mr. Fatz, Mr. Carellas, Mr. Newsome)

26 Mar 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA))SUBJECT: Concurrence with 2005 Base Realignment and Closure Connectivity
Attribute in the Military Value (MV) Model

1. I have reviewed and concur with the BRAC 05 Military Value Attribute "Connectivity".
2. This concurrence signifies that:
 - a. That the Connectivity Attribute, as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing government databases or from reliable third sources.
 - d. That any weights applied within the equation are/will be valid.
 - e. That the curve of the value function is/will be consistent with the military value of the attribute.
3. POC for this action is the undersigned at 703-602-7210.

MARK F. BARNETTE
COL, GSChief, Information Infrastructure Modernization,
Army CIO/G-6



DEPARTMENT OF THE ARMY
CENTER FOR ARMY ANALYSIS
Wilbur B. Payne Hall
6001 Goethals Road, Suite 102
Fort Belvoir, Virginia 22060-5230

REPLY TO
ATTENTION OF: CSCA-RA

31 March 2004

MEMORANDUM FOR RECORD

**FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA))**

**SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute**

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Accessibility
 - b. Critical Infrastructure Proximity
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at 703-806-5391.

Encl (*dated attribute narratives*)

David J. Russo
DAVID J. RUSSO
GS-15, DAC
Division Chief, Resource Analysis

24 March 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA))

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:

a. **C2 TARGET FOR FOCUS FACILITIES**

2. This concurrence signifies that, for the above listed attributes:

a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.

b. That the methodology supports the purpose.

c. That the data required supporting the model are available either within existing Army databases or from the installations.

d. That any weights applied within the equation are valid.

e. That the curve of the value function is consistent with the military value of the attribute.

3. POC for this action is the undersigned at Christie P. Smith, 703-604-2450,
Christie.Smith2@hqda.army.mil.



PETER F. PORCELLI
COL, GS
Chief, Plans and Operations Division

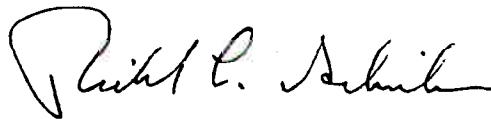
Encl (*dated attribute narratives*)

19 May 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Buildable Acres
2. This concurrence signifies that, for the above listed attributes:
 - a. The attribute (s), as defined, is an effective installation military value measure for its stated purpose(s) and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at U. S. Army Engineering Research & Development Center, Construction Engineering Research Laboratory (CEERD-CF-N).

Encl (*dated attribute narratives*)Richard L. Schneider
DBIV, U. S. Army
Project Manager/Research Architect

18 August 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the BRAC 05 MV attribute "Brigade Capacity".
2. This concurrence signifies that, for the above listed attribute:
 - a. The attribute, as defined, is an effective installation military value measure for its stated purpose and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is the undersigned at 703.636.3138.

Encl



Wesley L. McClellan

COL, GS

Chief, Force Management Initiatives Division

AMCSU

MEMORANDUM FOR Assistant Secretary of the Army for Infrastructure Analysis
(DASA-IA)

SUBJECT: 2005 Base Realignment and Closure (BRAC) Military Value (MV) Model
Attributes

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Maintenance and Manufacturing Production Capacity.
 - b. Ammunition Storage Capacity.
 - c. Munitions Production Capability.
 - d. Joint Workload Flexibility.
2. This concurrence signifies that, for the above listed attributes:
 - a. The attributes are, as defined, effective military value measures for their stated purpose and for the DoD Criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required supporting the model is available either within existing Army databases or from the installations.
 - d. That weights applied within the equations are valid.
 - e. That the curves of the value functions are consistent with the military value of the attribute.
3. We have not reviewed or concurred in the Supply and Storage MV as it does not fall within the purview of this Command.
4. In addition to the attributes noted above we have also reviewed the RDTE Mission Diversity attribute. As stated previously during the staffing of this attribute, we believe that it is inadequate to measure the MV of RDE facilities. We believe that in addition to measuring mission diversity, it is also essential to capture the capacity to accomplish the mission.
4. POC for this action is Mr. Daryl Powell, 703-806-8701.

ENCL (Dated Attribute Narratives)


Mr. David J. Shaffer
Director, U.S. Army Materiel
Command Analysis & Logistics

04/02/04 13:42 FAX 703 806 9043

AMC BRAC OFFICE

002

8 April 2004

MEMORANDUM FOR RECORD

FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR INFRASTRUCTURE
ANALYSIS (DASA (IA)

SUBJECT: Concurrence with 2005 Base Realignment and Closure Military Value (MV)
Model Attribute

1. I have reviewed and concur with the below listed BRAC 05 MV attributes:
 - a. Operations/Administrative Facilities
 - b. Area Cost Factor
2. This concurrence signifies that, for each of the above listed attributes:
 - a. The attribute, as defined, is an effective installation military value measure for its stated purpose and the DOD criteria.
 - b. That the methodology supports the purpose.
 - c. That the data required to support the model is available either within existing Army databases or from the installations.
 - d. That any weights applied within the equation are valid.
 - e. That the curve of the value function is consistent with the military value of the attribute.
3. POC for this action is Christie P. Smith, 703-604-2450,
Christie.Smith2@hqda.army.mil.

2 Encl



Peter F Porcelli
COL, GS
Chief, Plans and Operations Division



DEPARTMENT OF THE ARMY
OFFICE OF ECONOMIC & MANPOWER ANALYSIS
UNITED STATES MILITARY ACADEMY
WEST POINT, NY 10996

REPLY TO
ATTENTION OF

MADN-OEMA

3 June 2004

MEMORANDUM FOR RECORD

SUBJECT: BRAC Data Certification

1. FACTORS: Installation Local Labor Supply Attribute

2. DESCRIPTION: This metric represents the available labor supply of individuals ages 25 and older within a 50 mile radius of each installation by education category (high school drop-outs, high school graduates, some college, college graduates, and post college degrees) and weighted by cost of living adjusted median annual earnings by education category.

3. DATA SOURCES: There were three primary data sources used to calculate this attribute.

a. GeoLytics Data: GeoLytics stratifies the U.S. Census 2000 Long Form data into finely graded geographical regions. We use this to determine the number of people ages 25 and older by education category who live within a 50 mile radius of each installation. The Total Army Basing Study provided the longitude and latitude used for each location. See www.geolytics.com for more information on the data. Note, Puerto Rico is not contained in this data. Therefore, we used 2000 Census data to determine population by education category for Fort Buchanan. Since approximately 70 percent of the island's population lives within 50 miles of Fort Buchanan, we impute populations as 70 percent of the island total within each education category.

b. 2000 Census Data: GeoLytic data does not contain median earnings by education category, so we use the 2000 U.S. Census data to determine median earnings by education category for each state. See www.census.gov/hhes/income/earnings for more information. Note, median earnings by education category is not available in the 2000 Census Data for Puerto Rico. Therefore, we impute median earnings by education category using median earnings by occupation category for Fort Buchanan.

c. Missouri Economic Research and Information Center (MERIC) Data: Since there is no widely accepted state-level cost of living adjustment factor, we use the MERIC Data because it focuses on state-level comparisons and incorporates a wide range of goods and services: groceries, utilities, healthcare, housing, transportation, and other miscellaneous items for 2003. See www.ded.mo.gov/business/researchandplanning/indicators/cost_of_living/index for more information.

4. METHODOLOGY: Ascertaining available labor supply in a region involves a measure of both quality and quantity. We assess quantity by determining populations within a 50 mile radius of each installation by the five education categories listed above using the Geolytic Geographical 2000 Census data. We capture quality by matching cost of living adjusted state-level annual median earnings by education category to each installation. To create a comparable index for each installation, we use a four step process illustrated below by Fort Monmouth, New Jersey.

MADN-OEMA

SUBJECT: BRAC Data Certification

	Population	Median Earnings	COLA
High School Drop-outs	2,482,522	\$24,329	111.6
High School Graduates	2,959,063	\$32,389	111.6
Some College	2,431,979	\$38,429	111.6
College Graduates	1,980,290	\$51,657	111.6
Post College Degrees	1,366,125	\$69,597	111.6

a. Step 1. We normalize median annual earnings within states by high school graduate median annual earnings. For example, Fort Monmouth has median annual earnings of \$24,329 for high school drop-outs and \$32,389 for high school graduates. Therefore, we divide both by \$32,389 to get a high school normalized earnings index of .7511 for high school drop-outs and 1.0 for high school graduates.

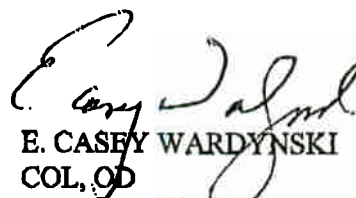
b. Step 2. We adjust this factor so that earnings are comparable across states by dividing by the state level cost of living (COLA) index, which we normalize by the State of Texas. An example of how we normalized the COLA is as follows. Since Texas has a COLA index of 90.3 and New Jersey has a COLA index of 111.6, we divide both by 90.3 and get a Texas normalized index of 1.0 for Texas and 1.236 for New Jersey. Therefore, a high school drop-out at Fort Monmouth has a COLA adjusted weight of .6078 (.7511/1.236).

c. Step 3. We multiply the COLA adjusted state-level median annual earnings index for each education category by the population in each education category and sum them for each installation to create a comparable measure of available labor supply within a 50 mile radius of each post. High school drop-outs at Fort Monmouth contribute 1,508,841 to the total Fort Monmouth labor supply metric of 11,168,696.

d. Step 4. We normalize the labor supply measures by the installation with the largest labor supply (Fort Monmouth) so that each installation has a labor supply measure that ranges from zero to one. A one denotes the installation with the largest labor supply.

5. The data used in this analysis is found in the accompanying excel file: BRAC-output-oema-v2.0.

6. I certify that the information supplied is accurate and complete to the best of my knowledge and belief.



E. CASEY WARDYNSKI
COL, OD

Director, Office of Economic & Manpower Analysis

ANNEX 6. MVP TECHNICAL DOCUMENT

This appendix provides a technical description of the linear-integer program TABS used to determine the final portfolio of Army installations. The Military Value Portfolio (MVP) model maximizes the total value of installations within the Portfolio based on MVI results, subject to the needs of the Army.¹

6.1 MVP PURPOSE

MVP identifies the best “portfolio,” or set of Army installations with the highest MV to meet future Army needs. The MVP is a linear-integer program that maximizes the MV of a set of Army installations subject to a set of constraints to ensure the model provides a portfolio capable of meeting defined Army requirements.

All installations have MV; TABS measured the MV of installations (MVI) based on installation and community characteristics. To develop MVP, TABS examined the installations with lower MV. In the event the Army does not require the installation’s assets (because other installations with higher MV can satisfy the same missions), then closing the installation and using the associated savings for other priorities increases overall Army MV. An installation such as this would then be removed from the portfolio. In this way, MVP helped the Army determine the minimum-sized portfolio that meets Army requirements.

6.2 THEORY AND DEFINITIONS²

The MVP and OPM³ are classified as *combinatorial optimization* models. Combinatorial optimization (CO) considers problems of minimizing or maximizing a function of one or more variables subject to:

1. Equality or inequality constraints
2. Integrality restrictions on some or all of the variables

The generalized class CO problems are the linear integer programming problem (IP). We define the IP as

$$\max \{cx : Ax \leq b, x \in Z_+^n\}$$

where, Z_+^n is a set of nonnegative integral n -dimensional vectors, and $x = (x_1, \dots, x_n)$ are the *unknowns* (variables). A *case* of the problem is defined by the parameters (data), c, A, b , with c an n -vector, A an $m \times n$ matrix, and b an m -vector.

For the MVA process, the IP variables represent a logical relationship, i.e., are constrained to equal 0 or 1. For example, for the MVP the decision variable indicates either the installation is included within the Portfolio or not; for the OPM, the variable

¹ A complete discussion of MVI and MVP is in the MV Assessment Results document; the technical discussion of the MVI model is contained in Annex 4 of the MV Supporting Document.

² This theory discussion in this section is adapted from Nemhauser and Wolsey, pp 3-7.

³ See Annex 7 of MV Supporting Document for a complete description of the Option Portfolio Model (OPM).

indicates either the scenario is included within the Option or not. We obtain the 0-1 IP in which $x \in B^n$, where B^n is the set of n -dimensional binary vectors. Our problem becomes

$$\max \{cx : Ax \leq b, x \in B^n\}, \text{ where, } x = \begin{cases} 1, & \text{if the event occurs} \\ 0, & \text{otherwise} \end{cases}$$

The set $S = \{x \in B^n, Ax \leq b\}$ is called the feasible region, and a $(x, y) \in S$ is called a feasible solution. A case is said to be feasible if $S \neq \emptyset$ (Null). The function $z = cx$ is called the objective function. A feasible point x^o for which the objective function is as large as possible, i.e., $cx^o \geq cx \forall (x, y) \in S$ is called an optimal solution. A feasible IP may not always have an optimal solution; it may also be *unbounded*. A case is unbounded if for any $\varpi \in R^1$ there is a $(x, y) \in S$ such that $cx > \varpi$. Assuming the parameters are rational, the feasible solution to the 0-1 IP is optimal, or the problem is unbounded.

The 0-1 IP problems we solve in the MVA are related to the capital budgeting and the *knapsack*, problem. For example, suppose there are n -projects, with the j th project, $j = 1, \dots, n$, has a cost of a_j and a value of v_j . Each project is either done or not, i.e., partial completion of a project is not allowed. A budget b is available to fund the projects. The capital budgeting problem is written as follows

$$\max \left\{ \sum_{j=1}^n c_j x_j : \sum_{j=1}^n a_j x_j \leq b, x \in B^n \right\}.$$

The problem is choosing a subset of projects to maximize the sum of the costs while not exceeding the budget constraint. Problems of this type may have several constraints.

Let $N = \{1, \dots, n\}$ be a finite set and let $c = \{c_1, \dots, c_n\}$ be an n -vector. For $F \subseteq N$, define $C(F) = \sum_{j \in F} c_j$. Suppose we are given a collection of subsets \mathfrak{F} of N .

A common way of defining \mathfrak{F} leads to important classes of combinatorial optimization problems known as Set Covering or Set Packing problems. These problems are formulated as 0-1 IPs. Let $M = \{1, \dots, m\}$ be a finite set and let $\{M_j\}$ for $j \in N$, i.e., for

$i \in M$

$$a_{ij} = \begin{cases} 1, & \text{if } i \in M_j \\ 0, & \text{if } i \notin M_j \end{cases} \quad x_j = \begin{cases} 1, & \text{if } j \in F \\ 0, & \text{if } j \notin F \end{cases}$$

F is a cover constraint $\Leftrightarrow x \in B^n$ satisfies $Ax \geq 1$ and is a packing constraint $\Leftrightarrow Ax \leq 1$, where 1 is an m -vector whose components all equal 1. Constraints of this type are found in the MVP and OPM

6.3 MVP KEY ASSUMPTIONS

The following key linear programming assumptions were made:

1. *The objective values are additive.* This assumption must be valid if the original MVI assumptions hold.
2. *The objective values observe constant returns to scale.*
3. *The alternatives can be separated.* We assume for the MVI model that installations do not interact or provide synergies that affect MV.
4. *The input data are deterministic.* All data used for the MVI has been provided through an auditable source.

In addition to the above linear-programming assumptions, we also assume the MVI value functions are measurable. Preference theory, on which Multi-Objective Decision Analysis models are based, usually provide *ordinal values*, i.e., they only rank preferences. Because we carefully assessed the *swing weights* and measurable value functions, the MVI provides *cardinal values*, which can then be optimized.

6.4 KEY LIMITATIONS

MVP does not *close* or *realign* installations. It provides a portfolio of installations to the BRAC Senior Review Group (SRG) that TABS can then use as a starting point for its scenario analysis for BRAC 2005 actions.

The MVI derived for each installation measures the immutable characteristics of the installation. MV does not consider the units that currently occupy an installation; instead, it considers an installation's current capability and flexibility to support different unit types. Therefore, MVP does not have the ability to station units; it only evaluates potential stationing.⁵ Because units are not moved by MVP, stationing action costs are not captured. For example, MVP does not account for new or upgraded MILCON due to unit moves. Stationing costs are captured in other BRAC 2005 analyses, e.g., COBRA analysis.

⁵ The Optimal Stationing of Forces (OSAF) model used in the BRAC 2005 analysis provides TABS with a starting point for scenario analysis.

6.5 DATA INPUTS

The MVP model has two primary inputs, one input for the objective and another for the constraints. The sole input for the MVP objective function is provided by the MVI model's installations' respective military values. MVI results are located in the Army Installation Military Value Results document; we attach the MVI results at Table 1 of this document as well for ease of reference.

Table 1 lists the data used by the MVP constraints to ensure that Army requirements are satisfied by the installations' assets within the chosen Portfolio. The third column of Table 1 provides the requirement that the Portfolio must satisfy given the percentage of the total required listed in column 4. For example, 90 percent of the total available impact area at the 87 studied Army installations equals 1.54 million acres. Using the capacity constraints, the MVP model ensures that the sum of all assets across Army installations represented within the constraints is contained within the Portfolio.

	Total Capacity	Requirement	Constraint	Unit of Measure
HVY MVR Land	4,430,585	4,386,280	99%	acre-days
Light MVR Land	1,363,357	1,336,090	98%	acre-days
Impact Area	1,711,727	1,540,554	90%	acre-days
Buildable Acres	353,461	282,769	80%	acre
Supply and Storage	60,400,253	51,340,215	85%	square feet
Ammo Storage	50,938	43,298	85%	square feet
Maintenance	16,727	15,055	90%	square feet
Production	6,119	2,448	40%	square feet
Munition Prod Explosive	31	16	50%	square feet
Munition Prod Metal parts	5	2	39%	square feet
Munition Prod LAP	51	22	43%	square feet
General Instructional Fac.	8,078,768	7,270,891	90%	each
Applied Instructional Fac.	5,607,375	5,046,637	90%	each
Ops/Admin Fac.	45,842,427	41,258,184	90%	each

Table 1. Army Capabilities Constraints in the MVP Model

Table 2, column 2 shows the total number of processes available in the current Army inventory corresponding to the RDT&E capability in column 1. The feasible portfolio must satisfy the Army's RDT&E requirement by including at least one installation for each of the processes shown in Table 2.

RDT&E Cover Constraints	Number of Processes
Weapons (Munitions & Armaments + Direct Energy)	13
Ground Vehicles (Land Combat)	8
Information Systems Technology (C4ISR)	7
Air Platforms (Air Combat)	7
Sensors, Electronics, and Electronic Warfare	6
Chemical & Biological Defense	3
Human Systems	3
Space Platforms (Space Combat & Ballistic Mis	2
Battlespace Environments	2
Materials & Processes	1
Sea Vehicles (Sea Combat)	1

Table 2. Current Army RDT&E Capability

Table 3 provides a listing of the unique capabilities that the portfolio must satisfy. The SRG approved each of these capabilities, thus “fixing” these installations or enclaves on them, in the final Army Portfolio.

Installation	Unique Capability
Holston AAP	Sole permit-holder to produce energetics
Radford AAP	Sole permit-holder to produce TNT
Lake City AAP	Only producer of small arms ammunition
Pine Bluff Arsenal	Sole permit-holder to produce white phosphorous. Also, chemical defense equipment provider
Watervliet Arsenal	8 unique manufacturing capabilities
MOT Sunny Point	Sole east-coast, deep-water port capable of handling munitions
Fort Myer	Houses Arlington Cemetery and the Old Guard
Fort Detrick	Medical Research Mission
Tripler AMC	Only Medical Center in Pacific
Walter Reed AMC	Medical Research & Congressional Medical Mission

Table 3. Unique Capability Constraints

6.6 FORMULATION

As previously mentioned, the MVP is a 0-1 IP. The MVP maximizes the total value of the portfolio, subject to a set of capability constraints (Table 1), and cover constraints (Table 2). In a very general form, the MVP is formulated as follows.⁶

Indices :

j = installation

c = Army requirement

Parameters :

v_j = MV for installation j [MV units]

g_{jc} = installation's j capacity for Army requirement c [square feet, acres - days]

K_c = Army capability for requirement c [square feet, acres - days]

N_{\min} = the minimum number of installations that satisfy Army capacity requirement c

Decision Variable :

$x_j = \begin{cases} 1, & \text{if installation } j \text{ is contained in the portfolio} \\ 0, & \text{otherwise.} \end{cases}$

Objective Function :

$$\max \sum_j v_j x_j \quad (1)$$

$$\text{s.t. } \sum_j g_{jc} x_j \geq K_c \quad (2)$$

$$\sum_j x_j \leq N_{\min} \quad (3)$$

$$x_j \in \{0, 1\} \quad \forall j.$$

The objective function, equation (1) maximizes the military value of the installations in a given portfolio; each portfolio is a feasible solution. TABS determines an efficient frontier of installations with N_{\min} , equation (3), which is incremented (beginning at 1) until the first feasible portfolio is obtained (satisfies all constraints), and is then iterated until all installations enter the portfolio; the last iterated portfolio includes all Army installations. The minimum solution satisfies all constraints and thus all of the Army capability and cover requirements, equation (2). Each model solution on the efficient frontier after the constraints are satisfied includes additional excess capacity, but also includes additional value.

⁶ This is a general form for the formulation. A more defined formulation is in the Installation Military Value Assessment Results document.

6.7 ITERATIVE SOLUTIONS

We conducted two forms of sensitivity analysis. First, we examined how installations moved in and out of the solution as the model determined different size Portfolios. Possibilities existed of installations being “in” a solution, but later excluded as the number of installations in the portfolio increased. This phenomenon is due to the different installation capacities and how adding installations changes the total Army capacity with additional installations and their respective military values.

To conduct this sensitivity analysis on the solution, we increment N_{\min} and iterate the model up to the maximum-sized portfolio, and then consider the result. Figure 1 provides an example showing a subset of 24 installations in the first five feasible portfolios.⁷ The second row shows the number of installations contained in the solution and the third row is the resulting military value. For example, column one contains the first feasible portfolio, with 63 installations, and a total military value of 206.

Portfolio:	P1	P2	P3	P4	P5
Inst:	63	64	65	66	67
MV:	206.036	208.242	210.385	212.326	214.238
Name	Value	Value	Value	Value	Value
I1	1	1	1	1	1
I2	0	0	0	0	0
I3	1	1	1	1	1
I4	1	1	1	1	1
I5	0	0	0	0	0
I6	0	0	0	0	1
I7	1	1	1	1	1
I8	1	1	1	1	1
I9	0	0	0	0	0
I10	0	0	0	0	0
I11	1	1	1	1	1
I12	1	1	1	1	1
I13	1	1	1	1	1
I14	1	1	1	1	1
I15	1	1	1	1	1
I16	1	1	1	1	1
I17	0	0	0	0	0
I18	1	1	1	1	1
I19	1	1	1	1	1
I20	1	1	1	1	1
I21	1	1	1	1	1
I22	1	1	1	1	1
I23	1	1	1	1	1
I24	0	1	1	1	1

Figure 1. Selection of First Five Feasible Portfolios

⁷ Complete portfolio results are contained in the Army Installation Military Value Results document.

In Figure 1, a “1” signifies that the corresponding installation is contained in the portfolio, while a “0” signifies exclusion. For example, I1 is contained within all portfolios. Conversely, I2 is not contained in the solutions and I6 enters at the fifth solution, P5. In all cases, an installation enters the solution as the model increases the size of the portfolio. Gaps in the solution were considered due to technical interest, because they provided a feel for when, if at all, an installation entered the portfolio.

This type of review highlights those installations that the Army would keep once all constraints were satisfied based on their MVI value. If the SRG questioned constraints, the additional solutions indicate the installations the Army would pull into the portfolio to satisfy the new constraint. For example, if the Army changed the general instructional capacity constraint from 90 to 92% then Fort Leavenworth would enter the portfolio.

Figure 2 provides the amount of general instructional facility and operational/administrative space within portfolios with different numbers of installations (63 to 87).

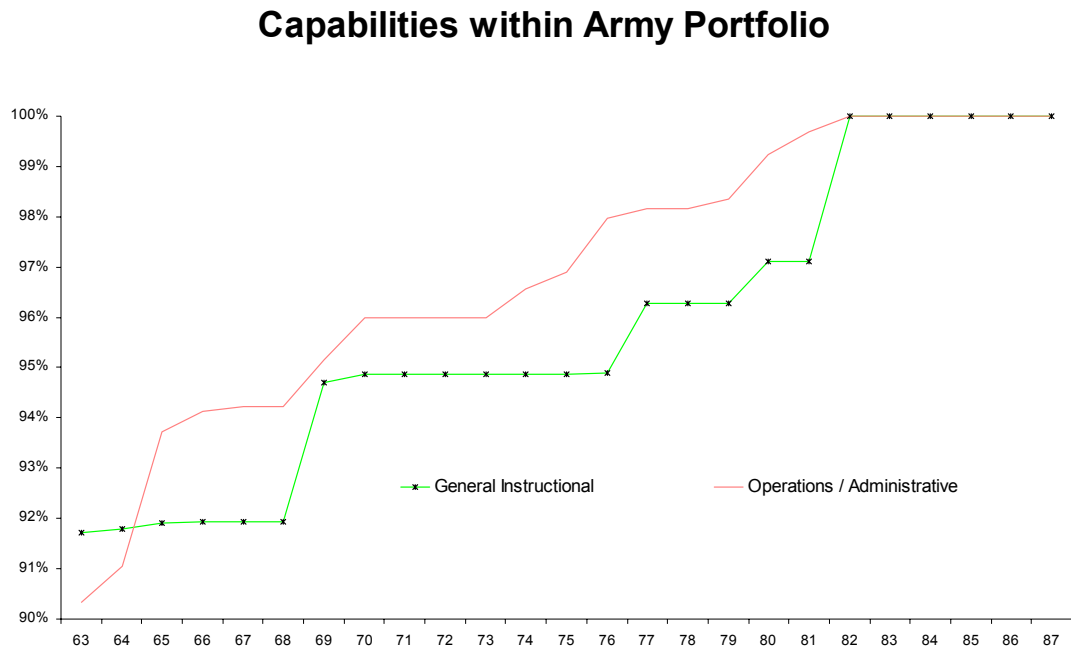


Figure 2. Example Capability Across Portfolios

The portfolio with 63 installations has ~90% of the Army’s total operations/administrative space and ~91% of the general instructional space. When moving from a 63-installation portfolio to one with 87 installations, percentages of these capabilities increase until all installations are in the portfolio with 100% of both current capabilities.

6.8 CAPABILITY CONSTRAINTS

Our second review examined the robustness of the capability constraints. For example, the review identified which of the constraints were found to be the most binding. Binding refers to those constraints that force the model to add the last installation into the first feasible portfolio. As these binding constraints are relaxed, fewer installations are required to satisfy the capability, and, thus, fewer installations are in the portfolio.

For example, if we require 88% of the administrative capability instead of 90%, then we would expect an installation to fall out of the portfolio. We examined each of these constraints and determined the installations that would leave the portfolio if the constraints were relaxed (or enter if increased).

6.9 EFFICIENCY FRONTIER

In Figure 3 we plot an efficient frontier to examine the returns to scale of our solution, which demonstrates a slight decreasing returns effect meaning that for every additional installation added to the portfolio, the additional value gained for the additional installation is of decreasing benefit. Table 4 provides the data from our example frontier; the total number of installations within the first ten portfolios, the military value, average military value for the installations, and the incremental military value provided by the last entering installation. The data illustrates the decreasing returns seen in the average MV and incremental value as additional installations are added to the portfolio.

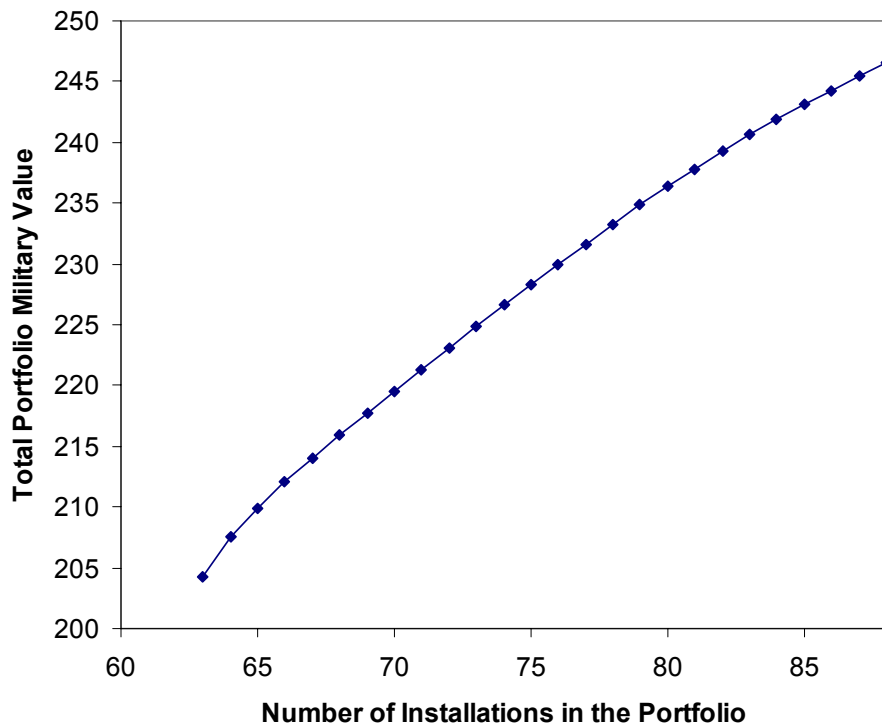


Figure 3. Efficient Frontier for Feasible Portfolios

Number in Portfolio	Total MV	Average MV	Incremental MV
63	206.04	3.27	
64	208.24	3.25	2.21
65	210.39	3.24	2.14
66	212.33	3.22	1.94
67	214.24	3.20	1.91
68	216.13	3.18	1.89
69	217.98	3.16	1.85
70	219.78	3.14	1.80
71	221.56	3.12	1.79
72	223.33	3.10	1.76
73	225.05	3.08	1.72

Table 4. Efficient Frontier Calculations

6.10 SUMMARY

This appendix provides a technical summary of the Army's MVP model. MVP identifies the best "portfolio," or set of Army installations, with the highest MV that meets future Army needs given a set of capability constraints that the MVP must satisfy. MVP uses MVI results as its primary input. Additional information on MVP can be found in the Report: Military Value Assessment and Approach and also in the Military Value Results Document.

6.11 REFERENCES

Nemhauser, G.L. and Wolsey, L.A. *Integer and Combinatorial Optimization*, New York, Wiley, 1988.

ANNEX 7. THE OPTION DEVELOPMENT AND EVALUATION MODULE (ODEM)

7.1 Scope

This document discusses the results of the Option Development and Evaluation Module (ODEM), which is depicted in Figure 1. ODEM products inform the scenario decision selection process by providing the Portfolio of scenarios required to meet a selected set of capacity requirements given Army budget constraints.

Module	ODEM (Option Development and Evaluation Module)	
Models	OVM	OPM
Products	Scenario Evaluation	Options Evaluation

Figure 1. ODEM Module, Models, and Products

This document provides the TABS' ODEM results and a technical overview. The section entitled ODEM Technical Overview, explains the development of the attributes, OVM methodology, weighting, and the mathematics behind the ODEM.

7.2 Background

The ODEM Module includes the Option Value Model (OVM) and the Option Portfolio Model (OPM) models; each is outlined within Figure 2.

7.2.1 Option Value Model (OVM)

The OVM determined the overall scenario value within a common set of attributes. When the TABS Group developed scenarios based on MVI, MVP, capacity analysis, and other analyses, OVM was employed to determine the overall value of the scenarios. The model used MVI, unit stationing, and implementation costs as inputs. Similar to MVI, it produced a ranking of scenarios from 1-to-n.

7.2.2 Option Portfolio Model (OPM)

The OPM determined the set of scenarios that maximize the MV of an option subject to a budget constraint and a set of capacity constraints. The model used outputs from OVM to maximize the value of a set of scenarios subject to these sets of constraints, which provided a review of all scenarios within a broad context across all Army assets and requirements. The options differed depending on additional constraints applied to the model and/or additional dollars available within the budget. Using OPM, the Army developed a set of options to use as a basis for recommendations.

model and/or additional dollars available within the budget. Using OPM, the Army developed a set of options to use as a basis for recommendations.

OVM	OPTION VALUE MODEL
Purpose	Determines the MV of a scenario. The scenarios are evaluated for their MV relative to each other based on the installations involved within the scenario.
Product	A ranking of scenarios from 1 to n
Use	- Provides input for OPM analysis - Assists with scenario prioritization
Method	MODA
Description	TABS develops multiple scenarios based on MVI, MVP, capacity analysis, and other analyses. Once the scenario is built we determine its overall MV with OVM. OVM includes the MVI inputs (MVI never changes within any analyses), but we introduce unit stationing and implementation costs.
OPM	OPTION PORTFOLIO MODEL
Purpose	Determines the set of scenarios that maximizes MV of an option subject to meeting a budget constraint.
Product	An option that consists of multiple scenarios
Use	Provides a set of options that TABS can use as a basis for recommendations
Method	Optimization: OPM uses outputs from OVM and maximizes the value of a set of scenarios subject to implementation cost. The options differ depending on the additional constraints applied to the model (e.g., constraints can force particular scenarios into the final option).

Figure 2. OPM and OVM Model Descriptions

ODEM is analogous to IEM. Just as MVI ranked installations, the OVM model ranked scenarios based on a set of attributes. Using an optimization model, the OPM model determined the portfolio of scenarios that maximized the total scenario military value subject to a budget constraint; this is similar to the role of the MVP model in IEM. An example of the ODEM process is outlined in Figure 3. This example assumes there are 190 scenarios to choose from, and three portfolios are determined using three different budget levels. An ODEM *Option* is defined as a set of scenarios that provide the greatest overall scenario value for a given budget level.

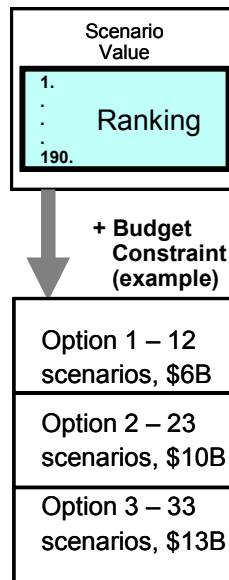


Figure 3. ODEM and the Prioritization Process

The OVM determines the 1-to-190 ranking for the scenarios in this example and determines a value for each scenario. As shown in Figure 3, when a budget constraint is applied using the OPM, it results in 12 scenarios in Option 1, and 23 & 33 scenarios in Options 2 and 3, respectively.

7.3 Guidance

TABS briefed all portfolio results to the BRAC Senior Review Group (SRG). The BRAC SRG provided specific guidance on changes or enhancements to the interim and final results, and approved TABS requests to continue with the analysis.

The ODEM approach was briefed on 30 November 2004. At this meeting, the BRAC SRG:

- Approved the OVM and OPM analytical approaches

The second ODEM update occurred on 7 December 2004; TABS provided an update on the ranking of scenarios from the OVM due to updates in installation data, and the initial Army Options. At this meeting, the BRAC SRG:

- Approved interim OVM and OPM insights
- Directed scenario tradeoffs

The third ODEM update occurred on 14 December 2005. At this meeting, the BRAC SRG:

- Approved the planned funding at the medium level (\$9.4 Billion)
- Approved the final prioritization with suggested trade-offs

Please reference BRAC 2005 SRG materials for further information about guidance matters.

7.4 Process

The scenario development process is an iterative process. As more information became available, the input data (Army and JCSG Scenarios) for ODEM changed, e.g., scenarios developed by the JCSG, or existing scenarios combined to form stronger or dominant scenarios, were added to the existing pool of scenarios for consideration. As a result, initial ODEM runs informed the starting process for high payoff options, and later ODEM runs helped examine the budget sensitivity of different portfolios of scenarios.

During the ODEM development phase, the maximum number of Army scenarios prior to 28 October 2004 was approximately 650. Many of these scenarios were dominated by other scenarios. For example, one scenario closed Fort Monroe and moved the tenants (including TRADOC HQ) to other installations, while another scenario focused on consolidating TRADOC functions (including the HQ) at another installation. Because the closure of the Fort Monroe scenario *dominated* the consolidation scenario, a new scenario was created, which combined the components of the two older Fort Monroe and TRADOC scenarios. Using this process of combining and eliminating dominated scenarios, the pool of army scenarios was reduced to 305 on 28 October 2004.

TABS ran ODEM continually between 28 October 2004 and the first SRG meeting on this subject (6 December 2004), where the first interim ODEM results were presented. The Army analyzed the early ODEM runs, and dominant scenarios were noted. Because of the iterative nature of the ODEM process, the pool of Army scenarios to be evaluated for the two BRAC SRG meetings in December fell to 192, shown in Figure 5. As of 14 February 05, the last time ODEM was run, 168 Army and JCSG scenarios existed.

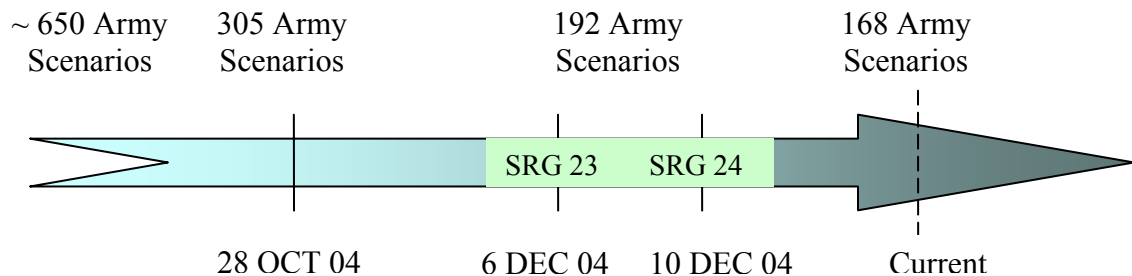


Figure 4. ODEM Process Timeline

7.5 ODEM Results

7.5.1 OVM

The OVM attributes and weights are shown in the Swing Weight Matrix (Figure 5). Each scenario received a value for the attributes in the matrix, with the higher-weighted attributes contained in the upper-right corner of the matrix and the lower-weighted attributes in the lower-left corner of the matrix.

Efficiency	Transformational-Joint	DOD Criteria 6,7, and 8
<ul style="list-style-type: none"> • NPV • Closure (sf and acres) 100	<ul style="list-style-type: none"> • Training improvements • Logistics improvements 75	<ul style="list-style-type: none"> • DoD Criterion 6 25
<ul style="list-style-type: none"> • Military positions realigned • Civilian positions eliminated 75	<ul style="list-style-type: none"> • Realignment to AFRC 25	<ul style="list-style-type: none"> • DoD Criterion 7 • DoD Criterion 8 • TAA inactivation 5

Figure 5. OVM Attribute Swing Matrix

7.5.2 OVM constraints

The OVM combined scenarios that provided the maximum overall value at a given budget level. To do this, the OVM ensured that the option solution satisfied three sets of constraints, as explained in the technical section.

The first set of constraints ensures that the OVM solution, i.e., an *Option*, does not contain units moved from one installation to another across multiple scenarios. The Army addressed this by examining the UICs of an Option and ensuring that each existed in only one scenario within that Option. Early in the ODEM process, the typical OVM contained about five or six scenarios with interactions with one or more scenarios. By the time the final run for SRG 24 was made, the dominated scenarios were eliminated from ODEM and only Scenario 185 had interactions with Scenarios 484 and 487, i.e., if Scenarios 484 or 487 were included in the Option, then Scenario 185 had to be excluded and vice versa.

The second set of constraints ensures that an Option does not include scenarios that both moved units to an installation and closed that installation. Early OVM runs contained more than 15 of these constraints, with interactions containing multiple scenarios. By the time the results were presented to SRG 24, the dominated scenarios were removed, and only 10 interacting scenarios remained. The interactions for this constraint set are shown in Table 1.

	C1	C2	C3	C4	C5	C6	C7
Scenario48	1	0	0	0	0	0	0
Scenario59	0	0	1	0	0	0	0
Scenario178	0	0	0	0	0	1	0
Scenario185	0	0	1	0	0	0	0
Scenario281	0	0	0	0	0	0	1
Scenario289	0	1	0	0	0	0	0
Scenario300	0	0	0	0	0	0	1
Scenario302	0	0	0	0	1	0	0
Scenario303	0	0	0	1	0	0	0
Scenario378	0	0	0	1	1	1	0
Scenario484	1	1	1	0	0	0	0
Scenario487	1	1	1	0	0	0	0
Total Interactions	3	3	4	2	2	2	2

Table 1. Scenario Interactions due to Proposed Closures.

A “1” in a row of Table 1 states that the corresponding scenario had interactions with another scenario. For example, Scenario 378 interacted with three other scenarios; Scenario 303, Scenario 302, and Scenario 178. Thus, if Scenario 378 was included in an Option, the other three scenarios could not also have been included in the same Option.

The final constraint is the budget constraint and within the budget constraint is a scenario's *adjusted one-time cost*. The scenario cost is defined as the *one-time cost* to implement the scenario, minus 1/3rd of the six-year net savings (not counting the military pay savings due to moving military personnel to other functions). If no savings are captured during the first six years of implementation, then the net savings is assumed to be zero. Figure 6 provides an example of the Army scenario costing approach.

Costing Approach

	One-Time Cost	6-yr Net costs	Savings	1/3 rd of Savings
No MILPAY	\$10.0	\$6.0	-\$4.0	-\$1.3
With MILPAY	\$10.0	\$7.0	-\$3.0	-\$1.0
No savings	\$10.0	\$12.0	none	none

	Change One-Time Cost	One-Time Adjusted Cost
No MILPAY	\$10.0 - \$1.3	\$8.7
With MILPAY	\$10.0 - \$1.0	\$9.0
No savings	Use higher cost	\$12.0

Figure 6. Army Scenario Costing Approach, Example

The top chart shows the three possible conditions that an Army scenario can meet. The first row shows a scenario that does not affect a unit containing military personnel. Its one-time implementation cost is \$10 and six-year net costs are \$6. We assumed that the net savings captured from implementation of the scenario would be \$4 because of the avoidance of the six-year costs normally incurred. Because it is unlikely to capture all of the savings generated and apply them solely to BRAC scenarios, we assumed only 1/3rd of the savings would be applied to the scenario's one-time costs. For example, in the "No MILPAY" case, the total savings generated was \$1.3 which could be applied to the one-time cost of the scenario as shown in the first row of the lower table in Figure 6.

The second row of the upper table of Figure 6 is an example of a scenario containing savings generated as a result of military units being moved. The costs due to the military personnel are captured, i.e., the savings were set aside because the military slots were going to be used somewhere else. As a result, the one-time adjusted cost for the scenarios with the MILPAY case was higher than the first case examined.

The final condition shows a case where no savings exist in the first six years of implementation. As expected the adjusted one-time cost is at least as much as the previous two cases examined. For this case, if the six-year net costs are greater than the one-time implementation costs, the six-year net costs are used as the adjusted one-time

cost for calculation of the *Option Budget*. Using the costing rules discussed above, the OVM ensures that the sum of the adjusted one-time costs are less than the given Option Budget.

7.6 ODEM Technical Overview

This section provides a technical description of the Option Development and Evaluation Module, which is composed of two models: The Option Value Model and the Option Portfolio Model. As addressed previously, the OVM provides a 1 to n ranking of Army BRAC scenarios based on a discriminating set of attributes. The OPM maximizes the OVM generated value subject to constraints on scenario interactions and implementation budgets. The OVM is a multiple objective decision analysis (MODA) process that is consistent with the techniques found in the MVI Technical Document.¹

General discussions on development, characterization, and the TABS application of value functions, weights, and the corresponding assessment process are also covered in the MVI documentation. The Notation and definitions introduced in the MVI Technical Document are also used for ODEM.

7.6.1 The Option Value Model

The OVM determines the highest valued scenario and is analogous to the MVI; both models use an additive value function, and meet the necessary and sufficient conditions for using measurable value functions. Design of the qualitative value model and assessment of the OVM attributes are the same as the MVI. The OVM contains four capabilities supported by 12 attributes. (Figure 7).

¹See Annex 4, MV Supporting Document

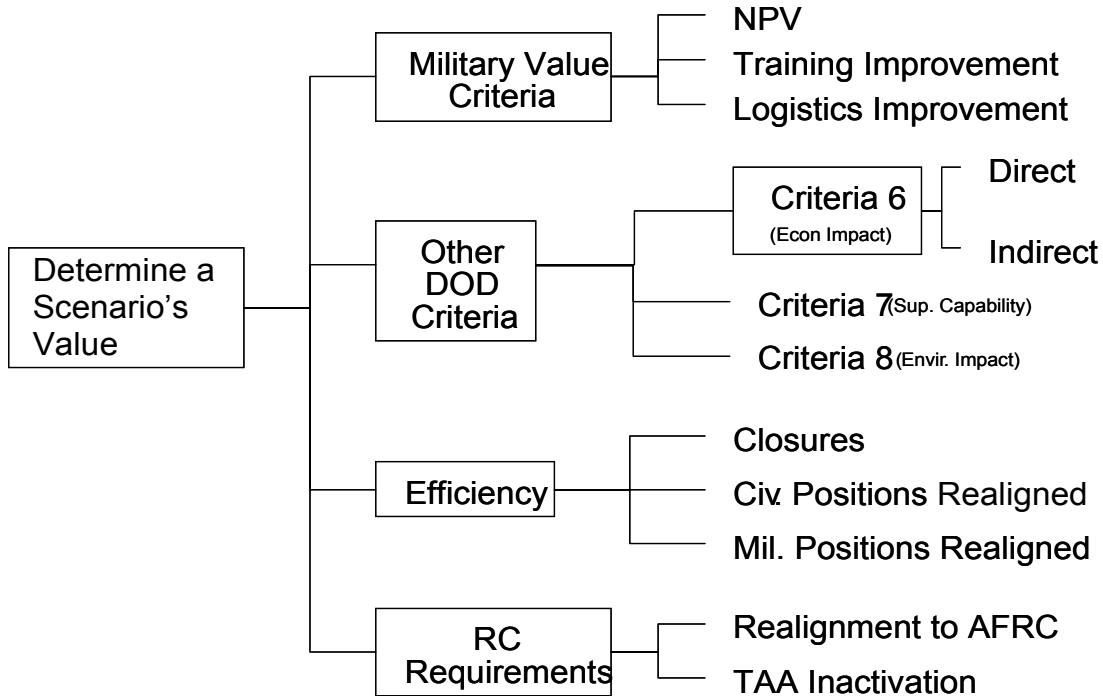


Figure 7. The OVM Qualitative Model

The analysis team abbreviated the survey approach for the construction of the qualitative model for the OVM (versus the MVI approach) because it could take advantage of the MVI work to inform this effort. To provide a starting point for construction of the value model, the analysis team constructed a survey and circulated it amongst TABS Mission Team members to collect SME preferences. The Mission Team members were asked to comment on what attributes were considered the most important, e.g., does the scenario enable improved mobilization, or does the scenario improve the Army's operational effectiveness or readiness?

BRAC legislative criteria, this survey, and MVI research, provided the basis for recommendations to the BRAC Senior Review Group (SRG), who provided guidance and approval of the qualitative model. Such inputs also helped to establish the objective's tradeoffs. Once the fundamental objective hierarchy was established, attributes were selected based on the goals necessary to support the overall fundamental objective.

7.6.2 OVM Attribute Assessments

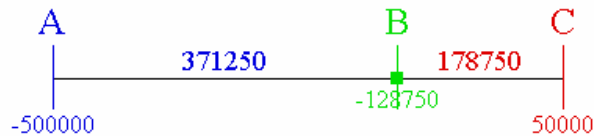
Of the 12 OVM attributes, the following six use natural scales, which we assessed using the mid-value method described in the MVI technical appendix:

1. *NPV* – NPV of Costs over 20-year horizon

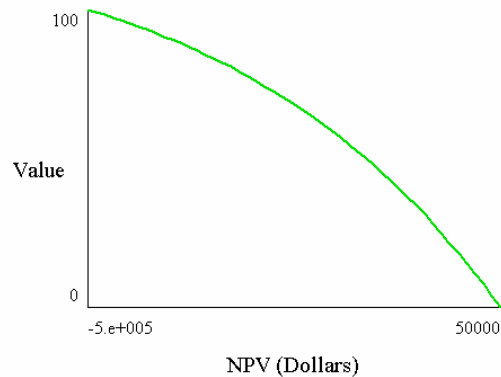
During the assessment process for the NPV attribute, the analysis team proposed that any scenario with an NPV cost greater than \$50,000 received no value, and

any scenario with more than \$500,000 savings received the maximum value of 100. The NPV value function is the only non-linear value function in the OVM using natural scales. The following figure illustrates the mid-point assessment for the NPV value function.

Please set Level B so that the change from Level A to Level B has the same Importance as the change from B to C

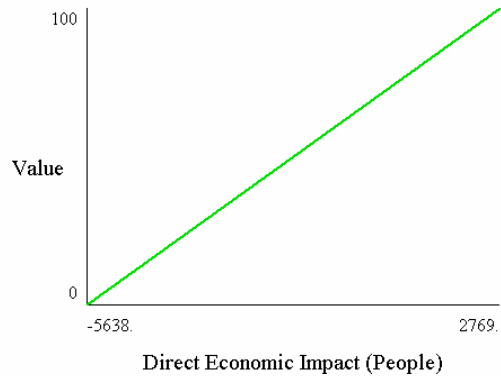


Using the mid-value assessment method (explained in the MVI technical document), the analysis team determined the level of -\$130,000 equated to a mid-value of 50. The corresponding exponential value function is shown in the following figure.

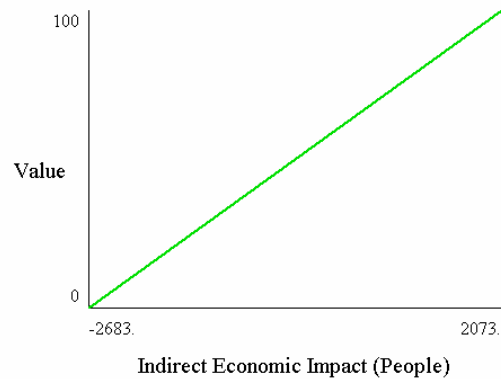


This function illustrates the overwhelming preference toward savings within the scenario.

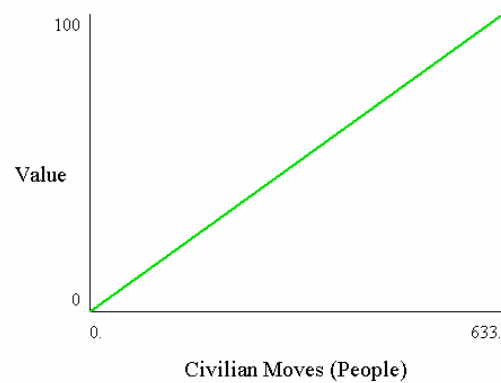
2. *Direct Economic Impact* – the direct economic impact on people affected. The number of people affected by the economic impact of BRAC actions is outlined within Criteria Guidance and recorded within the EIT and PIMS systems.



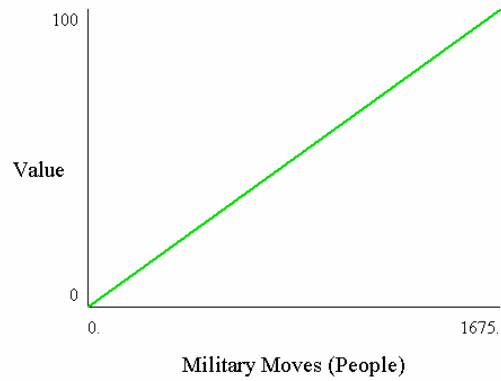
3. *Indirect Economic Impact* – the indirect economic impact on people affected.



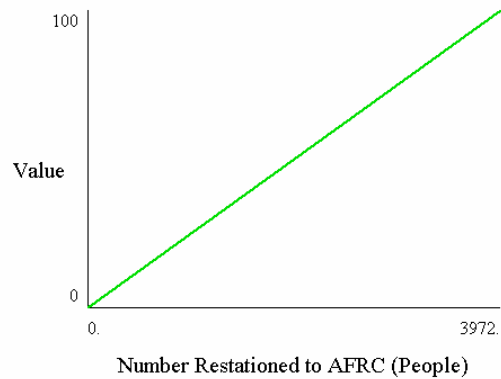
4. *Civilian Moves* – the number of civilian positions available for realignment.



5. *Military Moves* – the number of military positions available for realignment.



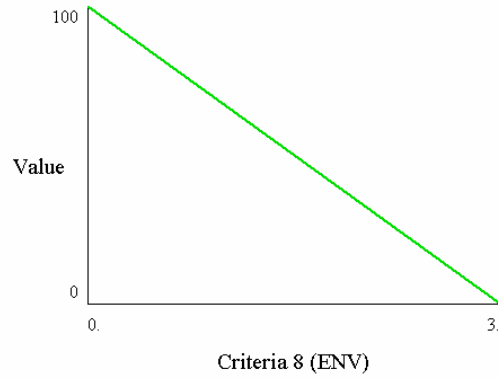
6. *Number Restationed to AFRC* – the number of people restationed to an Armed Forces Reserve Center as a result of the scenario.



Unlike the above OVM attributes, the following use *constructed* scales. As the name implies, these scales are based on constructed criteria and usually are represented by integer scores, i.e., the measure may take on only integer levels that result in discrete values. The following five attributes use a traditional constructed scale:

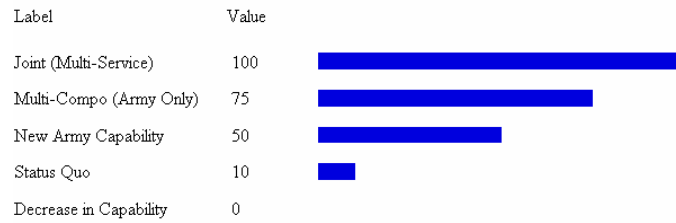
1. *Criterion 8* – the environmental impact of the BRAC scenario.² The scale for this value function is constructed, with a range from 0 to 3. Even though this function is represented as continuous, the resulting values are discrete.

² The environmental impacts of scenarios is outlined within each scenario's submission.



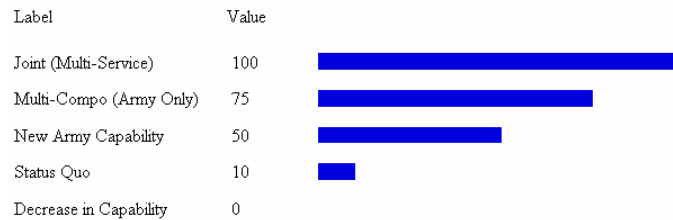
2. *Training Capabilities* – a measure for how much the scenario contributes to training. The following four attribute’s scales are shown as histograms.

Value histogram for Training Capabilities labels



3. *Logistical Capabilities* – a measure for how much the scenario contributes to training.

Value histogram for Logistics Capabilities labels



4. *Criterion 7* – the affected community to absorb the infrastructure impact of incoming BRAC actions.

Value histogram for Criteria 7 labels



5. *TAA Related Inactivation* – the scenario receives value if it results in a Total Army Analysis (TAA) inactivation of a facility.

Value histogram for TAA Related Inactivation labels



Only one OVM attribute used the multi-dimensional constructed scale, and it was assessed using the same technique described in the MVI technical document.

6. *Closure* - gives value for the number of acres and square feet of facilities closed.

	SF Closed		
	>0 to <100K	>= 100K and < 1M	>=1M
Acres Closed			
<5000	10	20	30
<15000	50	70	80
>=15000	70	80	100

7.6.3 Swing Weight Matrix

We follow the same process as with the MVI to determine the model weights using the Swing Weight Matrix, shown in Figure 8.

Senior Leadership Priorities		
Variation of Scale	Efficiency	Transformational -Joint
	NPV Closure (sf and acres) 100	Training Improvements Logistics Improvements 75
	Military Positions Realigned Civilian Positions Eliminated 75	Realignment to AFRC 25
		DoD Criteria 6,7, and 8
		DoD Criterion 6 25
		DoD Criteria 7 DoD Criteria 8 TAA Inactivation 5

Figure 8. OVM Swing Weight Matrix

“Senior Leadership Priorities” provide the defining dimension for the columns of the weight matrix, and “Variation of Scale” is the defining dimension for the rows of the matrix. We use the same process as used for the MVI to assess the weights and calculate the global weights.

7.6.4 Attribute Characteristics

The attribute characteristics are summarized in Table 2. The first column contains the attribute name. Column two gives the type of scale for the attribute: constructed or natural. The third column gives the range for the attribute’s scale and the corresponding units for the scale. The global weights are used by the additive value function explained in the MVI technical document. The last column describes the assessment type; either linear or non-linear if the scale is natural or value increment technique if the scale is constructed. The mid-point level is given for the non-linear assessment.

Attribute	Scale Type	Scale Range	Global Weight	Assessment Type
NPV	Natural	-500K to 50K (Dollars)	0.1695	Non-linear Mid-point = -128750
Tng. Improvements	Constructed	Labels	0.1271	Value Increment
Log. Improvements	Constructed	Labels	0.1271	Value Increment
Closures	Constructed	Labels	0.1695	Value Increment
Civ. Pos. Eliminated	Natural	0 to 633 (People)	0.1271	Linear
Mil. Pos. Realigned	Natural	0 to 1675 (People)	0.1271	Linear
Direct Econ. Impact	Natural	-5638 to 769 (People)	0.0424	Linear
Indirect Econ. Impact	Natural	-2683 to 2073 (People)	0.0424	Linear
Criteria 7	Constructed	Low, Med, High	0.0085	Value Increment
Criteria 8	Constructed	0,1,2,3	0.0085	Value Increment
Realign. to AFRC	Natural	0 to 3972 (People)	0.0424	Linear
TAA Inactivation	Constructed	T/F	0.0085	Value Increment

Table 2. OVM Attribute Characteristics (as of 9 February 2005)

7.6.5 Option Portfolio Model

TABS uses the Option Portfolio Model (OPM) to determine the best set of scenarios to maximize the value of an Option. The model makes each Option subject to a set of constraints and evaluates the scenarios in each Option. The first constraint is a budget constraint; OPM evaluates an Option against a given budget level. OPM also evaluates Options regarding two either/or constraints. The first either/or constraint pertains to closures; some scenarios may close an installation, while others may move units to that installation. The BRAC SRG can approve only one of these scenarios for that installation. The second either/or constraint involves Unit Identification Codes (UICs). Some UICs are present in multiple scenarios, but each UIC can be included in only one BRAC SRG-approved scenario.

The Army has more than 5400 UICs in its inventory, with thousands initially affected by 600 proposals (approximately 170 of the proposals dominate the remaining 430 proposals). The OPM was designed with this large data set in mind. The OPM was developed in Microsoft Excel, which facilitated the display of output to the senior Army leadership. The TABS team uses the Premium Solver V5.5 with the XPRESS solver plug-in to solve the MIP. The formulation of the OPM follows:

Indices

i = Scenario, alias \underline{i}

j = UIC

$k(\underline{i})$ = set of scenario(s) \underline{i} which
contain closed installations

Parameters

M = number of UICs (columns) generated

N = number of Scenarios to consider

L = budget level

$a_{ij} = \begin{cases} 1, & \text{if Scenario } i \text{ includes UIC } j \\ 0, & \text{otherwise} \end{cases}$

v_i = value of Scenario i

c_i = implementation cost of Scenario i

Variable

$x_i = \begin{cases} 1, & \text{if Scenario } i \text{ is used} \\ 0, & \text{otherwise} \end{cases}$

$$\max \sum_{i=1}^N v_i x_i \quad \text{Objective Function} \quad (1)$$

$$\text{S.T. } \sum_{i=1}^N a_{ij} x_i \leq 1, \quad j = 1, \dots, M \quad \text{More than one UIC cannot be contained within an included scenario} \quad (2)$$

$$x_i \leq 1 - x_{\underline{i}}, \quad \forall i, \underline{i} \in k(\underline{i}), \quad i \neq \underline{i} \quad \text{If Scenario } \underline{i} \text{ closes an installation, then Scenario } \underline{i} \text{ cannot move a unit to the closed installation} \quad (3)$$

$$\sum_{i=1}^N c_i x_i \leq B_L, \quad L = \begin{cases} \text{Low budget} \\ \text{Med budget} \\ \text{High budget} \end{cases} \quad \text{Budget constraints} \quad (4)$$

$$x_i \in \{0,1\}, \quad i = 1, \dots, N. \quad \text{Binary constraints} \quad (5)$$

Equation (1) shows the formulation of the objective function, i.e., the dot product of the Scenario value, v_i , and the scenario decision variable, x_i , where x_i is 1 if Scenario i is in the portfolio, and 0 otherwise. Implementation of equation (1) is shown in Figure 9, with the objective function result shown in the cell labeled *Portfolio OV*.

			Total OV	Total Number of Scenarios in Portfolio
			5368	96
			\$6,114,107	\$6,114,244
				3121
Scenarios	Scenario MV	Scenario In Portfolio		
Scenario1	34.0	0		
Scenario2	24.0	0		
Scenario3	24.0	0		
Scenario4	43.0	0		
Scenario6	36.0	1		
Scenario7	23.0	1		
Scenario9	35.0	1		
Scenario10	31.0	0		
Scenario11	35.0	0		
Scenario12	35.0	1		

Figure 9. Partial OPM screen shot showing the scenario military values and scenario decision variables.

The first column of Figure 9 shows the scenario names; the second column shows the value for a scenario v_i (data from the OVM output). The third column contains the decision variables x_i . The first two columns of the second row give the totals for the scenario value and number of scenarios in the Option.

The first row of the fourth and fifth columns show the implementation of equation (4). The right hand side of equation (4), i.e., the maximum allowed budget B_L , is the total amount of one-time portfolio costs allowed for a given Option. The OPM budget constraint provides an efficient means to produce Options of different scenarios at a given budget level L . The cell, *Total Cost of the Scenarios in Portfolio*, includes the sum of all the six-year one time *net costs* for all scenarios in the portfolio. The net costs include one-third of the expected savings for all the scenarios in an Option. We do not include military pay in our savings calculations because we assume military positions will be realigned to fulfill other Army manning requirements.

The savings from scenarios provides additional budget dollars, which makes scenarios with savings desirable. In effect, the budget constraint forces scenarios with savings into the solution for each budget level, and the value model provides a means to distinguish and prioritize scenarios. In addition to the budget constraint, the OPM uses two other constraint sets to ensure that conflicting scenarios are not included in the same Option.

The first constraint, equation (2), ensures that more than two scenarios containing the same unit does not exist in a portfolio. To reduce the number of possible decision variables and constraints in the OPM, the analysis team pre-processed the data to generate *columns*, which represent all viable solutions. A “1” in the matrix shown in Figure 10 indicates that the same unit, represented by its unique Unit Identification Code (UIC), is contained in two or more scenarios. For example, column C3 contains a “1” corresponding to Scenario 16 and Scenario 28. This indicates that these two scenarios share the same UIC and as such are not allowed in the same Option.

Constraints	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Scenario1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario16	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Scenario17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario28	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Scenario29	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario30	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 10. Column generation for set packing constraints

The equation shown in Figure 11 is an Excel array formula, which implements the left hand side of the set packing constraint of equation (2). If a formula is greater than “1”, it indicates that the constraint is active and that the solution is infeasible.

Scenario Cover Constraints	
Set Packing Constraints	
Constraint ID	
C1	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C2	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C3	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C4	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C5	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C6	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C7	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C8	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C9	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C10	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C11	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C12	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C13	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)
C14	=MMULT(TRANSPOSE('Set Packing Constraint'!B2:O191),Model!C4:C193)

Figure 11. Left hand side of equation (2) set packing constraints.

Figure 12 shows the implementation of the right hand side of equation (3). This constraint ensures that units moved by one scenario, e.g., Scenario 106, will not be included in an Option where those units are moved to an installation that is closed by another scenario, e.g., Scenario 107. Figure 12 also shows that Scenario 84 contains a UIC that is moved to an installation closed by Scenario 148, and as such is not allowed.

Then Not	Scenario 23	Scenario 59	Scenario 107	Scenario1 85	Scenario4 84
Scenario105	1	1	1	1	1
Scenario106	1	1	=1-C6	1	1
Scenario107	1	1	1	1	1
Scenario108	1	1	1	1	1
Scenario122	1	1	1	1	1
Scenario148	1	1	1	1	=1-C117
Scenario149	1	1	1	1	1
Scenario150	1	1	1	1	1

Figure 12. Implementation of right hand side of equation (3).

Not shown in the OPM formulation is the ability of the analysis team to “fix-in” or “fix-out” a scenario into an Option. This capability allows senior Army leadership to implement military judgment in the OPM. The example in Figure 13 shows that a total of 4 Scenarios (out of 170) are “fixed-out” of the Option, and a total of 5 Scenarios (out of 170) are “fixed-in” to the Option.

	Total Fixed Out	Total Fix In
	4	5
	Fix Out of the Portfolio	Fix In the Portfolio
Scenario11	1	0
Scenario12	1	0
Scenario13	1	1
Scenario14	1	0
Scenario15	1	0

Figure 13. Example of right hand side of fix-in/out constraints.

Figure 13 also provides an example where we fix Scenario 13, designated by a “1” into the portfolio based on the SRG guidance. A “0” in the “fixed-out” column would signify a scenario that is forced out of an Option (not shown).

Figure 14 shows the output for the OPM. The first row shows the maximum allowed one-time budget B_L . As the budget constraint is relaxed, i.e., B_L is increased, different Options are generated, which results (usually) in a greater number of scenarios in an Option. The third row is the total portfolio option value for the given column, i.e., the result of the objective function. The “Number” row indicates the number of scenarios contained in the given portfolio. The fifth row contains the 20-year NPV savings for the portfolio. The “One Time” row contains the sum of the 6-year one-time costs for the scenarios in the given Option. A “1” in the remaining rows indicates that the scenario is contained within the Option. For example, Scenario 13 is contained in all the Options shown in Figure 14, and Scenario 12 is not in any of the Options shown.

Budget (\$)	5270900	5376318	5481736	5587154	5692572	5797990	5903408
	Final Value	Final Value	Final Value	Final Value	Final Value	Final Value	Final Value
Portfolio OV	531	1125	1550	1905	2212	2483	2726
Number	16	34	47	58	67	76	84
NPV	3900805	3415121	3349834	3242217	3280123	3233472	3190519
One Time	5270176.24	5375715	5481619.06	5587042.44	5691873.38	5797155.95	5902367.8
Name	Final Value	Final Value	Final Value	Final Value	Final Value	Final Value	Final Value
Scenario1 In Portfolio	0	0	0	0	0	0	0
Scenario2 In Portfolio	0	0	0	0	0	0	0
Scenario3 In Portfolio	0	0	0	0	0	0	0
Scenario4 In Portfolio	0	0	0	0	0	0	0
Scenario6 In Portfolio	0	1	1	1	1	1	1
Scenario7 In Portfolio	0	0	0	0	0	0	0
Scenario9 In Portfolio	0	0	1	1	1	1	1
Scenario10 In Portfolio	0	0	0	0	0	0	0
Scenario11 In Portfolio	0	0	0	0	0	0	0
Scenario12 In Portfolio	0	0	0	0	0	0	0
Scenario13 In Portfolio	1	1	1	1	1	1	1
Scenario14 In Portfolio	0	0	0	0	0	0	0
Scenario15 In Portfolio	0	0	0	0	1	1	1
Scenario16 In Portfolio	0	0	0	0	0	0	0
Scenario17 In Portfolio	0	0	0	0	0	0	0
Scenario18 In Portfolio	0	0	0	1	1	1	1
Scenario19 In Portfolio	0	1	1	1	1	1	1
Scenario20 In Portfolio	0	0	0	0	0	0	0
Scenario21 In Portfolio	0	0	0	0	0	0	0
Scenario22 In Portfolio	0	0	0	0	0	0	1
Scenario23 In Portfolio	0	0	0	0	0	0	0
Scenario24 In Portfolio	0	0	0	0	0	0	0
Scenario25 In Portfolio	0	1	1	1	1	1	1
Scenario26 In Portfolio	0	1	1	1	1	1	1
Scenario27 In Portfolio	0	1	1	1	1	1	1
Scenario28 In Portfolio	0	0	0	1	1	1	1
Scenario29 In Portfolio	0	0	0	0	0	0	0
Scenario30 In Portfolio	0	0	0	0	0	0	0
Scenario31 In Portfolio	0	0	0	1	1	1	1
Scenario32 In Portfolio	0	0	1	1	1	1	1
Scenario33 In Portfolio	0	0	0	0	0	0	0

Figure 14. OPM output for increasing budget level

7.6.6 Risk Analysis

We can evaluate the results of the OPM shown in Figure 15 by plotting each of the portfolio's Option Value versus the Option's 6-year one-time costs as shown in Figure 15. We refer to this plot as the OPM efficient frontier.

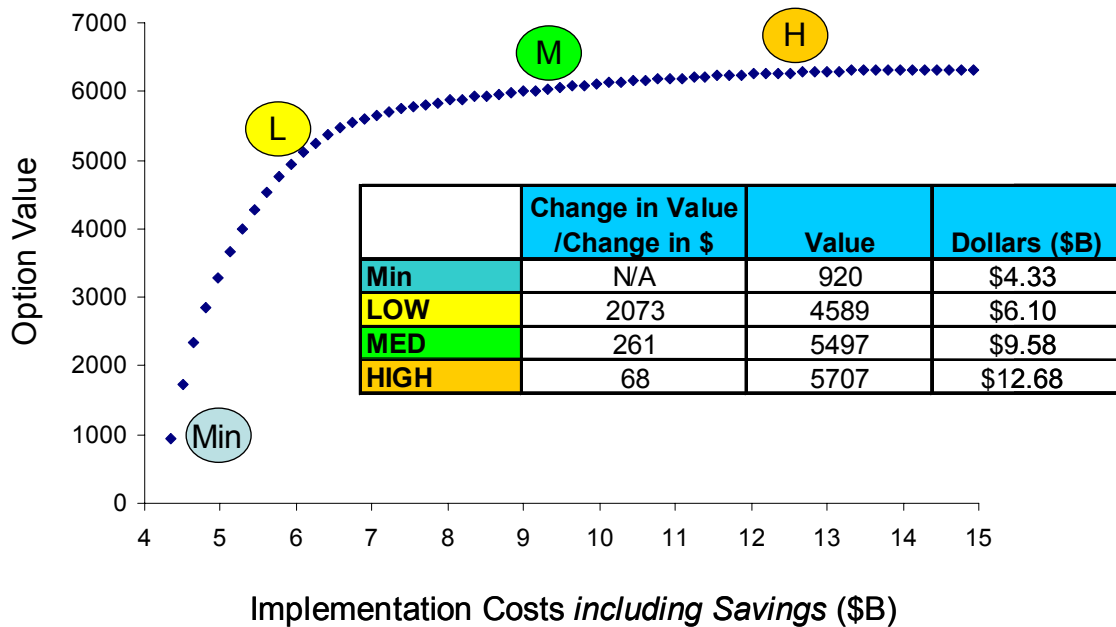


Figure 15. Example Efficient Frontier and Risk to Army Programs

The different points shown in Figure 15 are areas of interest on the curve that are important to the BRAC SRG due to the required funding levels (final values are listed in the ODEM Results Appendix). TABS defined the level of risk as the risk to other Army programs due to possible budget cuts required to pay for approved BRAC scenarios. At the *Low*-risk level, the Army expects little risk to its programs because of the expected savings for Army scenarios and the available DoD wedge; low risk also equates to low cost and low value. *Medium* risk occurs at a level where the BRAC SRG expects the DoD wedge and scenario savings to fund a smaller portion of Army BRAC scenario costs. At the *High*-risk level, the BRAC SRG expects a benefit from the DoD wedge and savings, but due to the level of required investment, the Army would need to fund much more of the BRAC scenarios with funds from other Army programs.

Figure 15 also illustrates the diminishing returns as the model considers increasing budget levels. As the second column of the table in Figure 15 shows, little value is gained per dollar invested when increasing from the Medium- to High-risk level.

7.7 Conclusion

The ODEM Module includes a multi-objective decision analysis (MODA) model that ranks Army scenarios and an optimization model that maximizes the value of scenarios for a given budget level. ODEM provides TABS a means to examine different portfolios of scenarios and illustrate the risk to Army programs given a COBRA-estimated cost, schedule, wedge contribution, savings, and budget level.

TABS completed this prioritization prior to integration; results are in the ODEM Results section.

After submission of candidate recommendations and integration, TABS used budget restrictions, final wedge allocation, and military judgment to finalize Army prioritization.

ANNEX 8. SRG REFERENCES

Military Value materials (MVI & MVP) were briefed in multiple SRG briefings. The SRG's in which significant MV data was discussed include:

- SRG 6
- SRG 10
- SRG 16
- SRG 22
- SRG 23
- SRG 24
- SRG 31
- SRG 36

The following two sections are excerpts from Section 1.2 of *Appendix B. Military Value Results* document and provide an overview of historical milestones of when MV topics were discussed before the SRG and their respective results. For further information about MVI & MVP materials briefed to the SRG, please reference BRAC 2005 SRG documents.

8.1 MVI

TABS briefed all MV results to the Army BRAC SRG. The Army BRAC SRG provided specific guidance on changes or enhancements to the results and approved requests to continue with the analysis, given the MV baseline.

Initial MV results were briefed on 25 February 2004, which allowed the Army to start scenario development based on this initial result. At this meeting, the BRAC SRG:

- Approved the MV analytical approach
- Approved the MVI attributes (installation characteristics such as Direct Fire Capability, Light Maneuver Area, Air Quality, etc.)
- Approved the relative importance of the MV attributes (weighting)

The BRAC SRG realized that data updates could cause changes in the MVI results and on 24 August 2004, the Army provided an update on attributes, weights, and the initial ranking of installations to the BRAC SRG due to data developments. At this meeting, the BRAC SRG:

- Authorized portfolio analysis using revised MVI results

The second MV update occurred on 19 October 2004; the Army provided an update on the ranking of installations due to updates in installation data. At this meeting, the BRAC SRG:

- Approved the updated MVI pending additional information

A third MV update was briefed to the BRAC SRG on 22 February 2005.

The final MVI results were briefed to the BRAC SRG on 29 March 2005. The BRAC SRG approved changes to the model and the final results. Please reference BRAC 2005 SRG materials for further details.

8.2 MVP

TABS briefed all Portfolio results to the BRAC SRG, which also provided specific guidance on changes or enhancements to the interim results and approved the request to continue with the analysis, given the MV baseline.

The MVP approach was briefed on 24 August 2004. At this meeting, the BRAC SRG:

- Approved the MVP analytical approach
- Authorized portfolio analysis using initial MVI results

The second MVP update occurred on 19 October 2004. TABS provided 1) an update on the ranking of installations due to updates in installation data, 2) capacity listings and unique Portfolio requirements, and 3) initial Army Portfolio results. At this meeting, the BRAC SRG:

- Approved the updated MVI pending new information
- Approved interim MVI and MVP results
- Extended the Portfolio to include Fort Leavenworth

On 30 November, the BRAC SRG:

- Extended the Portfolio to include Fort Hamilton, Adelphi Labs, and Fort Buchanan

On 7 December, the BRAC SRG:

- Extended the Portfolio to include Lima Army Tank Plant

A MVP result update was provided to the BRAC SRG on 22 February 2005; BRAC SRG approved the update.

Final MVP results were briefed to the BRAC SRG on 29 March 2005; BRAC SRG approved the update. Please reference BRAC 2005 SRG materials for further details.

ANNEX 9. DOCUMENT SUMMARIES

9.1 Joint Vision 2020

This annex provides a summary of selected documents that TABS reviewed during the MV research phase. A complete set of references is within section 9.6.

Date published: June 2000

Author: JCS Director for Strategic Plans and Policy, J5; Strategy Division

Summary: Joint Vision 2020 is very broad in its wording and not very useful for gleanings guidance bearing on transforming installations. It is consistent with other more detailed documents (Transformation Planning Guidance).

General points derived from the text:

- 1. Information Superiority.** A “key enabler of transformation”. This superiority will lead to “decision superiority”. The “global information grid” (GIG) will create the “network-centric environment required to achieve this goal.” Therefore, these capabilities and infrastructures on installations have greatly increased in importance since 1995 and will continue to increase through 2025. But the cost of acquisition (net present value) relative to other man-made facilities and certainly non-manmade capacities such as maneuver space and encroachment, indicate that, *as a component of MV selection criteria, this component should increase slightly* over its level of consideration in BRAC 95.
- 2. Deployment.** Though very general, the document talks of US Forces being “faster” and capable of conducting “prompt” operations using “tailored” joint forces comprised of both Active and Reserve components to “rapidly project power worldwide.” The document lacks specifics that differentiate between deployment in 1995 and 2025 but the references to tailored forces including RC do point to a difference that is better defined in other documents.
- 3. RC.** “In most cases, a joint force comprised of both Active and Reserve components will be employed.” Also talks of our “Our increased dependence on the RC” in terms of Soldier care priorities.
- 4. Well-being.** Document emphasizes that DoD will “continue to focus on members’ standard of living and a competitive compensation strategy” to “attract the quality individuals” needed. The “increasing percentage of members with dependents will require a commitment to family-oriented community support programs and as much stability as possible”. Though this percentage of Soldiers with dependents trend was occurring in 1995, *there was no MV criterion that evaluated quality of life through assessment of support programs and facilities. Whether they are the best long-term measure (especially given the 20-year look for this BRAC), MWR facilities are at least quantifiable and may need to be included in the assessment.*

Detailed outline of impact on BRAC Installation Military Value Analyzer:

Topic: Information Superiority

Applicable DoD Criteria and 1995 Army MV Criteria¹	Change from 1995 to 2005
DoD #1: Mission & #3- Contingencies, Mobilization & Future Requirements <u>Army MV Criterion:</u> Information Mission Area (IMA)	Indicates a very significant increase in information technology and capability using the GIG
Remarks bearing on MVA	
Information superiority is a key enabler of transformation. (pg 3) “Information superiority” leading to “decision superiority” “give the joint force a competitive advantage.” (pg 8) “Development of a global information grid will provide the network-centric environment required” to achieve the goal of “a fully synchronized information campaign.” (pg 8,9) Though IMA capability in 2005 and 2025 is much more important than in 1995, its relative value for assessing MV out 20 years is small given the cost and ease of upgrading IMA assets so its importance as a criterion component should likely go up only slightly vis-à-vis more enduring MV factors.	

Topic: Power Projection

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD#1:</u> Mission <u>Army MV Criterion:</u> Deployment Network	No strong indicator in document as to the change vis-à-vis power projection in 1995.
Remarks bearing on MVA	
Calls for “faster” joint forces (pg 2) capable of “rapidly projecting power worldwide to achieve full spectrum dominance.” (pg 6)	

¹ The 1995 Installation MV Assessment used the word “criteria” to describe the measurable attributes of its assessment model. The 2005 MVA used “attribute” to differentiate between the model and the DoD Selection Criteria.

Topic: Reserve Component Preparedness

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1 and #3</u> : Mission & Contingencies, Mobilization & Future Requirements <u>Army MV Criterion</u> : Reserve Training, and Mobilization Capability	No strong indicator in document as to the change vis-à-vis RC in 1995.
Remarks bearing on MVA	
“Some situations may require only one Service, but in most cases, a joint force comprised of both active and reserve components will be employed. (pg 12)	

Topic: Well-being

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD</u> : none <u>Army MV Criteria</u> : none	Indicates that family support will increase because of recruiting & retention challenges and a higher percentage of families.
Remarks bearing on MVA	
“Will continue to focus on our member’s standard of living and a competitive compensation strategy to ensure we attract the quality individuals we need”. “Second, the increasing percentage of members with dependents will require a commitment to family-oriented community support programs and as much stability as possible.” (pg 14)	

9.2 DoD Transformation Planning Guidance

Date published: April 2003

Author: DoD (SECDEF signature)

Summary: The document defines critical elements of transformation, assigns roles and responsibilities and describes how DoD will organize to implement transformational capabilities. The transformational outcome is described as: fundamentally joint, network centric, distributed forces capable of rapid decision superiority and massed effects across the battle-space. These transformed forces must be able to take action from a forward position and, rapidly reinforced from other areas, defeat adversaries. It states that the US is transitioning from an industrial age to an informational age military where the power of distributed, networked forces and shared situational understanding will transform warfare. Though specific guidance for transformation of installations is not directly addressed, there are points from which priorities for that transformation can be inferred.

General points derived from the text:

Deployment. The guidance calls for rapidly deployed joint forces to deploy from and to dispersed points with emphasis on massing effects but not forces. Says this will be done by using “modular forces”. Though the difference from 1995 is not address specifically, it appears that we need not only better deployment capability but that it has to spread to all locations, including RC units, so this instant, tailored, joint task organization and deployment can happen simultaneously from multiple points (to include logistics). As far as military value, this criterion should increase in relative importance from 1995.

- 1. Information.** Transformation is from an “industrial age” to “informational age” force, and those forces need to be more “network-centric” and less “platform-centric”. On installations this translates to the capability of its communications backbone and therefore “IMA” (from BRAC 95) is more important in 2005 (and again in 2025) than in 1995. But the cost of acquisition (net present value) relative to other man-made facilities and certainly non-manmade capabilities such as maneuver space and encroachment, indicate that, *as an MV selection criterion component, IMA will increase slightly, if at all*, over its level of consideration in BRAC 95.
- 2. Homeland Defense.** Calls for enhanced coordination between DoD and other government agencies at all levels. This could equate to allocating space (and thereby weighting available space more heavily) to such agencies on army installations. It could also be a stationing consideration for appropriate headquarters elements (e.g., the numbered CONUS Army HQ’s) on posts nearer to their “border of interest”. Was not a component of MV in 1995.
- 3. Joint Training.** Calls for a Joint NTC. The need for “joint” training should be included as an order of merit when assessing “Army” installation training areas – this means possibly weighting the airspace more heavily than in 1995. Should a maneuver box be used as a means of differentiating between training areas (best maneuver space does not equal largest maneuver space), it should include a vertical dimension.
- 4. Joint RDT&E.** Calls for such facilities and/or capabilities to be able to test systems in a joint environment. May not be an effective means of differentiating between installations MVs (although one proving ground could have a more joint impact area, facilities themselves can be re-produced and adapted at low cost relative to the 20-year look to 2025). It could

result in consolidation of assets within DoD and therefore figure solidly in the follow-on scenario and portfolio development analysis.

5. **Joint PME.** Same basic discussion as RDT&E. Excess capacity resulting from DoD consolidations may factor more in scenario development than comparisons of MV.

Detailed outline of impact on BRAC Installation Military Value Assessment:

Topic: Deployment

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD#1</u> : Mission <u>Army MV Criterion</u> : Deployment Network	Indicates a very significant increase in information technology and capability
Remarks bearing on MVA	
<p>Does not explicitly address a change from 1995</p> <p>Discusses strategic imperative of reacting to threats quickly and not having large forces tied down for lengthy periods of time. (pg4)</p> <p>Indicates transition from emphasis on mass to the power of distributed networked forces. (pg 5)</p> <p>Cites the objective of defeating the threat using standing joint force HQs task organized with “modular forces capable of seamlessly joint and combined operations.” (pg 10)</p> <p>Calls for CONUS and forward based <u>joint</u> forces to rapidly deploy to and from austere anti-access area denial environments. (pg 33)</p> <p>Cites a vision for a “smaller, more lethal and nimble joint force.” (pg 17)</p> <p>All of the above indicate the requirement for smaller army forces and/or parts of forces rapidly deploying from and to multiple locations as part of a networked joint task force...no longer send the Rangers or 82d immediately and then the rest as soon as possible. Requires a smaller force with increased deployment speed and flexibility.</p> <p>In the 1995 MV assessment, deployment capability was measured using only one attribute that was weighted from 30-80 points out of a possible 1000 for 8 categories (e.g. 60 pts or 6% of a maneuver installation’s assessment).</p>	

Topic: Information

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1 & #3</u> : Mission & Contingencies, Mobilization & Future Requirements <u>Army MV Criterion</u> : Information Mission Area (IMA)	Indicates a very significant increase in information technology and capability
Remarks bearing on MVA	
<p>Transition from “industrial age” to the “informational age” and aligning DoD with the on-going information revolution to develop “information-enabled organizational relationships and operating concepts. (pg 5)</p> <p>Transformed forces will be “less platform-centric and more network-centric” with systems that provide “actionable information” at all levels of command. (pg 10)</p> <p>All six of the QDR joint operational goals reference information superiority and highlight the requirement for that capability to be “across the spectrum of participants” many of which will be at CONUS bases.</p> <p>In the 1995 MV assessment, IMA was measured using only one attribute that was weighted from 10-70 points out of a possible 1000 for all 13 categories (e.g., 10 pts or 1% of a maneuver installations’ assessment).</p> <p>Though IMA capability in 2005 and 2025 is much more important than in 1995, its relative value for assessing MV out 20 years is small given the cost and ease of upgrading IMA assets.</p>	

Topic: Homeland Defense

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
No specific mention under DoD criteria or Army MV criteria	Newly stated requirement for DoD
Remarks bearing on MVA	
<p>Calls for enhanced coordination among agencies and across all levels of government. (pg. 7)</p> <p>Could result in non-DoD homeland defense agencies stationed on military installations or military headquarters co-located with these activities specifically for combating terrorism. Though this could be a consideration in assessing MV existing attributes addressing expandability would account for accommodating such agencies on installations. Should existing Army headquarters such as FORSCOM or the numbered Army HQs be considered for relocation, proximal or co-location with an applicable HD agency could be a decision attribute.</p>	

Topic: Force Protection

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
No specific mention under DoD criteria though it could be under #3 Contingency. No physical security and/or force protection criteria in Army MV analysis	Indicates a very significant increase in the importance of force (installation) protection
Remarks bearing on MVA	
<p>Cites 2001 QDR with Goal #1 being protecting critical bases of operations to include the US homeland and Goal #5 includes enhancing survivability for space systems and supporting infrastructure. (pg 11)</p> <p>Though this would likely play a significant role in stationing considerations between host countries overseas, it is very hard to quantify in any meaningful way to a relative assessment of a CONUS installation's MV as there are few geographically threatened areas.</p>	

Topic: Joint Training

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1</u> : Mission <u>Army MV Criteria</u> : Several, such as impact area, maneuver acres, special airspace	Increased emphasis here is on jointness that in most cases means including airspace with maneuver land.
Remarks bearing on MVA	
<p>Cites the 4 Pillars put forth in the QDR. Pillars #3 & #4, include a requirement to study the existing infrastructures in support of the development of a joint national training capability. (pgs 19, 21)</p> <p>This could result in an increased criteria weighting for joint use impact area and land & air maneuver space. Might need to define "maneuver box" in 3 dimensions.</p> <p>The development of the Joint Experimentation Campaign Plan should address improvements to joint military operations in urban terrain (MOUT). (pg 34)</p>	

Topic: Joint RDT&E

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1</u> : Mission <u>Army MV Criteria</u> : T&E ranges, T&E Facilities, and T&E Mission diversity	Increased emphasis here is on joint which, when applied to installations could imply potential consolidation of capabilities.
Remarks bearing on MVA	
<p>Cites the 4 Pillars put forth in the QDR. Pillar #4 includes a requirement for a “Joint TEC” for evaluating capabilities in a joint environment. (pg 20)</p> <p>Do not think that the document indicates a need for increasing installation capability and/or assets for this function but rather potential consolidation of such capabilities refocused on “joint capability” testing.</p> <p>In the 1995 MV assessment, T&E capability was measured using 3 attributes whose weights added to 450 points out of a possible 1000 (45%) for only one category (Proving Grounds). The MV attributes were never applied to other categories capabilities (such as commodity installations), which also do T&E, or maneuver training installations that may have the range area and buildable acres to accommodate this capability.</p>	

Topic: Joint Professional Military Education

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1</u> : Mission <u>Army MV Criteria</u> : Applied and General Instructional Facilities	Same as Joint RT&E
Remarks bearing on MVA	
<p>Do not think that the document indicates a need for increasing installation capability and/or assets for this function but rather potential consolidation of such capabilities refocused on “joint capability” education.</p> <p>In the 1995 MV assessment, professional education was covered in the “professional schools” category which was assessed using 20 attributes; under the mission criteria the two primary attributes were applied instructional facilities (135 points) and general instructional facilities (235 pts) which were 37% of the installations MV assessment.</p>	

9.3 Concepts for the Objective Force White Paper

Date published: September 2002

Author: Objective Force Task Force

Summary: The Concepts for the Objective Force White Paper is harder to translate to installation transformation as it is on a higher conceptual level than other documents and makes no direct references to installation concepts.

General points derived from the text:

- 1. Deployment.** Though the concept of installations being force projection platforms was in place in 1995, this document indicates that the Objective Force (OF) will deploy faster from more points simultaneously in CONUS in joint TFs so it could be inferred that better facilities are more important and are needed at a lot more than just the “maneuver” installations of BRAC 95.
- 2. Mobilization.** Cites the shift to “Train, Alert, Deploy” from “Alert, Train, Deploy” which means moving RC forces to AC installations and Major Training Areas (MTAs) as part of mobilization will not be the “rule” as it was in 1995. This means greater RC training pre-alert but a reduction in the importance of AC installations serving as mobilization stations. The OF requirement that “selected RC forces with unique complementary capabilities which must be maintained at readiness levels commensurate with the active forces” also indicates that early entry RC forces may need to be at or on installations with better deployment facilities.
- 3. Sustainment.** Indicates strongly that the OF will have a smaller supply and maintenance footprint and operational logistics tail. Hosting deploying forces could actually have a slightly increased supply requirement (for deployment basic load) but the amount of installation “space” dedicated to logistics in “sustaining base” installations should be significantly reduced.
- 4. Collective Training.** Many capabilities that are either new or significantly improved indicate that the enduring installations that have deploying units on them will need robust training areas to include greater maneuver area (boxes), MOUT sites, water training areas, and increased, more unencumbered airspace (both joint attack and lift air and UAVs). These installations may need to hose all deploying TF “slice” units so that they can train together prior to alert.

A detailed outline of the impact on BRAC Installation Military Value Analyzer follows:

Topic: Deployment

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
DoD#1: Mission Army MV Criterion: Deployment Network	Suggests that more posts, to include RC, will need deployment capability – this increases “deployment” as a selection factor for all installations not just a few categories as in 1995.
Remarks bearing on MVA	
Says OF units will deploy “through force projection from the CONUS” with “unprecedented levels of responsiveness.” (pg 9)	

Topic: Mobilization

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
DoD #1: Mission & #3 Contingencies, Mobilization & Future Requirements Army MV Criteria: RC Training, Mobilization Capability	Indicates a great reduction in the use of intermediate (AD) installations as mobilizations stations. This should reduce importance of these facilities in assessing an installation.
Remarks bearing on MVA	
Cites the shift to “Train, Alert, Deploy” from “Alert, Train, Deploy.” (pg 12) OF “requires selected RC forces with unique complementary capabilities which must be maintained at readiness levels commensurate with the active forces.” (pg 18)	

Topic: Sustainment

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1</u> : Mission <u>Army MV Criteria</u> : Several criteria for storage, maintenance and production.	Strongly indicates a reduction in the overall sustainment footprint both in the industrial base and on installations in general. Also indicates that facilities on troop installations will go away from single purpose types to multi-purpose facilities.
Remarks bearing on MVA	
<p>The OF must be unburdened of significant deployment and sustainment tonnages.” (pg 9)</p> <p>“New propellants” will “reduce ammunition weight”. The Army will aggressively reduce its logistics footprint and replenishment demand.” (pg 13)</p> <p>It “will deploy fewer vehicles” and will seek to achieve maintenance efficiencies through more reliable systems and commonality across joint formations.” (pg 15)</p> <p>The Future Combat System’s “lethal effects reduce ammunition weight and cube.” (pg 15)</p> <p>“Exploitation of more reliable systems, systems commonality,” “and improved system maintainability will reduce maintenance and supply requirements.” (pg 16)</p>	

Topic: Training Areas

Applicable DoD Criteria and 1995 Army MV Criteria	Change from 1995 to 2005
<u>DoD #1</u> : Mission <u>Army MV Criterion</u> : Maneuver Acres, Mechanized Maneuver Acres, and Special Air Space	Indicates more importance of 3-dimensional (air) maneuver space for training in the various austere landing zone deployment platforms (e.g. VTOL). Could even indicate a weighting of water maneuver “space” for training on sea born deployment platforms for which BRAC 95 had no MV criteria.
Remarks bearing on MVA	
<p>The OF will “operate faster” (pg 8) and be “organized into more deployable, smaller” (pg 9) formations using airlift and sealift capabilities that “reduce reliance on improved airfields.” (pg 9)</p> <p>“Platforms will negotiate all surfaces” to include “water crossing.” (pg 11)</p> <p>“Mounted units require the capability to conduct route reconnaissance” “at greatly increased speeds.” (pg 12)</p> <p>The OF will have the capability to “destroy the enemy formations at longer ranges, with smaller calibers, greater precision.” (pg 12)</p> <p>Manned and unmanned aerial vehicles will improve situational understanding.” (pg 13)</p> <p>The OF must be trained for an environment that “is growing more and more urban.” (pg 14)</p> <p>OF “leaders must be capable of training their units without significant external support packages.” (pg 19)</p>	

9.4 Installations in 2020 White Paper

Date published: Oct 2003

Author (POC): Mr. Ron Young, OFTF

Summary: Though in initial draft form, this document provides a vision of what transformation will do to installations and the nature of their functions; both individually and for the army-wide portfolio.

General points derived from the text (using MVI Functions):

- 1. Support Army and Joint Training Transformation.** Digital ranges linked to the GIG enable “live-virtual-constructive training”, which optimizes training opportunities by linking live training at national training centers and home stations with “virtual” training facilities located anywhere in the world. The ability to synthetically link non-contiguous training areas reduces the need for large contiguous maneuver space as a necessity for full spectrum (squad to UA) readiness training.
- 2. Project Power for Joint Operations.** Discusses CONUS installations being seamlessly connected “home station to foxhole” and serving as Unit of Employment (UE) Home Station Operations Centers. This allows the C2 of the joint force from CONUS thereby reducing the deployed footprint. Installations are “nodes” in the GIG. The live virtual training construct allows for final training, mission planning and rehearsal from the “motor pool” out through the GIG or information hubs to all joint units of a deploying JTF.
- 3. Support Army Materiel and Logistics Transformation.** Consolidating sustainment activities into two tiers. National Maintenance Centers support regionally thereby reducing maintenance footprint at combat force home stations (maneuver installations). The GIG enables “anticipatory logistics support” and makes increased technical expertise reading available anywhere, any time. Having a “help desk” at National Centers reduces a home station facility requirement which frees space for other activities. Vehicle and equip condition is monitored through on-board systems linked to National Centers through “distribution based logistics operations”. Two-level maintenance and repair-by-replace methodologies reduce both inventories and the need for large maintenance and repair facilities. GIG enables greater asset visibility and anticipatory support from National Centers. Deploying units are equipped and supplied at the point of departure to conduct operations immediately upon arrival in the AOR so Unit of Action (UA) home stations could need to accommodate this capability (if not planned for an ISB).
- 4. Enhance Soldier and Family Well-Being.** Advanced technologies will help provide full dimension protection to installations and their people without having to resort to a “walled city” environment. Security is seamlessly linked to local, state and federal law enforcement. Protection for the installation extends beyond boundaries to protect key external support nodes (communications, water, and power). Services not available on post are provided through mutual support agreements with civilian agencies thereby freeing resources for provision of services that are over-utilized or unavailable anywhere in the community as a whole.
- 5. Achieve Cost Efficient Installations.** Discusses providing a common set of “base support” services on installations or within “regions” thereby providing a resource multiplier. Multi-purpose, adaptable complexes consolidate unit functions (admin, maintenance, training and logistics). Single purpose facilities are the exception. Installations and surrounding

communities share infrastructure and services to create mutual benefits and decrease costs. These include provision of medical care, education opportunities. Redundancy is eliminated and military and civilian communities both benefit.

- 6. Maintain Future Stationing Options.** States that the majority of US combat units are no longer permanently based OCONUS but will conduct short and/or long-term ops on a semi-rotational basis.

Detailed outline of impact on BRAC Installation Military Value Assessment follows:

2005 Function	Sub-function (DoD Criteria) & applicable reference
Train	<u>Maneuver space (DoD #1,2,4).</u> “Joint and combined arms training centers, or digitally enabled, non-contiguous maneuver areas become more the norm as interoperability is improved.” “Training centers” may be simultaneously and seamlessly linked to home station installations that are primarily focused on platoon proficiency and limited combined arms maneuver training or institutional centers to expand their training capabilities.” “Joint and combined arms training centers, or digitally enabled, non-contiguous maneuver areas become more the norm as interoperability is improved.” “Digitally enabled training facilities provide the flexibility for Soldiers, units, and command staffs to train from geographically separate locations in a synthetic environment thereby optimizing training opportunities and increasing readiness.” “Live-Virtual-Constructive connectivity increases the flexibility in training methods while decreasing the requirements and adverse environmental impacts associated with live training alone.”
Impact on MV and Change from BRAC 95	

The ability to virtually integrate live and virtual training from garrison to multiple dispersed training areas and facilities can offset and mitigate the need for the larger contiguous maneuver boxes (all dimensions) required to meet the far greater tactical dispersion of the joint “Future Force”.

Army RC and joint ground sea and air units can all “fight” in real time from local training areas on up to the NTCs. This increases the value of minimally encroached upon and conveniently local training areas.

“Virtual” training creates no noise, air pollution, etc lessening the impact of encroachment on training areas. “Virtual” training and simulations permits a far greater percentage of training to be conducted in the cantonment area at home station thereby enhancing quality of life by reducing family separation and deployment time. Virtual training is less expensive both in terms of dollars and manpower.

In 1995, smaller, less efficient or capable training areas were targets for closure. Now, they can be virtually added to the acreage of the larger training spaces thereby reducing pressure on those installations and costs of movement to consolidated training sites. Especially key given OPTEMPO for RC units.

2005 Function	Sub-function (DoD Criteria) & applicable reference
Project Power	<u>C2/Admin & Deploy (DoD #1,2 & 3).</u> “Embedded training extends training, mission planning, and rehearsal capabilities to the “motor pool” through the installation connectivity within a region or across the Nation as situational awareness is enabled through the information hubs.” “Units prepare for operations via a training environment without walls extending from billeting and housing areas to around the globe.” “Simultaneous deployment from multiple sites within a region provides unprecedented deployment agility to responsiveness to meet a myriad of missions across the full military spectrum.” “Installations serve as “nodes” in the global Information grid providing command, control, and support to rotational or deployed forces throughout the battle space, across the full spectrum of Army Operations.” “Information hubs provide seamless connectivity and interoperability extending the Commander “reach” to accessing the unique capabilities knowledge centers or centers of excellence.” Home Station Operations Centers (HSOC) at Unit of Employment installations are critical to reducing the deployed footprint and are staffed continuously all year long to meet operational requirements, collating and disseminating commanders’ critical information.
Impact on MV and Change from BRAC 95	

Those attributes of the IT infrastructure that are not immediately remedied through additional Army funding become much more important to MV.

The “Future Force” deployment scheme and “Train-Alert-Deploy” paradigm makes deployment facilities more important relative to other functions than they were in 1995.

Deployment facilities become a more important attribute at installations not previously in the “maneuver” installation category.

2005 Function	Sub-function (DoD Criteria) & applicable reference
Logistics	<p><u>Maintain, Distribute, Supply & Store (DoD #1,2,4)</u></p> <p>“Consolidating sustainment activities into two tiers allows for National Maintenance Centers to provide support across a region or worldwide thereby reducing the logistical footprint required at an installation where combat units are stationed.”</p> <p>“Units are equipped at the point of departure to conduct operations immediately upon arrival.”</p> <p>“Technologies such as networked communications and directed energy weapons have drastically changed facility and infrastructure requirements.”</p> <p>“Fully modernized installations no longer require large maintenance and repair facilities as all off-system repairs are focused on returning line replaceable units and assemblies back to supply for redistribution.”</p> <p>Sustainment installations provide regional support or serve as National Centers with a global support role.</p> <p>As more installations convert to fully Objective Force unit stations, excess space can be reallocated to reduce the facility maintenance and repair backlog.</p> <p>The same reach capabilities provide the necessary connectivity that enables anticipatory logistics support and increased technical expertise for units whether at home station or deployed.</p>
Impact on MV and Change from BRAC 95	
<p>Most aspects of transformational logistics point to smaller infrastructure requirements across the Army to support deployed forces, through “maneuver” installations to National Centers.</p> <p>Those installations with power projection requirements may need greater storage space for “prepositioned” deployment support packages but this will be offset by the overall reduction in requirements for on-hand stocks.</p> <p>As with other functions, IT infrastructure is a key enabler to making this happen. This is a greatly increased role vis-à-vis BRAC 95 and those aspects of IT that are outside the Army’s capability to remedy through funding become potential MVI attributes.</p>	

2005 Function	Sub-function (DoD Criteria) & applicable reference
Well-Being	<p><u>Force Protection, MWR (DoD #1.4)</u></p> <p>“Installations and communities are integrated and mutually supporting. Regional, city, and installation master planners work together to leverage common infrastructure and services to create mutual benefits and decrease operating costs.”</p> <p>“In some locations, surrounding communities provide medical, dependent education or emergency services to mitigate lack of on-post capabilities.”</p> <p>“In 2020, installation security and protection incorporate advanced technologies such as biometrics, smart cards, entity “tagging” and tracking, networked sensors, smart, CBRNE, and weapons and munitions detection capabilities. Security procedures and capabilities are linked to local, state, and federal law enforcement activities enhancing responsiveness and increasing survivability.”</p> <p>“The use of emerging and advanced technology such as sensors and detectors enhances the security posture of the installation without having to resort to an “entrenchment” or “walled city” environment.”</p> <p>“Protection and security considerations extend beyond the physical boundaries of the installation and include infrastructure support nodes located in or shared with the local civilian community or centers of excellence.”</p>
Impact on MV and Change from BRAC 95	
<p>Stresses a much greater relationship between installation and community and therefore the need to use the community attributes, as they relate to military well-being, in the military MV; not done in BRAC 95. BRAC 95 also had no MWR attributes (dropped from BRAC 93) and only housing and medical were assessed under well-being. TRICARE had barely come into existence for BRAC 95; now nationwide.</p> <p>MV focus is on providing maximum efficient quality services not “owning” the most facilities.</p> <p>There was no force protection or security considered in BRAC95. Document infers that in the future, physical measures of security (fences, physical isolation) may yield to more sophisticated means of protecting the force and installation.</p>	

2005 Function	Sub-function (DoD Criteria) & applicable reference
Cost Efficient	<p><u>(DoD #1,4)</u></p> <p>“Regional, city, and installation master planners work together to leverage common infrastructure and services to create mutual benefits and decrease operating costs.”</p> <p>“In other cases, both civilian and military communities augment each other in mutual support agreements thereby maximizing resource investments within a community or region.”</p> <p>“Redundancy is eliminated and military and civilian communities will both benefit.”</p> <p>“Within any given region, the collective capabilities and capacities of installations provide a resource multiplier far exceeding what any one installation can provide.”</p> <p>“Multi-purpose, adaptable complexes now provide support to consolidated functions such as maintenance, training, and logistics. Single purpose facilities are by exception.”</p>
Impact on MV and Change from BRAC 95	
<p>BRAC 95 did not include regional or civilian facilities and services (except housing) in their analysis.</p> <p>Stationing becomes more flexible because of the shift to multi-purpose facilities.</p> <p>BRAC 95 did not take into account “installation friendly” communities as an MV component but favorable rules for spousal employment, dependent education, and access to MWR are contributors to military well-being.</p>	

2005 Function	Sub-function (DoD Criteria) & applicable reference
Future Options	<p><u>(DoD #1,4)</u></p> <p>Land use and environmental considerations become less divisive as perspectives and appreciation for the benefits of close community ties outweigh the occasional disadvantages of close proximity to military installations.</p>
Impact on MV and Change from BRAC 95	
<p>BRAC 95 did not take into account “installation friendly” communities as an MV component but the ability to reduce expansion and encroachment friction contributes to long-term viability of the installation.</p>	

9.5 Army Campaign Plan (ACP)

Date Published: 12 April 2004

Author (POC): ODCS, G-3

Summary: The ACP directs the planning, preparation and execution of Army operations and transformation using an operations order (OPORD) format which includes taskings to all “subordinate units” (HQDA and MACOMs). Much of what is put forth reinforces existing TABS principles that have already been highlighted in other documents but the ACP adds significant clarity to projected force structure changes and timelines that could be incorporated in both Scenario development and, potentially, BRAC implementation. Impact on MVA is minimal, with no changes to planned attributes.

General points derived from the text:

1. Reinforces many TABS MV principles and fundamentals:

- a. *Unit manning* is key to the “campaign quality Army with joint and expeditionary capabilities.” Longer tours mean an increase in the importance of the host installation and community to Army “family” well-being. TABS has added well-being attributes to its MVA. Defines Army members as being “Active Component, USAR, National Guard, DA Civilians, veterans, retirees, family members, and select contractors”.
- b. “*Top-notch Installations*” must be resourced as part of the “Army’s center of gravity”. First reference to “center of gravity” found.
- c. *Leverage BRAC*: Leverage “the Base Realignment and Closure process to build a campaign-quality Army with joint and expeditionary capabilities in this decade”. Assumes “BRAC-associated moves will not begin until 2006.” Under the “Adjust Global Footprint” objective it tasks FORCOM and Army Special Operations Command (ASOC) to implement CONUS basing to support IGPBS [Integrated Global Presence Basing Study] process and BRAC decisions.”
- d. *Mobilization*: Modernize RC mobilization, deployment, and demobilization policies and procedures.” “Re-engineering pre- and post-mobilization actions and supporting infrastructure to maximize the RC mission timeline.” First reference to “post-mobilization” as a specifically separated requirement.
- e. *Institutional Army*: “adapt the IA to meet the needs of the Future Force.” “Remove unnecessary layering and duplication and consolidate functions within the Army.”
- f. *Logistics Structure*: “Develop a joint, interdependent end-to-end logistics structure that integrates a responsive civil-military sustaining base”. “Consolidate “within Army and DoD maintenance, depot, and materiel development facilities to increase effectiveness and improve efficiencies.” No changes to earlier documentation review’s focus.
- g. *HSOCs*: Establish home station operating centers in order to provide reach and expanded expeditionary C2 capabilities”. No changes to earlier reviews.
- h. *Power Projection*: “Identify “key locations, resourcing manning, and building joint power projection installations to support mobilization, demobilization, and rapid deployment of CONUS-based forces”.

- i. *AC/RC Balance*: Emphasis will be placed on “balancing AC and RC force structure to reduce or eliminate high demand/low density (HD/LD) unit disparities.”
- j. *Homeland Defense*: No mention

2. *Provides specific unit transformational timelines and force structure guidance that should be considered in scenario development and execution:*

- a. *AC/RC Balance*: “AC strength can be exceeded as required to include by up to 30K for 4 years” while “RC strength will not change.” BRAC 2005 actions will be executed starting in 2006. The additional short-term “space” needed for the potential temporary increase in end strength, if required, will be through FY08. Though additional, permanent facility space should not be retained specifically for this requirement by TABS. TABS planners should consider its impact on the timing of potential BRAC recommendations.
- b. *Modularity and near-term basing*: Numerous changes in CONUS force structure and re-stationing from OCONUS are outlined and, though not necessarily a military value consideration, must be considered in TABS scenario analysis and synchronized in recommendations for BRAC execution.
- c. *Army “Ramp-up”*: “First, ramp up from 33 to 43 transformed BCT (UA)s. Second, at the appropriate time, decide whether or not to continue to build an additional 5 BCT (UA)s (43-48 AC BCT(UA)s).” As this potential additional ramp-up is outside the TABS timeline, the portfolio analysis will have to include a hedge, in total infrastructure capacity retained, to accommodate this potentiality.

9.6 Other Documents Reviewed

In addition the above documents, TABS reviewed several other documents, but we do not include summaries in the interest of brevity. Others documents provided content and possible references, but were not fully summarized including:

Reference Information	Remarks
QDR 2001 (DoD, 30 Sep 01)	Provided broad Transformation concepts, including BRAC's role in Transformation, but did not provide insights on installation specific military value characteristics.
Concepts for the OF White Paper (OFTF, undated)	An informative reference for Transformation trends from which military value attributes and guiding principles can be inferred. Much of the document's content was superceded or duplicated by the "Objective Force in 2015 White Paper" discussed above.
Concept for Future Joint Operations – Expanding Joint Vision 2010. (Joint War-fighting Center, May 97)	An informative reference for Transformation trends from which military value attributes and guiding principles can be inferred. Much of the document's content was superceded or duplicated by the "Joint Vision 2020" discussed above.
CSA's 15 Immediate Focus Areas Briefing (Army G8, Sep 2003)	An informative document that complements the Transformational documents summarized above by adding a more "current" Army focus. Solid source for "guiding principles"; less so for installation MVA attributes.
The Army Plan 2005-2020 (Army G8, Jul 02)	Largely a funding document with priorities for near and midterm programs and initiatives. Provides potential guiding principle material (e.g. consolidate PERSCOM) as well as specifying 3 primary tasks for installations: power projection, training support and well-being.
GAO Report on DoD Approach to Managing Encroachment on Military Training (2 Apr 03)	An informative reference from which military value attributes and guiding principles can be inferred. Highlights the main sources of encroachment, both internal and external, as they pertain to military training.
GAO Report on Reserve Enclaves (Jun 03)	Focused BRAC 95 failure to adequately plan for the enclaves that resulted from certain closure recommendations. Lessons learned for future scenario development, but not for stationing or assessing military value of RC enclaves.
GAO Report on Homeland Defense (Jul 03)	Introduces potential DoD roles in HD/HS operations but indicated that the role would be more in the form of support of civil authorities and RC force structure changes instead of any significant AC stationing changes.
Defense Installations 2001, (DoD Installations Policy Board, Aug 2001)	Provided DoD's vision for installations, but was based more on changing or improving business practices (privatization) than on the characteristics of installations. Included concepts for joint basing, well-being, RCI, and standardization throughout DoD.
Army Strategic Planning Guidance (Final Draft) (Army G3, Nov 03)	Provides overarching guidance on the direction of the Army but not to the level of specificity that would add to the existing body of attribute development references. Does specifically say that the RC will "lead our efforts to protect the homeland". Also provides a good

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Reference Information	Remarks
	description of the CSA's 16 Immediate Focus Areas and the Strategic Readiness System.
Draft Joint Pub 3-26, Homeland Security (Joint Staff, 11 Sep 03)	States that DoD's primary role in National Homeland Security Strategy is the protection of National critical infrastructure (NCI), Defense Critical Infrastructure (DCI) and civil support for domestic emergencies. It identifies examples of DCI but does not discuss or suggest ways in which installations can be reconfigured to support HD/HS.
Draft Future Combat System Order, Appendix F, System Training Plan (TRADOC, 16 Jan 03)	Most of the document is of little import to MVA but Section 3.5, Training Constraints, has good information on FCS-specific requirements or implications for maneuver areas and firing ranges.
Draft TRADOC Pam 525-4-0, Maneuver Sustainment Operations (31 Jan 03)	Discusses transformational changes in more detail than other publications and focuses on maneuver in the AOR vice installation-specific implications. States that: <ul style="list-style-type: none">• Proximity to strategic force projection platforms (seaports, Air Force Bases) will remain important.• Installations must be prepared for a raid influx of RC units.• Certain installations will become Home Station Operations Centers for deployed forces.
Draft Objective Force Ranges White Paper (Army G3, 30 Jul 03)	Document has specific focus on ranges and was used in the development of guiding principles and attributes for ranges.
GAO Report DoD Chemical Weapons Destruction Program (Sep 03)	Addresses programmatic execution problems. Report does not contain information on installation characteristics as they relate to the chem-demil mission, potential future basing, or MV assessments. Does include dates for the potential closures of chem-demil activities, which could bear on the installations' future missions.
4 th Annual Report to the President and Congress on Terrorism and WMD (15 Dec 02)	A National command-level review that focused on challenges and critical areas but did not do so to the level of detail where installation specific characteristics or stationing requirements might be gleaned.
FY03 Army Well-Being Action Plan (Army G1, 10 Oct 03)	Detailed plan for prioritizing and resourcing multiple aspects of well-being but with more emphasis on programs and policies than facility or installation-specific requirements. TABS used it in the development of guiding principles and attributes for well-being.
Army Power Projection Master Plan (Army G4, July 2002)	Largely focused on systems development and procurement but did not reflect the impacts of new deployment platforms on training requirements and facilities. Plan was used in the development of guiding principles and attributes for training and power projection.
Draft TRADOC Pam 525-3-35, Force Projection (31 Jan 2003)	Provides specifics on deployment training and facilities requirements to include the need for a greater number of units and types of units to train to deploy from a greater number of nodes to include "brown water access points and dirt airstrips." Pamphlet was used in the development of guiding principles and attributes for training and power projection.

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Reference Information	Remarks
FM 1, The Army (14 Jun 2001)	Overarching document focused largely on how the Army goes about fulfilling its Title 10 functions. No installation specific or inferred information.
FM 3-0, Operations (14 Jun 2001)	Provides the overarching doctrinal direction for the conduct of full spectrum operations detailed in other Army manuals. No installation specific or inferred information.

ANNEX 10.LIST OF SUBJECT MATTER INTERVIEWEES

This annex provides the names of subject matter experts that were interviewed by TABS during the MV research phase. Their insights were used to develop MV attribute criteria and as part of TABS' calculation of Army installations' military value.

Name	Organization	Date
COL Mike Pfenning	G1, DAPE-HR. Human Resources (Well-being)	23 Jul 03
Mr. Mike Burchett	G3, DAMO-FMI. Force Management Initiatives (Stationing)	18 Jul 03
Mr. Tom Macia	G3, DAMO-TRS. Training Simulations (Training Land & Ranges)	01 Aug 03
MAJ Paul Rosewitz	G3, DAMO-ODM. Deployment & Mobilization	13 Aug 03
LTC(P) Randy Mock	G3, DAMO-ODL. Security, Force Protection & Law Enforcement (Homeland Def)	28 Aug 03
COL Juan Claudio	G3, DAMO-TRI. Institutional Tng	03 Sep 03
COL Scott Patton	G3, DAMO-ZXG. Army Initiatives Group (Transformation)	03 Sep 03
COL Robert McClure	G3, DAMO-SSW. War Plans (HD/OCONUS restationing)	04 Sep 03
MAJ Dan Valente	G3, DAMO-SS Homeland Defense & Force Security	11 Aug 03
COL Robert Steinrauf	G3, DAMO-ZR. Resource Analysis & Integration	08 Sep 03
COL Ricki Sullivan	G3, DAMO-ODS. Military support (Homeland Def. & Force Protection)	10 Sep 03
COL Gracus Dunn	G4, DALO-ZAG. Transformation Executive Office	23 Jul 03
LTC Brett Weigle	G4, DALO-ZAG. Transformation Executive Office	23-Sep 03
COL John Brown	G4, DALO-FPM. Force Projection / Distribution	31 Jul 03
COL Dennis Danielson	G4, DALO-DPZ-B. Program Development	24 Jul 03
COL Daniel Taylor	G4, DALO-SMV. Sustainment (Maintain)	28 Jul 03
COL Mark Barnette	G6, SAIS-IOM (IT infrastructure)	24 Jul 03
Mr. Stan Shelton	IMA, SFIM-PL (Installation Infrastructure)	14 Aug 03
LTC Paul Mason	ACSIM, DAIM-MD. Operations (Transformation)	08 Aug 03
COL Richard Hoefert	ACSIM, DAIM-ED (Environment)	14 Aug 03
JCSG 0-6's	HQ&Spt JCSG (BRAC)	07Aug 03
Mr. Rick Jacksha	MEDCOM (Medical)	30 Jul 03

Name	Organization	Date
Mr. Jeff Brenton	G8/PA&E, CIPAD	01 Aug 03
Mr. Rick Sprague	ASA(FM)	01 Aug 03
LTC Fred Gellert	Objective Force Task Force (Transformation)	15 Sep 03
Mr. Joe Pieper	ASA(ALT) Trusted agent (SRG)	23 Sep 03
LTC(P) Ed Sweeney	NGB "BRAC Chief" (SRG)	25 Sep 03
COL Michael Staszak	Director of the OCAR Staff (SRG)	30 Sep 03
COL John Durkin	TRADOC DCS Personnel Infrastructure & Logistics (Institutional Training)	2 Sep 03
Mr. Wallace	G3, DAMO-FMI. Force Management Initiatives (Stationing)	18 July 03
Mr. Bechtel	G3, DAMO-SS	4 Sept 03

ANNEX 11.MVA AFFINITY DIAGRAMS

This annex provides the detailed affinity diagrams for the Military Value Installation (MVI) value model. Affinity diagramming is used to identify creative grouping of issues.¹ Affinity diagramming has been used to develop qualitative value models.

11.1 Key BRAC 2005 MVA Source Documents

The following are the key source documents used during TABS MV analysis.

Reference	Abbreviation*
Title X	T
BRAC Law	L
DoD BRAC Criteria	D
JCSG Criteria April 22 2003	J
Joint Vision 2020	2020
DoD Transformation Planning Guidance	DODTPG
The Army Plan 2005-2020	TAP
Objective Force in 2015	OF15
Objective Force White Paper	OFWP
Army Stationing Strategy 2003	S
G-8 U/A U/E Stationing Analysis	G
ACSIM Installation Functions	A
BRAC 95 Categories	B
TABS Principles	TABS

*Document names were abbreviated to simplify the affinity diagramming.

¹ “Affinity Diagrams”, Module 4, *The Tools of Total Quality*, <http://www.hq.navy.mil/RBA/text/tools.html>

11.2 Capability: Support Army and Joint Training Transformation

The analysis team examined research documents and extracted key words that defined the functions that future Army installations must support. Several key words were found in multiple references; these were listed and associated with their corresponding references as a means of documenting their relevance. Here is the affinity diagram we used for the first capability.

For example, in the table below, the key word “Train” was found in the S, T, J, D, and G references, “MTA” was found in the B reference, etc. These tables are not exhaustive, but do provide an overview of the affinity effort.

Key Word	Reference	Key Word	Reference
Train	S, T, J, D,G	Simulations	OF15
MTA	B	Availability	D
Support	TABS, S	Ranges	J, S
Future	D	Education	J
Readiness/TF	D, L	Info Hubs	A, OF15
OF	OFWP	Info Superiority	2020
Environment	OFWP	Network centric	DoDTPG
LOS	S	UAV awareness	OFWP
Schools	B	Smaller/faster	OFWP
Joint/TF	L, D, DoDTPG	Joint Prof Schools	DoDTPG
Airspace	S	Individual	
Diversity	S, L	Collective/Unit	
Maneuver	B	Impact area	

Here are the Training sub-capability affinity diagrams.

Education		Ranges		Maneuver Space	
Schools	B	Ranges	J, S	MTA	B
Joint	L	Future/OF	D/OFWP	Maneuver	B
Individual		Joint	L	Simulations	OF15
Collective/Unit		Environment	OFWP	Ranges	J, S
Prof Schools		Availability	D	LOS	S

		Impact area		Joint	L
				Diversity	S, L
				Future/OF	D/OWFP
				Airspace	S

11.3 Capability: Project Power for Joint Operations

Key Word	Reference	Key Word	Reference
Deploy	2020, DOD TPG, G8, TABS	Mobilization	Law, S, D
Simultaneous Deploy	OF 2015	Reconstitution	TABS
Power Projection	2020	MOB Centers	OF2015
Responsiveness	OF White Paper	C2/Admin	B95
RC Preparedness	2020, OFWP	Headquarters	J
Ports	B95	Organize	T10
Deployment Centers	A	Virtual Staffing	OF2015
Sustain Deployment	S		

Here are the Project Power sub-capability affinity diagrams.

Organize		Mobilize		Deploy	
C2/Admin	B95	Mobilization	Law, S, D	Deploy	2020, DOD TPG, G8, TABS
Headquarters	J	RC Preparedness	2020, OFWP	Simultaneous Deploy	OF 2015
Organize	T10	MOB Centers	OF2015	Deployment Centers	A
Virtual Staffing	OF2015	Responsiveness	OWFP	Sustain Deployment	S
		Ports	B95	Responsiveness	OWFP

11.4 Capability: Support Army Materiel and Logistics Transformation

Key Word	Reference	Key Word	Reference
Equip	T	Commodity	B95
Joint RTDE	TPG	Modernize	TABS
Technical	J	Maintain	S
Supply	J	Two-level Maintenance	OF2015
Develop	S	Sustain	TABS
Test	S	Support	J
Acquire	S	Industrial	J
Storage	J	Industrial Facilities	B95
Distribution Based Logistics	OF2015	Depots	B95
Just-in-Time Logistics	OF2015	Support Ammo Capability	S
Systems Commonality	OFWP	Ammo Production	B95
Support Joint Force		Proving Grounds	B95
Lethal Effects Reduce Ammo Weight/Cube	OFWP	Ammo Storage	B95

Sub-capability affinity diagrams.

RDTE		Maintain		Supply & Storage	
Joint RDTE	TPG	Maintain	S	Supply	J
Technical	J	Two-level Maintenance	OF2015	Distribution Based Logistics	OF2015
Develop	S	Sustain	TABS	Storage	J
Test	S	Support	J	Just-in-Time Logistics	OF2015
Acquire	S	Systems Commonality	OFWP	Support Ammo Capability	S
Commodity	B95	Depots	B95	Ammo Storage	B95
Modernize	TABS	Support Joint		Reduce Ammo	OFWP

RDTE		Maintain		Supply & Storage	
		Force		Weight/Cube	
Proving Grounds	B95	Industrial Facilities	B95	Ammo Production	B95

11.5 Capability: Enhance Soldier and Family Well-Being

Key Word	Reference	Key Word	Reference
Well-Being	2020	Economic Impact	Law
Quality of Life	S,TABS	4 Env. Pillars	S
Encroachment	S	Housing	
Communities	A	Educate	
Medical	J,B95	Health Care	
Env. Impacts	S	Dental	
Env. Costs	Law	Force Protection	
Env. Sustainability	S	Veterinary	

Sub-capabilities:

Health Care		Well-being		Environment	
Medical	J, B95	Well-being	S, TABS	Impacts	S
Dental		Housing		Sustainability	S
Veterinary		Communities	A	Pillars	S
		Safe and Secure		Secure Sanctuaries	A
		Force Protection			

11.6 Capability: Achieve Cost Efficient Installations

Key Word	Reference	Key Word	Reference
Manpower	D	Outsource/priv.	OF15
Affordability	G	CIVPAY	
Excess Cap	SecDef	Housing cost	
Payback period	L	BASOPS	
Availability of FAC	D	Force protection costs	
Sustainable	S	Health care	
Facility Cost	G8	Environmental Cost	
Sustainment cost	A	ACF	
Minimum footprint	S,TABS	SRM	
Efficiency	S, SecDef		

Sub-capabilities for Achieve Cost Efficient Installations:

Manpower		Installation Costs	Facilities	
Manpower cost	D	BASOPS	Availability of FAC	D
Outsource/priv.	OF15	Force protection costs	Sustainable	S
CIVPAY		Environmental Cost	Facility Cost	G8
Housing cost		ACF	Sustainment Cost	A
Health care			SRM	

11.7 Capability: Maintain Future Stationing Options

Key Word	Reference	Key Word	Reference
Contingency Requirements	D, L	Safe and Secure	S
Operational Effectiveness	G8	Buildable Acres	
New Mission Flexibility	S	Energy	
Restationing of OCONUS Forces	TABS	Utilities	
Homeland Security/Defense	S, D, TPG	Local Area Support	
Secure Sanctuaries	A	Regional Installation Density	
Homeland Defense Staging Areas	L	Facilities	

Sub-capabilities:

Contingency Requirements		Mission Expansion		Homeland Defense	
Contingency Requirements	D, L	Buildable Acres	B95	Homeland Security /Defense	S, D, TPG
Operational Effectiveness	G8	Water		Homeland Defense Staging Areas	S
New Mission Flexibility	S	Energy			
Restationing of OCONUS Forces	TABS	Utilities			
		Local Area Support			
		Regional Installation Density			

Category: Logistics #1
Interviewee: Principal
Attendees: None
Date/Time: June 5, 2003 1500
Interviewer: LTC Willie McFadden
Recorder: Mr. Joe McGill
Questionnaire Version: 1

1.) Primary Concerns: “This question can be approached from two distinct perspectives: a parochial perspective, and an Army perspective. As for the ‘parochial’ perspective, we should ask things like ‘How should one consolidate HQs?’. There are two points to consider: all evaluators must be put together and so should all other HQ elements. When consolidating HQs elements, Ft. Belvoir is the best location. Will BRAC ’05 allow for these realignment efforts?”

“There is very little recognition that test ranges are considered to be as important as they should be. Large-space testing is not addressed adequately.”

“We can not do 4th or 5th order of impact analysis. I am interested in what we can preserve that is *not* contained in the first or second order of impact analysis.”

We need to preserve large-scale information assurance and large-scale joint testing.

“As for the ‘Army Perspective’, the Army will never break away from the parochial emphasis to do a ‘system of systems’ approach. The Army sub-optimizes and allows the other services to outmaneuver it. The Army leadership does not have the ‘guts’ for this sort of fight. It is exceedingly tough for them to say that they will close the ‘big’ installations. The Army leadership does not know how to use BRAC properly to assure Army objectives. We need to look at how to enable what we want.”

2.a) Transformation/Objective Force Impacts: “The Army looks at ‘Army-unique’ things for deciding where the Objective Force launch point will be. This approach is not ‘street-smart’ and has no joint characteristics. I am a big believer that the transformed Army must be ‘synergistic’ in terms of its stationing. Installations that are close together (such as White Sands and Ft. Bliss) should be consolidated into one base that can accomplish *ALL* the objectives for training the new Army. This new sort of base would have everything that would be needed to do this. For future training, we must eliminate these distinctions and move toward multi-use, multi-service joint bases. Bases that can train, test, evaluate, and field all at the same time.”

2.c) Climate Deficiencies: “BRAC ’05 will not solve the Jungle Climate issue. We are currently negotiating with Panama for use of our old bases. We have redundant

Geographic areas. Network-centric system of systems is what the future should be. This must enable Information Assurance jamming and supply protection from information warfare, etc.”

2.e) Force Protection: “Co-locating will save significant money as well as enable us to protect all of our important assets as they are only in one place concentrate on consolidation at places that have the major necessities (Dugway example). In terms of ranges, force protection will never be cheap because of so many small places.

2.f) Homeland Defense: “ We should be willing to relocate, especially if it will help synergy and increase functional expertise. Dugway could be a chem/bio center of excellence, BRAC can fix its remoteness.”

2.g) Homeland Defense Impact on Installations: “Using staging areas for homeland defense is a good idea. Joint use is required. We must be able to segregate properly to maintain security and properly integrate homeland defense personnel.”

3.a) Worst-case Scenario/Contingency Planning: “Loss of normal transportation is a major factor in a worst-case scenario. We are tied to getting to APOD or SPOD in some way. The worst case is having an installation you can’t get to. Large airfields are more and more valuable and will be major in terms of the Objective Force. The center of gravity is shifting to airfield structures. Do not get hung up on ‘miles to port’.”

3.d) Deployment: “BRAC should help with Army deployment but it probably won’t. We should also tie in virtual training with live exercises. Schools are important, but you can and should collapse them into multi-mission oriented schools.”

5.) Changes Since BRAC 95/Final Comments: “BRAC 2005 will be about enabling the Army of the future for 2020, not the old parochialism of closing bases that dominated BRAC 95. We know that jointness is important, but big questions, ‘Where, How, etc’, preclude an overarching guidance for the Army. We don’t know what we like, but will know when we see it. This is not a good approach. We need to be focusing on WHAT WE WOULD LIKE TO HAVE.”

Category: Personnel #5
Interviewee: Principal
Attendees: Deputy 1, Deputy 2, Deputy 3, Deputy 4, Deputy 5, Deputy 6
Date/Time: 20 October, 2003 1100
Interviewer: Mr. John Bott
Recorders: Mr. Robert Dow, MAJ Lee Ewing
Questionnaire Version: 1

1.) Primary Concerns: “Pure availability. Quality of life issues. We have an enclave at Ft. Stewart that is being used for mobilization, demobilization, and medical holds. The quarters are considered substandard.”

“We should be asking: What should our mobilization capacity be? Where should it exist? Where to train? Where do these functions exist? How does this factor into a model?”

“Why do we put too much pressure on our Mob stations? During OIF-1, we overwhelmed them.”

“My main concern is that we will overreact to this and start a major campaign to construct new buildings. We don’t necessarily need that many new buildings; we can make changes in *how* we do things by changing our mobilization policy (e.g. – train, alert, deploy). We haven’t sized up MOB. What is the MOB formula? I am *NOT* an advocate of building a bunch of things.”

“Our facilities are below the threshold. Cinder block buildings are substandard.”
(Suggestion - we put soldiers into local hotels)

“How do we participate in BRAC? We have facilities we would like to get rid of or put on the candidate list.”

“We need to look at *regions* not installations. What does the *region* have to offer?” (Deputy 1)

“I am after the mobilization mindset. Units should be able to train, certify, and deploy locally. Maybe we should look at the big picture – joint use, using other services facilities and land.”

“Here’s an example. The 30th Brigade, which is a heavy Brigade (2 tank battalions and 1 Bradley battalion) is based in New York, West Virginia, North Carolina, and Ohio. They assemble at Bragg, Drum, and Stewart then head off to Camp Pickett. Can you believe it? Pickett? We were ordered to close Pickett, now we have to use it. We had to use it because Bragg was at capacity.”

“We have inherited a bunch of installations from past BRACs (e.g. Ft. Chafee, Indiantown Gap, Hunter-Liggett) but they are under-funded.”

“The AC did not depart in its entirety for Iraq. They were supposed to be gone for the RC to mobilize and use their empty barracks.”

“We need to segment the process. We can do more with the LTAs (Local Training Areas). Intense collective training requires ranges. We need to re-look the entire process and have an AC/RC rebalance. We have a huge inventory of infrastructure that goes unused during mobilization. We have that list and it is available from us.” (Deputy 1)

2e,f,g) Homeland Defense/Force Protection: “We have to use contractors in the future to guard bases. The key to Force Protection is decentralization. Concentrated people become more of a target, however they are easier to defend (fewer places require fewer resources and the resources are less dispersed).” (Deputy 1)

“We need to put money in different places, e.g. remote sensors (not necessarily hire more guards). We have to use technology to replace manpower.”

4a.) Transformation / Simulations: “Certain aspects in training will use simulation, it will help take some of the burden off of training lands and ranges, but it is not a cure all. Simulation will change the training requirements in the future. We need to look for a balance between simulation and going down range.”

“Aviation has done this for a while, they seem to have a good balance. We should look to them.” (Deputy 1)

5.) Changes Since BRAC 95 / Final Comments:

“At our level it’s not much different, however, in BRAC 95 we said ‘we’re not playing’. We want to play this time and we want to look at it differently. The key is how do we measure the value added by doing it.”

“We will be meeting with Dr. College today to discuss opportunities for better coordination on BRAC 2005. That is also a major change – there was no Dr. College last time.” (Deputy 1)

“The difference is likely due to different leaders today in the Pentagon and the Administration. Hopefully jointness will be a bigger factor. Joint programs are almost guaranteed funding by Congress today, so joint installations are a good thing. We need to leverage other services installations.”

“The challenge is applying a subjective measure to something we don’t usually think about.”

“It is important that we have measures that look at the availability and use of training lands and how their use is restricted by environmental and encroachment regulations.” (Deputy 4)

“We created an environmental buffer around Camp Blanding. We are the first in DOD to do this. Secretary DuBois loved it, said that it sets the standard for DOD.”

“We are better than the civilian community at taking care of our installations and its environment. Take a good look at what JRTC has done. It is no longer Ft. Polk, it is a conglomerate of Air Force and Army facilities. DOD is leveraging that it has been a very good custodian of its land.” (Deputy 1)

“How do you model the unknowns? If you don’t factor in the unknown, then the model is worthless.”

“The environmental regulations definitely impact us. Ft. Hood has been shut down during certain periods because of restrictions on training lands.” (Deputy 1)

Category: Personnel #4
Interviewee: Principal
Attendees: Deputy A, Deputy B, Deputy C
Date/Time: August 14, 2003 0900
Interviewer: Mr. John Bott
Recorder: Mr. Rob Dow, Ms. Peggy Mencl
Questionnaire Version: 1

1.) Primary Concerns: “That we maintain the capabilities, facilities, acreage, and infrastructure to conduct the training we need to do. That we also retain the billeting facilities capable of conducting the RC mobilization mission, this is something that nobody is looking at. We got rid of the World War II wood and didn’t replace it with anything, the result was we had soldiers sleeping in motor pools, tents, and everything else; we could have had a real problem. The mobilization capability must remain paramount. There is a great MOAT facility at Ft. Polk that is very unique, it needs to be replicated. Polk also has a great railhead, we need this at Irwin. We also need to take into account proximity to APODs and SPODs and the ability to rail head to get to them.”

“We need to ‘worst-case’ this. Once they (installations) go away, we’ll never get them back.”

“Having an expansion capability is critical.” (Deputy A)

2b.) Joint Basing/Stationing: “The Air Force closed England AFB near Ft. Polk, this didn’t make sense, we should have done something about it and not let it get away.”

“We also need to look at the State-Owned Mobilization Stations (SOMs), there are about 10-12 of them. They are geared more towards Title 32 than Title 10.”

“A good example of joint training is March AFB. An incredible desert training facility.” (Deputy B)

“Re-deployment could become an issue, we need adequate facilities, such as medical and housing.” (Deputy A)

“We also need to look at Air Force or Navy bases within an hour of an Army base that may close to see if we can capitalize on some of their assets.”

“For expandability of training areas, we should worst-case this. We are not even close to spinning up for 5027.”

“We have 650,000 soldiers on active duty right now. That needs to be the number you plan for, not the 480,000 number.”

“I think you use 1 million as your measure, that would encompass all active duty and reserve component, this doesn’t even include the 270,000 civilians.” (Deputy A)

“We are still spending \$25 million a year on the selective service system.”

“There are planning documents to draft doctors and nurses, but how are you going to ‘green’ them? This needs to be worked out with the MEDCOM folks. We may need a specialized draft to get at other critical functions like IT and linguists.”

2 e,f,g.) Homeland Defense: “A lot of the Homeland Security mission will be for the National Guard and Army Reserve.” (Deputy A)

“Consolidating Guard and Reserve facilities within a town or city is a good thing, but don’t overdo it and give the soldier too long of a drive. This could hurt retention and safety.”

“BRAC is a great opportunity for USAR facilities to integrate with AC installations.”

“We have 5,000 reserve centers and armories, some towns have multiple RC facilities from different services.” (Deputy A)

“There will be a requirement for QRFs across the country that will be Guard and Reserve units.”

“You need to ask NORTHCOM what the stationing and Assembly Area requirements for these forces (HLS) will be.” (Deputy B)

“I would urge you to think about the ‘what ifs’ for contingency operations and planning. Where do you house, feed, and support mobilized folks from the National Guard?”

“DIHRMS – the Defense Integrated Human Resources Management System. What are the implications of this system for installations? HR Centers? It is moving into the Joint world and has real estate implications.” (Deputy B)

“In mobilizing the 150,000 soldiers on active duty right now, the Army used 26 PPPs and PSPs, they were primarily manned by about 17,000 Army Reservists. It took that many to put 150,000 out the door. There were two conclusions drawn from this:

- 1.) That is about the number needed to project that many soldiers.
- 2.) The geographic spread to do the job – the number of Mob stations isn’t the issue, the location of them is.

“We must also keep in mind that until the Abrams Doctrine is changed, we *will* mob the Reserves and need these facilities. To execute almost any plan, we’ll need a big chunk of RC capabilities in a hurry.”

“If we do Unit Manning, we need to keep the facility requirements for it.”
(Deputy A)

“My most important point is that we *must* fight to keep a good mobilization capability!”

Category: Personnel #3
Interviewee: Principal
Attendees: Deputy
Date/Time: 20 June, 2003 1000
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “We must be mindful of what we are in the middle of. Significant operations include 16 brigades in Iraq and 1 in Afghanistan, with 2 brigades being converted to Strykers at Ft. Lewis.”

“When we reset the force, it won’t ‘look’ the same as it does now, I wouldn’t want this basing business to drive transformation. The Bases *support* the operating force – that should be kept in mind.”

“We think a lot about units, people, and the mission, but then there’s the families. Some bases just don’t provide much for the families; spousal employment, good schools, etc. The Army suffers a lot by not taking advantage of spousal employment. We are going to have an Army that is 50% married. Some states offer in-state tuition to military personnel, but some still don’t, Virginia and Texas included. Georgia just authorized it.”

Dr. Parnell: “Should the retiree community be considered?”

Principal: “Sometimes the reason the retiree community exists is because there is an installation there. I don’t know how much of an impact they should have on this process, but they shouldn’t be considered a driver.”

2a.) Transformation/Objective Force Impacts: “Issues with Transformation have surfaced. TRADOC realizes that they are going to have to do a lot of training for the FCS U/A. In 2010 the first one comes online, these units require a much larger space than we first thought. How are we going to handle this? I think TRADOC may be leaning towards an NTC-type solution but I’m not so sure that that is the best solution. It may be better to bring the schoolhouse to the unit base. The basing has to support the Objective Force schedule.”

“Maybe Stryker Brigades shouldn’t be stationed at installations without sufficient training areas.”

2e,f.) Homeland Defense: “At our present level, we have 16-18,000 Guard and Reserve troops on duty for Force Protection including 8,500 Guardsmen being used to guard Air Force Bases. We have had some weaknesses in Guard recruitment, but the Guard says

they have a plan to make this up. There are 138,000 reserve component troops on duty right now, including 55,000 for Iraq.”

3a.) Worst-case Scenario/Contingency Planning: “Decreasing our footprint overseas, mainly in Europe, is another major movement. Are we going to put them in the States? We need to consider these things. If we move units back from Europe we’ll certainly have to fund barracks and housing. I think we would like to man Korea on a rotational basis, 6 months at a time. Unit rotations and Unit Manning implies leaving families behind, this is a major consideration. I doubt we’ll be ready to have Korea rotations until 2007, I haven’t seen the detailed plan on it yet, but we may need to re-station the 2nd ID.”

“By 2007, we want soldiers to not have to pay for any housing out of pocket. With that capital stream we’ll be able to improve the Army’s housing stock (the RCI Program – contractor owns the housing and leases it back to the soldiers). We do not have enough money to just go out and build houses; the high BAH helps alleviate this. Investors are willing to buy into the capital stream. Talk to Dr. Fiore about this.”

3c.) Mobilization: “The bottom line is, we have to be able to put these units where they can train *and* deploy. There are obvious trade-offs; Ft. Hood is great for training but when it’s time to deploy they have to get on trains and head down to Beaumont – this seems to work good for them, but does it elsewhere? The Stryker brigades may be lighter but they’re not *that* much lighter, ships are still a good thing. The bulk of our most recent deployment was done by ship and it will continue to be done this way in the foreseeable future.”

Dr. Parnell: “Does the idea of Transformation affect the organizational structure of the Army (echelonement)?

Principal: “It’s all still in the works. I would think we’d want to resolve it pretty soon.”

4d.) Privatization: “There ought to be an analysis of each installation to see if privatization is beneficial there. Maybe have a ‘score’ for each installation. Either way, a comprehensive cost-benefit analysis needs to be done.”

4f,g.) Joint Training/Warfighting: “What is gained by joining co-located bases? If something is gained by combining them, then fine. It is certainly something that needs to be looked into on a case-by-case basis.”

5.) Changes Since BRAC 95/Final Comments: “Division is so different now. The functional JCSGs are a new approach which adds a new dimension to the analysis.” (Deputy)

“Are we concerned about being attacked by missiles still? If so, then dispersion is an issue.”

“We need some good Power Projection Platforms where we can perform that mission, housing is needed to do this. Ft. Dix and Ft. McCoy are reserve installations we’ve used; I think 7,000 troops went through Ft. Dix.”

“Politically, I see the impact on contractors as the same as the impact on the civilian workforce. This should be kept in mind.” (Deputy)

Category: Personnel #2
Interviewee: Principal
Attendees: None
Date/Time: 16 June, 2003 0700
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “The Reserve’s ‘perspective’ is not different than the Army’s. We have no constituency other than the Army, unlike the Guard, which is a more complete force. The only thing that the Active Component leadership does that bothers me is ‘benign neglect’, particularly in the case of installations. My biggest concern is ignorance and bias in the Army against the Reserves.”

Example: A MOUT Course was in the POM to be constructed at Ft. Dix but the G-3 invalidated it because the Army Reserve doesn’t have any light infantry units. However, the Guard, which has many light units, trains at Ft. Dix.

“The Reserves had a 36% reduction in the 90s and 50% of the Reserves went through an organizational construct change.”

“We in the military should begin with a requirements-based objective.” (and should do so with BRAC)

“The Reserves, in the past, have never run installations, today we run 2 major ones, Ft. Dix and Ft. McCoy, at a cost of hundreds of millions of dollars. The decision to have the Reserves run these was made by DoD, Congress, and the BRAC Commission, not the Reserves. Although, we are very proud of our stewardship, and I am *NOT* saying that Ft. Dix and Ft. McCoy should be realigned.”

“A concern of mine is that we cite mobilization as a primary mission, but we don’t really fund it or appear to make it a priority. We need a larger focus on the mobilization mission. In the past round of mobilizations we had a major billeting issue. It is unrealistic to rely on the Active Component to have been deployed before the mob mission starts and assume their facilities will be available for the reserves to use. We need to thoroughly examine the training lands and facilities for the mob mission. It is important that we have a standard for mobilizing RC Forces. We were using gymnasiums and everything else imaginable for billeting last time around.”

“Mobilization is a core competency, we need to mobilize smarter.”

“When we mobilize individuals or small teams we use Active Component installations and burden the hell out of them with onesies and twosies, it detracts from the mission of mobilizing larger units or teams.”

“We have GSU units that mobilize at one installation to then go to another installation to help them mobilize other units!”

“I am pushing for us to do mobilization better and would caution against doing it the way we do now.”

“We need a realistic perspective on mobilization, we had a huge billeting shortage with the last mobilization.”

2a.) Transformation/Objective Force Impacts: “The way I’m tackling Transformation is to be proactive and be a participant in the process and not stand by and observe the Army doing it.”

Dr. Parnell: “Is the Transformation of Installations (IMA, etc.) having an effect on Reserve installations?”

Principal: “The Reserves can close installations outside of BRAC by using the land-swap program.”

e.g. A Reserve Center with 10 acres of land that isn’t really of value to us can be gotten rid of and we can use the funds to get better stuff built where we need it at no additional cost to the taxpayer. (This same ‘in-kind’ trade was mentioned by Ms. Menig of ACSIM as well)

“I am rather proud of the fact that we are full partners with IMA.”

“We are integrating fully with NETCOM, this merges our CIO with the Army G-6/CIO. Army Reserve PERSCOM is merging with Army PERSCOM. These efficiencies help us concentrate on our primary mission of training and doing mobilization. In the past, we ran the Reserves as a separate Army. Our paper gets graded on how well trained we are, how ready we are, and how well we Mobilize.”

“The last time, we carved out little enclaves like Ft. Devens and passed them to the Reserves, also Camp Parks in California. We then had to run these places.”

2g.) Homeland Defense: “We are seeking no role with regard to C2 or management of Homeland Security. We will fulfill whatever mission is given to us. The concept of operations of Homeland Defense is still very fluid. There is a NORTHCOM CONOPS which states that a Chem. unit in Boston is to move its equipment to Ft. Drum, put the unit on 96 hour ‘prepare to deploy’ orders, while keeping the unit at 15% mobilized, and that’s as far as the CONOP goes. That is unsat! No Reserve unit can stay on constant alert at a level of 15%!”

5.) Changes Since BRAC 95/Final Comments: “The comfort factor will be to go back and do it the way we did before. There was language in the past BRAC legislations to transfer stuff to the Reserves. I am concerned that there is *not* legislation that clears this up.”

“If anybody can do this right, it’s Craig College.”

“There is a GAO report that references Ft. McPherson and states that FORSCOM has special requirements but that USARC can go anywhere. We have the same security requirements as FORSCOM.”

“The suddenness by which the reserves will be required changes how you train and equip them.”

“Mr. DuBois has stated the ‘The Army has done the worst of any service in BRAC’ but it was not clear but what metric.”

Category: Personnel #1
Interviewee: Principal
Attendees: Deputy
Date/Time: June 5, 2003 1500
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “Going to fewer and fewer installations is a concern. We don’t have enough places to mobilize people *RIGHT NOW*.” (emphasis not added)

“Increase in WMD probabilities. The strategy seems to be out of sync. A few good hits could eliminate most of the Army’s fighting force.”

“Posts should stay open for historical purposes, e.g. West Point, but not all of them. Just because you could move West Point to, say, the University of Minnesota (because it is, after all, a college) doesn’t mean you should.”

“BRAC must have the ability to make sure we can service the Guard and Reserve, civilians, and the mobilization issue.”

“We should be eliminating ‘moving parts’ in our ability to go to war.”

“We must continue to pursue privatization where economically sound, it reduces costs.”

“Ft. Riley has a good work ethic. We should capitalize on these types of things.”

“Keep units collocated, it is inefficient not to have it so.”

“The IMA folks have a different perspective, we are more concerned about the personnel.”

“Housing is a big issue. We need to ask ‘How much should be on-post, how much should be off-post?’

“We put considerably more into family programs that only benefit on-post families.”

“Space on-post should be better utilized, e.g. Golf Courses, they only benefit retirees and some officers.”

“Should we be building more housing? BAH is better, this is major change from BRAC ‘95, BAH has been leveled. There are incentives for contractors to build if we move troops to an installation – and they will.”

2.b) Joint Basing/Stationing: “There could be some synergies. Medical and Admin functions should be streamlined. These two areas represent homogenous skills that would be a good place to start. But these changes won’t gain us land, which is what we need.” (Deputy)

“There could be some streamlining. We should join Ft. Bragg and Pope AFB. You could merge operations like housing, MWR, medical, AAFES functions, etc. This ties in to my early comment on asking ourselves what we need on-post and what we need off-post”

2.f) Homeland Defense: “Posts with large housing tracts are greater targets for terrorism, Bader-Meinhoff should have done it in Germany.”

3.a) Worst-case Scenario/Contingency Planning: “The problem of billeting a division somewhere, we have nowhere to put them.” (Deputy)

4.) Joint Warfighting: “We need maneuver space. Most places can’t do Brigade on Brigade, except NTC and Ft. Hood (I think). We will start to rely on more virtual training.” (Deputy)

5.) Changes Since BRAC 95/Final Comments: “We have leveled the World War II wood facilities. What if we had to mobilize a whole National Guard Division? We do not have that capability anywhere. Moving troops would stuff installations full and we would have no place to mobilize from. In winter 2002, we were mobilizing troops from tents at Ft. Drum.”

“We need to look at the services we (the Army) offers and ask ‘Who are they servicing?’ Things like Child Development, Family Assistance during deployment, etc. We should ask, ‘If we move a division back from Europe, can its receiving installation support it?’ The biggest challenge is *NOT* going to be with the troop posts, it is how are you going to handle the schools and functions like that.”

Category: Other #10
Interviewee: Principal
Attendees: Deputy 1, Deputy 2
Date/Time: 20 November, 2003 0900
Interviewer: MAJ Lee Ewing
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “It’s going to be a political process, logic and military value won’t have much to do with it. What is important is how it plays out in Congress. Congress accepts that we have 25% excess but it’s not in *their* backyard. My worst fear is that they will close the wrong places, but that’s a military perspective. We’re going to be jerked around here, we may close some of the wrong things. OSD will probably submit a plan with 40% on the table then compromise to 20%.”

“When it comes to closing bases, I think location is *most* important. I think you should think of property values (PRV) as sunk costs, they should be irrelevant. Location is key from a power projection and family perspective. We have to be near good air, sea, and rail transport, and we have to consider the attitude of the surrounding community. Local schools are important; how do they treat you? Do soldiers and their families get the in-state tuition rate? Families, kids, and schools should be a key consideration.”

“The facilities on-post should be secondary. Barracks are not important, but unit cohesion is.”

(Because of its location) “For example, Augusta, Georgia treats our families well. If I were to take Ft Gordon, I would give it straight As because of its power projection capabilities and the surrounding community.”

“I think we need to use this BRAC to re-station TDA and TOE units. We are going to be a more stable force in the future; soldiers will be at their first duty station for seven years, e.g., if we co-locate the operational and infrastructure (Army), we can stabilize the force. For example, if you’re an artilleryman (officer), you can spend a long time at Ft. Sill by going from assignment to assignment while staying on-post. You serve in the Corps Artillery as a Lieutenant, go to the Advanced Course, go to Battery Command, go to the schoolhouse, either Artillery, or local ROTC or NG. Then stay at Ft. Sill for Field Grade positions. If we also had a headquarters element there, like TRADOC, you could even do an assignment there. Conversely, if you were an armor officer or drill sergeant, you would only go to Ft. Knox for one assignment in a training unit. This is a good example as to why Headquarters elements should be near maneuver elements: soldiers could do multiple assignments at one post.”

“An alternative to co-locating within the Army would be to station Army elements with other services. We could do more with situations like Pope-Bragg and McChord-Lewis. If you were to put TRADOC at an Air Base, it could utilize some of

their commonalities, but it wouldn't leverage the runway. The problem with joint stationing maneuver brigades is that the Air Force and Navy don't have the necessary footprint."

"Look at Ft. Gordon again, thru SIGENT we bring Joint to Ft. Gordon."

2.c) Climate Deficiencies: "Alaska is a smart move to keep it; we need the ability for cold weather training. Don't worry about Light maneuver training. We must worry about Heavy maneuver training because you just can't do that anywhere" (because of ranges, heavy maneuver land).

"Jungle training school is not a great need now. We can get access down South if we need it. Desert training is good at Ft. Bliss. We need to expand and capitalize on Ft. Bliss (not only for its desert training, but its capacity for future expansion). And of course, Ft. Irwin is our premier training site."

2. e,f) Force Protection / Homeland Defense: "This should not be a big issue for BRAC purposes, I wouldn't worry about protecting the critical nodes. We studied the problem and the National Guard has adequate coverage (see reference below). It's more of something for the First Responders and the Guard to worry about."

3. b,c,d,e) Mobilization and Deployment: "We are going to have a smaller logistics tail so we need to be able to get out of home station quickly. A Division will have a different headquarters construct, which will include a Home Station Operations Center (HSOC) to leverage reach-back. The HSOC will need a facility where it can fight from, but it can probably be done almost anywhere (in CONUS). Right now, we are flying UAVs (overseas) from small metal buildings in CONUS."

5.) Changes Since BRAC 95 / Final Comments: "I'm not sure what was considered in 95. Congress will wrestle with who got screwed the last time and look to even things out. California got screwed last time but Virginia was a gainer, so maybe this time Virginia will lose something."

"Environmental restrictions are important when relevant to the mission. If you can't do the mission because of restrictions then let's get out of that installation. We should stop playing with the environmentalists and the communities that make it tough on us should be penalized." (DAMO-TR and ACSIM have unique information on this)

"With the OP-Tempo of the Army, more units will be CONUS based; Brigades will be together longer, families will be fixed. Quality of life issues become very important, e.g., child education is first (priority), spousal employment opportunities (are

second priority), medical facilities, favorable in-state tuition rates for military families, e.g., a local community that cares” – this is what’s important.

MAJ Ewing: “What do you think about a criterion based on local school system quality?”

Principal: “Good, you can get data on which school systems are better than others by speaking with the folks from MCEC (Military Children’s Education Coalition), speak with Dr. Mary Keller in Killeen, Texas.”

“We are going to be a CONUS-based institution in the future. We will have less forward-deployed presence, there will be more overseas rotations which leave the families behind. Our soldiers will also be stationed in one place longer. When they leave their families behind, they need to be in good communities.”

“Currently within the TDA we have 15 school locations. The ideal outcome would be to force us to co-locate schools. Branches want to keep individual schools. (We should break the ‘Branch’ mentality). We need a new construct, which has fewer branches. We can use BRAC to do this.”

“Ft. Leonard Wood is already the home of Chemical, MP, and Engineer training, so it’s a start in that direction.”

“Don’t close Ft. Rucker. With the 16 airfields around and its airspace it would be difficult to replicate, though not impossible. Maybe the Army could move aviation training to Ft. Bliss, but you would need to replicate the airfields.”

“If you closed Ft. Huachuca, you could move its missions to Ft. Gordon. However, the Army could move a maneuver brigade to Huachuca.”

MAJ Ewing: “What about this concept for Joint?”

Principal: “The Navy and Marine Corps don’t have much for us and the Air Force just doesn’t have the footprint we need. All we could move to Air Force facilities are TDA units or admin.”

“Other than Armor, Infantry, Artillery, and Aviation; everything else can go anywhere.”

“BRAC is an opportunity to move Branches, it will help us takedown the Branch mindset.”

“What keeps me awake: Not funding the move and not getting the appropriations in time. Cutting support to the BRACed post would also keep me awake. I would cut SRM and MILCON, but you’ve got to keep it running prior to the move. You’ve got to take care of the troops.”

“You’ve also got to help the MACOM Commanders and below. You (the BRAC Team) have to be the heat shield. The Post Commanders and I shouldn’t have to take the heat and testify before Congress. Locally, they will try to drag us in to it.”

“I would also look at the relative value of the installation. If the Army is going to be dragged through the mud, make sure it is worth the fight. Don’t waste the political capital if you don’t have to.”

“Depots are a different issue (stay away from them), they are too political. OSD is going to do it anyway; the Army should stay as clean as possible. We can’t get crossways with OSD, let them take the heat.”

Category: Other #9
Interviewee: Principal
Attendees: None
Date/Time: 5 August, 2003 1400
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

Principal has written extensively on past BRACs and BRAC-related issues, specifically dealing with the industrial base. The session with him was more of an open discussion than an interview.

“How do you determine requirements of an industrial base facility? What metrics do you use? Canada privatized its industrial base starting in the ‘60s and culminating in ‘98. They also privatized many non-defense industries, such as Canada Rail and Air Canada. I’m not sure if they’ve privatized log depots though.”

“There are major differences this time around. All of the easy, obvious, high payoff closures are gone. This next round will be much more costly up-front to do. It’s going to be tougher to do what’s right – cross-service and cross-MACOM consolidations. I think if the services don’t present a more ‘joint’ package, that Rumsfeld will send us back to the drawing board. There are great economies to be made in more ‘jointness’. There are a lot of operational efficiencies to be made in joint stationing at places like Eglin.”

“The JCSGs were used to a much lesser degree in ‘93 and ‘95.”

Dr. Parnell: “Are they more robust this time around?”

Principal: “I’m not sure, I haven’t followed it closely. It seems that Mr. DuBois is taking a leading role.”

“I’m not a big supporter of the Military Value criteria method. The value of an installation is that it is based on a need and a mission. The portfolio approach is a big improvement, but how do we do it jointly? That the other services are developing their methodologies independently is a problem. The Army could look like heroes if they come up with a solution or some proposals on this.”

“The Ft. Lewis commander tried to get McChord to be joint managed, but they said no way in hell!”

“Ft. Bliss has 1.2 million of the finest acres and there are no maneuver brigades there.”

Dr. Parnell: “Do you know of other people we should talk to?”

Principal: “Barry Hollman at GAO. GAO has been the most prolific writer on BRAC. Also John Nerger, he worked BRAC ’93.”

Dr. Parnell: “Have we saved money from BRAC?”

Principal: “There really is no way of knowing how much we’ve saved in BRAC. I’m quite certain we’ve saved a few billion.”

“I think you’ll come out of BRAC *not* recommending closing ammo plants. They have a high environmental clean-up cost, few employees, and a high PRV. Besides, you can close some of these outside of BRAC anyway.”

“I would caution you to not get to wrapped up in the industrial base, they will eat up your up-front costs.”

“That you are using a twenty-year horizon is a good thing, it is the right thing to do. You should also do long-term PRV studies.”

“The Navy spent 11 of the 22 billion dollars that the services had in the past 4 BRACS, and half of the installations closed were Navy. The Army only closed 1 major installation in BRAC ’93 – Vint Hill Farms, and it was only a ‘major’ installation on a technicality. You need to get strong guidance from the Secretary and Chief to do joint, cut programs, and close bases.”

“Be careful not to overestimate the value of selling this stuff.”

“If I were going to hedge, I would hedge on maneuver space, I don’t buy into the simulator concept. If I were going to be conservative on something, it would be maneuver space. GEN Reimer was very worried about bringing force structure back from Europe. The 3rd ACR was put at Carson so Bliss could receive future forces.”

“The criteria used last time had a lot to do with costs, e.g. buildings. This time you should look at the immovable aspects: acreage, geographic location (including climate, weather, terrain, resources, vegetation), and finally population and urbanization. Maybe stationing troops at Yakima or Pinion Canyon should be an option.”

“This has got to be top-driven.”

Category: Other #8
Interviewee: Principal
Attendees: Colleague
Date/Time: 20 June, 2003 1130
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

The meeting with Principal and Colleague was more of an open discussion than an interview. Principal has worked funding issues of past BRACs for the Army.

“There’s too much we can’t control because of politics. Often times we transfer properties *gratis* which cuts into our projected revenue.” (Principal)

“Maybe the problem is with the built-in process which offers property to other Federal agencies first.” (Colleague)

“Environmental restrictions are the biggest problem. We spent \$5.3 billion in the past 4 BRACS (’88,’91,’93,’95) and \$3 billion of it was on environmental remediation. UXO (unexploded ordinance) takes up the biggest chunk of environmental costs. Colorado, Massachusetts, and California are the worst states to deal with.” (Principal)

Dr. Parnell: “Does every installation have an analysis on its projected clean-up costs?”

Principal: “More or less. There is a database at the Army’s environmental office.”

Dr. Parnell: “Which round was the biggest hit for the Army?”

Principal: “1988 was big for BRAC.”

Dr. Parnell: “Have we really, no kidding, saved money?”

Principal: “I don’t know if there’s an actual report, but there’s data that says we have. About \$1 billion a year.”

Colleague: “Keep in mind that cost avoidance and savings are two different things.”

Dr. Parnell: “Is there a minimum number of people it takes to ‘turn on the lights’?”

Colleague: “There are levels of service that need to be followed. Talk to Steve Bagley.”

Dr. Parnell: “What about joint possibilities?”

Colleague: “At McChord-Lewis type situations, I think you need to discern if we are doing stuff together or just living near each other. From a financial administration standpoint, true integration is ten years on the horizon. There is the Financial Management Modernization Plan (FMMP).”

Principal: “If you close an installation with another service activity there, you must provide for that service elsewhere.”

Category: Other #7
Interviewee: Principal
Attendees: None
Date/Time: 29 July, 2003 1300
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott

1.) Primary Concerns: “That the Army is in sync with all of the other SecDef initiatives. Hopefully, with a new Secretary and Chief, we will get back in sync. I think Craig and his team have their heads in the right place, but it is very important to get with the new Chief and Secretary and make clear what must remain, what must endure, so that we have a ‘go to war’ capability. To get a training site in Poland may be a good thing, but we should try and maintain Graf and Hoenfels.”

“We are trying to achieve a common standard across all installations, but I’m held back by BRAC ’05 – waiting until we know what is going to stay. Band-aiding isn’t OK; it’s why we created IMA in the first place. There is no migration of funds out of BASOPS to mission without the signatures of the Big 4 – Secretary, Chief, Deputy Secretary, and Vice Chief. The programmers have cut BASOPS; Dr. Fiore is livid about this. I know what I want to do with IMA – achieve a common standard. BRAC ’05 is delaying our progress because our budget is being cut until BRAC is complete. We seem to be in a decision loop now. We cannot aggressively pursue our common standards without money programmed into the FYDP.”

“The enduring installation is the installation which has no senior command brand on its front gate (‘Home of the Armor’, ‘Home of TRADOC’, etc.). Mr. Dubois once stated that the main gate sign should read, ‘US Army’, and on that installation will reside many Army elements and other Services’ as well, the Army would just to be the host. It could be that someday it will be a DoD installation. We’ve already proven with IMA that breaking down the walls is a good thing. Now, how do we take the next step?”

“Places like Ft. Bliss, White Sands, and Holloman need to be looked at as packages for BASOPS. We need to not care what MACOM owned it or whether it was a training, maneuver, or depot installation.”

“We need to look at other Services’ installations and they need to look at ours. There needs to be a cross-service corporate look at installations.”

Dr. Parnell: “Is BRAC ’05 an opportunity for them?”

Principal: “Yes. General Reimer had a re-stationing vision. What do we want our divisions to look like? For example, the 2 divisions in Europe have two of their brigades in Europe and one at Ft. Riley. General Reimer felt bad about ending his stint as Chief with that construct still in place.”

“We talk about Ft. Future and the transformed installation. What it tries to develop is the model installation for the Objective Force. How does our Army footprint shape-up to serve the Army of 2020? What do we do about installations in communities that want us there but not our noise?”

“White Sands and Ft. Bliss are the best examples of installations that offer maneuver land.”

“Another compelling factor is what has changed since 9-11, the closed post. The Air Force and Navy never went open; we have been for many years. If you developed the ‘model gate’, you could end up dedicating a lot of space to it (stand off area, long access entry roads up to the gate, etc.).”

“When you drive through any gate, you should ask yourself, ‘What makes this a keeper?’ We need to know what we need – all light force requirements, all Objective Force requirements, all MOUT requirements, etc. Can we do 40% of tank training in a building? For training in the future, how much of it will be branch-specific?”

“The Army is always accused of having the weakest lobby on the Hill because we are not unified. It’s AMC/G-4 vs. FORSCOM/USARC vs. TRADOC. Why doesn’t the Army do this better? We are the most diverse force!”

“Barracks and housing are our priorities to get up to snuff. We need to know how many soldiers we’re going to have living off-post and whether we’ll have sufficient off-post facilities.”

Dr. Parnell: “What is the message with that?”

Principal: “We have to understand that installations are central to readiness and should get part of the readiness budget. Having ‘good’ installations is not just about quality of life issues and well-being.”

“It would be helpful to get Army senior leadership to understand the Army base of the future to 2010, 2015, 2020.”

“We sometimes use C-hut clusters for housing when it would be less expensive to build something using cement. But we use the C-huts because to Congress they look less permanent than cement.”

“BRAC ’05, if done right, will be beneficial to the Army. We need to get rid of places we don’t need. We have to have fewer walls, gates, and buildings. We need to have some mega-bases.”

“A Ft. Future war-game took place at NDU in July 2003 that was sponsored by ACSIM. It was a rough effort, but it was a good first shot.”

“We haven’t even established the management norms, standards aren’t just about facilities. IMA provides a tremendous asset to the BRAC Team; we need to hold to the Dubois model. The 3rd ID leadership doesn’t have to worry about Ft. Stewart while they’re deployed, but the 10th Mountain and 25th ID did when they went to the Balkans.”

Category: Other #6
Interviewee: Principal
Attendees: None
Date/Time: 21 July, 2003 0900
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “Funding concerns me the most. By 2011 we will be C3 and C4 in almost every category (see chart). Without better funding the safety and environmental guys will shut us down. Sewers are already red! We can’t have 181 installations, we have sufficient funding for 2/3rds of them.”

“What keeps me up at night is that a building will come down on top of someone or that someone will drink tainted water.”

There are three solutions to funding problems:

- 1.) Get more money from Congress
- 2.) Be more efficient (BPR)
- 3.) Divest (BRAC)

“The BPR is the ‘Business Process Redesign’ program. It’s an efficiency program, it’s a good thing but it has its limitations.”

“It costs \$105 million to run Ft. Bliss, \$50 million for Ft. Monroe – this is in ‘as of today’ systems.”

Dr. Parnell: “Jointness? Are there good opportunities?”

Principal: “Absolutely. I believe we need a DoD IMA. We (DoD) are a corporation that doesn’t do good corporate management. During the McNamara era we came up with PPBS systems that are terrible. IMA is all about getting away from decentralization – managing installations has become a core competency. Once you make the leap from AMC, TRADOC, and FORSCOM run installations to Army run installations, you can make the leap from Army, Air Force, and Navy run installations to DoD run installations.”

“IMA was stood up in 6 months. This type of new construct would normally have taken the Army 2 years to get going.”

“Pope-Bragg, McChord-Lewis, Dix-McGuire are no-brainers, they should be merged and run jointly. I think it can be done and should be done.”

“The ISR is in three parts – Environment, Facilities, and Services”

Dr. Parnell: “Contingency factors?”

Principal: “We can fit the existing Army into an institution with less infrastructure. We can put units at Ft. Riley and other installations. We have land we are not using. American companies close facilities all the time and increase production and jobs elsewhere. People can move, they have that freedom.”

“The chief meets with the country’s top CEOs on a regular basis and corporate America always tells us the same thing – we are too slow.”

“We can put a plan together to run installations if the war fighters tell us what the mission is – what they want from us. We have to know what is needed before we write the plan.”

“They were going to move FORSCOM to Ft. Hood but the airport wasn’t big enough.”

Dr. Parnell: “What is the minimal number of people required to turn on the lights?”

Principal: “It’s not a specific number, it depends on the installation. There are 95 services within BASOPS. We want to establish a standard level for services for each type, i.e. bowling alleys and fitness centers. There are differences across installations. For example, Ft. Knox and Ft. Sill are similar installations but Knox has 19 people doing ACS (Army Community Services) while Sill has 6. But Sill has better gyms than Knox. This type of stuff should be standardized, Coca-Cola and McDonalds have it down to a science.”

“Right now we’re budgeting on historical data. By FY05 we’ll have the standards set, by FY07 it will be budgeted properly. This will not be as traumatic as the installations think. We can adjust funding within an installation to meet standards and the most an installation has to move in or out is 3% (this is for services).”

“There are two types of standards; IFS – Installation Facility Standards (billets, roads) and Services (standing in line at mess halls, etc.).”

Dr. Parnell: “Any final thoughts?”

Principal: “I am a BRAC advocate. Next year we are funded at 68% for BOS, I can’t imagine how we’re going to do this. We are also at 93% for facilities. The BOS funding just turns on the lights, these are must funds. What you do with this type of funding is take a risk with things like the roof. Things have been getting worse and worse in the last ten years.”

“We are not good master planners, our installations look makeshift. When we build, we don’t think it through.”

Category: Other #5
Interviewee: Principal
Attendees: None
Date/Time: 01 July, 2003 1100
Interviewer: Dr. Greg Parnell
Recorders: CPT John Harris, Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “At some point we may not have opportunities like this anymore (in the future) so we need to make the most of it. Congress wants us to be able to station the base force (12 divisions).”

“We won’t give up land-masses because we’ll never get it back.”

“Not sure if we use property correctly. We have to watch what we do with the AC/RC training areas. How are these utilized? Ft. Dix, Ft. Chaffee, and Hunter-Liggett?”

“We need to make the best use of our land.”

TRADOC is the heart and soul (of branch); (Branch GOs) will fall on their sword.

- Intellectual capacity.
- Need down time.
- Spent money elsewhere (that was earmarked) to tear down wood barracks.
- We had \$100 million earmarked for demo in FY98 and TRADOC didn’t make use of it.
- Schools have eyed facility at Ft. Leonard Wood.

Dr. Parnell: “How will installations transform with the Objective Force?”

Principal: “I don’t see a difference for us, we provide services either way.”

- Provide housing and services.
- Contract out more.
- Fewer civil servants.

Dr. Parnell: “What about Joint installations?”

Principal: “They tried this in San Antonio (SARPMA) and also a similar thing in Hawaii. The problem is that everyone wants their asset sitting there for them. When you start talking about Joint, it gets very hard, however I think a Dyn Corp could run a Pope-Bragg type situation. We just contracted out a lot of Ft. Bragg.”

Dr. Parnell: “Have they tried to merge the Tidewater area?”

Principal: “No, not yet.”

“What you would have to do with Joint bases is give the command to a service and make them the proponent, e.g. Army gets Pope-Bragg, Air Force gets McChord-Lewis, Navy gets Tidewater. If there were a DIMA, the services would just pay the bill to DIMA.”

Joint installations

- Same as Guard & Reserve; scheduling
- Navy bought into Army (idea that) I need to rate you
- Could someone run Pope and Bragg
 - o \$ Savings
 - o (Eliminate duplicate) Garrison Staff

JCSG

Navy does regional services.
How close to oversee and manage?
Bitching would go on at service level.
Navy is going to IMA

Dr. Parnell: “How about leases?”

Principal: “There are essentially three types of leases; MepCom, USAREC, and NCR.

Total:	\$750M
USAREC (recruiting offices):	\$250M
MepCom:	\$40M
NCR:	\$460M

“There are very few leases in the field, just some offices and maybe some supply and storage.”

“We would like to give away Ft. Belvoir EPG for in-kind construction. We could trade Engineering Proving Grounds (Ft. Belvoir) to finance a new building. We already gave away 123 acres.”

“We had considered putting AMC and PersCom on the EPG out on Rt 7. Now we could put them on Ft. Belvoir, but the biggest problem there is going to be the traffic on Rt 1. When we built the DLA complex we also built the Fairfax County Parkway. The traffic issue shouldn’t stop us from doing something.”

Dr. Parnell: “What about Synchronization?”

Principal: Synchronize BRAC with other initiatives.

- Reset of Europe; decision in 2-3 weeks. Are we going to have 0,1 or 2 divisions there?

- We know where SBCTs are going.

5.) Changes Since BRAC 95/Final Comments:

The decisions are harder this time around.

- a. '88 troop move
- b. '91 & '93 nothing
- c. '95 a little more

“The reasons for moving are harder, the easy decisions are gone.”

“We keep getting more environmental bills, the EPA keeps deciding things are bad for you.”

“Earlier rounds did not consider environment as a part of cost. However, the decision should not be based on cost. You’ll make a bad decision and leave it for other generations.”

“Installations are under funded. TOA is funded at 69%.”

Principal: “Any other thoughts or issues?”

- Where do we go train?
- With distant learning how much do you need a TRADOC?
- Should we buy more simulators?

“RAND did a report and concluded that if we can buy a piece of land, we should. We should get all we can get our hands on. However, owning property is expensive so we should shrink it down.”

“How many installations can we afford? We have 182 installations now. Germany is 25% more per soldier, Korea is cheaper because of fewer families. DoD can’t pay the school bill. We should move to Romania or Poland. If we weren’t in Germany, it would be a lot cheaper.”

Dr. Parnell: “If we saved money from Germany, would it be put somewhere else?”

Principal: “Yes, probably carriers.”

“The big thing we’re doing to save money is RCI / Housing contracting.”

“OpTempo has increased \$1.2B.”

Dr. Parnell: “What about the 25% excess figure?”

Principal: “Here’s the thing; take the population of Ft. Hood, add up what space they need, and subtract it from what they have – there’s your excess. In reality, the excess we have is spread out all over the place, or it’s in old buildings. What they are primarily talking about when they say ‘excess’ is square feet.”

Category: Other #4
Interviewee: Principal
Attendees: None
Date/Time: 20 June, 2003 1500
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott

Principal stated that ACSIM/IMA is responsible for 78,000 people and \$15.3 billion of the Army budget.

1.) Primary Concerns: “How we take care of the installations we’ve got. It concerns me that we will come up with the best list possible but that it won’t come out the other end that way (Congress). We don’t need 5 maintenance depots, we haven’t for a while, there’s only enough work for 2 and a half. It also concerns me that this could be our last chance to get rid of some albatrosses but that we won’t. I’m afraid we won’t take advantage of all of our potential joint opportunities. I’m not opposed to joint bases, I think it’s a good thing.”

“I also think we need to dispose of what we say we are going to dispose of. We still have 149,000 acres from past BRACs that we haven’t gotten rid of. We’ll still have land from Ft. Ord in 2022. The environmental costs worry me; define ‘Pristine’ to me! The issue isn’t that nobody wants the land (the 149,000 acres mentioned above); it’s the condition that they want the land *in* that’s the problem. I want to get rid of as much of this land as possible before ‘05 because I know I’m going to get more. It is just as much work to get rid of a 3 acre plot as it is a 62,000 acre plot.”

“It bothers me that OSD says we’ve got 25% excess but never identifies the unit of measure. 25% of what? Square feet, number of places, acres, buildings? This may cause expectations on the part of some folks that end up not being met.”

2a.) Transformation/Objective Force Impacts: “What are we going to look like? It is unrealistic to think that we are ever going to own a piece of land big enough to train the Objective Force. If we stay with a division structure, are we going to try to put all 3 brigades on one post? How will we handle this? What if we want to do a division exercise?”

“We’re going to have to build more maintenance areas but we shouldn’t build them the way we do now. The motor pool should be part of the company area.”

“With the Objective Force, are we going to want soldiers living in barracks? Are we going to provide 3 hots and a cot? Some people say soldiers should be allowed to live off-post after 36 months on duty regardless of rank.”

“We have to keep in mind that the force we have now is the force we are going to have for a while. By 2010 we’ll only have 2 Stryker Brigades.”

“Why do we have GS civilians doing jobs contractors can do? We have to learn to write contracts better, ‘Statements of Work’. I think we’ll see a lot of contracting in the future. I have 6 installations that have done no A-76 contracting.”

“Our installations will be very different. They will be information hubs, holistic communities, secure sanctuaries, combat preparation and sustainment centers, and deployment centers. A deployment capability doesn’t necessarily mean railheads, but we have to be able to get the people where they need to be.”

Dr. Parnell: “How do the other services do Installation Management? Do you foresee a DIMA-type organization down the road?”

Principal: “The Navy is changing how they do installations, they will look like ours, more centralized. The Air Force asked us to brief them on how we came up with IMA. OSD would very much like to have IMA succeed. I would not be surprised if down the road we had a DIMA.”

“There’s going to be more and more centralization of defense because that’s what technology is all about. Installation sovereignty no longer exists because Post Commanders no longer have control of the money. But in order to have decentralization, there has to be rules to how the game is going to be played. I can foresee a time in the near future when we don’t need all the echelons we have in installation management.”

2e.f.) Homeland Defense: “If there has been any impact on installations, I’m not aware of it, other than the establishment of CBRN Teams and a heightened desire for force protection. If the Guard and Reserves are going to have a role in it, that needs to be taken into stationing considerations.”

Dr. Parnell: “How many people does it take to ‘turn on the lights’ of an installation?”

Principal: “People, I don’t know, it varies, but as for resources, consider this: Only 68% of BASOPS and 93% of SRM *required* funding was funded. Furthermore, 89-91% of BASOPS funding requirements are *must* funds, e.g. water, electric, phone, contracts, etc. There is a definite fixed cost to keep a base open. We’ve got too many little bases and labs. If you can move a lab, you should, unless the lab *has* to be where it is for a reason.”

5.) Changes Since BRAC 95/Final Comments: “OSD is going to play in this one, in the past they just stamped what the services did. The JCSGs are new, OSD is going to look at Joint and Joint will trump what the services want. The services have a tendency to not

look across the fence. Last time, OSD just put a cover sheet on what the service did, this time OSD is driving the train.”

“There has got to be people on the TABS team who can afford to be hurt, they can’t just be people that are available. When this is done we’ve got to take care of them. This is important work, I believe Dr. College’s team will put together the best list we can come up with.”

Dr. Parnell: “How can we make it more palatable for Congress?”

Principal: “Focus on compromise, it’s part of the system. MILCON bothers me. Once you put it somewhere it’s a 50-year decision. Let’s not commit MILCON to places that are going away, let’s be smart about it.”

Dr. Parnell: “Is the current IT infrastructure capability something we should look at, e.g. the Global Grid?”

Principal: “Certainly we should ask if it’s something we should walk away from. If it comes down to a Military Value question, then no – Military Value should trump it.”

“I have a concern; as we move forward with the Objective Force, will we separate ourselves from the concept of an Armor School, Infantry School, Artillery School? Ft. Knox is not the best place for an Armor School. Are we going to end up with a Battle School?”

“Thanks to IMA, we now have a set of standards for things like sidewalks, bike trails, etc. We based them on the city of Chicago because it was voted the best by the Association of City Managers. We have also started using postal addresses, with streets going north and south and avenues going east and west. IMA can bring these kinds of things to the field and make improvements, but it can’t deliver without the funding.”

“As for the Objective Force, someone needs to start telling people what it is. We need to know so we can start doing MILCON for it.”

Category: Other #3
Interviewee: Principal
Attendees: None
Date/Time: June 16, 2003 1400
Interviewer: LTC Willie McFadden
Recorder: Joe McGill
Questionnaire Version: 1

1.) Primary Concerns: “Nothing. There is really nothing in BRAC that keeps me up at night.”

2a.) Transformation/Objective Force: “Tough to determine now. We are at an early stage. I am concerned about a number of things. C4ISR is a key enabler, we followed it up, but if we can’t use the real power of the Objective Force, it would be bothersome.”

“The industrial base has to be taken into consideration when we look at where we locate our training areas.”

LTC McFadden: “What would you see as the cost to modify our training areas for the Objective Force?”

Principal: “There would be capital investment, but long term intuition says we will save money.”

2b.) Joint Basing/Stationing: “I would be disappointed if we were not co-located at a number of areas. Why can’t we have an Air Force wing at Ft. Hood? Elements of the industrial base should be considered, industry should be close to where we re-align.”

2c.) Climate Deficiencies: “Pick a Parallel, if nothing grows there, we don’t have reason to care. Overall, I think we’re in pretty good shape. I’d be surprised if we had any climatic concerns.”

“This question would be better answered by the trainers.”

2d.) Encroachment: “The frequency spectrum of operations for the Objective Force is an issue. We must have the space to exercise our new systems. FCS power requirements and vertical space requirements will be issues.

LTC McFadden: “There is an encroachment issue?”

Principal: “Yes!”

2f.) Homeland Defense: “I do not have the requirements from Commander - North and cannot answer this.”

“I do not know who we’ll use to deliver Army capability.”

3a.) Worst-case Scenario/Contingency Planning: “Must have access to all four...land, sea, air, and rail. A network infrastructure supporting deployment.”

“It costs more to live on the Coast. Why bear the cost when you can get there fast (using advanced air and land routes)?”

“Co-location of Air Force and Army assets gives you an advantage.”

3b.) Mobilization: “Do we have the right force mix? No. BRAC needs to look at the restructuring of the force. The majority of our MPs, logistics, and psyops is in the reserve and we use them heavily.”

“High and low density hauling of the Reserve Component should be active. This is a structure issue”

“BRAC will not impact mobilization all that much.”

“Time at mobilization stations is important.”

“We need sufficiently large cantonment areas.”

3d.) Deployment Requirements: “We need a ‘smart’ infrastructure: buildings that can monitor, regulate, and manage energy consumption (temperature, moisture, lighting, etc.)”

3e.) Deployment Impact on Installations: “Are we going to live on or off post? Have garrison cities or just garrisons?”

“Is it better to have all those families living on post? Unfortunately, the schools there suck; so people leave post to take their kids to school.”

4a.) Joint Warfighting: “Its cheaper to use simulation than to do it live. However, I’m not sure if you could replicate everything (to the extent that it would make simulation completely realistic)”

“Nowhere to train when you have lots of iron on the ground.”

“If you can properly utilize Sims, you may open up more places to being considered irrelevant.

4d.) Using Other Services Installations: “All kinds of ways. This IMA business is the first step. IMA is Transformational!”

“Regionally, we can do a lot together. We all use utilities and companies. If we acted together we’d have a hell of a gain. Knowing where all skill-sets are along a broader base is worth its weight in gold.”

5.) Changes Since BRAC 95/Final Comments: “Grind enough out of the IMA thing to do more than in ‘95”

“I’m more interested in Realignment than I am in Closures. In terms of closing, we’ve still got things to be resolved...Cameron Station...For Christ’s sake, come on.”

Increased emphasis on Site-Characterization “would be useful.” Major issues:

- a. Soil samples
- b. Ground penetrating radar
- c. Know the characteristics of the site
- d. Contamination?
- e. “People do not do ‘do-vigilance’ right now”
- f. “Consider that things might happen after walking away...things like Lead Based Paint and Asbestos. We may be better to ‘encapsulate’ places like this rather than paying a cost down the road.”

“Why have so much lease space? Major issue: If you stacked up all the lease space and don’t consider costs and/or savings of moving them to bases, you’ve missed big things. The return on investment would be significant.”

- a. “We need to get out of this”

“Commuting patterns must be considered for civilians.”

“Failure to look at unions bothers me.”

“Assess space allocation...In the electronic world, you don’t need huge offices, etc. Make space allocation a part of the equation.”

“In 2020, we’re still going to have the Army looking very similar. We may have 8 or 10 UA’s in the Objective Force.”

We need to consider this: “If things look well, what does the Army look like in 2023?”

Costs of transformation: A transformed brigade will contain less people.
“The vertical dimension is going to be more important”

Category: Other #2
Interviewee: Principal
Attendees: Deputy
Date/Time: 16 June, 2003 1300
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “I don’t worry about it (BRAC). Dr. College is in charge so it will be done as best as we can do it.”

“I have no doubt that we (Army, DoD) will do it right, but politically it will get messed up. I’m more worried about what doesn’t get closed. We’ll waste money on places we keep open that could be better spent elsewhere.” (Deputy)

Dr. Parnell: “What can Dr. College do to help Congress accept what we have done? To get them to accept our recommendations?”

Deputy: “Congress will pit the services against each other to get what they (Congress) wants. The services need to get on the same sheet of music. You make the political process much more difficult for Congress if the services provide a united front.”

Dr. Parnell: “It appears that DoD has a real ownership in this, which is key to its (BRAC’s) success.”

Deputy: “In ’95 we had ‘Service BRACs’, we thought of it (BRAC) as ‘What can we give up to save money’. This time around we must put up a united front. DoD must get the services to have the same perspective. I think this time we have a more cohesive Department.”

2b.) Joint Basing/Stationing: “If we are going to fight jointly we should live jointly. Having things like combined messes and schools are good things, we should integrate infrastructure.”

“When it’s logical, we should combine operations, e.g. admin facilities. Our biggest challenge is to change cultures – to get people to work, live, and think outside their stovepipe. Jointness provides that opportunity.” (Deputy)

“There are opportunities for joint housing, e.g. Ft. Myer.”

Dr. Parnell: “Installation management – is the next step a DIMA, and if so, would it be positive?”

“Yes, we should, and yes, it would be positive.” (Both)

“Installation management is a huge part of the bill. If you have a ‘Defense’ installation manager in the Tidewater area (for example), you’re going to end up with haves and have-nots.” (Deputy)

“The Air Force has installation standards, the Army doesn’t.” (Principal)

“So, the challenge with a DIMA is – do the standards go up or down?” (Deputy)

“For IMA, this year was a transition year, it will be fully funded next year, then we’ll see how things go.” (Deputy)

“It is maturing quickly.” (Principal)

Dr. Parnell: “Any other areas we should go joint?”

Principal: “Streamline our inventory; vehicles, copters, equipment. I realize we need utility helicopters, recon helicopters, and attack helicopters, but couldn’t the services use the same one for a given mission? We need economies of scale and we need to have standards.”

“We should fill a requirement, not a parochial interest. We have a poor track record of doing defense acquisition and there have been almost no improvements.” (Deputy)

2e.) Force Protection: “Bosnia and Kosovo were handled as supplementals but were eventually brought into the main budget which in turn made it bigger. I presume Force Protection will be the same.”

4d.) Privatization: “It makes the political part of the equation harder, you now have not only the Services and GS civilians fighting something, you have corporations coming in to fight it also.” (Deputy)

5.) Changes Since BRAC 95/Final Comments: “We try to be a little more proactive, not do Congress’ work, but try to mitigate some of the fall out from BRAC. Maybe a losing district could pick up some Homeland Security business to soften the blow.”

“Try and offer a ‘government’ package when looking at BRAC, you could take the wind out of Congress’ sail.” (Deputy)

Category: Other #1
Interviewee: Principal
Attendees: Deputy
Date/Time: June 16, 2003 1030
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “That we get this thing right – and there are a lot of factors to consider. What does the Army look like 15 years from now? Transformation? Where are we positioned? Do we put troops somewhere else overseas or bring them home? Are we able to tackle the no-kidding tough political issues? Can we finally close the bases we just don’t need? Have we got the depots about right? Have we got the ammo storage down right?”

“Budget integration piece – how does it impact budget and when will we get the money integrated into the budget?” (Deputy)

Dr. Parnell: “Is there a wedge in the Army budget for BRAC?”

Principal: “A little, a very small amount. We haven’t come to grips with a lot of dollars for BRAC 05.”

Dr. Parnell: “When is the first chance you’d have to be able to affect it in a major way?”

Principal: “’06.”

Dr. Parnell: “Has OSD built a wedge (in the budget)?”

Principal: “I think, but I don’t know the amount.”

“The ’05 piece would have to be submitted with an amended budget. There are three elements that go into it: resources, budget integration, and supporting and defending it” (Deputy)

Dr. Parnell: “Synchronization?”

Principal: “DOD talks about transforming PPBS – there are a lot of taskers out there to do this which came out of the QDR. There were no 180-degree turns to come out of these things. There are moves to possibly merge all components into one MILPER Budget (AC/RC/NG). If it works, OSD would possibly try it with the operating budgets as well. I think the Army has the best transformation roadmap, better than any other services’ or DOD agencies. What OSD would like to see us reform is echelonement.

The importance OSD attaches to its pet projects detract from doctrine, training, equipping, and officer and NCO education.”

“I’m concerned about the Presidential Performance Measures. What are the objectives of the President? What does he want to see come out of BRAC?” (Deputy)

“Are we spending money in the right places, e.g. in SRM (Sustainment, Restoration, Modernization)? The biggest change to come out of TIM/CIM (Transformation of Installation Management) is cultural. The Army’s culture has always been to decentralize; TIM does a 180-degree turn from that. The local decision maker *cannot* switch money from one account, e.g. O&M, to another, e.g. SRM, without checking with HQDA. There are good reasons for that, but it still takes control from the local decision-maker.”

“Our installations are not standardized like the Air Force’s, which is part of the impetus for TIM.”

“The next QDR will have a lot of ‘lessons learned’ from Afghanistan and Iraq. We need to ask, ‘Where do we want our forces around the world given our new strategy. Whatever strategy comes out of the QDR will dictate where you want forces but we won’t get this (the QDR) until February 2006, whereas BRAC is on a 2005 timeline.’”

2 f.g.) Homeland Defense: The impact on the base budget was minimal, but the impact on the supplemental budget was significant. Operation Noble Eagle picked up most of the funding for this. The biggest cost has been the mobilized Guard and Reserves. It is still too young to be able to budget for it. We don’t know the extent of it; it is going to become an unpopular appropriation. There are about 8,000 Army National Guard troops on active duty guarding Air Force bases. Keeping the Guard and Reserves on active duty is going to exact a price on recruiting and retention.

2b.) Joint basing/stationing: “DoD has tried to make a JNTC, a notion that was put forth in the last QDR. The idea was to take advantage of what’s already out there. I think there will be a move towards it in the future, something along the lines of an NTC-Nellis relationship. Despite this, I don’t see how it leads to base closings.”

“I can give examples of great relationships, e.g. Bragg-Pope, you can’t have one without the other. I would think of it in terms of Power Projection Installations. If someone were to close down an installation, what impact would it have on a sister service?”

“I don’t see it leading to the closing of bases, it’s not political feasible. I would hope we would have administrative efficiencies that lead to more ‘purple’ functions, but you have to ask, ‘How well will this work?’” (Deputy)

5.) Changes since BRAC 95 / Final Comments: “IT may be the biggest difference since the Bottom-up Review. Previous BRAC rounds have taken the low hanging fruit, no matter what you choose this time around, there is going to be a political pissing contest. Just think about it; if you hypothetically say that you’re going to combine the ADA and Arty school, does that mean you close Ft. Bliss or Ft. Sill? If so, get ready for a political shitstorm.”

Dr. Parnell: “Has the Army saved dollars in the past BRACs?”

Principal: “Don’t know, it’s hard to gauge, tough to follow the money trail.”

Deputy: “The savings certainly didn’t live long if it (BRAC) did (save money)!”

Category: Operations #13
Interviewee: Principal
Attendees: Deputy
Date/Time: 18 November, 2003 1400
Interviewer: Dr. Greg Parnell
Recorders: LTC Russ Hall, MAJ Doug Tuttle, Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “I worry that saving money will interfere with accomplishing the mission. I’m afraid we might close some great installations that we might need in the future. I’m afraid we might break faith with some of our retirees. I’m afraid we may add some turbulence to everything that is going on right now.”

“These are very difficult times to be cutting installations, we are at war and are spread far and thin. The GWOT has made us rethink a lot of things that we previously wouldn’t have thought of.”

“We filled virtually every installation we have to Mob for OIF. If we had cut everything that some people wanted us to cut (divisions, brigades, structure, etc.) we couldn’t have fought this war. I am just cautioning you against cutting stuff we need. Maybe there is room to cut, maybe there is room to save money, but there should be connectivity to the American people we serve. Having costly installations is a price they are willing to pay. Bigger bases become bigger targets. There may be something to be said for keeping stuff dispersed. If you put a major command element like, say, FORSCOM at Ft. Hood and someone hits Hood, not only have they taken out the tactical units but the C2 also.”

“We should come out of BRAC 05 better positioned for the future. We have to think about collective training, maneuver space, and ranges. We also need to have a training capability at home station. It’s easier for the Air Force and Navy because they don’t need land, the Air Force just needs a landing strip and a few buildings.”

“We have to look at encroachment and keep in mind that some places are more user friendly than others. We have to posture ourselves for greater deployability. During Desert Storm, the boats were waiting for us, now we were waiting for the boats because we got to the ports quicker. We need to take another look at the ports; some are more friendly and accommodating than others. Charleston (SC) was friendly; Beaumont (TX) and Jacksonville (FL) were not. At some ports, the unions stood in the way of us moving out quicker. Union rules prevented soldiers from loading boats.”

“We need to keep a good mix of training environments; urban, dessert, mountain, jungle.”

“We also have to keep a presence in our communities. Bigger and fewer may not be better than more and smaller. We have to be near large population centers, this helps

with recruiting and retention. Some places, like Ft. McPherson, contribute greatly to the local community. They love McPherson down in Atlanta, there are no complaints. Closing Ft. Dix was a mistake; it was the second most utilized Mob Center for OIF. Dispersion also relates to C2, it may be a bad idea to have your C2 near your tactical units. On 9/11, the Army's was the only Command Center that wasn't affected by the attack (this demonstrates the significance of COOPs). Dispersion also has value for Homeland Defense."

"Joint installations are important; the McChord-Lewis, Pope-Bragg type situations, but having different services is also important. The Air Force doesn't want to mix with us, we might lower their standards, but we should look for efficiencies at the co-located situations."

"The Army does not *own* any air space in the US; we use it through agreements with the FAA."

"We must leave room for expansion and for changes."

"We should look into linking RC schools and facilities. For example, at Ft. Lewis we have a PLDC for the Guard, one for the Reserves and one for the Active Army, so we're trying to join them so they can share instructors and facilities. Then we said how about we do the same thing with BNCO and ANCO? Now we're thinking about doing this across the country and maybe establishing 5 regional NCO centers. We ought to think about these kinds of things."

"Whatever we do, the RC has to come out of this better off. You ought to go visit McClellan and Dix and see what we did to these places, it will make you puke."

"Force Protection has to be more than just concrete barriers."

"Transformation has to permeate all of our force structure."

"Because of transformation and deployability needs, you've got to build for flexibility and the unknown."

Dr. Parnell: "How do we manage maneuver areas for flexibility?"

Principal: "We put constraints on our weapons systems so that we can train on them."

"I would close Davison Army Airfield at Ft. Belvoir. We have Andrews nearby and there are encroachment issues, noise issues, and a small runway at Davison. That is where they could have put the Army museum. All we have there are 2 UC-35s and 16 helicopters."

“We have to be able to get out of town. You should go visit one of our new deployment facilities at Stewart, Bliss, Campbell, McChord, Hood, or Drum.”

“We are going to centralized management of ammo, this will be a good thing. All I know is that I need ammo to train and fight, let AMC do what it wants with storage and distribution, just make sure I have it when I need it. I don’t want to store it, guard it, and manage it.”

5.) Changes Since BRAC 95 / Final Comments: “The high Optempo of the Global War on Terrorism. Installations are now training and fighting and serving as a refuge for our families. With Homeland Defense, we have to think our way through this. We have got some work to do, we just don’t know right now.”

“Installations must be power projection platforms, that is the only reason they exist! Everything else is ancillary. They should also have training facilities and be safe places. They should also serve as real communities for our families. Installations should blend with and enhance their environment and they ought to respect the Army’s traditions. You have got to respect the traditions of the services, if I wanted to join the damn Air Force I would have joined the damn Air Force, if I wanted to join the damn Navy I would have joined the damn Navy.”

“Why are we doing BRAC? Who asked for this? What happens if this administration loses the next election? The American people are OK with our installations.”

Category: Operations #12
Interviewee: Principal
Attendees: None
Date/Time: 18 November, 2003 1000
Interviewer: Dr. Greg Parnell
Recorder: LTC Rich Hall, MAJ Doug Tuttle, Mr. John Bott
Questionnaire Version: 1

As with some of the other sessions with SMEs and deputies, the meeting with Principal was more of an open discussion than an interview. LTC Hall and MAJ Tuttle have continual interaction with SMEs from FORSCOM.

Principal: “There are a lot of initiatives out there to do home station training, but you’re never going to get away from collective training. You should speak with LTG Inge (1st Army) about this and the mobilization issue.”

Dr. Parnell: “What are the key things we can’t get wrong?”

Principal: “Collective training events – it’s where you develop leaders. Soldier skills you can pretty much do anywhere, the collective training environment is what you need to focus on; combined arms, joint, etc. The admin staff can fit in the margins, make sure you get the joint and collective training piece right. “

“In ’95, we decided to try joint control for housing in Hawaii. It didn’t work because the standards were different. The Air Force wasn’t going to live in Army barracks. RCI can help this. Even in the Army you won’t find predictable levels of service and standards across the board.”

“We need to look at places like McChord and Lewis (co-located installations) for efficiencies.”

“The Guard has some nice training boxes that we should be looking at for our use.”

“The separation between the services is graying everyday. Joint operational training is where we want to go. This is true for the Guard, Reserves, and Active Duty. I would talk to JFCOM about this.”

“Now we have a new deployment criteria that has changed the order of precedence for attributes. Ft. Drum scored very low at one time but it is now at the top of the list.”

LTC Hall: “Drum is a good example of the Guard leveraging an AD installation.”

Principal: “When we did the first round of BRAC, there was no consideration for regional savings. We ended up enclaving places which cut into our savings. There was nothing in the law for enclaving, so we winged it.”

Dr. Parnell: “What do you think of a DIMA?”

Principal: “I’ve always thought we should have a DIMA. The mission commanders being a tenant makes sense to me, but the Installation Management Activity (IMA) cannot treat the mission commander poorly. IMA is not getting the money it needs to improve ranges, training areas, and everything else. In the past, if a mission commander wanted to keep a range open all weekend, he did it, maybe new roofs didn’t get put on buildings that needed them, but at least the range was open. Now, the mission commander has to get permission from the Post Commander to keep ranges open and often times there’s no money for it. I think the IMA model can work.”

Dr. Parnell: “What FORSCOM initiatives do you have underway that could be utilized by BRAC?”

Principal: “Our structure is poorly stationed right now. We overloaded Ft. Hood, then started parceling out the ass and trash.”

LTC Hall: “Unit integrity is a key piece, is this what you’re getting at?”

Principal: “I wish it were that easy. There is an optimal array of forces that in peacetime can contribute to training, BRAC can help pay for the re-stationing of these forces. No matter what installations you close, it will give us an opportunity to re-station more logically.”

“The AC/RC mix is a big issue. The Guard is going to push for the HLD mission.”

“We had a lot more stability in the previous BRACs than we do now– changes in doctrine, transformation, GWOT, etc.”

Dr. Parnell: “What impact does Homeland Defense have on installations?”

Principal: “None. Obviously, force protection has gone up, but I don’t know if I were doing BRAC that I would make up data concerning which installations were better protected. I would tell you that in terms of installations and structure, protection of the homeland has not changed.”

5.) Changes Since BRAC 95 / Final Comments: “Merging of the services is most significant. There is no reason we can’t have combined senior service schools. Places

like Peterson AFB in Colorado have huge empty buildings, there's no reason they can't be used by other services. We tried with McChord once but it didn't work. There may have been some agreements with the standing up of the Strykers, but I haven't been kept in the loop with them. We closed England AFB outside of Ft. Polk, then leased it to the community, then the Army leased it back. We could not stop the Air Force from closing it because it had no Air Force value."

"If we don't get it right this time then we haven't learned anything in ten years."

Category: Operations #11
Interviewee: Principal
Attendees: None
Date/Time: August 29, 2003 1300
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “Concepts in time – how is the Army going to organize and operate in the future? What about the NMS, DPG, and contingency planning? If the Army must deploy on little or no notice, we need to look at global stationing, forward deployment, and deployment capabilities.”

“Conceptually, a second factor is Home Stationing. When you deploy a division, do you bring the command center with you or rely on reach back?”

“Logistics are our most broke concept – I don’t know if we even have a concept for it, it bothers me. Is it ‘factory to foxhole’? Are we going to have a joint logistics command? For stationing purposes, you need to know what your logistics footprint is.”

“You can’t make BRAC decisions without knowing what our global basing strategy will be. If the 1st AD goes from Iraq to CONUS, that is a new way of doing re-stationing. You should read COL Ben Allen’s report on our Global Basing Strategy.”

Dr. Parnell: “Are there any other reports or initiatives we should be aware of?”

Principal: “There’s also a Joint Re-stationing study, a TRADOC study on Force Protection, and GEN Kern’s studies over at AMC.”

“What I was most intrigued about from the TRADOC Force Protection report was that you can no longer do force protection at the front gate, it has to be done in the community. We *know* that Al-Qaeda had guys in the States taking flight lessons and there were even some who went on military installations! To really do FP, all of our installations have to be networked across the services. We also have to be linked in with FEMA, the Intel community, and local law enforcement.”

“(General) John Abrams had some good concepts like merging branches (Arty and AD, Infantry and Armor, MI and Signal). He was starting to reorganize new units along these lines; he was trying to streamline the combat developments community. If you’re going to transform the Army, you better transform TRADOC!”

“Do we deploy properly? When you deploy a division, does all the traditional stuff go with it? (LTG) Richard Cody is looking at all of this.”

Dr. Parnell: “What about training space?”

Principal: “Let’s take a snapshot, say 2018. In 2018, we’ll have 6 Stryker Brigades with 1 in Europe. We’ll have maybe 10 FCS U/As, 3 U/E Xs, and 1 U/E Y (the U/E X is somewhere between today’s Division and Corps, the U/E Y is between today’s Corps and Army). The 82nd and 101st will still be as they presently are, and the 3rd Corps will be as we know it today. Now, station for this. Just based on the U/As, one would think we would need more space just because they can operate over a much larger area. So here are a few thoughts.”

1.) Do all 3 Brigades have to be at the Division HQ’s installation? Could we put 1 brigade in Alaska, 1 in Hawaii, and 1 at Lewis with the Division flag in Hawaii? We try to put them together today namely because of training. This is common to today’s basing strategy; we may be too stove-piped in our branches right now. The FCS will have more of a combined arms concept.

2.) Can we build individual competencies at Home Station without going to MTAs? For example, can you build your competencies at a small base like Ft. Lewis so when you go out the gate to Yakima you capitalize on your premier training time there? Whereas Ft. Hood is a huge training site, but are you trained any better than at Lewis?

3.) The last thing is, we are struggling with digital training. How much of an IT backbone does each post need? What competencies are expected of soldiers coming out of TRADOC training? Connectivity will be big for future training architectures.

“The only training places I know of that *have* to be expanded are NTC and JRTC, this we know.”

Dr. Parnell: “Are there opportunities for Jointness? Is this more of a Joint BRAC?”

Principal: “I was at Ft. Bragg for 2 years, there shouldn’t be a fence between Pope and Bragg. A problem is the different standards. It makes all the sense in the world to combine them (contiguous installations), especially in the Norfolk area, and when you get into force protection and anti-terrorism, it must be done. This should lead to other consolidations such as budget systems, maintenance, etc.”

Dr. Parnell: “How about joint training?”

Principal: “Training should be joint tonight! Look at Millennium Challenge 2002, we had 4 services working 4 different boxes. The western confederation of training areas has so much potential: Fallon in north Nevada, Nellis, NTC, 29 Palms, China Lake NWC. Alaska could be confederated with it also. European training could be confederated as well: Germany, Poland, Romania – all of those old Warsaw Pact training areas. BCTP needs to be joint also, don’t know how you do this though. Joint logistics has me worried.”

5.) Changes Since BRAC 95 / Final Comments: “Two areas that really need realignment for efficiencies are TRADOC and AMC. When I was at TRADOC I was taken back by the parochialism of the commandants, the way it manifests itself to fight BRAC is amazing. Leavenworth, Carlisle, and TRADOC have to lead the way on joint doctrine and training. Arty and ADA should be merged, so should Signal and MI. Mr. Rumsfeld is terrific for this (BRAC). If we don’t do it right under him, it won’t be done.”

Category: Operations #10
Interviewee: Principal
Attendees: Deputy
Date/Time: 25 July, 2003 1400
Interviewer: LTC Michael Kwinn
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “There are some potential positives, my worry is getting it right. I worry about our training base for medicine to support the warfighter. I worry about our power projection capabilities at our MTFs (Medical Treatment Facilities). I worry less about delivering healthcare locally. I want our in-coming surgeons to be able to work on more than just typical peacetime soldier injuries. They have to be able to ply their trades, we need skills maintenance.”

23% of the MEDCOM TDA is battle rostered against hospitals.

“When we send a deployable hospital out, it needs the same skills as a combat hospital.”

LTC Kwinn: “Is it the right number, the right location, or something else?”

Principal: “You need the right patient volume to support a full practice.”

50% of the Army medical community is civilian: 50,000 strong, 27,000 civilians

LTC Kwinn: “Is it better to have a few large concentrations or several smaller facilities?”

Principal: “We had 49 hospitals in 1989, today we have 28. Seven of the facilities that were hospitals are now super-clinics. At Ft. Rucker what I really need is flight medicine, not a full-blown hospital. At Ft. Hood and Ft. Bragg we have very large facilities. We are a population driven organization and we also adapt with technological advances. A variety of things affect our dynamic.”

LTC Kwinn: “How do retirees play into this?”

Principal: “They definitely do. At places like El Paso they are a major part of our population. Tricare now has the ability to give coverage whether there is an Army medical facility there or not. The cost to DoD is lower because medicare/medicaide kicks in.”

“All of the commanders want more green-suiters at their medical facility.”

“Our GMEs are vital to us in terms of recruiting and retention.”

2.b) Joint Basing/Stationing: “We are pushing more along these lines. We are putting forth the idea of a Joint Medical Command. We oppose a Defense Health Agency, but a JMC that understands military medicine is a good thing.”

LTC Kwinn: “Joint because it’s military, where as Defense would be to civilian oriented?”

Principal: “Yes.”

“At places like San Antonio, do we need a Wilford Hall and a Brooke? Wilford Hall is 25 years old, they do Air Force AIT at Lackland and they use Wilford as a power projection platform.”

2.a) Transformation: “We’ve been dovetailed in right along. We’re combining MOSs and increasing training from 10 weeks to 16 weeks. We are sending them right into Iraq. We have created a “Tank Table 8” for medics for sustainment. They need to keep their medical skills while being soldiers.”

2.e,f) Homeland Defense/Force Protection: “We are restructuring our Combat Support Hospitals so that they are 100% mobile. It’s a 44-bed hospital. It’s a little smaller than a MASH, they are designed to be able to add 40 more beds, then add 80, then join two of them to make a 244-bed hospital. It has modules that seem to work in Iraq. We are making them more mobile and deployable.”

“Now, for Homeland Defense, the Reserves have MEET sets (Mission Essential Equipment Training). I say we put one in every FEMA region with a 44-bed module.”

LTC Kwinn: “Are there any Reserve Mob issues coming up?”

Principal: “Yes, their medical readiness is subject to debate. We put \$23 million dollars into Reserve dental to make folks deployable, but 30% were non-deployable.”

5.) Changes Since BRAC 95/Final Comments: “The Joint functional analysis – it’s different than a pure facilities focus. If you close Ft. Gordon, for example, I can move my people to other places. From the medical perspective, we should consider leveraging what the VA does.”

“In Europe I had a major hospital planned for Heidelberg which is on hold. In Korea they’ve got some quality hospitals working at state-side levels so the Army doesn’t necessarily need its own.”

Category: Operations #9
Interviewee: Principal
Attendees: Deputy A, Deputy B
Date/Time: July 28, 2003 1000
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “There are two things we need to think of.

1.) “The Political nature of BRAC – whether or not we can ever really do what we want to do and need to do. Every politician just wants to keep ‘their’ place.”

2.) “It (BRAC) has to be related to the future. There has to be linkage between installations, stationing, infrastructure, institutions, equipping, and RC (see attached table). I have found that we have bunches of people working all of these issues separately; we have a stationing bunch, an infrastructure bunch, an equipping bunch – it has to be correlated. The stovepipe method to solving problems bothers me. We are now deciding where to put the U/As, but it has to be correlated with everything else.”

2a.) Transformation/Objective Force Impacts: “It (the Objective Force) should be the driver for certain installations. Ultimately, the fielding of the FCS should essentially be the driver for installations. BRAC should be anchored on this (he holds up the Objective Force 2015 Report, see “installations section” pages 29+30). The ‘Objective Force’ is nothing more than a synonymous term for the Army of the future.”

Dr. Parnell: “How can we drill down to get the requirements?”

Principal: “You have to get it from each organizations lane (mentioned above).”

Equipping – ASA-ALT	Institution – TRADOC/AMC
Stationing – G-8	Installations – ACSIM
Infrastructure – G-6	RC – OCAR/NGB

“I will be pulling it together in a report in a few weeks for the Army of 2020.”

Dr. Parnell: “What issues do you see are beyond the control of the Army?”

Principal: “The Joint piece. Networking installations means a new way of doing training and education, e.g. distance learning. This will impact how many and which installations we need. This is not completely under our control. With the proper equipment, you could do up to a division level exercise virtually.”

“I don’t think we have a firm grasp on the mix between installations, institutions, and infrastructure. We are wed to brick and mortar.”

“We need to define what we need, then let that drive our resources. The Army has always been 24% of the Defense budget. As long as we have a short range planning policy, we will never get beyond it.”

2b.) Joint Basing/Stationing: “I don’t know the details of Joint basing, not sure what’s intended by it. It’s important to consider, we often do not figure out jointness until it’s shooting time. If we were actually located next to each other, we could probably solve some of our problems. We should train with them (the other services) on a continuum. We talk about interoperability, but not interdependence. Take a Ft. Lewis and McChord situation – hell, McChord might as well be in Ethiopia. We need to get to the next level above co-location. I think SOCOM has this figured out. The JNTC is a step in the right direction, but I don’t know how far they are going to get with this. Installation staffs are one thing, the mission is something different.”

Dr. Parnell: “Any other issues? Are we going to need more land?”

Principal: “It will be a mix of land and simulators. We have little packets and parcels of land everywhere, but they are really draining off MILCON dollars. I do not know whether we need more, I do know that we will need some large parcels of land but not necessarily contiguous. There are 200 UAVs in a U/A, can you imagine the airspace needed for that?”

“The U/A will have a front of 200-300 kms, we just don’t have that space. It will come down to grouping together (architecturally) a bunch of installations. A related small grouping of larger installations is the way to go.”

“Having an Army facility in every congressional district has its political value but it doesn’t help training.”

“My key point is that the mission should drive the installations.”

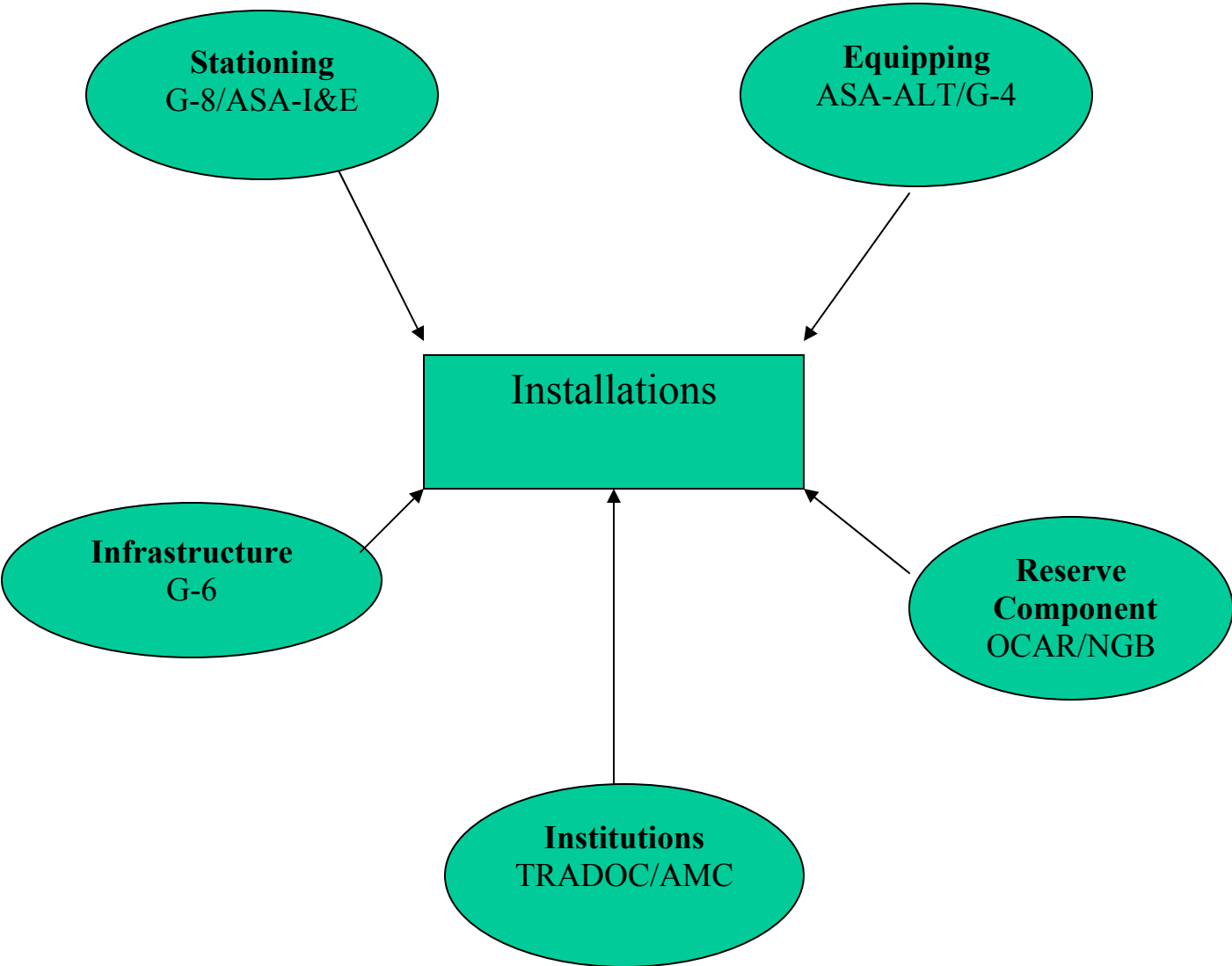
“Have we ever thought about what we want or need? That should drive us to make decisions. We’ve got to get beyond the FYDP. The political system we have will never let us organize for the future.”

“Do we have infrastructure that is of no value? Absolutely!”

“Do we waste money on them? Absolutely!”

“Keeping little places open will hurt us.”

“Installations for the Objective Force are *profound combat multipliers*. They are the **sustaining base** for the fighting force in more ways than they used to be!” (emphasis not added by author)



Category: Operations #8
Interviewee: Principal
Attendees: None
Date/Time: 02 July, 2003 1100
Interviewer: Mr. John Bott
Recorder: None
Questionnaire Version: 1

The meeting with Principal was more of an open discussion than an interview. He will be a good resource as we move forward as he has a wealth of institutional knowledge.

1.) Primary Concerns: “I think Mr. Rumsfeld has this right, we need to do this together, otherwise you end up with 4 ‘service BRACs’. At places like Pope-Bragg they shouldn’t be separated by a fence. I’ve seen in Texas and Hawaii where attempts were made to merge operations but it didn’t work because we didn’t do it right. We don’t need a bunch of small installations that take up people and resources.”

2a.) Transformation/Objective Force Impacts: “Transformation will impact stationing, it’s got to because you’re doing things so differently. We have to deploy *much* quicker. If we have to move in 96 hours, we have to be able to. If you’re going to transform the Army, you have to get everyone on board.”

3a.) Worst-case Scenario/Contingency Planning: “Dr. College needs to be told how many brigades and divisions you’ll have. He needs to look at all installations and consolidate. We don’t need half the stuff we’ve got. We can do things like have Marriott feed us, and other privatization measures. We went to 5 or 6 depots last time, there’s plenty of land there, why not put HQs on depots?”

5.) Changes Since BRAC 95/Final Comments: “If it doesn’t have value, close *it*! Military Value is a buzzword; if we’re going to have the same number of units, the maneuver installations are OK. Why not use Ft. Jackson for all training (Basic)? Knox is not the best place for tank training. The Ft. Leonard Wood construct is a good example for not using installation types. Ft. Belvoir is a good place for all HQs, moving out of leases is a great idea. We have to find a way to leave the politics out of it.”

Category: Operations #7
Interviewee: Principal
Attendees: None
Date/Time: 02 July, 2003 1100
Interviewer: Dr. Greg Parnell
Recorder: CPT John Harris
Questionnaire Version: None (open discussion)

We met with Principal to discuss the Army's new Strategic Readiness System (SRS).

The idea for SRS is based off of the balance scorecard. SRS's goal is to measure and consolidate key readiness indicators. One of the key ideas from the meeting is the idea that there are "leading and lagging measures." This maybe useful to help develop metrics and show traceability from BRAC study back to SRS measures. This system may die with the old chief.

Category: Operations #6
Interviewee: Principal
Attendees: None
Date/Time: 02 July, 2003 1000
Interviewer: Mr. John Bott
Recorder: None
Questionnaire Version: 1

The session with the Principal was more of an open discussion than an interview. We will be able to call on him for future assistance. He will serve as a good POC in his subject area and is a wealth of institutional and operational knowledge.

- 1.) I have been working on 2 primary projects:
 - 1.) Joint Training Capacity – where can we find efficiencies
 - 2.) Global Posture and Global Positioning

“We are bringing home 2 divisions from Germany in the next two years.”

As far as we are concerned, there are 3 basic criteria for an installation:

- Power Projection
- Range and Training Capacity
- Expandability

“The ability to project is becoming more and more important.”

“Echelonement is becoming a big issue. By December '04 we will be moving towards a standing J-Force HQs to be stood up by '05. How the Army organizes underneath it is an unknown. We need to figure out how to merge and reconfigure 5th Corps and USAREUR to do both Title X and operate. The Objective Force echelonement decision is due by July '03. We are now structured as SSC – Corps – Division – Brigade. Something will go away, probably either the Division or Corps.”

Category: Operations #5
Interviewee: Principal
Attendees: None
Date/Time: 01 July, 2003 0730
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “Our biggest challenge will be our ability to do it ‘right’, because ‘right’ is in the eye of the beholder. The political realities of what you can and can’t do will be a major problem.”

“There is great opportunity here to fix some things that need fixing. What we may say is very important, Congress may disagree with and ask if we’ve looked at 2nd and 3rd order effects.”

“There are some places we should consolidate – some HQs and leases. I’m not against leases, but in our area (the NCR) there are some moves that can be made. There’s a whole lot to be said about security at a place like Ft. Belvoir as opposed to the Hoffman Building.”

“We did a U/A study where we looked at training, billeting, and deployment as the primary considerations. We need to see how much training will be virtual. This provides us with a great opportunity which we are taking advantage of, but as we field the more modern systems we can do more.”

“I think we will use more Joint training going forward – things like NTC and Twenty Nine Palms.”

“As for the impact on the Reserve Component, we need to look at the force mix and maybe move some more chem.-bio units to the Active Component, also some more Psyops and Civil Affairs units need to go AC. We need to get to a rapid, fully deployable Active Component so we don’t need to mobilize the RC to accomplish a mission. This would represent a shift from the Abrams Doctrine. You’re still going to have a need for Mob Stations but there will be less stress on them.”

“As the team (TABS) approaches this, the starting point should be ‘What is the go-to-war requirement?’. Sometimes, to save spaces, the easiest place to go is the combat units, but we have to be careful we don’t go there. We should look at the TDA slots first.”

Dr. Parnell: “What are some assumptions we should use for the 2025 force?”

Principal: “We have to be careful what we look at to contract out. My position is, you start with the combat force and say ‘This is non-negotiable!’ But we also need to

keep in mind that we need military folks in analytical positions as well, not all of our analysts should be civilian or contracted out. Every time we contract out we lose *people*, we need to be aware of more than just the bottom-line each year. The same principle applies to installations.”

2a.) Transformation/Objective Force Impact: “Digitized ranges, maintenance facilities, barracks upgrades, RCI, railroads, ammo hot pads, a lot of focus on the ability to rapidly deploy. There are also encroachment and environmental issues – the various animals.”

2e,g,f.) Homeland Defense: “A great number of soldiers are locked up doing gate guard, we need to be able to contract out installation security, we’re tying up ‘go to war’ soldiers doing this. Also, at airports, weapons sites, etc. I can’t tell you today what my requirements are for Homeland Defense, but we know it will increase across the board (the dollars tied to it).”

Dr. Parnell: “What about the 25% excess we hear about, comments?”

Principal: “25% of what? I have not heard the metric. OSD gets accused of a lot of things that I have no idea where they got them.”

Dr. Parnell: “Depots, logistics – opportunities for consolidation?”

Principal: “AMC is doing a lot of work in this area, there is room for efficiencies. In my mind, the area that is ripe for consolidation is logistics. Private industry went to school on the military, now it’s our turn to go to school on private industry; Wal-Mart, Sears, etc. They have distribution systems that are efficient.”

“If we’re going to lighten ourselves up, we need to have responsive logistics that don’t have to come off of a green truck. We have to do a better job of inventory management. The danger to us is, ‘what if I need it but can’t get it?’. You have to have some on-demand storage, but we need to be smart about it.”

“We’re going to have a lighter force (the 82nd, 101st) for a while. We’re just finishing the 1st Cav for digitization, the 4th ID is only 1 brigade digitized.”

Dr. Parnell: “What about keeping BRAC synchronized? Anything else we should be tracking with this?”

Principal: “What AMC is doing – consolidation of arsenals, supply, log initiatives. G-4, AMC, G-3 are the key players in this.”

3a.) Worst-case Scenario/Contingency Planning: “We will still have engagement on the peninsula, but it will not be as big as it is now. Europe also will have a presence but it will probably not look like it does today.”

5.) Changes Since BRAC 95/Final Comments: “We already got the low-hanging fruit in ’95. I do not think we are looking at a force reduction, our biggest challenge is from the political standpoint – doing things in conjunction with Congress.”

“We have an opportunity to do some consolidation overseas. We are politically more receptive to bringing stuff back. The C2 played a crucial role in ’95, and they will play an even greater role this time, as will the Joint Staff. JFCOM will play a much greater role in training forces, so there are more opportunities to do Joint. McChord-Lewis, Pope-Bragg type situations – how much can we save? Medical, dining facilities, utilities?”

“RCI has been a win-win for the Army, why not barracks? If it works for housing, why not have the same approach for dining facilities? You have to watch things like commissaries and PXs.”

Category: Operations #4
Interviewee: Principal
Attendees: None
Date/Time: 18 June, 2003 1600
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

NOTE: The interview slot for the Principal was scheduled for 1600-1630, however it did not begin until 1610, thus limiting our time with him.

1.) Primary Concerns: “My major concern is training areas, both maneuver land and ranges. We still have to have ranges; simulation will only get us so far. How else are we going to do collective training without land and ranges? We don’t fully arrive at the Future Combat System (FCS) until 2015, so up until then we still have a current force training requirement.”

2a.) Transformation/Objective Force Impacts: “Different caliber weapons, longer range weapons, more distributed battle space. We will be fighting in a larger area.”

2b.) Joint Basing/Stationing: “NTC along with Nellis AFB and Twenty Nine Palms provides for a good multi-service training environment. Ft. Bliss along with the MacGregor Range Complex and White Sands Missile Range also provides some good opportunities. Along with JRTC, we should make sure we keep these two key locations.”

“In Hawaii we are expanding Schofield by buying Parker and Del Monte but we must hold on to the Kohukas.”

“Yuma, Fallon, Choco Mountain, are prospects for joint use. Eglin AFB has good vertical take-off.”

2c.) Climate Deficiencies: “I don’t think we have any major deficiencies as far as climate variation goes.”

3a.) Worst-case Scenario/Contingency Planning: “We have room at Ft. Riley, Ft. Bliss, and Ft. Carson and could have room at Ft. Knox and Ft. Benning if we made some shifts. But we need to improve the family housing, motor pools, and ranges.”

3b.) Mobilization: “We must improve our Power Projection capability. Ft. Bliss, Ft. Stewart, and Ft. Campbell are OK. We need to be able to mobilize the Guard and Reserves. We have to take a good look at PMMTCs, when divisions come back they will occupy space on the installations, but we will still need the Power Projection capability.”

5.) Changes Since BRAC 95/Final Comments: “It’s a hard question. People look at infrastructure and say ‘We’ve got to get rid of stuff.’ It’s usually TRADOC and AMC posts that get looked at, FORSCOM is OK. I don’t have an answer for it, but the reason it’s so expensive to run an installation is because they have been so under-funded for 15-30 years. We put no money into them; the housing is poor, the water plants are poor, etc.”

Category: Operations #3
Interviewee: Principal
Attendees: None
Date/Time: 9 June, 2003 1400
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “We posture ourselves so that in the future we have the training land we need as well as other training enablers such as ranges and simulators.”

“We can’t just go and buy land, so we need to look carefully at what land we own.”

“In some cases we own land where the infrastructure (billeting, mess halls, etc) isn’t that great, so they may be looked at for BRAC, but we can *never* get the land back!”

“Environmental issues are a big concern.”

“Hawaii is strategically very important to us, it is worth what we pay in environmental considerations.”

“We want to make sure we bring troops back to CONUS with training and force protection as paramount considerations.”

Green, Amber, Red Training Cycle:
Green – full training
Amber – post support
Red – individual training

“At installations with only two brigades, you are either at Amber or Red, so I prefer installations with three brigades.”

“When a CBG comes back, it stands down for a year, the Army doesn’t do this.”

“The AC/RC mix is an important factor, we need to look at this.”

“It would be good to have a QDR view along with BRAC.”

“We need varying climate and terrain to train on.”

2a.) Transformation/Objective Force Impacts: “Objective Force is able to operate over a larger area, there is a requirement for more maneuver area.”

“Simulators will help but there will still be the need for live training areas.”

“Due to reach-back, the need for CSS has been cutback a little, but there is still a need for these capabilities.”

“6 Month unaccompanied tours put more strain back at home stations: daycare, commissaries, etc.”

“More brigades CONUS puts more strain on CTC throughput.”

“I see JFCOM taking a greater role in training the forces. We must maintain out Title X responsibilities.”

“Looking at BRAC from an OSD perspective is a good thing, but we shouldn’t lose our Army perspective.”

“Losing England AFB near Ft. Polk was a missed opportunity for the Army.”
(From BRAC 95)

“We need to look at the other service testing facilities for training.”

“We are now looking into a JNTC, but we should think of it as a capability, not a ‘site’. The other services do not have anything *close* to what we have (in terms of training land).”

2c.) Climate Deficiencies: “We need a good, no kidding, jungle area.”

“We do not have post-alert train-up time, especially for RC CS and CSS units. Not having the training capabilities at home stations is an issue.”

2g.) Homeland Security: “This is more of an RC/NG role with the AC as a back-up. The training requirements for it are a little different. We don’t need large land areas but we do need regional MOUT sites.”

3b.) Mobilization: “A lighter force makes us more mobile but we still have to be *trained* in advance. Reach-back capability allows you to have a lighter footprint in the AOR. With the SBCTs you can put a force on the ground, get the job done, and come back. Airfields will become more important going forward. The mix of Legacy, Interim, and Objective Force puts more requirements on an installation.”

4d.) Army Use of Other Services' Installations: "This BRAC we need to look at Joint use of their existing active installations. We need to see if there are other services' lands we can use."

5.) Changes Since BRAC 95/Final Comments: "Train, Alert, Deploy should be the new construct going forward for RC forces."

"We need to look at BRAC from a DOD/Joint stand point. If the Army's desired outcome is not in-sync with DOD's desired outcome it could cause problems. We need to ensure we are *all* in sync."

"There are not enough brigades to do all that the Army wants to do *and* maintain a good quality of life. The Army is too busy right now."

"The Navy can be in Green cycle and fulfill a requirement just by *being there*, the Army can't do this. If you're at NTC, you can't do something else."

"G-3 supported TIM for base support functions but not for training enablers, they lost the fight on that one."

"I am concerned that DOD will take over running the installations. This would be OK for base support functions but not for training enablers. If DOD took over training enablers, they would suffer, but I don't have an issue with them running security, mess halls, etc."

"With IMA running the show we have folks in charge who have been S-3s, unit Commanders, installation Commanders, etc. They've been there and have an appreciation for what goes on."

"I don't think we should make changes just for changes sake."

"Institutional training provides good opportunities for Joint possibilities."

NOTE: DoD Training Transformation effort by Dr. Chu – we need to get more information on this.

Category: Operations #2
Interviewee: Principal
Attendees: Deputy A, Deputy B
Date/Time: June 9, 2003 0930
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “Installation Information Infrastructure Modernization Program (I3MP). We have a grand plan to implement how the Army will do reach-back by leaving behind some elements and deploying only the tip of the spear.”

“We are already down a path that we need to take into consideration. There are existing Joint programs but we need to see how we can better collaborate. There are sprinkles of jointness going on, but not enough.”

“DoD initiatives to set the Force Structure. I fear all the stuff going on (size of force, composition of force, encroachment decisions) will not be synchronized.” (Deputy A)

“I am also concerned about IT MCA projects that are already programmed. I don’t want to see us build something on an installation we end up closing.” (Deputy A)

“One of the things about the last BRAC that got really dorked up is closing a base that has other off-post responsibilities.” (Deputy A)

He gave, as an example, the fact that Ft. Ord was closed and that it was responsible for Camp Roberts that wasn’t closed (Camp Roberts runs a satellite facility). This meant that another installation, Ft. Lewis in this case, had to step up to take over part of its operations. He was pointing out that we need to watch “second and third order effects.” (Deputy A)

“We need to look at optimizing opportunities on installations where we have put in upgraded IT infrastructure.” (Deputy B)

Locations of the services IT schools: Army – Ft. Gordon, Air Force – Keesler AFB, Marine Corps – Quantico, Navy – spread around Orlando and Norfolk. There may be efficiencies here.

Dr. Parnell: “Are there measures of IT capabilities that capture the value of the installations? What measures should we use?”

Deputy B: “There are service level metrics. Talk to ISEC, they have that info and worked the last three BRACS. They have a ‘Lessons Learned’ book.

Principal: “They (ISEC) manage the I3A (Installation Information Infrastructure Architecture).”

2.g) Homeland Defense: Army Knowledge Management (AKM) – a “virtual one network”. “We have put our arms around the Army’s various networks, they all have to be taken into consideration as we move forward. They are all at different states. We also have to pay attention to what Defense is doing.”

“First we consolidate, then we regionalize. We also have redundancy built in for Continuity of Operations (COOP) purposes.”

4.d) Joint Basing/Stationing: “When there is a situation where it doesn’t really matter where a unit is stationed, then it should be joint if possible. However, moving a course is one thing, if the assets for the course can be replicated, but if they can’t be replicated, then the school should stay where it is.”

“TRADOC was funded real poorly, so that we couldn’t support the Air Force if we had to. I sure would have liked to have been funded the way the Air Force was. It costs a whole lot less to run a Ft. Gordon in the Army than it would if it were in the Air Force.” (Principal was former Post Commander at Ft. Gordon)

“We should look at situations like Ft. Bragg and Pope AFB, but we need to determine whether there is going to be a joint installations command or whether we will give a particular service the responsibility of running a mega-installation.” (Deputy A)

Dr. Parnell: “As for Force Protection, have costs been run up?”

Principal: “Yes, this has been fairly significant. There are little places we have that just couldn’t do the mission so they had to go to rent-a-cops or use reservists. Also there were situations like Wright-Patterson which has ELEVEN gates! There are currently 9,000 Army Guard troops guarding Air Force bases. Each installation needs to look for internal efficiencies. We could use biometrics in lieu of people. There’s a program out there but it’s under-funded.”

“We have signal units guarding posts.” (Deputy A)

5.) Changes Since BRAC 95/Final Comments:

Dr. Parnell: “Any questions we didn’t ask but should have?”

Deputy A: “We have a one-time shot to do everything synchronized and do it right. Everything seems to be tracking on its own lane – encroachment, objective force, moving forces from Europe – we need to synchronize.”

Deputy B: “We need decisions on where the Stryker Brigades are going. Also, distance learning is becoming a big thing, this could lead to a potential drawdown of locations.”

Nellis and NTC are contiguous; there could be possibilities there.

“Every place I go to is BRAC-proofing.”

There are a high number of small locations and facilities throughout the country, “We are spending lots of money keeping them connected.”

Category: Operations #1
Interviewee: Principal
Attendees: None
Date/Time: June 5, 2003 1400
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “Get the Army position correct for the Army and not let Congress make decision. If we should keep an installation, then say so, if we should close an installation, then say so.”

2.a) Transformation/Objective Force Impacts: “The U/A maneuver box is significantly larger than the maneuver box for a traditional maneuver brigade. For example, if an Objective Force U/A were to invade DC, one battalion would be coming up from Richmond, one would be coming from Front Royal and the third would be coming down from Pennsylvania. The point being, it covers a much larger area. We will need additional maneuver space. As we transform, we will need places that can grow. NTC with additional land and Ft. Bliss are all we have that can handle it.”

2.b) Joint Basing/Stationing: “More importantly, how can the other services use our installations. I don’t know if we can use their installations, but they can certainly benefit from ours. There may be some possibilities, like maybe somehow using Nellis and NTC together.”

2.c) Climate Deficiencies: “Not that I’m aware of. We should strive to keep an Arctic environment, but right now I think we have a good mix. We should also try to keep the CMTC in Europe.”

2.d) Encroachment: “The Army should remain concerned. We’re doing less training on weekends in places like Graffenwoer. It should be kept uppermost in our minds.”

2.e) Force Protection: “The more you consolidate, the more vulnerable you become. For example, Ft. Hood makes a great target. However, BRAC shouldn’t be too concerned with it since we will protect the installations we keep. It’s not as though we should move things into the heartland to make them safer.”

2.f) Homeland Defense: “Not so sure Homeland Defense repositioning has a major impact on BRAC. Much of what we do for Homeland Defense (e.g. preemption –

Afghanistan and Iraq) happens overseas. Being near good transport is what's important, the ability to project forces."

2.g) Homeland Defense Installation Impact: "I can't think of anything."

3.a) Worst-case Scenario/Contingency Planning: "Worst-case stationing would be to have to put several brigades in an area that is not accessible. Reasonable proximity to a seaport or a place with good rail is what you want to keep. We are moving towards temporary basing overseas, a rotational basis. It reduces the overseas footprint. We should continue to pursue a rotational overseas basing strategy – it has less costs, fewer security concerns, and fewer quality of life concerns. The move from Germany will have a huge impact on your work, it could happen fast."

3.b) Mobilization: "Army Transformation will improve mobilization, it reduces what is needed to get to the fight. However, even though it is more mobile, we will still rely on sea transport to get most of the stuff there. We should continue to utilize pre-positioned stocks. We will depend more on air, less on sea, but we're still limited by air."

4.a.) Joint War-fighting: "We're going to have to capitalize on multi-service installations. For example, why can't we put some of the Air Force units onto Army installations?"

4.d) Future Deployment: "It may be my bias, but I think other services can benefit more from Army installations than we can from theirs. Our installations are larger and more multi-functional. I'm not sure how we take advantage of theirs."

5.) Changes Since BRAC 95/Final Comments: "Not sure what we looked at last time. We must look at the ability to maintain a healthy base – e.g., the community wants you there, there is a good work force, there is a reasonable cost of living."

Comments.)

Dr. Parnell: "Any questions we should have asked?"

Principal: "Don't know if it comes out in BRAC analysis, but the local work force is key. In some parts of the country if you give them a GS-12 job they're appreciative and will work hard, we should look to stay in areas with a reasonable cost of living. We must keep the DA civilians in mind as we do this."

Category: Logistics #8
Interviewee: Principal
Attendees: Deputy
Date/Time: 3 December, 2003 0900
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “The process has got to be without prejudice and must be transparent, it should be above reproach. There cannot be mistrust in the process itself. From a logistics perspective, I’m concerned we don’t do something stupid. We cannot close a military installation we may need later. When it comes to military value, it’s going to be subjective. Some of the areas we’ve invested in with logistics may not be relevant in the future.”

Dr. Parnell: “What initiatives do you have underway that BRAC can support?”

Principal: “Operational C2 can be conducted from home station now, this reduces the amount of stuff we need to send forward. Home station’s ability to conduct C2 until it needs to go forward is important. SOCOM does this already, we want to take that concept and fit it to logistics.”

Dr. Parnell: “Emphasis on Joint this BRAC – what are the opportunities?”

Principal: “There are significant opportunities, the problem is getting everyone to agree on military value. OSD involvement in this BRAC has got to include defining what ‘joint’ means up front. The issue is how we define joint. The one area we’re focusing on is distribution – the procedure to do joint supply is not agreed on.”

Dr. Parnell: “How should we measure military value of logistics for our installations?”

Principal: “It’s difficult. First, you have to define the mission. Capacity by itself doesn’t mean anything, what’s important is how it supports readiness. How about an attribute like ‘responsiveness’? Would it be proximity to a seaport? How about the network to get to the seaport? TRANSCOM should tell us what APODs and SPODs to focus on. We have to be able to define the attributes – what does it mean to be able to support readiness? Defining the attributes is the hard part, getting the data should be easy. We need to identify what the military value of depots is. What activities are important to be done in depots?”

“Maybe one way of approaching this is to say what the ideal installation is and define its attributes.”

Dr. Parnell: “If there were a DIMA, would there be opportunities in the logistics area for this to be a factor?”

Principal: “It would be better to give one service the executive proponentry for it than to have OSD run it (installations). The issue gets back to joint procedures. We would need to define the left and right limits and set objectives. OSD tends to think that the only way it can improve things is if it takes over running them. Are there opportunities when you have abutting installations? Absolutely! But the procedures need to be defined.”

Dr. Parnell: “How do we establish the capacity for logistics for 2025? Do we just use OSD’s force structure and project logistics requirements for that future force structure?”

Principal: “The baseline is the current force structure. In defining military value we have to put a lot of weight on expandability, flexibility, and adaptability. These terms are relatively esoteric and we need to spend some time defining them. OSD has to tell us what the major power projection platforms (PPPs) will be, as well as the key airfields and seaports.”

Dr. Parnell: “In logistics, do we get more flexibility by being able to contract out?”

Principal: “That actually reduces your flexibility. If you depend on contracting, your hands are tied. Some people say we keep our unused capacity in case we need it during war, well hell, we’re at war! Some of our excess may be because it’s mismanaged. The challenge for us in the depot system is figuring out what we want it to be able to do.”

5.) Changes Since BRAC 95 / Final Comments:

“I would have a hard time giving too much credit for having a good IT infrastructure.”

“Our installations need to be good homes for our families.”

“We need to consider the retirees in the area.”

“The joint process (JCSGs) are about two-months ahead of the services. This creates a problem in getting service inputs into the joint process.”

Category: Logistics #7
Interviewee: Principal
Attendees: None
Date/Time: 11 September, 2003 1130
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “I’m concerned that the political environment will negate the good you do and that the services might become too parochial and not think jointly. We are a split-based command, and we would like to move to Ft. Eustis or Ft. Story as soon as possible, we don’t want to wait until ’05.

“Our piece, as a MACOM in a joint environment, often gets us left out of the development process. We need to make sure we do not eliminate our power projection platforms (PPPs) and strategic ports. Proximity to a PPP is important when looking at installations and which ones will survive.”

“We only have two strategic ammo plants, SUNY Point and Concord, one on each coast.”

“The ability of the installations to be upgraded for new technologies, like communications, are also important. We are relying more and more on technology at the ports. During OEF we had bottlenecks at the ports.”

“We have 14 strategic ports, the Transportation Engineering Agency (TEA) has all the data you need on ports, they are located in downtown Norfolk.”

Dr. Parnell: “Does your Command have a role in Homeland Security?”

Principal: “The Coast Guard is responsible for the security, we are just a tenant at the ports. Our CONUS units don’t even have weapons and masks, we are a TDA organization.”

3.b) Mobilization: “We have 214 active duty military in our organization and 3000 reservists, we rely on them heavily. We have to call up the reserves to deploy active duty soldiers; we have no active duty DSBs (Deployment Support Brigades). We are working with LTG Helmly to make the DSBs multi-compo.”

“Something that needs to be looked at is which reserve units are going out of which ports, it is not done right presently. 80% of CONUS power generates from 12 PPPs.”

Dr. Parnell: “What about unit manning?”

Principal: “Being that we are a TDA organization we are not as impacted by it. The problem I have is that we were cut down too much. We can fix manning by leveraging the guard and reserves. In the past our reserves never deployed, now they do.”

5.) Changes Since BRAC 95 / Final Comments: “Our Ops center is at Ft. Eustis, and our HQs is split between Eustis and Alexandria. If I were king for a day, I would collapse our HQs down and utilize Eustis fully. Moving us to Ft. Belvoir does nothing for us, we’re still split. To maximize synergy for us at Eustis, we could also move the TEA there. I think there is support to move folks out of the Capital region, We’d be the first to volunteer.”

“I totally support the joint route, I think we need to consolidate what we can.”

Category: Logistics #6
Interviewee: Principal
Attendees: Deputy 1, Deputy 2
Date/Time: 09 September, 2003 0800
Interviewer: Dr. Greg Parnell
Recorders: MAJ Adam Shepherd, Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “This is the critical BRAC in the Defense Department, and also the hardest.”

There are four main characteristics that make it different from other BRACS:

- 1.) The Joint perspective
- 2.) Force Protection
- 3.) Moving to a distribution focus (‘factory to foxhole’)
- 4.) Unit Manning (this is not just about ‘people’)

RCI is a great idea – 20 years of BAH going into RCI or 20 years of money going into a house we’ll own? At Navy installations, people live off-post.

“We have many models for stationing an Army division (housing, training), but many of our models do not connect well to the industrial base.”

“The issue we need to look at is the places that do specialized munitions – we need to consolidate.”

“One reason for going to IMA was to improve the quality of our installations by having standards – some of the have-nots would start to get funding. This same principle applies to the ‘factory-to-foxhole’ concept.”

“We need to evaluate the state of our installations.”

“We need to know where our Centers of Excellence are – an independent assessment. For example, Monmouth was established as CECOM Headquarters because AT&T-Bell labs were nearby, but that is no longer the Center for Excellence for that mission.”

“Where is the soldier focus for the US Army? Some say Ft. Benning, but our Soldier Center is in Natick. It (Natick) is a Joint installation that has the Postal Service, FBI, and Marine Corps at it. It is near MIT – how do you evaluate a University? Maybe what we do is sell it to MIT.”

“We do small arms at Picatinny, maybe we could tie Picatinny to West Point and Natick Labs so that we have a geographic Center of Excellence in New England or the Northeast. There’s a political aspect to being in New England as well, there are a

hundred Universities in the Boston area. What I'm saying is that there's a different way of looking at things."

"Another one that troubles me – proposals to consolidate all of the service research agencies. The Army's is in the research triangle in North Carolina – how do you calculate the Military value of that? We have no way of objectively analyzing the loss of that capability."

"Collectively, when you say 'factory-to-foxhole', where does it all come together?"

"What about the PEO/PM community? Most of them are on industrial base installations."

Other pieces – build an enterprise network of systems that requires infrastructure, DLA/TRANSCOM/AMC. The way the JCSGs are organized will not get us there. They are organized around the old supply and logistics stovepipes. One of our proposals is a Joint Logistics Command.

TRANSCOM should be a 'surface' command. Not just ground.

The enterprise solution – a lot of people have their fingers in it but you can't build an enterprise without it all being connected.

"If a blackout occurred here, we could be cut out of the loop with what's going on in Iraq and Afghanistan. We need back-up power."

"There are going to be some consolidations across the industrial base, I don't know what the other services parts are. We have four NASA pieces – what happens to them?"

"We have about 104 pieces of real estate around the world. We probably need 50 of them at the most!"

"The industrial base in Germany and Korea must be factored into the equation."

DLA warehousing affects us because they are on our installations.

"What about moving the Guard onto depots? Maybe it makes sense to close a bunch of scattered armories."

Depots: The old terms of 'depot', 'arsenal', and 'industrial base' facility are anachronistic. They are interchangeable, the definitions are problematic.

"We need to know where is the Army going to keep its Patriot Batteries."

Red River is the only place that fixes tracks 24/7, it gets support from Texas A&M.

We only have 2 ½ arsenals – Rock Island, which is much more of a Headquarters post than an arsenal, Watervliet, and Pine Bluff (the half), it is small and needs to be rebuilt.

“If you turned it over to the PMs, they would close everything and turn it over to contractors. Contractors can be more efficient but they have different motivations. What if one of them goes out of business or one of their suppliers goes out of business? Industry and government working together makes more sense than going one way or the other.”

Congress wants to see increases in building industrial infrastructure.

Category: Logistics #5
Interviewee: Principal
Attendees: Deputy
Date/Time: 02 July, 2003 1000
Interviewer: Dr. Greg Parnell
Recorder: CPT John Harris
Questionnaire Version: 1

1) Primary Concerns:

OSD tri-service acquisition and analysis of the services.

Kern has done a lot of work on reorganizing AMC

Dr. Parnell: “What pitfalls and risks do you see?”

Principal: People who are trusted agents whispering on the Hill. After Army finished list, OSD at 11th said that not enough stuff was on the list. They added a 2nd test installation.

Don’t get surprised by OSD leadership.

There are opportunities for consolidation. Not necessarily get rid of land.

More efficient ways to manage ranges. We should have a range management structure with single control and clear out duplicate facilities.

Close sleds from Holland to England and then back to Holland.

Give someone charge of test ranges.

Encourage public and private partnership. Allow private companies to use range and then reimburse.

Land, sea, and airspace will not come back.

May require investment at better facilities to close others.

Services or Congress are not encouraged by privatization of ranges.

Create RAND type analyst structure for intellectuals.

3rd wave

- take all civilian analyst and privatize.
- Need uniformed services members.

We need a single commander for all test ranges.

- report to OSD for resources
- rate by services vices

Dr. Parnell: “Is there a parallel position that is similar?”

Principal: Nothing comes to mind except Joint commanders. We could save money and modernize.

Programs will be born joint.

Iraq is the most joint thing we’ve done. It violated all traditions of warfare.

All testing could be done at White Sands

Dr. Parnell: “OF and FCS are going to require more land?”

Principal: Yes, they are, right.

We can use simulation

Most don’t work very well.

Can’t create hardship.

Training has similarities.

“Real training capability is important.”

“Simulation has its place.”

Re-deploy from Germany?

From Kansas deploy to Germany or Poland for training.

We are going to have to get out of Seoul; get south if the Koreans have the dollars
to do it.

Category: Logistics #4
Interviewee: Principal
Attendees: Deputy
Date/Time: 02 July, 2003 0900
Interviewer: Dr. Greg Parnell
Recorder: CPT John Harris, Mr. John Bott
Questionnaire Version: 1

1) Primary Concerns: “We should’ve done this 12 years ago, we’re a half generation too late, but I understand why. I’m not that concerned about the individual services, but I’m concerned that we as a whole won’t get it right.”

“Overall, I don’t understand what we are doingwave a wand. What are we supposed to have at the end (ref. military capability)?”

“We are into the eaches. Do we really know what we want at the end? Do we know what we’re supposed to be able to do? What the heck will we have at the end?”

“What we’re doing now, with more detail and more legislation, is what we did between WWI and WWII, with grave consequences.”

“We know we need a capability-based force that can fight today and in the future across the full spectrum and what not, but what do we do in BRAC? When the balloon goes up, who will make the assessment that we can go to war with what’s left? I am not sure we have the capability (analysts) to do that.”

“Who will make the assessment we can go to war with what we privatize or outsource?”

“Recent wars have been smaller; you spend a lot. Can industry turn that around quickly? Will we have the capability to go to a full, major war?”

“If your system doesn’t fight when the balloon goes up, I don’t care about it. Show me how this fights.”

“Industrial base (depots, ammo, and arsenals) is 50+ years old, we haven’t invested in it, we need to modernize it. We could give this to industry. There is a RAND study on how to dispose of these things which is good. However, there are things like links for ammo that we can’t privatize because no one wants to do it and there are others, like some material and packing fibers, that no one else does. We must go outside the US to get these things. We would have to start a new industry, which is very costly. General Kern and I are concerned about what we have left organically from the industrial base when this is over. The folks who say we should contract everything out or go to private industry have not looked at everything carefully enough.”

“I have reviewed what General Kern and AMC have recommended and by and large I agree with it. They have a good plan to modernize and streamline the industrial base.”

“Explosives and propellants won’t be used in 50+ years. Will solid-state lasers be done in depots? Nano-technology - where will it be done?”

“We need to do a business case analysis for each one. Did it make a difference years down the road? The organic base is the issue.”

6) Test/Evaluation Comments: “White Sands and Hood (sic – Bliss) are a good opportunity to merge operations. Using same technology, lasers. They are isolated enough. Good idea for joint.”

“In terms of labs, AMC has done a good job, RDT&E Uniformed Scientist. Basic concept is fine.”

“We don’t have systems testing, we need a system of systems for requirements, some way of measuring military capability, modeling and simulation is behind the power curve.”

“Do we as a service or DoD need to do all testing? We can monitor contractors.”

“Very few models are looking at the nuclear stockpile, yet every year DoE says the stockpile is good to go. We should use a civilian model.”

“We are already doing some joint operations, we use Corpus-Christi AAP to share services; helicopter, ammo, etc., are consolidated as a result of other BRACs. We share where there is an opportunity. We also partner with industry when feasible.”

Dr. Parnell: “How is BRAC ’05 different from BRAC ’95 and others?”

Principal: “I think we’ll have better preparation and know what to expect.”

“It’s too early to tell how different it is right now. The thing that concerns me with the previous BRACs is what they actually accomplished. Did what was supposed to happen actually happen? What were our savings? Someone needs to be charged with measuring the results of this.”

“It would take a generation to move to private sector jobs.”

“There is a smaller workforce out there this time, in time people won’t care, someone should be planning for the end.”

“At the end of World War II we knew what we had to do. When the wall came down, we were not similarly postured.”

“Ike was right on about forming the industrial complex with a caveat ‘don’t get too big’.”

“In WWII we could build a liberty ship for \$280k in one day. Ship building now takes 5 years.”

“We have clipped the low hanging fruit. We are busier today then before.”

“If you are doing it wrong, you get to repeat history.”

“We haven’t answered the fundamental question of what do you want the US military to do? Our assumption is the Objective Force.”

“We can run the military on 2% GDP. Our job is to figure out how.”

Category: Logistics #3
Interviewee: Principal
Attendees: Deputy
Date/Time: June 6, 2003 0900
Interviewer: Dr. Greg Parnell
Recorder: MAJ Lee Ewing
Questionnaire Version: 1

1) Primary Concerns:

I. “BRAC ‘05 is not an independent activity, to get BRAC 05 right you must capture results from other major Army initiatives and studies. “BRAC is integral, but it is a function of all of the other things and must be done in partnership”:

- a. “Repositioning of forces in post Iraq environment”
- b. “AMC; depots and Arsenals have too much overhead” We know this because “cost factors” are too great.
- c. Rotational unit deployments.
- d. “Army Transformation Implications”, i.e., “Stryker Bdes, U/As”.
- e. “Power Projection”, e.g., Billions of dollars spent on rail infrastructure at existing installations will be hard to duplicate elsewhere.
- f. “Logistics Transformation studies”.
- g. BRAC ‘05 needs to “capture” the results of these efforts.

II. “Many programs done in isolation” Dr. College should use SRG concept to bring issues forward (to avoid isolation).

2.a) Transformation/Objective Force Impacts: “Objective force will require equal training capacity or more” “Current Division requirement is “25 km”. Future Division requirements “75 km”. “Digital ranges must expand for the Objective Force”. “PA&E did a report on stationing analysis for Stryker Bdes and FCS”. “FCS report is close hold” and you will have a hard time getting it. “MOMs” they used would be useful for BRAC 05.

2.b) Joint Basing/Stationing: “Opportunities for integration with other services include NTC, Twenty Nine Palms, and Air Force bases. Potential link-up for Stryker Brigades near AF installations. There is a lot of value in being close to Air Force installations.”

2.c) Climate Deficiencies: “None.”

2.d) Encroachment: “It will be hard to expand from the installations we have. NTC is the only place that may expand. Environment and encroachment pressures will continue.”

2.f) Homeland Defense: “Largest impact of Homeland Security will be in RC not on AC forces. RC (mission) will prompt review of the number of installations for both state and federal programs. Key consideration for the Guard. Primary mission is war fighting. However, secondary mission is Homeland Defense.”

3.a) Worst-case Scenario/Contingency Planning: “The worst-case impact of forces re-stationing to CONUS could be eight Bdes and two division HQs, The best case is three Bdes. Two divisions may come back from Europe. Divisions in Europe only have two maneuver Bdes, so four Bdes two division HQs One Bde from Korea. Maybe three other separate Bdes also will come back.

3.b) Mobilization:

I. “More work to do on MOB, power projection. WWII wood structures are going away. Multi-purpose facilities like gyms can be used as MOB facilities. As part of BRAC, how do we make multi-purpose facilities for MOB? Ft. Polk and Ft. Drum may be case studies.”

II. “What do we assume as National Military Strategy”? (Parnell)

“Use the DPG and 1-4-2-1 strategy. We are relying more on Defense Department docs and less on Joint docs. There is a draft of the National Military Strategy. There is ‘no confusion on strategy’ at GO level. (OSD and ARSTAF) are implementing Bi-Annual Budgeting so no DPG update for ‘05. Publish next DPG in Feb. for 06. You may use ‘Contingency Planning Guidance’ but it is classified. The DPG is the most definitive. TAP is our interpretation of the DPG. Current TAP is a ‘90%’ solution. The next TAP should be released in December 03.

3.d) Deployment:

I. “Digital Ranges”

II. “Must maintain quality force. To maintain a quality force, we must address soldier well-being, e.g., ‘housing’.”

i. “Infrastructure, (IT) backbone”, i.e., IT infrastructure at Army installations must be improved.

ii. “Base operations and support accounts are not there”, (i.e., can’t do it all with current budget.)

4.a) Joint Warfighting:

I. “Joint training may affect the training centers more than the installations themselves. For example, use ‘Ft. Leonard Wood’ consolidation as a model. Joint training with other services, e.g., we don’t need separate infrastructure to train fire fighters. More of joint training will happen, not less.”

II. “If Logistics initiative works, then less supporters are required. Less training facilities needed for U/As. Look at the Logistics Transformation Campaign Plan.”

5.) Changes Since BRAC 95/Final Comments: “Not an expert in BRAC 95.” no opinion.

I. “Well-being should be addressed even though it is not a criteria (from OSD).”

II. “Privatization – we don’t want to walk away from our commitments (because it will be difficult to regain private sector trust latter on).”

III. “We are too big, we have too many places, too much infrastructure. It shows in our ability to pay bills and keep our quality of life at sufficient levels. We have an infrastructure for a 780,000-person Army versus a 480,000-person Army. The excess installations are in the following areas: Log, Depots, Arsenal, Training, NG”

Category: Logistics #2
Interviewee: Principal
Attendees: Deputy
Date/Time: June 5, 2003 1600
Interviewer: Dr. Greg Parnell
Recorder: Mr. John Bott
Questionnaire Version: 1

Principal stated that he had just met with Dr. College the day before our interview.

1.) Primary Concerns: “How we have set up the JCSGs concerns me. There is a significant amount of overlap and underlap as it relates to the Army.”

To many of the groups deal with “logistic” type issues, instead of having just one JCSG covering all of logistics. The “piece-parts” of logistics are divided up among to many JCSGs.

Logistics is made up of many parts – acquisition, production, supply and storage, distribution, war reserves, demil, etc.

The Army is the only service that has a realistic war reserve.

“Are all of the JCSGs going to have the same assumptions?”

“We have to define what the mission is before we can define what is excess.”

For example, for a “1-4-2-1” strategy, we can tell you what we need and what is excess, but without a NMS, we cannot tell you what is excess.

Dr. Parnell: “So do we assume the 1-4-2-1 and work from there?”

Principal: “I don’t know. We need to set some assumptions.”

“Even if we are told to keep an Army of X amount of troops (say, 400,000), we still have to know what you want that Army to do before we can tell you what is excess. *We need to define the mission!*”

“I need to know what I need to provide in quantity, commodities, and services before I can tell you what installations I need.”

“We need to define ‘What is storage?’ Is it ammo, missiles, Class I, III, IV, VIII, IX? Only Pine Bluff makes white phosphorous, and only the US government makes TNT. Do we need these things? Will white phosphorous be in our arsenal going forward? It’s needed in illum rounds.”

“Who will provide services, i.e. laundry and bath?”

“We must have capability-based requirements.”

“How you view the problem of ‘What is of military value’ is in the eye of the beholder. M-1s may be large and heavy but they kick ass on anything else out there. Humvees may be light and mobile but they get people killed.”

“The Army is trying to go to 2-level maintenance.”

“Outsourcing is great in peace-time, but it isn’t as good during war. I just paid a contractor \$10 million on one contract to service one system!”

“Contractors can’t get us ‘there’ because of indemnification. Do we have to train contractors? Equip them? Are they combatants?”

“We need to have the Reserves on a ‘Train, Alert, Deploy’ mode, not ‘Alert, Train, Deploy’ as it is now. During current operations, we gave some units only one week’s notice before they were gone on missions. We will lose soldiers and employer support if we keep doing this.”

“Where are we going to put troops that come home?”

91% of the forces in Iraq right now are Army forces. They also have the longest rotations (the Air Force only rotates for 90 days). The Marines are already gone.

2.a) Transformation/Objective Force Impacts: “Transformation has the potential to make a significant impact, but until it is resourced, it won’t have an impact.

“Single stock fund is a good example of a success.”

“We must improve how we acquire things. On-time delivery only works during peace time.”

70% of Army systems over the past 7 years never hit ONE key performance parameter.

95% didn’t have a key performance parameter (KPP) for logistics.

O + S cost escalation over the past 5 years was 8-10%.

We must have National Maintenance Standards.

“I am all for sizing capacity to requirements, but give me the requirements. If I have the requirements I can build you a divestiture plan. Let me execute and I will show you savings.”

We need to improve how we divest ourselves of property:

“We gave Ft. Ord away and didn’t get a dime for it, even though it was prime real estate and had two great golf courses.”

“Maybe we could give contaminated land to a Sierra Club type organization instead of converting it to secondary use.”

“Environmental remediation is to damn expensive!”

4.d) Role of Private Sector: “The private sector can have a significant impact. Privatization can be worth it if it is partnered with the government workforce effectively. Let corporate America do some aspects of the industrial base but it must be partnered with government.”

“If we know that we are not really going to get rid of something, then figure out a way to use it, especially if there are a lot of civilian employees.”

“Are we going to rely on single point of failure or foreign production?”

5.) Changes Since BRAC 95/Final Comments: “Total Army requirements (AC/RC/NG) should be much more significant this time around. Because of ‘Alert, Train, Deploy’, I can’t get people to the fight.”

“There is no RC representation in the JCSGs, this should be rectified.” (Deputy)

“We must accommodate all components (AC/RC).”

“The dollar savings claimed through BRAC were not delivered.”

Category: Personnel #6
Interviewee: Principal
Attendees: Deputy
Date/Time: 12 December, 2003 0930
Interviewer: MAJ Lee Ewing
Recorder: Mr. John Bott
Questionnaire Version: 1

1.) Primary Concerns: “I had a concern that we are too short-sighted when we do this, but I think you’ve rectified that by having a longer planning horizon.”

“I’ve seen maps of Ft. Richardson, Ft. Carson, and Ft. Benning from 50 years ago and of today that illustrate how much these areas have grown. The issue for me is; what is encroachment going to do to us? Look at a place like Ft. Bragg; encroachment there is affecting training”

“We cannot train, house, and project troops on a postage stamp installation. We need to determine how much training we will do at home station. Take a look at the range fans for some of our weapons systems; they’re huge!”

“The ability to afford all of the places we’ve got also bothers me. We continue to put money into the daily running of our posts but not into the improvement of them. The sound economic decisions you make will get twisted in the political process.”

“I would have to say my three main points are that we must have the ability to train, we must be able to afford all of our bases, and that we must somehow get to the joint solutions. How do we maximize the potential at places like Pope-Bragg and Richardson-Elmendorf?”

MAJ Ewing: “What are the 2 or 3 main drivers for the joint piece?”

Principal: “I’ll give you the one main consideration for jointness. At the end of the day, do you have a force that is joint and expeditionary in nature? That is the bottom line for figuring out the joint aspect. How do we make ourselves a more joint force? We’ve got to do it.”

MAJ Ewing: “Any insights on BRAC’s ability to move TOE and TDA units so they are better stationed?”

Principal: “It has to be done. Let me give you an example. How many Armor NCOs are there at Ft. Knox? Tons! What is the second highest concentration of Armor NCOs? Ft. Hood! If the school was co-located with the units, soldiers wouldn’t have to PCS and they could stay somewhere for several years.”

2.c) Climate Deficiencies: “We don’t have to have a place, so long as we have an opportunity. We don’t have to own a post with a certain training capability; we just have to be able to develop a doctrine. As long as we can get to and train in a particular environment, that’s what’s important.”

2. f,g) Homeland Defense and its Impact on Stationing: “We’re going to make sure the RC is optimized to be able to do Homeland Security and be a part of the war-fight.”

MAJ Ewing: “Is there an AC role?”

Principal: “The AC is not the First Responder. The Homeland Defense mission represents a role reversal from combat operations by having the AC back-up the RC. The RC is over-stretched right now; we have to get the force structure right. We need to look at the below-BRAC level facilities in the RC and look for efficiencies which will help us save money.”

“We need to leverage consolidations onto federal facilities. How are we going to propel change if we only do things on the margin? You may want to examine what the Air Force does in tying everything to Air Expeditionary Forces. Think about re-stationing out of Europe; where is the capacity to put these units? If you want to get at the joint warfighting piece, we have to determine if we are going to continue to put Army units at Army installations only. If you put value in having Army units at joint installations, maybe it will increase an installation’s military value.”

3. b,c) Mobilization: “The best way that BRAC can facilitate the mobilization mission is in the reserve component. We can help with mobilization by consolidating RC facilities onto installations.”

5.) Final Comments: “People need to realize that we do not have a World War II force and that we are not an industrial era Army. We have shorter missions now. The next adversary we face is going to get smart and realize that he can’t let us build-up big cans of kick-ass. This is the first time the all-volunteer force has conducted a lengthy operation.”

“We need to realize that the more installations we have, the more installations we have to network with IT. This increases your SRM and BOS costs. Will we be able to afford it?”

Deputy: “We need to keep in mind a reach-back capability. Higher Headquarters elements will be conducting the war-fight from home station and they will need to be networked in (this implies a greater force protection issue).”

ANNEX 13: Attribute Technical Papers

This annex contains technical papers that support various MV attributes. These papers were written by third-parties for the purposes of TABS' BRAC 2005 Analysis.

- 1. Statistical Significance of BRAC'95 Attributes**
- 2. Decision Analysis Support for BRAC**
- 3. Buildable Acres/Facility Conversion (#8,#36)**
- 4. Critical Infrastructure Proximity & Accessibility (#40,#17)**
- 5. Connectivity (#18)**
- 6. Force and Materiel Deployment (#14,#15)**
- 7. Rehabilitation Construction Factor Determination (#7,#8,#16,#22,#25)**
- 8. Installation Assessment Criteria**
- 9. Soil Resiliency (#11)**
- 10. Workforce Availability (#31)**
- 11. Environmental Elasticity (#38)**
- 12. Urban Sprawl (#39)**

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**STATISTICAL SIGNIFICANCE OF BRAC '95
ATTRIBUTES**

FEBRUARY, 2004



**CENTER FOR ARMY ANALYSIS
6001 GOETHALS ROAD
FORT BELVOIR, VA 22060-5230**

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STATISTICAL SIGNIFICANCE OF BRAC '95 ATTRIBUTES

SUMMARY

THE PROJECT PURPOSE was to identify BRAC 95 installation assessment attributes that were statistically significant in determining an installation's final military value 'score'.

THE PROJECT SPONSOR was the Deputy Assistant Secretary of the Army for Infrastructure Analysis (DASA (IA)).

THE PROJECT OBJECTIVES were to:

- (1) Determine which of the BRAC 95 installation assessment attributes were the most important in determining an installation's military value 'scores'.
- (2) Determine which attributes could be de-emphasized or eliminated from future BRAC studies without significant impact on an installation's ordinal ranking.

THE MAIN ASSUMPTIONS are:

- (1) Pareto analysis is sufficient for providing screening criteria.
- (2) It is possible to determine the statistical significance of attributes using a linear multiple regression model.
- (3) The attributes we analyze are statistically independent and there are no problems concerning decomposability.

THE MAIN HYPOTHESIS is that the BRAC 95 installation types have a small number of attributes that significantly impact the scoring and rank of an installation.

THE PRINCIPAL FINDINGS are:

- (1) There is a group of attributes that is statistically significant in determining the final BRAC 95 scores.
- (2) There is a group of attributes that fails to pass our screening criteria, and these attributes provide additional insights into the BRAC 95 weighting system and the Pareto analyses we employ.

THE PRINCIPAL RECOMMENDATION is to use the results of this study to aid analysts in determining the installation assessment attributes used in future Basing/Stationing studies.

THE PROJECT EFFORT was conducted by Mr. Joseph B McGill.

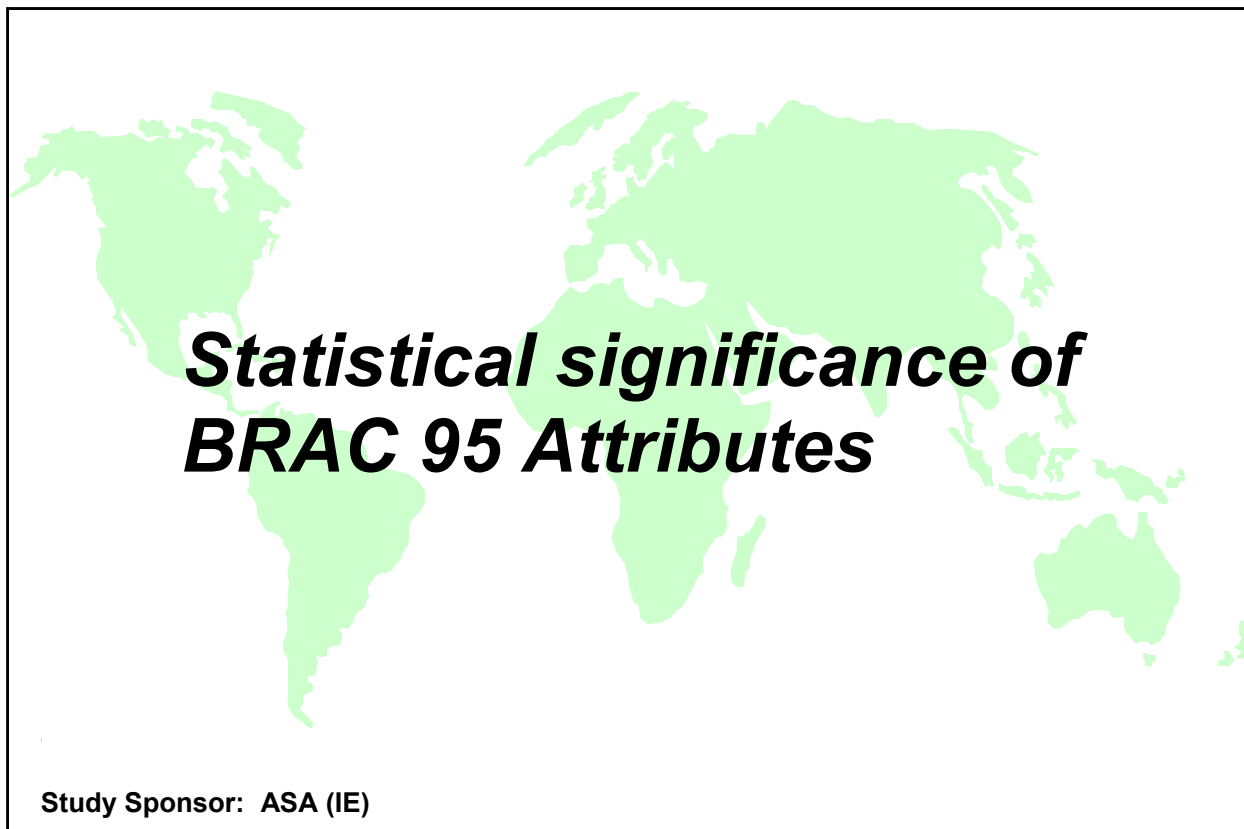
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1 INTRODUCTION



This project was conducted for the office of the Deputy Assistant Secretary of the Army for Infrastructure Analysis (DASA-IA). The work has included two desk-side reviews and an Analysis Review Board (ARB) at the Center for Army Analysis.

1.1 Purpose

- ☐ **Determine which attributes from BRAC 95 contribute most to an installation's final ranking.**
- ☐ **Identify attributes that contribute little to the final scores that determine the final outcomes of BRAC 95 and can possibly be eliminated or de-emphasized to produce a more efficient model.**

The TABS (The Army Basing Study) team requested that CAA conduct a statistical analysis of the BRAC (Base Realignment And Closure) 95 installation assessment attributes to determine which of the attributes make the greatest contributions to the final results. We assume that of the fifty-nine different attributes considered in BRAC 95, a small proportion are most important (contribute most to the total score) in determining an installation's final military value *score*. These scores are the numeric values decided upon by the BRAC 95 study team and are used to determine the final ordinal rankings for each installation in each installation type.

We use linear multiple regression analysis to identify which attributes, that determine the final scores each installation receives, are *statistically significant*, i.e., less than 10% probability that they affect the final scores by chance. This study also identifies a list of attributes that contribute less to the final scores, either because they are not statistically significant, or because they perform poorly in the screening criteria that we use (see section 2).

1.2 Approach

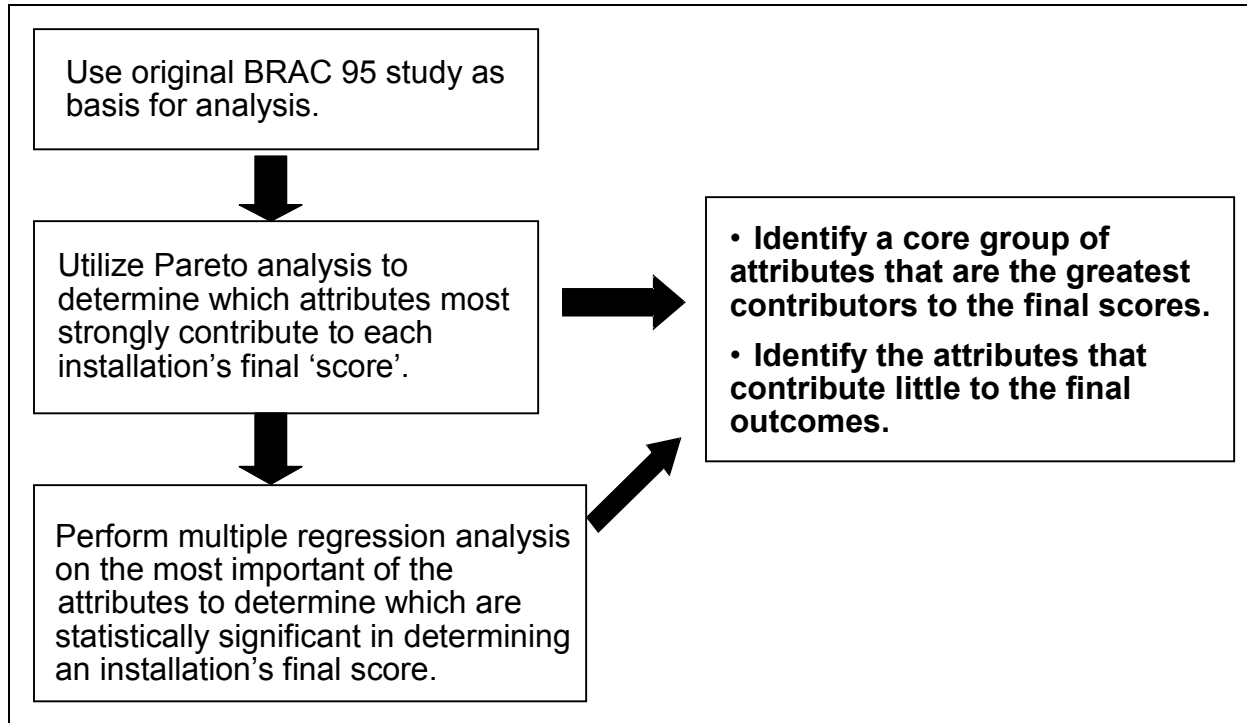


Figure 1. Approach

Figure 1 shows the study approach. Due to limitations on electronic copies of the original BRAC 95 data, we manually input the data from the printed copy of the original study into Microsoft Excel workbooks. We assign each installation type its own sheet in an overarching Excel workbook, allowing for easy manipulation and analysis of the BRAC data.

We are unable to perform regression analysis directly on the BRAC 95 model because it contains many more installation assessment attributes than installations within any given installation category or *installation type*. Thus, we must reduce the number of attributes examined in the regressions in order to allow for enough *degrees of freedom* (we discuss degrees of freedom in Section 2) to provide reliable measures of statistical significance. We use Pareto analysis to reduce and rank-order the set of attributes studied in the regression for each installation type.

Our analysis of the BRAC 95 attributes allows the compilation of two lists:

- 1) A list of those attributes that are statistically significant, which can be identified as the most significant in determining the final scores.
- 2) A list of those attributes that failed our screening criteria, i.e., are not considered in the regression analysis, but provide additional insights into the BRAC 95 weighting system.

1.3 BRAC 95 Methodology

- ❑ For BRAC 95, TABS used Decision Pad software to make decisions involving the numerous installations, installation types and attributes
 1. TABS developed lists of attributes and assigned weights to reflect their relative importance within the selection criteria
 2. Each installation's raw attributes (the measured/observed values) entered into Decision Pad software
 3. Decision Pad automatically scaled the raw attributes (1-10 ranking)
 4. Assigned weights then applied to the scaled scores and final scores computed for each installation
 5. Installations ranked based on final scores
- ❑ For the current study, we transferred the BRAC 95 data from the hard-copy report to Microsoft Excel spreadsheets.
 1. Original study's scores and raw attributes used
 2. Provides an acceptable representation of the original data used by BRAC 95 team

Figure 2. BRAC 95 Methodology

Figure 2 gives a brief overview of the methodology that the TABS team utilized in completing the BRAC 95 study. This methodology proceeded in four steps:

- 1) All of the installations in the analysis were divided into *installation types*, e.g., maneuver installations or ammunition storage installations, based on their primary function, thus BRAC 95 was a *stove-piped* analysis.
- 2) The TABS team developed a comprehensive list of attributes that support the quantitative measurement of the four Department of Defense Selection Criteria: i) Mission Requirements, ii) Land and Facilities, iii) Cost and Manpower, and iv) Future Requirements. The assigned weights reflect their relative importance within the associated selection criteria. The attributes and their corresponding weights were scrutinized in detail by the HQDA staff and the various MACOMs' teams.
- 3) Input data corresponding to each installation's attributes, i.e., the measured/observed values, and assigned weights were entered into Decision Pad, a DOS-based software used to facilitate decision-making based on data that was input manually. Decision-Pad scaled the raw attributes on a 1-10 scale using an internal normalization algorithm. The software then applied the assigned weights to the scaled attributes, and computed the normalized score for each installation.
- 4) The TABS team produced objective and defensible rankings of the installations for each installation type based on the final Decision-Pad scores.

The Army leadership approved the final rankings. The recommendation identified which bases were most important to the Army, and which bases should be realigned or closed.

In constructing the Pareto analyses, we cannot completely replicate the BRAC 95 methodology because Decision Pad does not allow access to the *exact* scaled values that it creates from the BRAC 95 input data. Without these scaled values, we cannot produce a complete replication of BRAC 95 for use in this study. The normalization equation we employ in Microsoft Excel does achieve greater than 90% accuracy in the reproduction of BRAC 95's final scores and resulting ordinal ranking of installations. This range of certainty provides a degree of confidence in the effectiveness of our Pareto analyses.

These problems do not affect our regression analysis because we use the BRAC 95 input data for the installation assessment attributes in conjunction with the final Decision-Pad scores.

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2 PARETO ANALYSIS

- ❑ Number of independent variables (i.e. BRAC 95 attributes) cannot be greater than the number of observations (i.e. the number of installations in a particular type)
- ❑ Pareto analysis used to single out the most important attributes to aid in the identification of a viable regression model
- ❑ Attributes' raw (observed) values normalized on a 1-10 scale to ensure that each receives equal emphasis prior to application of weights
- ❑ Weights applied to the normalized scores and average weighted scores for each attribute computed
- ❑ Between 5 and 8 attributes identified for each installation type for use in subsequent regression analysis

The analysis for BRAC 95 was stove-piped, i.e., all Army installations were categorized under one of the 13 installation types shown in Figure 3. Also, the attributes were not applied to the monolith. Attributes were only applied to the installation types where their associated *function* was thought to be applicable.

Installation Type	Number of Attributes	Number of Installations
Maneuver Installations	23	11
Major Training Installations	21	10
Command/Control/Admin Installations	20	15
Training Schools	26	14
Ammunition Production Installations	18	8
Ammunition Storage Installations	17	8
Commodity Installations	12	9
Depots	18	4
Proving Grounds	14	4
Industrial Facilities	17	3
Ports	16	2
Professional Schools	20	4
Medical Centers	17	3

Figure 3. Installation Attribute Counts

For example, there are 23 attributes associated with the installation type *Maneuver Installations* and only 12 attributes associated with the installation type *Commodity Installations*. We do not analyze 6 of the 13 installation types identified in BRAC 95 (highlighted in red in Figure 3) because they contain too few observations, i.e., not enough installations to conduct a meaningful statistical analysis. Not analyzing these 6 installation types means that we drop 20 (21%) installations and 19 (32%) attributes unique to these installation types from the final analysis.

To test for statistical significance, a regression model must contain the proper amount of degrees of freedom, i.e., one more than the number of independent variables. Without the proper amount of degrees of freedom we cannot obtain a reliable t-test, which is the basis of our measurement of statistical significance. For our analysis, we must therefore ensure that the number of installations within a given installation type is greater than the number of attributes evaluated within the given installation type.

In Figure 3, we illustrate the number of attributes in each installation type versus the number of installations, showing our need to limit the number of attributes we use in the regression models.

To overcome this limitation, and reduce the number of attributes that we consider in the final regression analyses, we employ Pareto analysis as a screening criteria. This technique allows us to select those attributes that contribute the most to the final scores and screen-out those that offer little contribution.

The Pareto Principle, or “80:20 rule” (in practical applications the ratio can fluctuate anywhere between 60:40 and 90:10), states that, in a given situation/data-set, a minority of input produces the majority of the results, i.e., 20% of the inputs drive 80% of the outcomes. The Pareto principle applies to many real-world examples ranging from business units (20% of a company’s products account for 80% of its sales revenues) to managerial issues (20 % of a manager’s employees account for 80% of his or her absentee problems).

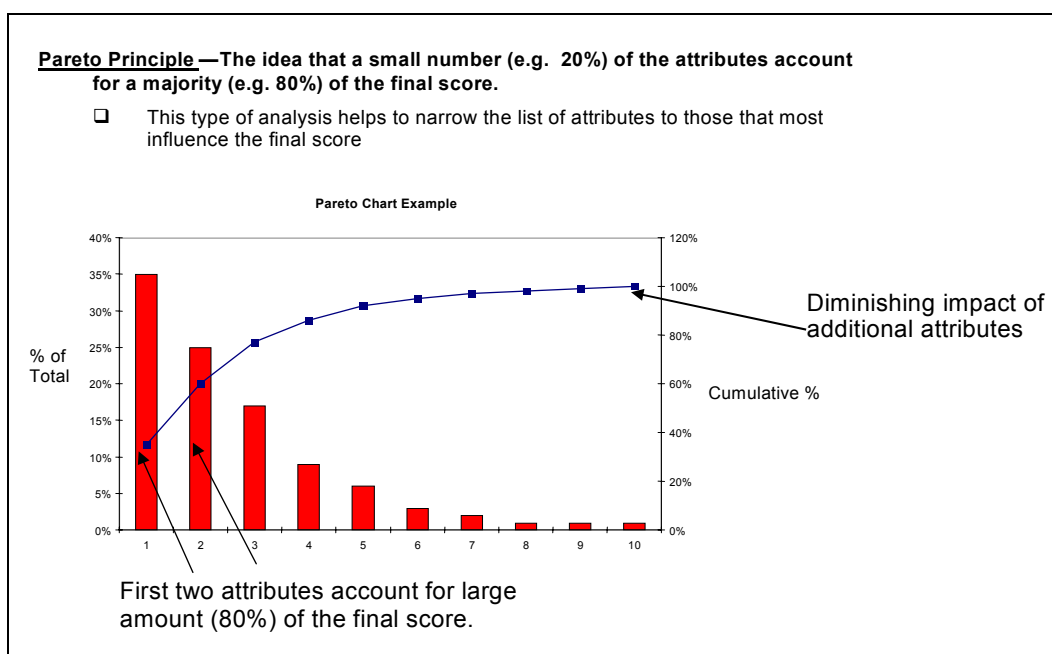


Figure 4. Explanation of Pareto Principle

Figure 4 shows an example chart created using the Pareto Principle that applies easily to these examples. The Y-axes represent the % of the total average weighted score (left side) and the cumulative % (right side) versus the installation assessment attributes on the X-axis. Appendix C (Figures 12-18) contains the charts for the Pareto analyses we perform for this study.

We apply this principle to each installation type, and identify the attributes that most influence the BRAC 95 analysis and provide enough degrees of freedom to be considered in the regression analyses.

We construct our Pareto analyses using a process that parallels the initial steps of BRAC 95’s methodology (Section 1.3, Figure 2); divergence occurs in the normalization process. We illustrate each step of the process with an example:

1. We normalize the input data (measured, observed values) for each attribute on a 0-10 scale using a standard normalization equation $10 * [(measured\ value - min) / (max - min)]$ for

those attributes where higher values are desired and $-10 * [(measured\ value - max) / (max - min)]$ for those attributes, i.e., cost, where lower values are desired], shown in Table 1.

Observed Data		Weight	Fort A	Fort B	Fort C
	Attribute #1 (size)	70	100 Acres	300 Acres	50 Acres
	Attribute #2 (cost)	30	\$100	\$50	\$200
	Total	100			

Table 1

Normalized Data		Weight	Fort A	Fort B	Fort C
	Attribute #1 (size)	70	2 Points	10 Points	0 Points
	Attribute #2 (cost)	30	6.7 Points	10 Points	0 Points
	Total	100			

Table 2

- For each attribute, we multiply the normalized scores by the attributes' original BRAC 95 weights to produce the weighted scores (Table 3).

	Weight	Fort A	Fort B	Fort C
Attribute #1 (size)	70	140 Points (70*2)	700 Points (70*10)	0 Points (70*0)
Attribute #2 (cost)	30	200 Points (30*6.7)	300 Points (30*10)	0 Points (30*0)
Total	100			

Table 3

- We compute the average of the weighted scores for each attribute in a particular installation type by averaging the weighted scores across all of the installations in a particular type, shown in column 6 of Table 4

	Weight	Fort A	Fort B	Fort C	Avg. Weighted Score
Attribute #1	70	140 Points	700 Points	0 Points	280
Attribute #2	30	200 Points	300 Points	0 Points	167
Total	100				447

Table 4

- We compute the % of the total average weighted score (column 7 of Table 5) by dividing each attribute's average weighted score by the sum of all average weighted scores.
- From the % of the total average weighted score, we compute the cumulative % (column 8 of Table 5) for each attribute and generate the Pareto charts (Appendix C, Figures 13-16).

	Weight	Fort A	Fort B	Fort C	Avg. Weighted Score	% of Total	Cumulative %
Attribute #1	70	140 Points	700 Points	0 Points	280	62.6%	62.6%
Attribute #2	30	200 Points	300 Points	0 Points	167	37.4%	100%
Total	100				447		

Table 5

With the BRAC 95 data, no situations emerge where 20% of the attributes make up 80% of the final scores in the Pareto charts. Most of the regression models we identify result from 40% of the attributes making up 60% of the final scores, but (as in other examples) these ratios fluctuate. We never achieve the 80/20 ratio mainly because of the influence of the original weighting of the attributes in BRAC 95. These original weights reflect what the TABS group felt was important when they designed the BRAC 95 analysis. Thus, we need to further analyze the attributes using the regression models. Our regression models contain anywhere between 5 and 8 attributes, and these attributes rarely make up more than 60% of the final scores. We use the Pareto charts to rank-order the attributes facilitating the choice of only the highest-ranking attributes for inclusion into the regression models.

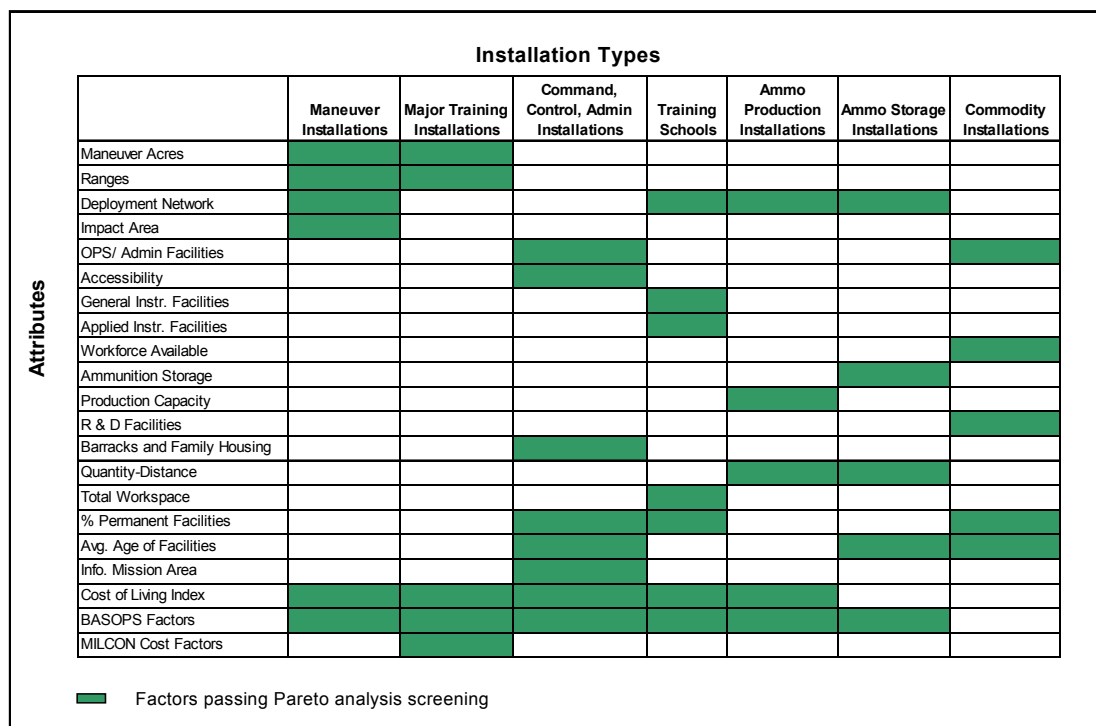


Figure 5. Results of Pareto Analysis

Figure 5 shows the results of the Pareto analyses through which we identify those attributes that contribute most to the final scores. We want to conduct statistical analysis on as many attributes as possible, while maintaining enough degrees of freedom to ensure reliable tests for statistical significance. Thus, the regression models for those installation types that have more observations (installations), e.g., Command, Control and Administrative Installations, have more attributes available for linear regression than the installation types with fewer observations, e.g., Ammunition Storage installations.

Not all of the highest-ranking attributes identified by the Pareto analysis are used in the linear regressions. During the regression phase, we identify variables that exhibit multicollinearity, i.e., a strong correlation among the independent variables, or introduce other un-desired bias into the models. In the event of correlation among the independent variables, we eliminate the problem variable and replace it with the next highest-ranking attribute in the Pareto analysis chart.

3 REGRESSION ANALYSIS

In this section we present the results of the regression models we analyze for each of the installation types that contain enough observations to provide the required amount of degrees of freedom. We provide three important pieces of information from our regression analysis of the BRAC 95 attributes:

- 1) The regression coefficients for each variable. These show how much impact (positive or negative) the variable has on the dependent variable (the final *score* in BRAC 95). For the majority of the attributes, positive coefficients denote stronger impacts. However, for certain attributes, e.g., Cost Attributes and Cost of Living Index, negative coefficients denote strong impacts.
- 2) The R-Squared values, which are general goodness-of-fit measures ranging from 0 (poorly fitted model) to 1 (perfectly fitted model). R-Squared accounts for the degrees of freedom in the model and measures the proportion of variability explained by the independent variables in the model.
- 3) The measure of statistical significance ($P > |t|$) for each BRAC 95 attribute included in the regression model. This measure, based on a t-test, is our confidence in the assertion that a given attribute is important in determining the final outcome (score). We measure statistical significance at the **0.1** level (a 10% chance that a given attribute's coefficient occurs by chance).

We subject our statistical models to tests for possible sources of bias such as multicollinearity (excessive correlation among the independent variables) and heteroskedasticity (the variance of the errors is not constant across all observations). Multicollinearity results in bias among the estimates of the coefficients, inflates the R-Squared values, and causes possibly important variables to show up as insignificant. We test for multicollinearity using simple correlation (i.e. *Pearson's r*, the most common bivariate measure of the strength of association between two variables) and a variable inflation attribute (VIF) test that tests whether the independent variables influence or explain one another. Heteroskedasticity does not necessarily bias the estimators (coefficients), but because the errors' variance is not constant, the standard errors of the estimates are incorrect, resulting in unreliable measures of statistical significance. We test for heteroskedasticity using a Cook-Weisberg test for constant variance among the model's errors.

We find that none of the models in the study exhibit heteroskedasticity. However, most of the models exhibit at least moderate multicollinearity among some of the independent variables. We correct these problems by eliminating the attribute that exhibits multicollinearity and substituting another attribute further down the list in the Pareto analyses. For example, the proxy attribute *mobilization capacity* is constructed by combining measures of mobilization billets, deployment network, ranges, maneuver acres, and workspace. When we include this *mobilization capacity* attribute in the regression models, it is the *only* significant attribute and the regressions exhibit high R-Squared values. While this attribute exhibits no multicollinearity in a basic correlation test, the VIF test reveals it as a major source of bias in the model. When we eliminate it, the R-Squared value drops and other, previously insignificant variables become significant. In order to minimize multicollinearity, we eliminate this proxy variable from all of the regressions run during the study.

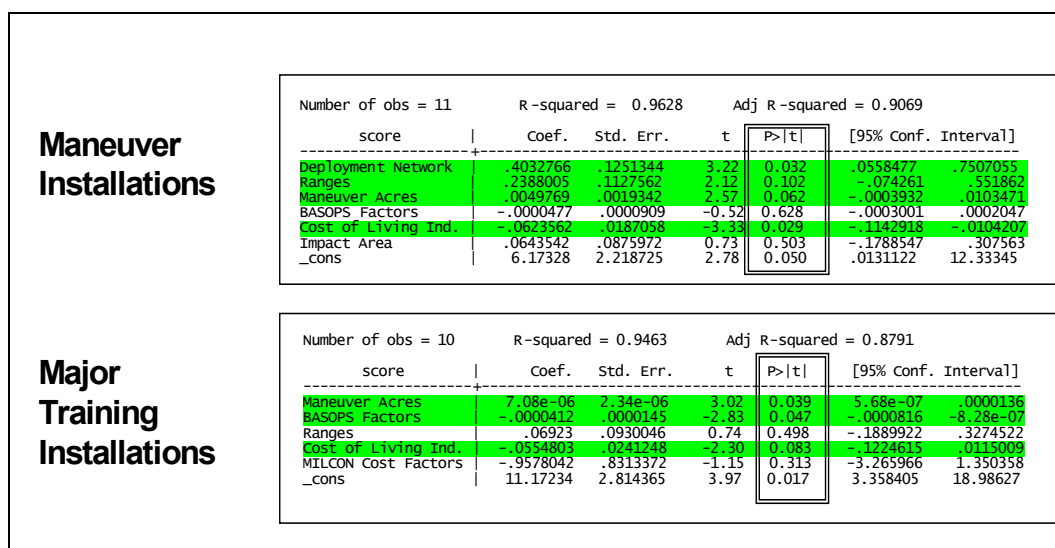


Figure 6. Regression Analysis of Maneuver and Major Training Installations

Figure 6 presents the results of the multiple regression models we analyze for Maneuver Installations and Major Training Installations (regression charts for the remaining installation types are in Appendix D, Figures 19 and 20). These charts show the model's R-Squared scoreD- (goodness of fit), as well as the attributes' coefficients (how they affect the dependent variable), standard errors and t-values, which are used in the testing for statistical significance and the confidence intervals (how high and how low the value for the coefficient might be). Using Maneuver Installations (Figure 6, Top) as an example, we note that there are 11 installations, i.e., observations, in this category. Using the Pareto analysis technique, we narrow the number of attributes to a list of 6, which provides enough degrees of freedom to test for statistical significance. Of the six attributes we include in the model, four (Deployment Network, Range, Maneuver Acres, Cost of Living Index) are statistically significant at the .1 level. The model has an R-Squared of .9628, suggesting that the attributes we include produce a well-fit model. Using the attribute *Cost of Living Index* as an example, we see that its coefficient is $-.06236$, meaning that for a one unit increase in the cost of living index, an installation's final score will decrease by .06236. This attribute has a t value of -3.33 and a P value of .029, i.e., we are 97.1% sure that the coefficient is statistically different from zero. We conclude from this information that rising cost of living indices have a negative and statistically significant impact on the final scores that installations receive in BRAC 95.

In Figure 7, we show a summary of the seven installation types we analyze and the attributes from these models that are statistically significant. Our findings indicate that there are 11 different attributes that achieve statistical significance for at least one installation type. Five of these 11 attributes (Deployment Network, Maneuver Acres, Ops/Admin Facilities, Cost of Living Index, and BASOPS Attributes) are significant in the regressions for more than one installation type. We further illustrate these statistically significant attributes and other aspects of the regression models in Section 5.

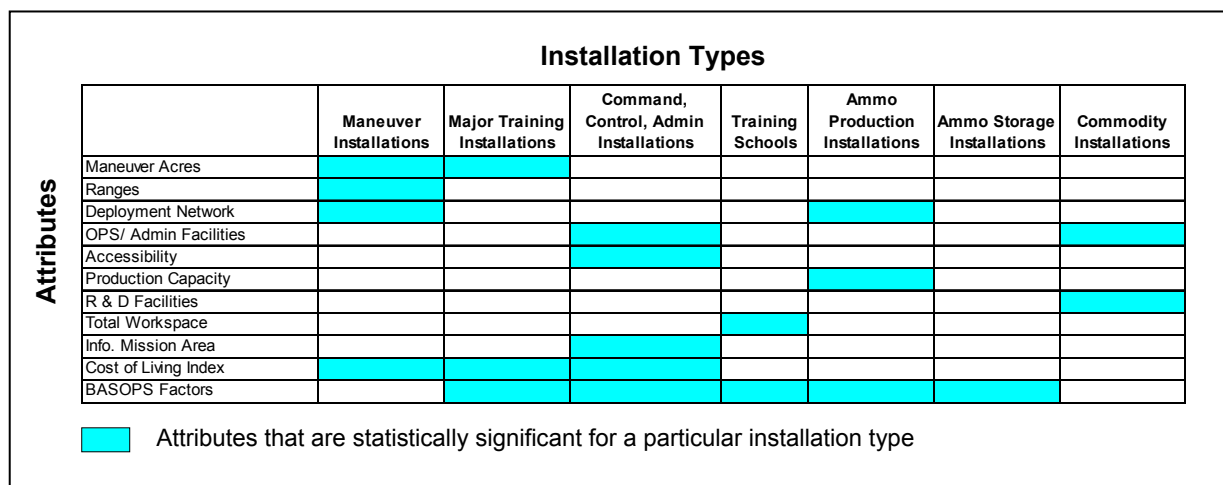


Figure 7. Statistically Significant Attributes

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4 LIMITATIONS

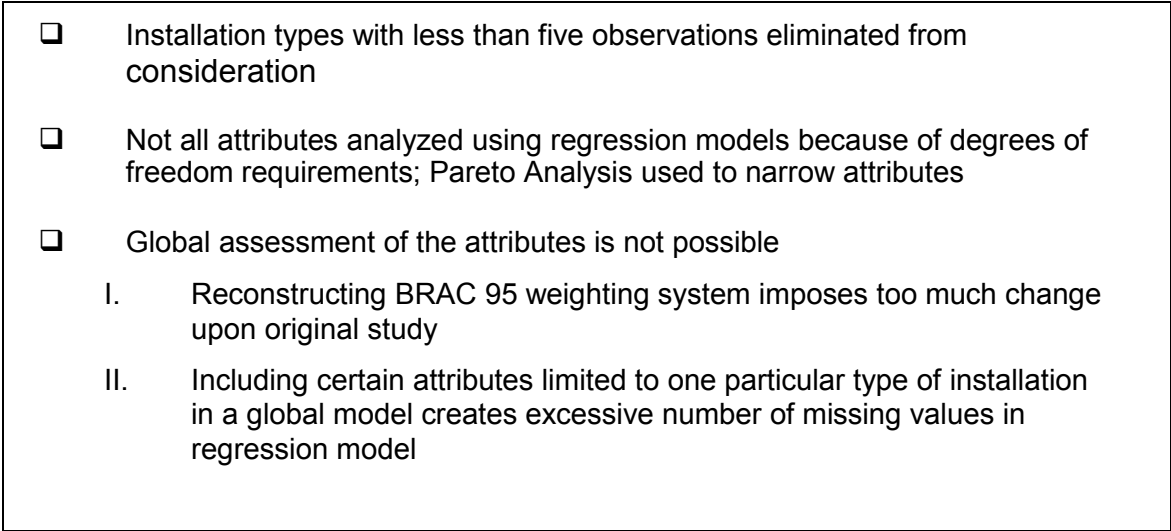
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- ❑ Installation types with less than five observations eliminated from consideration
 - ❑ Not all attributes analyzed using regression models because of degrees of freedom requirements; Pareto Analysis used to narrow attributes
 - ❑ Global assessment of the attributes is not possible
 - I. Reconstructing BRAC 95 weighting system imposes too much change upon original study
 - II. Including certain attributes limited to one particular type of installation in a global model creates excessive number of missing values in regression model

Figure 8. Limitations of This Study

In Figure 8 we outline some issues that limit the scope and analytical depth of this study. As we discuss in Section 2, our regression models must contain a greater number of installations than the number of attributes analyzed, to ensure the required degrees of freedom for the measurement of statistical significance. In BRAC 95, none of the installation types contain enough observations (installations) to include *all* of the attributes (for a particular type) in a regression model. Therefore, we employ Pareto analysis as a means to narrow the list of attributes included in the regressions down to only those that contributed the most to the final scores.

While the Pareto Analysis succeeds in narrowing the attributes enough to produce working regression models, the average weighted scores (Section 2, Table 4) used to create the Pareto analysis charts result in: (i) the systematic under-valuing of certain attributes, e.g., Total Buildable Acres; (ii) an inability to identify the individual contributions of certain attributes and installations that may affect the rankings. We elaborate on these issues in Section 5.2. To correct the shortcomings of the Pareto analyses, and attempt to address some of the issues resulting from the stove-piped structure of BRAC 95, we subjectively evaluate several attributes (Total Buildable Acres, Infrastructure, etc.) that we expect to perform well but under-achieve. Analytically, we should conduct a full sensitivity analysis, which would help to further define the list of attributes that contribute less to the final scores and provide additional insight into our exclusion of some potentially important attributes, but such an analysis is beyond the current scope of this study.

Finally, we cannot perform a *global* assessment of BRAC 95 (i.e., a model containing all of the installations from all installation types, as well as all of the attributes). Such an analysis requires a complete reformulation of the BRAC 95 study in order to reconcile and re-assign all the weights from the different installation types. Such a reformulation produces indefensible results.

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5 FINDINGS

5.1 Consolidated Findings

The charts in Figures 9 and 10 provide a consolidated view of the primary findings of this study. We divide these findings into two charts based on the four Department of Defense Selection Criteria (Section 1.3). Figure 9 shows the findings for the Mission Requirements criterion and Figure 10 shows the findings for the remaining 3 criteria (Land and Facilities, Cost and Manpower, Future Requirements). In these charts we show all of the attributes and installation types from BRAC 95, and we use color-coding to highlight the most important findings. These charts show:

1. Which installation types we analyze in our regression models (shaded pink)
2. Those installation types we do not analyze in this study (shaded grey)
3. Which attributes are statistically significant in the regression for a particular installation type (shaded blue)
4. Which attributes we include in our regression analysis that are not statistically significant (shaded green)
5. Which attributes BRAC 95 considers for a particular installation type, but are not included in our regression analyses (shaded black)

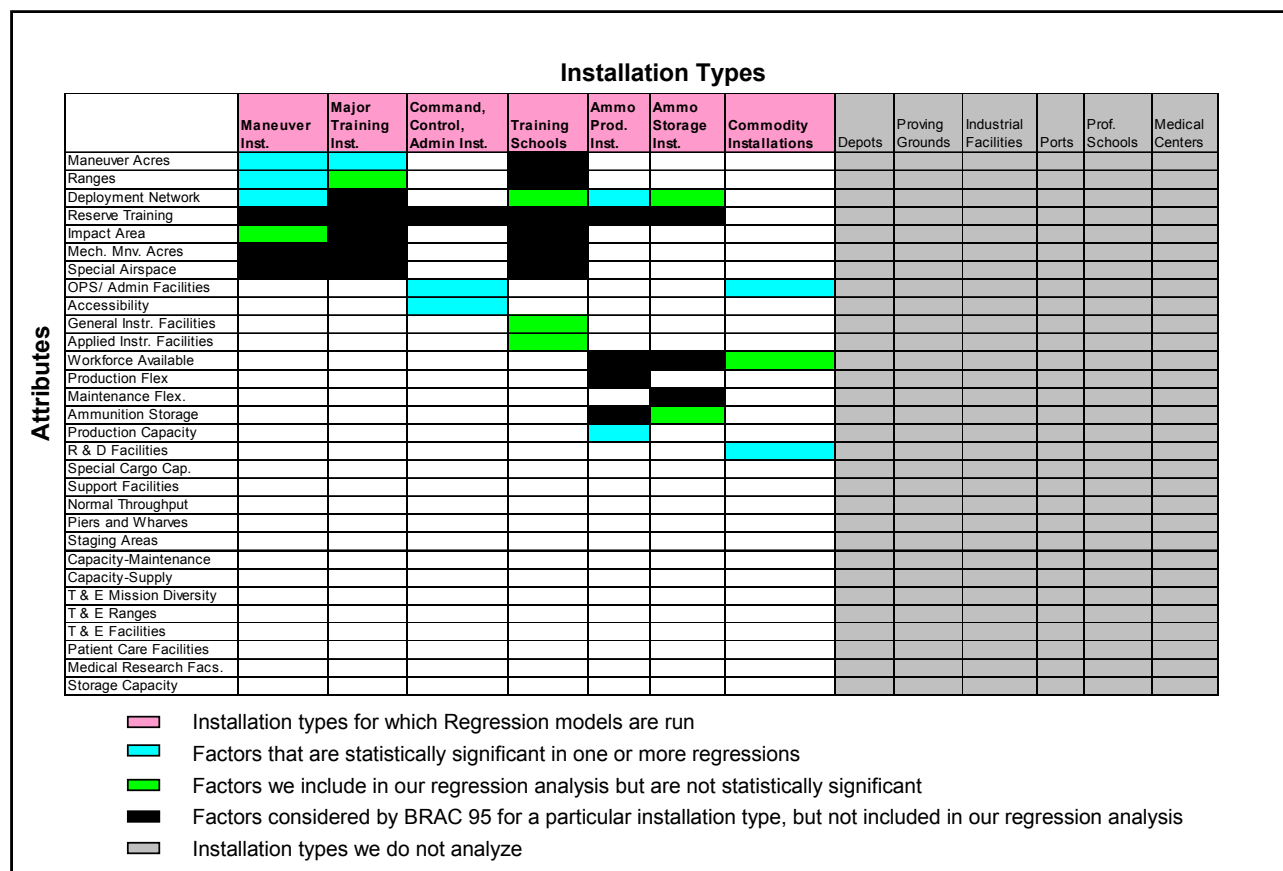


Figure 9. Consolidated Findings

We show in Figure 9 that of the 30 attributes included in the Mission Requirements criterion, only two (Deployment Network and Reserve Training) are present in BRAC 95's analyses for a majority of the installation types. The increased specialization among the attributes assigned to the Mission Requirements criterion results in fewer attributes being carried through for a majority of the installation types in this study. However, there is much less specialization among the attributes grouped in the other three Department of Defense selection criteria (Land and Facilities, Cost and Manpower, and Future Requirements), with 13 being carried through for the majority of installation types.

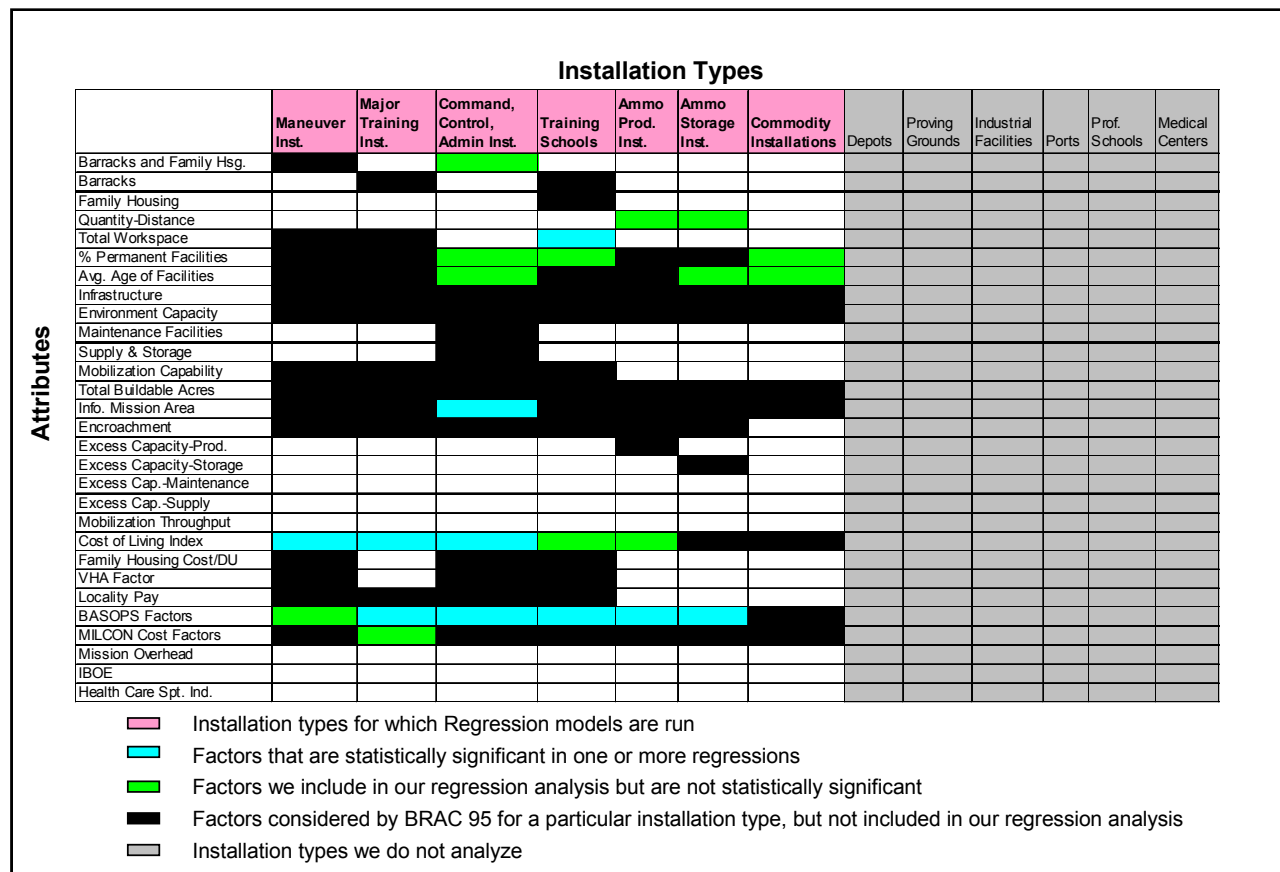


Figure 10. Consolidated Findings Continued

Using Maneuver Installations and Ammunition Storage Installations as examples, we can illustrate the utility of the consolidated findings in Figures 9 and 10 for the particular installation types. For Maneuver Installations, 6 of the 23 attributes (26.1%) are singled out by the Pareto analyses (green and blue shading) for inclusion in the regression model. Of these 6 attributes, 4 are statistically significant in determining the final scores an installation receives in BRAC 95. In the case of Ammunition Storage Installations, the Pareto analysis singles out 5 of the 23 attributes (21.7%) for inclusion in the regression model. Of these 5 attributes, only 1 is statistically significant.

In terms of the individual attributes, Figures 9 and 10 again show a wide range of successes and failures. Attributes such as BASOPS Factors perform well in the Pareto analyses (included in

the regressions for 6 of 7 installation types) and are significant in 5 of 7 (71.4%) of our regression analyses. Other attributes such as Average Age of Facilities perform better than others in the Pareto analyses (included in 3 of 7 regressions) but are not statistically significant in any of the regression analyses. Finally, attributes such as Total Buildable Acres and Infrastructure perform poorly in the Pareto analyses and are screened out of the regression analyses. In Section 5.2, we discuss in detail some of the questions raised by these screened-out attributes.

It is important to note that these statistical significance values are for the partitioned study. We develop different regression models for each installation type analyzed, i.e., we stove-pipe our analysis to mirror the BRAC 95 technique. In Figure 9 we show that in Ammunition Production Installations, production capacity is significant, but this is the only model for which this attribute is considered. Thus, it is not possible to assert that just because Production Capacity is significant for this one installation type, it is significant for all of the types. Similarly, factors such as Average Age of Facilities, which are never significant in any regression model, may be significant if all installations were considered in the monolith.

5.2 Attributes Failing Screening Criteria

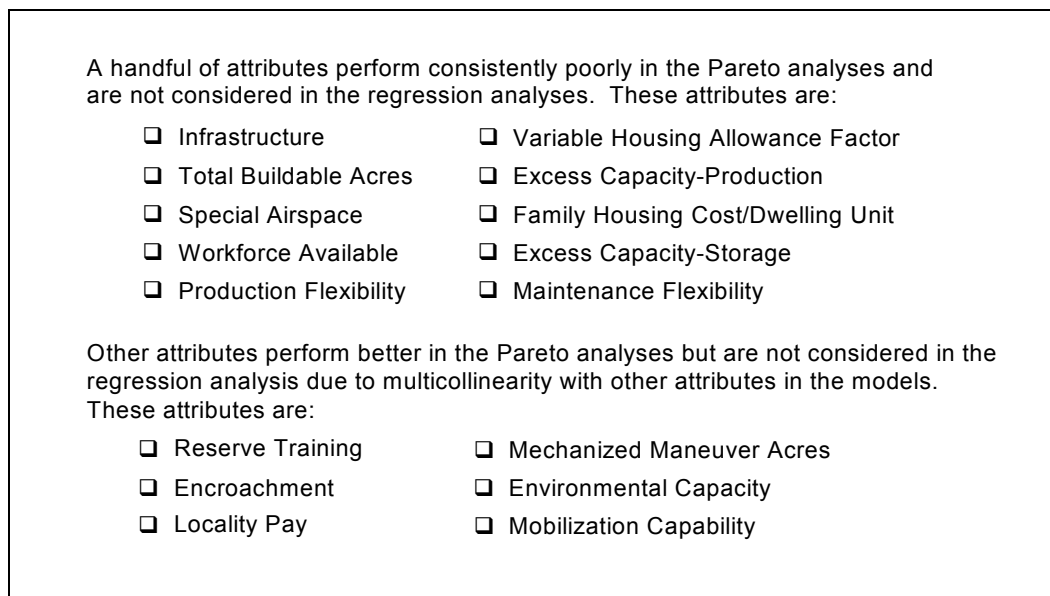


Figure 11. Attributes Failing Screening Criteria

In Figure 11, we assemble two groups of attributes that fail to pass our screening criteria. The first of these criteria is the Pareto analysis (Section 2) we perform for each of the installation types in order to narrow the number of attributes used in each regression. The second criterion is the test for multicollinearity (Section 3) we use to eliminate bias from our regression models, and therefore the corresponding attributes, e.g., the second group in Figure 11, are removed from the regressions.

The attributes in the first group consistently rank in the lower third (33%) of the attributes in the Pareto analyses and are never considered in our regression analyses. A comparison of the first group from Figure 11, and the consolidated findings in Figures 9 and 10 shows that more than half of the attributes in the first group are present for a minority (two or less) of the installation types. This limited applicability helps to explain the poor performances of attributes, e.g., Excess Capacity-Storage and Maintenance Flexibility.

Other Attributes such as Total Buildable Acres and Infrastructure, however, are present in BRAC 95 for almost every installation type and still never perform well enough in the Pareto analyses to warrant inclusion in the regression analysis. We identify two possible explanations for why these attributes are not considered in the regression analyses: i) Attributes that have instances of large, unevenly distributed ranges are systematically under-valued by the normalization equation we employ in constructing the Pareto analyses. For example, Total Buildable Acres ranges from a maximum of 132,572 acres to a minimum of 494 acres, the majority of the installations, more than 70%, are clustered close to the minimum while only one data point is near to the maximum range. Therefore, in cases where the majority of the observations is clustered around the lower range of measurement, attributes are more likely to fail the Pareto analyses; ii) The weighting system the TABS team uses in BRAC 95, and the structural constraints of the BRAC 95 analysis, i.e., the stove-piping of the installations and attributes, are more influential in determining the statistical significances of the attributes than we may previously have considered. We imply in Section 5.1 that just because an attribute is significant for one type of installation, i.e., in the stovepipe, we cannot assume that it is significant for all installation types considered as a whole. Furthermore, in Appendix E (Figures 21-24) we analyze the weighting for each attribute in eachE- installation type. These figures show that the attributes with the lowest weights are least likely to pass the screening of the Pareto analyses. Thus, the attributes that we analyze in the regression analyses are not necessarily the most influential attributes over all of the installation types.

The effects of the BRAC 95 weighting system may be better explained through an example using Total Buildable Acres and Infrastructure, two attributes that fail to perform well in the Pareto analyses. Figures 21-24 show that Total Buildable Acres only breaks the 5% threshold twice and Infrastructure breaks this threshold once, and neither of these two attributes survives the Pareto analysis. However, there are 5 cases in which an attribute contributes less than 5% to the total weight of 1000 and still passes the Pareto analysis. But of these 5 attributes, 4 make it into the regressions only because of other attributes being eliminated due to multicollinearity.

We cannot unequivocally assert that any of the attributes in the two groups in Figure 11 make little or no contribution to the final outcomes in BRAC 95, because all installation types are not examined. Eliminating the attributes in these two groups may produce simplified models, but not necessarily models with more explanatory power.

5.3 Conclusions

- ❑ 21 attributes survive Pareto analysis screening and are included in regression
11 of these attributes achieve statistical significance in at least one regression
- ❑ Of these 11 attributes, 5 (BASOPS Factors, Cost of Living Index, Maneuver Acres, OPS/Admin Facilities, and Deployment Network) are statistically significant for more than one installation type
- ❑ Because of stovepiped structure of BRAC 95 and limitations inherent in our Pareto analyses, we cannot conclusively state that factors which perform poorly in the Pareto analyses make little or no contribution to the final outcomes

In this study we statistically analyze BRAC 95's individual installation assessment attributes to determine which are most important in determining an installation's final ranking.

We fulfill our first goal, i.e., to identify those attributes from BRAC 95 that contribute most to an installation's ranking, in two important and informative ways: i) When we study all of the attributes from BRAC 95, we find that 21 contribute enough to the final outcomes to survive the Pareto analyses and are included in the final regression models. Of these 21 attributes we consider in the individual regression models, 11 achieve statistical significance in at least one installation type; ii) Of these 11 attributes that achieve statistical significance in at least one regression, 5 are statistically significant for more than one installation type (39%). These five are: BASOPS Attributes, Cost of Living Index, Maneuver Acres, OPS/Admin Facilities, and Deployment Network. For the installation types that we study (those that have enough observations to provide the required number of degrees of freedom to test for statistical significance), we show that a considerably reduced number of attributes are the most influential in determining the final scores and installation rankings.

We address our second goal, i.e., to identify those attributes that contribute little to the final outcomes, by identifying two groups of attributes that fail to pass the screening of the Pareto analyses, or are eliminated from consideration in the regressions due to multicollinearity with the other attributes in the models. We analyze the screened attributes individually and, in Section 5.2, provide some insights into why they fail the screening criteria. Conducting additional sensitivity analyses would help to further refine these groups of under-achieving attributes. However, such analyses are beyond the scope of this study.

We hypothesize that the structural constraints of the BRAC 95 analysis, i.e., the stove-piped nature of the analysis, impacts the findings of this study in two ways: i) certain attributes, which should be significant, or at the very least pass the screening criteria, are eliminated, e.g., Total Buildable Acres, which is analyzed in BRAC 95 for every installation type, but never passes the screening criteria, although it could be significant when all installations are considered in the monolith; ii) conversely, we cannot assert that the attributes we find to be statistically significant in the regression models we run for each installation type are statistically significant across all installation types, e.g., Production Capacity is statistically significant, but it is only considered by

BRAC 95 for one installation type. Therefore, we cannot assert that because Production Capacity is significant in this one installation type, that it is significant or applicable to the other installation types we study. It would be beyond the scope of this study to extend our analysis to include a global assessment of all the attributes and installation types which would help to control for some of the impacts of the stove-piping of BRAC 95.

APPENDIX A PROJECT CONTRIBUTORS

1. PROJECT TEAM

a. Project Director:

Mr. Joseph B. McGill

b. Team Members:

MAJ Paul L. Ewing

c. Other Contributors:

LTC Christopher Hill

2. PRODUCT REVIEWERS

Dr. Ralph E. Johnson, Quality Assurance

3. EXTERNAL CONTRIBUTORS

COL William Tarantino, ASA (IE)

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APPENDIX B REQUEST FOR ANALYTICAL SUPPORT

P *Performing Division:* RA *Account Number:* 2003246

A *Tasking:* Verbal *Mode (Contract-Yes/No):* In-house

R *Acronym:* SIGBRAC

T *Title:* Statistical Significance of BRAC '95 Parameters

1 *Start Date:* 11-Aug-03 *Estimated Completion Date:* 01-Oct-03
Requestor/Sponsor (i.e., DCSOPS): ASA(IE) *Sponsor Division:* DASA (IA)

Resource Estimates: a. *Estimated PSM:* 5 b. *Estimated Funds:* \$0.00

c. *Models to be Used:*

Description/Abstract:

The purpose of the study is to provide the TABS team with a list of parameters from the BRAC '95 study that contribute most to the final ranking of each installation. Multiple regression will be used to determine the statistical significance of the various attributes. A list of attributes that contribute little to the final rankings will also be identified.

Study Director/POC Signature: **Original Signed** *Phone#:* 703-806-5692

Study Director/POC: Mr. Joseph McGill

If this Request is for an External Project expected to consume 6 PSM or more, Part 2 Information is Not Required. See Chap 3 of the Project Directors' Guide for preparation of a Formal Project Directive.

P *Background:* Request to compile a list of parameters from the BRAC 95 study that are statistically significant in determining an installation's final 'score'.

A *Scope:* Scope includes the parameters and installations that were included and analyzed in the BRAC 95 study.

R *Issues:* Compilation of a list of statistically significant parameters from BRAC 95. Identification of a list of parameters that contributed little to the final 'scores'.

T *Milestones:*

July 2003: Presented initial results to Tech Director in a desk-side presentation.

September 9, 2003: ARB scheduled

Estimated Completion date: October 10, 2003

2

Signatures *Division Chief Signature:* **Original Signed and Dated** *Date:*

Division Chief Concurrence: Mr. David Russo

Sponsor Signature: **Original Signed and** *Date:*

Sponsor Concurrence (COL/DA Div Chief/GO/SES) : DASA (IA)

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APPENDIX C PARETO ANALYSIS CHARTS

Figures 12 through 18 show graphical representations of the Pareto analyses for each of the installation types that we analyze in this study. We detail the construction and general interpretation of these charts in Section 2 (Tables 1-5 and Figure 3). These Pareto charts are line-column charts on two axes. The Y-Axes represent the percent of the total average weighted score (see Tables 4 and 5) that each attribute composes as well as the cumulative percentage of each attribute. The X-Axes contain the installation assessment attributes.

Using the chart for Maneuver Installations (Figure 12) as an example, we show that Deployment Network is the greatest contributor to the total average weighted score (9%) and Information Mission Area makes the smallest contribution (1%). Figure 12 also shows that the first 8 (35%) attributes (Deployment Network through Mechanized Maneuver Acres) contribute 60% to the total average weighted score.

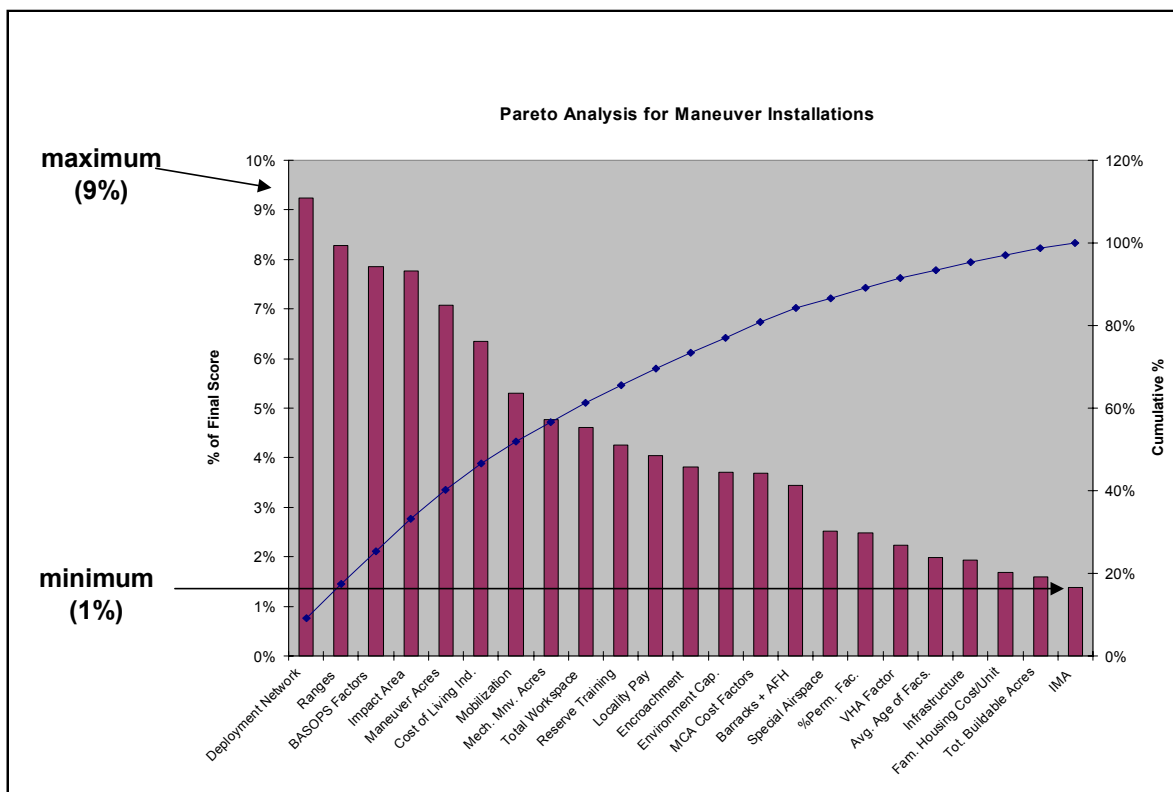


Figure 12. Pareto Analysis of Maneuver Installations

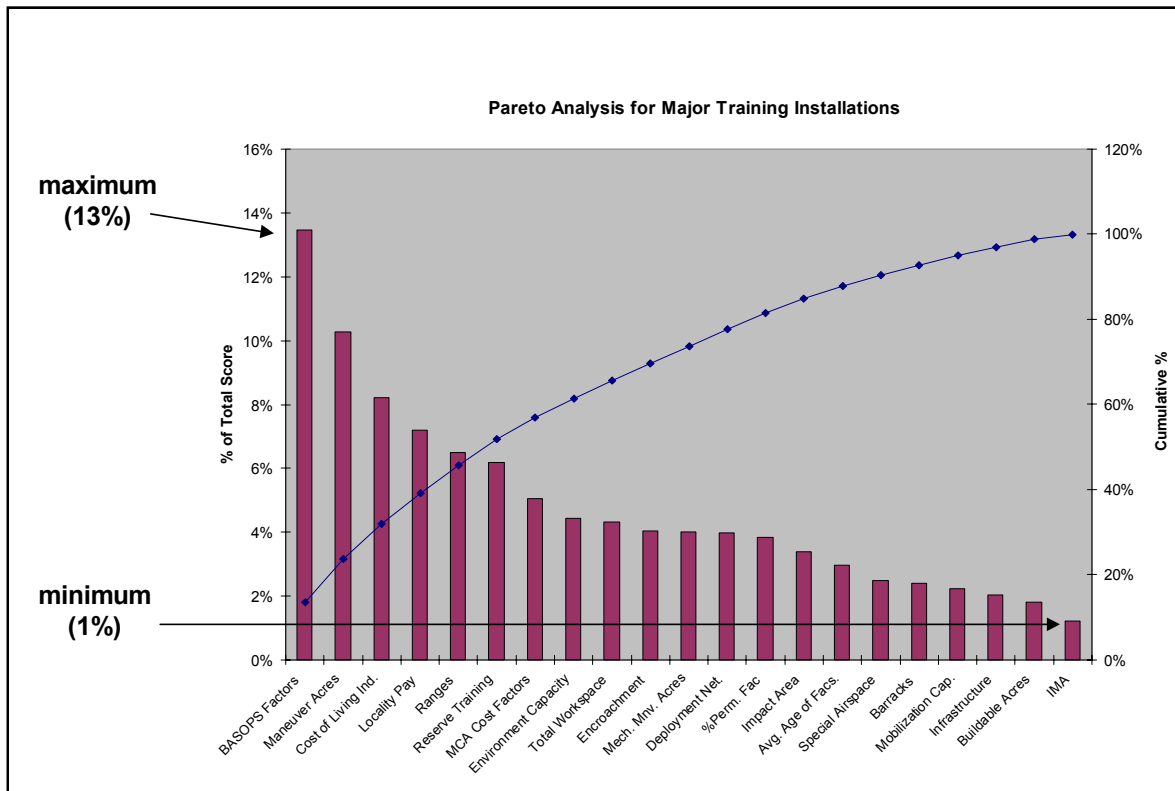


Figure 13. Pareto Analysis of Major Training Installations

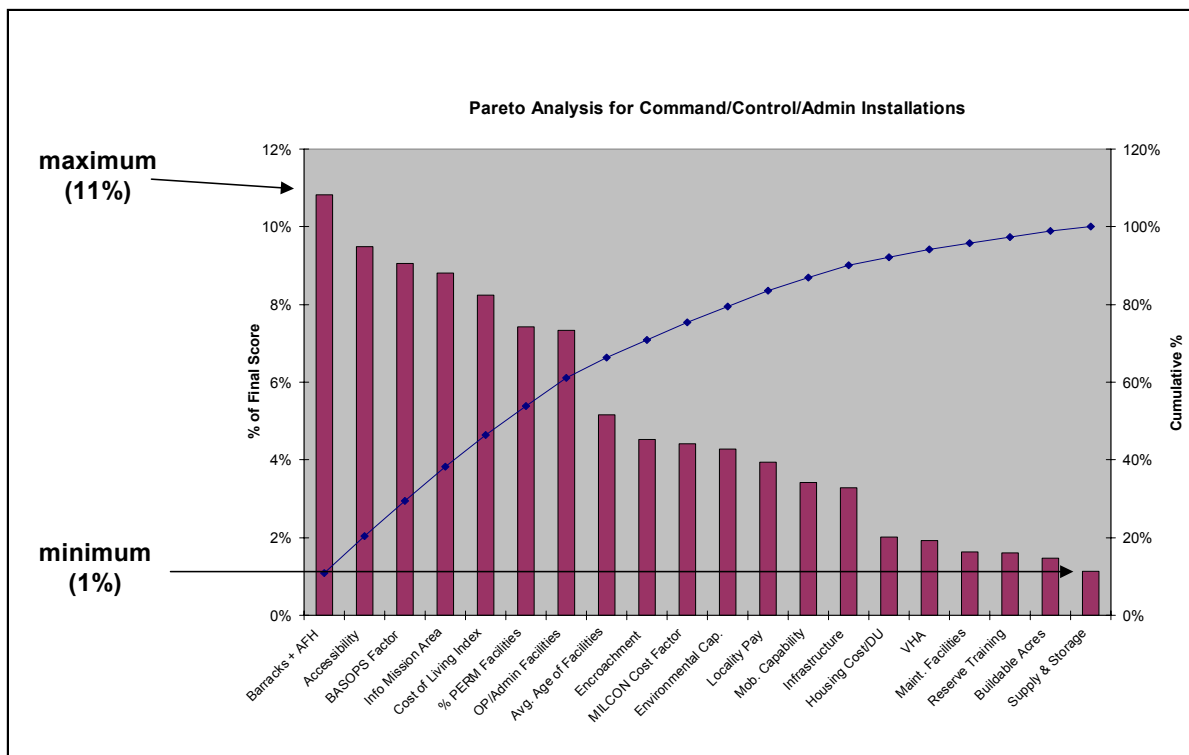


Figure 14. Pareto Analysis of Command, Control, and Admin. Installations

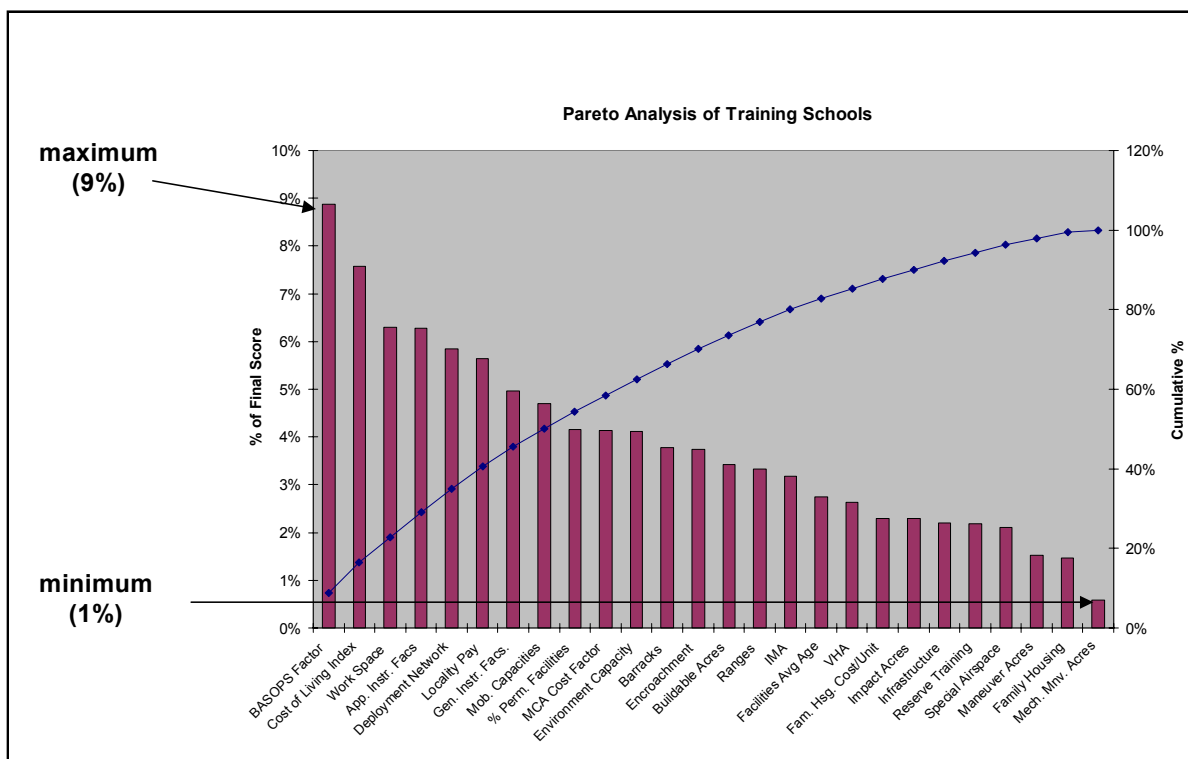


Figure 15. Pareto Analysis of Training Schools

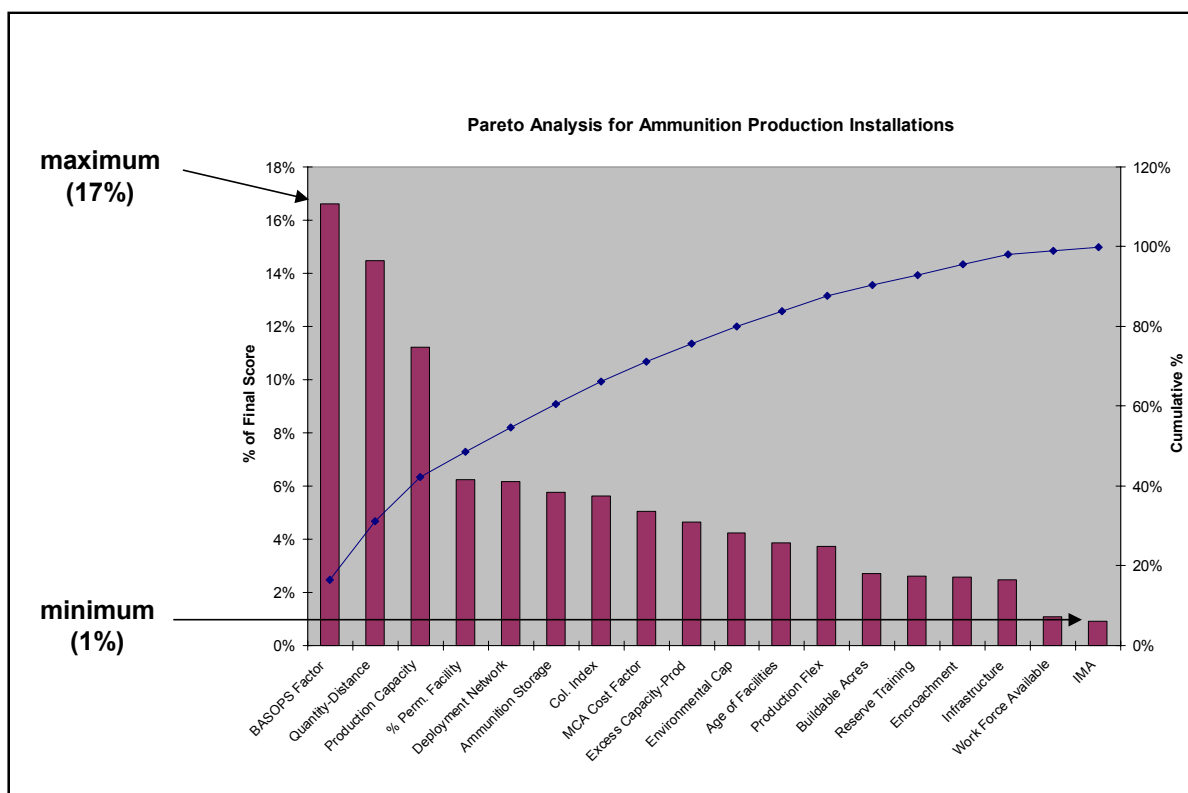


Figure 16. Pareto Analysis of Ammunition Production Installations

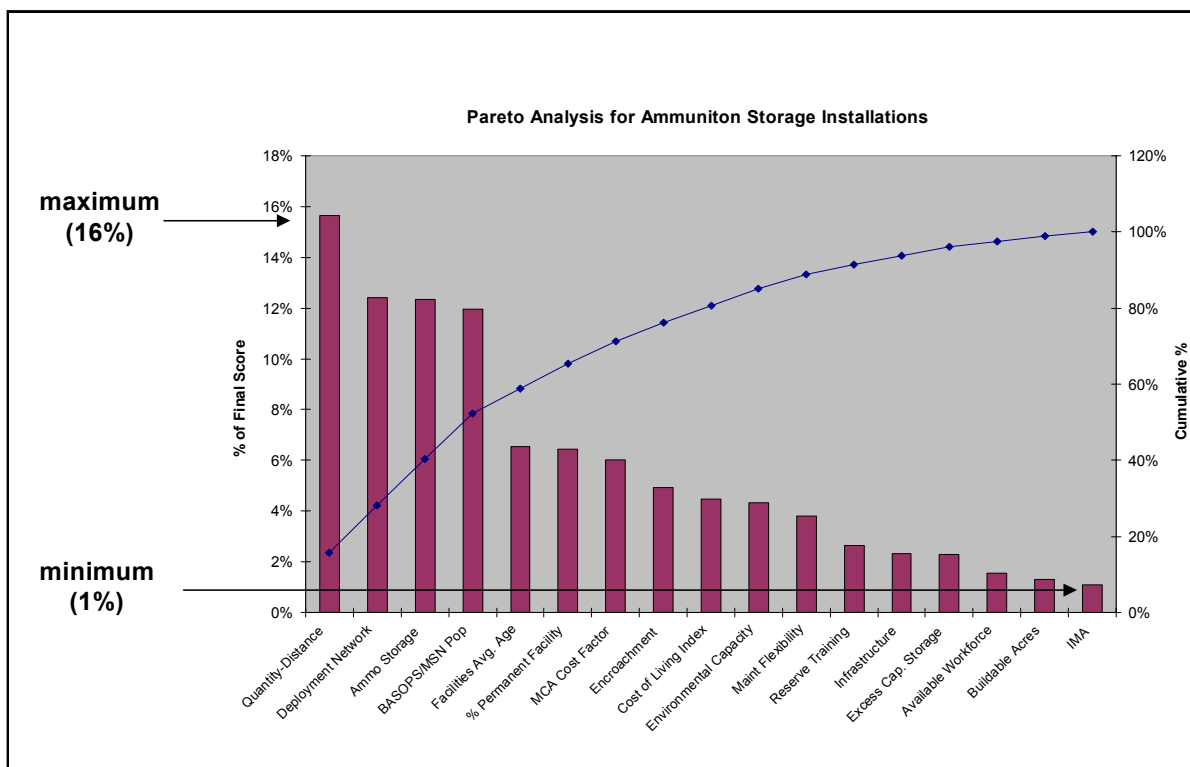


Figure 17. Pareto Analysis of Ammunition Storage Installations

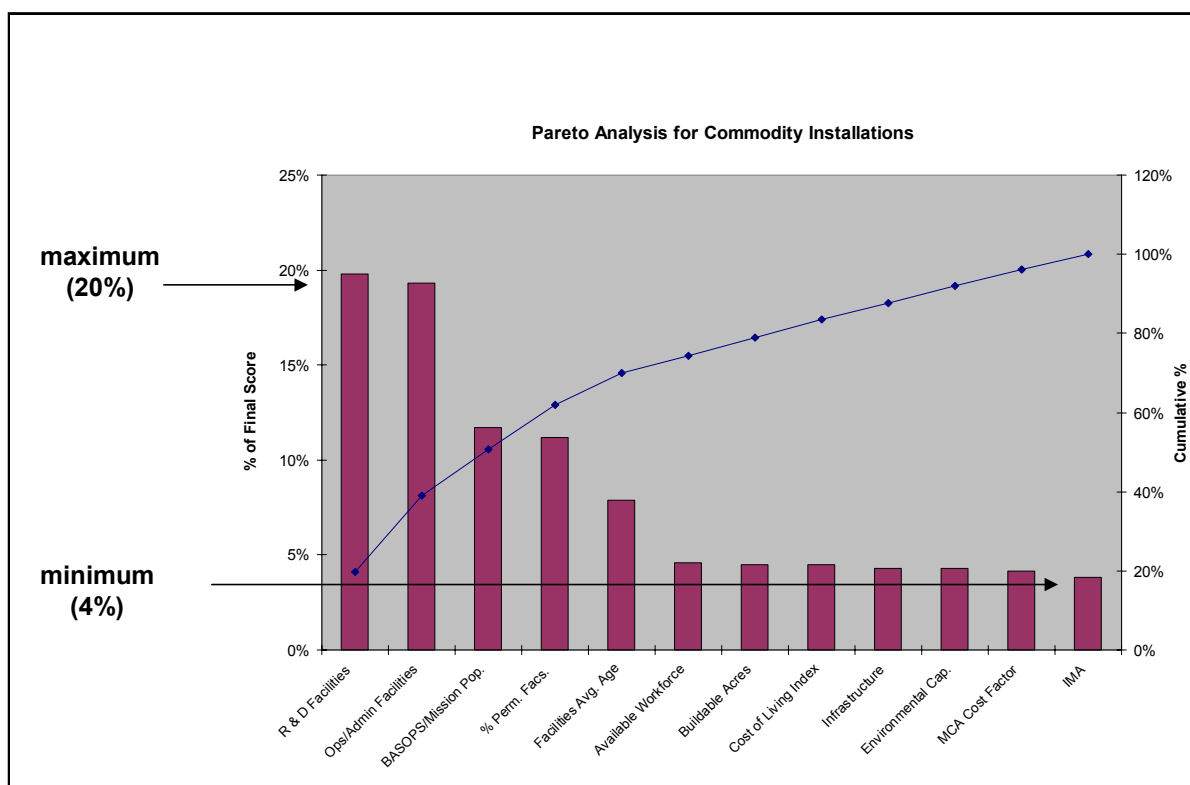


Figure 18. Pareto Analysis of Commodity Installations

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APPENDIX D REGRESSION ANALYSIS CHARTS

This appendix contains the charts for the remaining 5 installation types we analyze in this study. We include the charts for Maneuver and Major Training Installations in the main body of the report. We explain the interpretation of the findings in these charts in Section 3.

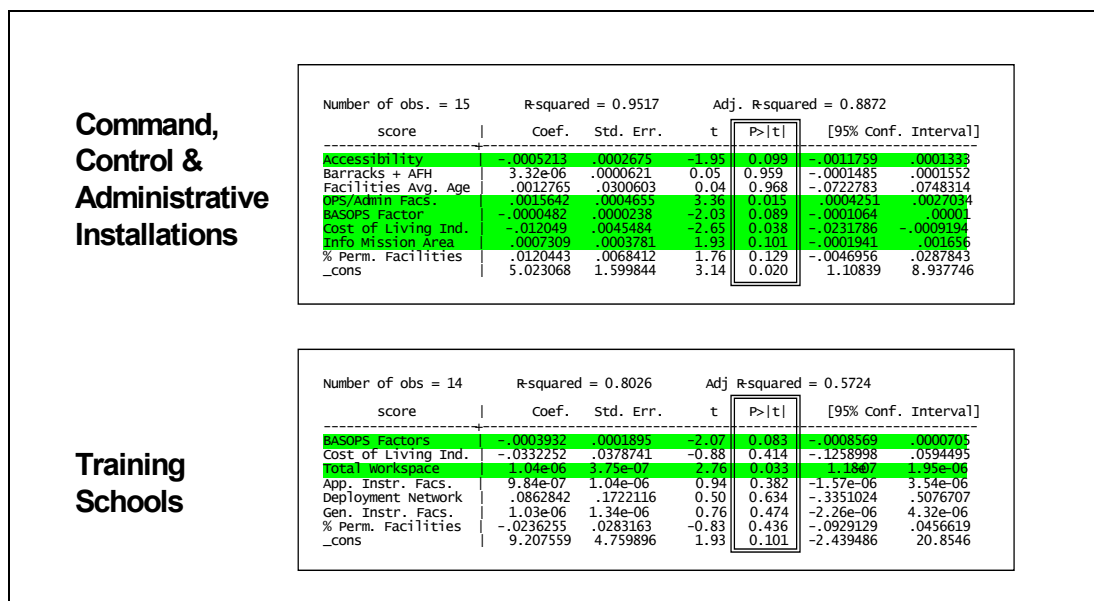


Figure 19. Regression Analysis

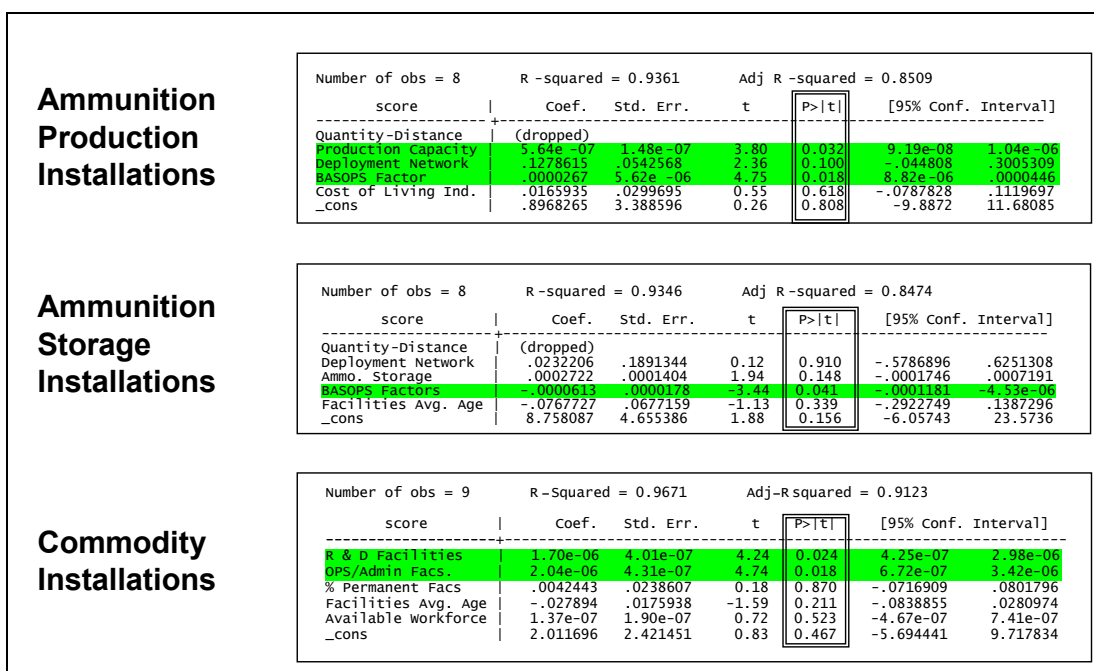


Figure 20. Regression Analysis, cont.

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APPENDIX E EXPLORATION OF BRAC '95 WEIGHTING

Figures 19 through 22 show our additional analysis of the weighting of the attributes in each of the seven installation types we analyze. The color-coding in these charts is identical to the color-coding used in the Consolidated Findings charts (Figures 9 and 10), i.e., attributes that are colored blue are statistically significant in the regression analysis, those that are colored green, are included in the regression model but are not significant, and those colored black are not considered in the regression model. These charts show all of the attributes that BRAC 95 considers for each installation type we study, their weights, the local percentage (how much of the individual DOD selection criterion the attribute composes), and the percentage of the total 1000 weighting points.

Using Figure 21 as an example, we show that of all the factors that are considered in the regression model for Maneuver Installations and Major Training Installations (highlighted in blue and green), only one (MILCON Cost Factors in Major Training Installations) had a percentage of the total weight that was less than 5%.

Maneuver Installations				Major Training			
	WEIGHT	Local Percent	Percent of Total		WEIGHT	Local Percent	Percent of Total
Maneuver Acres	80	18%	8%	Maneuver Acres	120	27%	12%
Ranges	70	16%	7%	Ranges	70	16%	7%
Deployment Network	60	13%	6%	Reserve Training	70	16%	7%
Reserve Training	60	13%	6%	Mech. Mnv. Acres	80	18%	8%
Impact Area	70	16%	7%	Impact Acres	70	16%	7%
Mech. Mnv. Acres	70	16%	7%	Special Airspace	40	9%	4%
Special Airspace	40	9%	4%	Mission Requirements	450		
Mission Requirements	450						
Barracks and Fam. Housing	60	27%	6%	Total Workspace	60	27%	6%
Total Workspace	60	27%	6%	%Permanent Facilities	30	13%	3%
%Permanent Facilities	30	13%	3%	Avg. Age of Facilities	25	11%	3%
Avg. Age of Facilities	25	11%	3%	Infrastructure	25	11%	3%
Infrastructure	25	11%	3%	Barracks	60	27%	6%
Environment Capacity	25	11%	3%	Environment Capacity	25	11%	3%
Land and Facilities	225			Land and Facilities	225		
Mobilization Capability	55	44%	6%	Mobilization Capability	30	24%	3%
Total Buildable Acres	35	28%	4%	Total Buildable Acres	35	28%	4%
Info. Mission Area	10	8%	1%	Encroachment	20	16%	2%
Encroachment	25	20%	3%	Deployment Network	30	24%	3%
Future Requirements	125			Info. Mission Area	10	8%	1%
Cost of Living Index	50	25%	5%	Future Requirements	125		
Fam. Hsg. Cost/Unit	15	8%	2%	Cost of Living Index	60	30%	6%
VHA Factor	15	8%	2%	Locality Pay	35	18%	4%
Locality Pay	30	15%	3%	BASOPS Factors	75	38%	8%
BASOPS Factors	60	30%	6%	MILCON Cost Factors	30	15%	3%
MILCON Cost Factors	30	15%	3%	Cost and Manpower	200		
Cost and Manpower	200						
Total Weight	1000			Total Weight	1000		

Figure 21. Analysis of Weighting

Command/Control/Administrative Installations				Training Schools			
	Weight	Local Percent	Percent of Total		Weights	Local Percent	Percent of Total
Reserve Training	50	11%	5%	Maneuver Acres	65	14%	7%
OP/Admin Facilities	140	31%	14%	Ranges	45	10%	5%
Info Mission Area	70	16%	7%	Deployment Network	35	8%	4%
Accessibility	50	11%	5%	Reserve Training	30	7%	3%
Barracks and Fam. Housing	140	31%	14%	Impact Acres	40	9%	4%
Mission Requirements	450			Mechanized Maneuver Acres	20	4%	2%
% PERM Facilities	40	18%	4%	General Instructional Facilities	60	13%	6%
Avg. Age of Facilities	40	18%	4%	Applied Instructional Facilities	60	13%	6%
Infrastructure	40	18%	4%	IMA	30	7%	3%
Maint. Facilities	40	18%	4%	Special Airspace	65	14%	7%
Supply & Storage	40	18%	4%	Mission Requirements	450		
Environmental Cap.	25	11%	3%	Barracks	40	18%	4%
Land and Facilities	225			Family Housing	20	9%	2%
Mob. Capability	40	32%	4%	Available Workspace	60	27%	6%
Buildable Acres	60	48%	6%	% Perm. Facilities	30	13%	3%
Encroachment	25	20%	3%	Facilities Average Age	25	11%	3%
Future Requirements	125			Infrastructure	25	11%	3%
Cost of Living Index	50	25%	5%	Environment Capacity	25	11%	3%
Housing Cost/DU	15	8%	2%	Land and Facilities	225		
Locality Pay	30	15%	3%	Mob. Capacities	65	52%	7%
BASOPS Factor	60	30%	6%	Buildable Acres	35	28%	4%
MILCON Cost Factor	30	15%	3%	Encroachment	25	20%	3%
VHA	15	8%	2%	Future Requirements	125		
Cost and Manpower	200			Cost of Living Index	50	25%	5%
Total Weight	1000			Fam. Housing Cost/Unit	15	8%	2%
				VHA	15	8%	2%
				Locality Pay	30	15%	3%
				BASOPS Factor	60	30%	6%
				MCA Cost Factor	30	15%	3%
				Cost and Manpower	200		
				Score	1000		

Figure 22. Analysis of Weighting, cont.

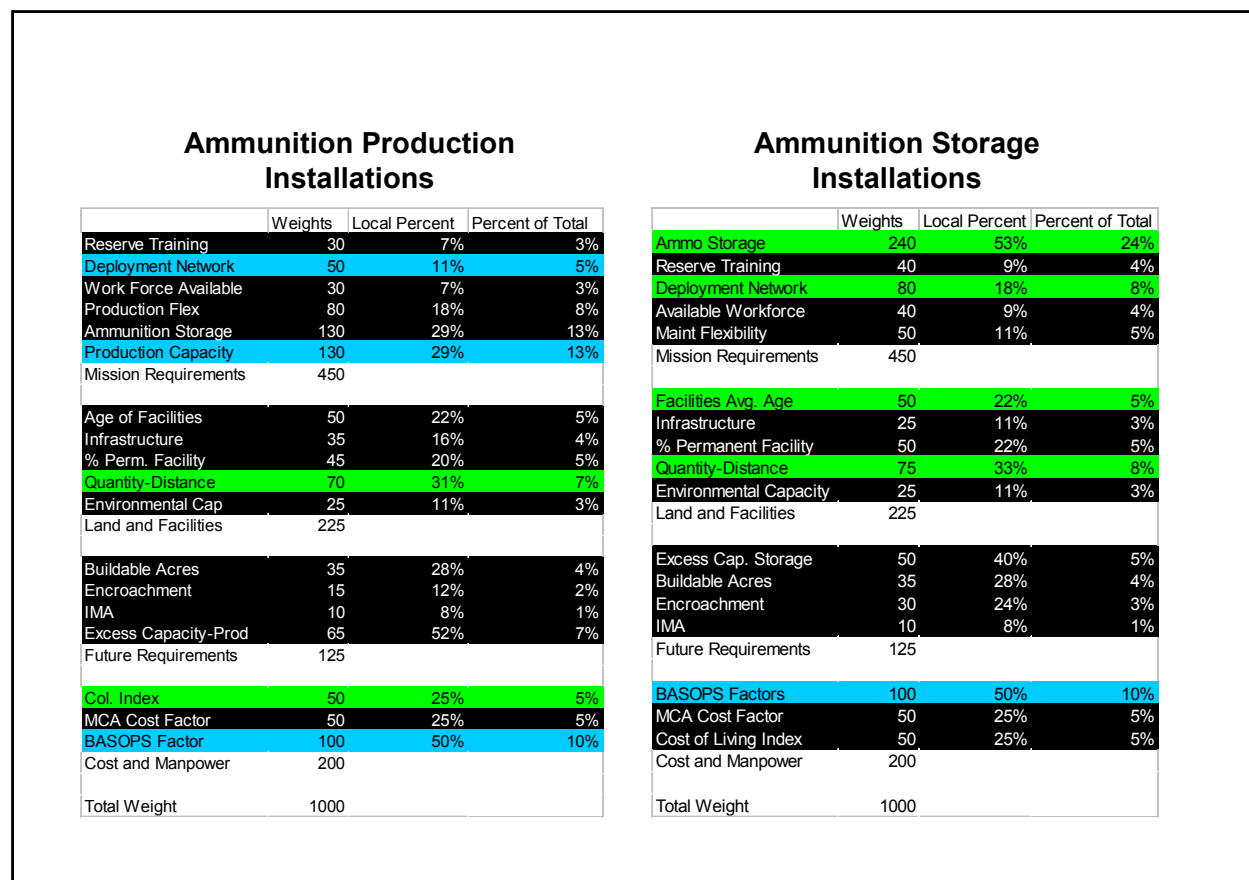


Figure 23. Analysis of Weighting, cont.

Commodity Installations

	Weights	Local Percent	Percent of Total
Available Workforce	50	11%	5%
Ops/Admin Facilities	200	44%	20%
R & D Facilities	200	44%	20%
Mission Requirements	450		
Facilities Avg. Age	75	33%	8%
Infrastructure	50	22%	5%
% Permanent Facilities	75	33%	8%
Environmental Capacity	25	11%	3%
Land and Facilities	225		
Buildable Acres	90	72%	9%
IMA	35	28%	4%
Future Requirements	125		
Cost of Living Index	50	25%	5%
MCA Cost Factor	50	25%	5%
BASOPS Factors	100	50%	10%
Cost and Manpower	200		
Total Weight	1000		

Figure 24. Analysis of Weighting, cont.

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U.S. ARMY

**Center for
Army
Analysis**

**DECISION ANALYSIS SUPPORT FOR BASE
REALIGNMENT AND CLOSURE**

MARCH 2004



**CENTER FOR ARMY ANALYSIS
6001 GOETHALS ROAD
FORT BELVOIR, VA 22060-5230**

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**Director
Center for Army Analysis
ATTN: CSCA- RA
6001 Goethals Road
Fort Belvoir, VA 22060-5230**

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Center for Army Analysis 6001 Goethals Road Fort Belvoir, VA 22060-5230			8. PERFORMING ORGANIZATION REPORT NUMBER CAA-R-04-14	
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13. ABSTRACT (<i>Maximum 200 Words</i>) The office of the Deputy Assistant Secretary of the Army for Infrastructure Analysis (DASA-IA) tasked the Center for Army Analysis (CAA) with conducting a series of interviews with senior Army leaders and subject matter experts (SMEs) to gain their insights and perspectives on the military value analysis portion of the Base Realignment and Closure (BRAC) process for 2005 to aid in the development of the Military Value Analyzer (MVA) Model. The findings of this process are to be used to develop attributes and determine possible weighting options for the MVA model. The analysis determines that according to those interviewed, the attributes associated with training and projecting the force should have the most significance in the model.				
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DECISION ANALYSIS SUPPORT FOR BASE REALIGNMENT AND CLOSURE**SUMMARY**

THE PROJECT PURPOSE. The office of the Deputy Assistant Secretary of the Army for Infrastructure Analysis (DASA-IA) tasked the Center for Army Analysis (CAA) with conducting a series of interviews with senior Army leaders and subject matter experts (SMEs) to discuss the military value analysis portion of the Base Realignment and Closure (BRAC) process for 2005. The purpose is to aid in the development of the Military Value Analyzer (MVA) Model.

THE PROJECT SPONSOR is the Deputy Assistant Secretary of the Army for Infrastructure Analysis (DASA-IA)

THE PROJECT OBJECTIVES are to:

- (1) Gain the insights and perspectives of senior Army leaders and SMEs on the BRAC process for 2005;
- (2) Create a database of interview summaries that could be analyzed to derive findings that would aid in the development of the Military Value Analyzer (MVA) model;
- (3) Use these findings to develop attributes and determine possible weighting options for the MVA model;
- (4) Discern any possible trends in the responses of the interviewees not related to military value which may be helpful in conducting BRAC 05.

THE SCOPE OF THE PROJECT is to interview senior Army leaders and SMEs who have valuable insights and experiences that can support the development of the MVA Model.

THE MAIN ASSUMPTION is that we would be given access to the personnel that would represent a diverse group of Army functions and mission areas.

THE PRINCIPAL FINDINGS are:

- (1) The interviewees believe the attributes dealing with training and power projection are the most significant drivers in assessing military value;
- (2) The interviewees believe this round of BRAC presents significant Joint opportunities upon which the Army should capitalize.

THE PRINCIPAL RECOMMENDATIONS are:

- (1) The results of this interview process should be used to aid in the weighting of attributes in the MVA Model;

(2) The MVA Model should give significant consideration to those attributes that deal with training and projecting the operational force;

(3) The Army should seek to capitalize on possible Joint opportunities.

THE PROJECT EFFORT was conducted by Mr. John M. Bott, Resource Analysis Division, Center for Army Analysis.

COMMENTS AND QUESTIONS may be sent to the Director, Center for Army Analysis, ATTN: CSCA-RA, 6001 Goethals Road, Suite 102, Fort Belvoir, VA 22060-5230

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1 INTRODUCTION

1.1 Introduction

Between June 2003 and February 2004 a team of analysts from the Army Basing Study (TABS) group, the United States Military Academy (USMA), and the Center for Army Analysis (CAA) conducted a series of interviews with senior Army leaders and subject matter experts (SMEs) to gain their insights and perspectives on the Base Realignment and Closure (BRAC) process for 2005. The objectives of this endeavor were to create a database of interview summaries that could be analyzed to derive findings that would aid in the development of the Military Value Analyzer (MVA) model and to discern any possible trends in the responses of the interviewees not related to military value that may be of use in conducting BRAC 05. This interview process was managed by CAA under the project title “Decision Analysis Support for BRAC (DAS-B).” By the time the project was completed, the interview team had conducted 40 interviews with a total of 68 senior Army leaders or SMEs.

The interviews discussed in this report are only those that were part of this formal interview process. Throughout the development of the MVA model and the BRAC 05 process, analysts from the TABS group and CAA met with, and will continue to meet with, senior Army leaders and SMEs as required.

1.2 Background

As part of its analysis for BRAC 2005, the TABS group is constructing the MVA model that will “score” Army installations on their ability to contribute to the accomplishment of all of the missions of the United States Army. The model will create a hierarchy that will consist of primary goals, sub-goals, and attributes (the model will be discussed in slightly more detail later on in this report). The TABS group determined early that it would be desirable to conduct a series of formal, documented interviews with a cadre of senior Army leaders to aid in the construction of the MVA model. The results of these interviews, along with extensive research and document review, have been used to determine which attributes should go into the MVA model and how much consideration should be placed on each attribute.

The interviews also served as a screening process to ensure that no major issues were overlooked in the development of the MVA model. By interviewing senior leaders and SMEs from Headquarters, Department of the Army (HQDA); Major Army Commands (MACOMS); Sub-ordinate Commands; Army agencies; and other government organizations, we ensured that we would be meeting with people whose past experiences and current positions covered a wide spectrum of expertise and areas of responsibility.

1.3 Approach

We first developed an interview questionnaire that would be used in all of the interviews. Next, we compiled a list of potential interviewees. The first set of interviewees (about 15), were identified as the priority list. The list was expanded to encompass a broader array of personnel and to ensure that more elements of the Army contributed to the process. Third, we assembled our interview team (the interview team is discussed further in section 2.1).

Once the interview questionnaire, list of interviewees, and interview team were assembled, we began scheduling and conducting the interviews. After completing the first ten interviews, we began to derive preliminary findings. As more interviews were conducted, we could derive additional findings and validate our initial findings. These findings were used to aid in the development of the MVA model.

1.4 Key Assumptions

We identified several assumptions going into the interview process. First, we assumed that we would be able to interview enough individuals to create a database large enough to produce credible conclusions. Second, we assumed that we would be granted access to the senior Army leaders. Finally, we assumed that our final interview list would cover a spectrum of organizations and individuals broad enough to eliminate any appearance of bias toward any element of the Army (i.e., leaders and SMEs interviewed would be representative of all of the Army's various functions and missions).

1.5 Key Limitations

Our key limitation was the time frame in which we wanted to finish the project. From the outset, we were on a tight schedule. This impacted our ability to meet with more people. Because of scheduling conflicts, several interviews were cancelled and re-scheduled multiple times. We constrained ourselves by limiting the number of interviewers in order to remain consistent throughout the process. This limited our ability to schedule multiple interviews simultaneously.

2 THE INTERVIEW PROCESS

2.1 Interview Team

Our interview team consisted of both interviewers and recorders. The interviewer's job was to ask the questions and keep the conversation flowing. The recorder's responsibility was to capture as much of what was said as possible by writing down the comments made by the interviewee in response to the interviewer's queries. The recorders relied solely on written notes. With only a few exceptions, one recorder was present at the interviews.

The Principal interviewer throughout the process was Dr. Greg Parnell of the United States Military Academy's Department of Systems Engineering. Dr. Parnell conducted 30 of the 40 interviews, while the remaining ten were conducted by other members of the team (Mr. John Bott – 5, MAJ Lee Ewing – 2, LTC Willie McFadden – 2, and LTC Michael Kwinn – 1). The Principal recorder was Mr. Bott of the Center for Army Analysis who recorded 31 of the 40 interviews. Figure 1 contains a complete list of interviewers and recorders as well as their organization and how many of the interviews they participated in (as either an interviewer or recorder).

Name	Agency	Interviews
Mr. John Bott	CAA	36
Dr. Greg Parnell	USMA	30
MAJ Lee Ewing	CAA	5
CPT John Harris	USMA	4
LTC Willie McFadden	USMA	2
LTC Rich Hall	TABS	2
Mr. Rob Dow	TABS	2
MAJ Doug Tuttle	TABS	2
Mr. Joe McGill	CAA	2
LTC Michael Kwinn	USMA	1
MAJ Adam Shepherd	TABS	1
Ms. Peggy Mencl	TABS	1

Figure 1. Interview Team Members

2.2 Interview Questionnaire Development

The interview questionnaire was developed by several of the team members after a thorough document review (see Appendix D). We developed a questionnaire covering a wide topic area that addressed several aspects of installation functions, such as maneuver, training, housing, testing, and supply and storage. Our objective was to have the interviewee drive the discussion

by giving them the opportunity to discuss the stationing issues they deemed most important. Therefore, the lead-in question was designed to generate open and frank discussion. The opening question was:

“When you think about BRAC 2005, what are your major concerns? What keeps you up at night?”

In many cases, the interviewee would take up a majority of the interview time by responding to this one question, which was our intent. For those who answered this question more succinctly, we continued with a series of questions that dealt with more specific topical areas. However, these questions were still open-ended so as not to drive the interviewee’s response. A sample of one of our follow-on questions is:

“How should the Army expand or integrate training on other Services’ installations?”

Questions of this nature allowed us to capture an interviewee’s insights on more focused areas of concern. We concluded all of the interviews by asking the following closing question:

“What are the most significant issues that should be considered in BRAC 2005 that were not considered in BRAC 1995, and are there any questions we didn’t ask but should have?”

This question served three purposes. First, it was used to draw on an interviewee’s past BRAC experiences, if applicable. Second, it allowed us to improve or modify our questionnaire for later interviews. And finally, it gave the interviewees an opportunity to make any final comments.

By using a standard yet flexible questionnaire, we ensured that we were not driving the interview results by asking pointed questions (such as, “Do you believe maneuver land is a significant BRAC consideration, if so how significant?”). Furthermore, we avoided using questions that involved a “scaled” response, for example, “On a scale of 1-10, 10 being the highest, how important should deployment attributes be?” Instead, the questionnaire gave the interviewer open-ended question options to be used in the event the interviewee did not drive the discussion from the outset.

2.3 Scheduling and Conducting the Interviews

We began scheduling the interviews in June of 2003, with the first three being held on 5 June. Our last interviews were conducted in February of 2004. The most challenging part of the interview process was trying to match the conflicting schedules of the interviewers and interviewees. On several occasions, interviews were cancelled due to scheduling conflicts that would arise on short notice. When the process was complete, we had conducted 40 interviews with a total of 68 individuals.

When we first requested a slot on the interviewees' calendars, we asked for a one-hour block of time. This proved to be a sufficient request as most interviews ranged from 50 to 70 minutes. Only seldom did we not get our requested one-hour block.

We provided the interviewees with a read-ahead that contained a brief explanation of why we were conducting these interviews. In addition, we had sample questions enclosed, but we emphasized that we did not want written responses nor were we looking for any hard data. We also re-assured the interviewees that the results of the interviews were non-attribution and that we wanted them to be as open and frank as they felt comfortable. We also asked that they not have any more people in attendance than they deemed necessary as we were looking for their personal insights, not those of their deputies or action officers. We did encourage them to have one other person sit in on the interview with them, but advised that they keep the number of attendees to a minimum. In most interviews, there was one other deputy or action officer in attendance. However, there were also interviews in which only the leader attended or multiple deputies or action officers accompanied a leader.

It was our objective to interview leaders from several different mission areas of the Army. We sought to meet with people who were responsible for logistics, operations, training, policy, personnel, installation management, and testing and evaluation.

Figure 2 illustrates the diversity of the organizations that contributed. It also confirms that we achieved our objective of meeting with individuals from a wide array of responsibility areas. The table divides the organizations into three categories: organizations responsible for the deployment, training, and management of the operating force; organizations responsible for logistics, the industrial base, installation management, and analysis; and organizations responsible for personnel, financial management, and non-Army or DOD agencies. The numbers in parentheses indicate how many principals from that organization were interviewed. This table also illustrates our impartiality in selecting organizations and agencies to interview. To see a complete list of the 40 interviewees and their organizations see Appendix C.

Operations & Training (16)	Logistics & Support (14)	Other (10)
ARNG	ACSIM (3)	ASA-FM&C (4)
FORSCOM (2)	AMC	ASA-M&RA (2)
G-3	ASA-ALT	DAS
G-3 FM (2)	ATEC	G-1
G-3 SSW	CAA	GAO
G-3 SSZ	DUSA-OR	RAND
G-3 TR	G-4 (2)	
G-6/CIO	IMA (2)	
G-8	MTMC	
G-8 FD	PAE	
MEDCOM		
OCAR		
OFTF		
TRADOC		

Figure 2. Organizations Interviewed

In addition to interviewing people across a broad spectrum of functional areas, we also sought to interview as many senior-ranking leaders as possible. By the end of the interview process, we met with 30% of the current four-star Generals and 21% of the current three-Star Generals. We also conducted interviews with 50% of the Deputy Under Secretaries of the Army and 60% of the Assistant Secretaries of the Army. Appendix E contains two tables that illustrate a breakdown of the 68 interview attendees by rank and title.

2.4 Interview Summaries

After conducting an interview, the recorder typed a summary of what was said. The objective was to be as complete and accurate as possible to try to fully capture what the interviewee said. For consistency, a standard format was used for the summary. This summary became known as the “main summary” and would contain almost everything recorded during the interview. Those comments that were deemed too critical or too inflammatory to an installation, a MACOM, or a type of installation, were taken out of the main summary and were saved in a separate summary that was called the “critical summary.” Only members of the interview team and select members of the TABS group had access to the main and critical summaries. These summaries have the

names of the interviewee and other interview attendees on them, but they are still for non-attribution outside of the group authorized to view them.

So that a wider, though still restricted, audience could have access to the interview results, a third version of the summaries was created with no names attached. Any reference within the summary that could indicate the interviewee's name or organization was removed. This version was accessible to other members of the TABS group or those with a need to see it in order to conduct BRAC 05 analysis. This version is called the "nameless summary."

All of the summaries were used to derive the findings that are discussed in the next chapter.

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3 FINDINGS AND ANALYSIS

3.1 Preliminary Findings

Upon completion of the first ten interviews, we developed some initial findings based on recurring themes. Each preliminary finding was supported by a series of quotes from the interview summaries. The eight initial preliminary findings are listed below without their supporting quotes (which appear in Appendix F under the final adapted findings):

- BRAC 2005 is the first OSD/Joint BRAC. This provides an opportunity to capitalize on Joint possibilities;
- Doing Army BRAC “right” means synchronizing BRAC with major Army initiatives (Transformation, Restationing units from Europe, Force reduction, etc.);
- The Army will need more training land. A premium should be placed on this;
- Mobilization and deployment capabilities should be significant considerations;
- Soldier and well-being issues are important considerations;
- DoD BRAC funding provides incentives and challenges;
- The Army should approach BRAC 2005 from a “Total Force” (AC/RC/NG) perspective;
- The Army / TABS Team / Dr. College will come up with the best list based on military value and cost effectiveness, but it will be overcome by politics.

As the interview process continued, these findings were validated, expanded, and then adapted to map to the six major goals of the MVA model. In this manner, we were able to use the interview findings to justify the structure and content of the model.

3.2 Relating the Findings to the MVA Model

As mentioned in the introduction, the MVA model has a hierarchy that consists of primary goals, sub-goals, and attributes. Throughout the interview process, the model began to take shape until it matured to a point where the primary goals could be set. After this was done, we could then map the findings to the MVA model. The model development and interview process were advancing simultaneously and were therefore contributing to each other. When we realized that the interviewees were placing special emphasis on a particular subject area, we would adjust the model accordingly. Likewise, if we believed the model was lacking attributes from a specific mission area, we would add to our interviewee list to ensure that representatives from those

mission areas had a say in the development of the model. The finalized first level of the MVA model hierarchy is listed below:

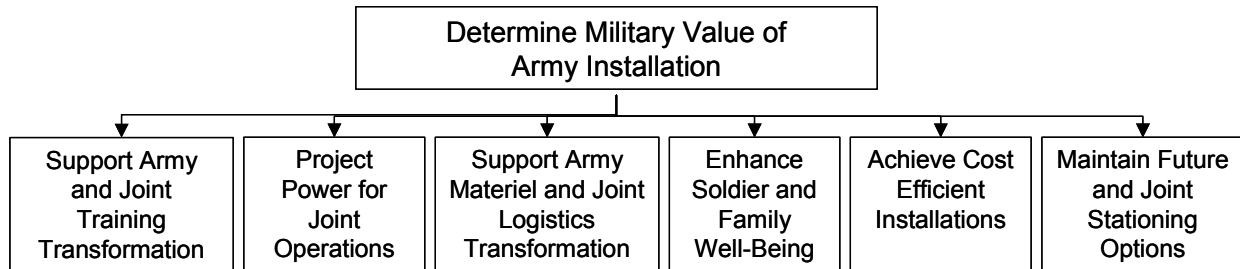


Figure 3. MVA Model Hierarchy (First Level)

The MVA Model has six primary goals (Figure 3). We adapted the preliminary findings by breaking them out into more specific statements and grouping them under the six MVA goals. To see a list of quotes from the interview summaries that support each finding, see Appendix F.

Our 19 findings are:

1. Support Army and Joint Training Transformation

- 1.1 There are significant Joint training opportunities.
- 1.2 The Objective Force U/A will need more, not less, training land.

2. Project Power for Joint Operations

- 2.1 The Army should approach BRAC 2005 from a “Total Force” (AC/RC/NG) perspective.
- 2.2 Mobilization mission should be a significant BRAC consideration.
- 2.3 Power Projection is an increasingly important BRAC consideration.

3. Support Army Materiel and Logistics Transformation

- 3.1 The Industrial Base provides substantial BRAC opportunities.

4. Enhance Soldier and Family Well-Being

- 4.1 Soldier and family well-being is an important BRAC consideration.

5. Achieve Cost Efficient Installations

5.1 BRAC funding enhances installation transformation and may help to alleviate under-funded accounts such as BOS and SRM.

5.2 DOD installation management may be more cost efficient for geographic areas with multiple installations.

5.3 The Army should continue to capitalize on Joint stationing agreements and pursue additional efficiencies.

5.4 Privatization provides opportunities for BRAC.

5.5 Environmental costs have a major impact on BRAC funding and implementation.

5.6 MILCON funding is a concern.

6. Maintain Future Stationing Options

6.1 The Army must synchronize BRAC with major Army initiatives.

6.2 BRAC 2005 is the first OSD/Joint BRAC and this provides the Army an opportunity to capitalize on Joint opportunities.

6.3 The Homeland Security mission has not yet been clearly defined and requirements have not yet been established.

6.4 The Army must consider the expandability and flexibility of its installations.

7. Additional significant comments

7.1 There are concerns that the political process (internal and external to DoD) will interfere with the potential positives of BRAC.

7.2 Other significant comments.

3.3 Tracking the Findings

To help us analyze our summaries based on the next level in the MVA model hierarchy, we created a spreadsheet matrix that contains all of the 40 interviewees' names and organizations on the left hand side with all of the goals and sub-goals of the MVA model along the top. We populated the matrix with "X"s if the interviewee mentioned a corresponding sub-goal (or

attribute within that sub-goal) as being important. A sample of this matrix containing only the first three goals and their corresponding sub-goals is shown in Figure 4 (the names of the interviewees and their organizations have been removed). This figure serves as an *illustrative example* of what the real matrix looks like and does not correspond to the actual matrix. Because the interview process was conducted for non-attribution, we do not show the actual matrix.

Goal :		Support Army and Joint Training Transformation				Project Power for Joint Operations			Support Army Materiel and Joint Logistics		
Sub-Goal : (Attribute)		Edu- cate	Impact Area	Man- euver	Environ- ment	C2 / Admin	MOB	Deploy	RDT&E	Mainten- ance	Supply
Interviewee	Organization										
Interviewee's Name	G-X		X	X	X	X	X	X			
Interviewee's Name	G-X		X	X		X	X				
Interviewee's Name	G-X				X		X			X	X
Interviewee's Name	Agency		X			X		X	X		
Interviewee's Name	Agency		X	X	X	X	X	X			
Interviewee's Name	G-X					X					
Interviewee's Name	G-X	X	X	X	X		X	X	X		
Interviewee's Name	Agency		X	X		X	X	X			
Interviewee's Name	ASA-X					X				X	X
Interviewee's Name	ASA-X					X					
Interviewee's Name	ASA-X		X	X	X	X	X	X		X	X
Interviewee's Name	G-X		X	X			X	X			
Interviewee's Name	ASA-X	X	X	X			X	X			
Interviewee's Name	ASA-X				X						

Figure 4. A Sample of the Findings Matrix

3.4 Matrix Results

Our next step was to tally the results in the matrix and chart them for comparison; Figure 5 demonstrates these results. The bar chart contains the names of the 18 sub-goals of the MVA Model along the bottom with their corresponding primary goal located in the boxes at the top of the chart. The numbers along the left side of the bar chart represent the number of positive responses from the interviewees. For example, the bar for the sub-goal “Impact Area and Ranges” under the primary goal *Support Army and Joint Training Transformation* indicates that this was mentioned as a significant BRAC consideration in 22 of the 40 interviews. This does *not* infer that the remaining 18 interviewees do not believe that this particular sub-goal or its related attributes are *not* important; it only means that it was not mentioned in their interview.

Concerning the primary goal level of the model, we determine that our interviewees place the most emphasis on the goals *Support Army and Joint Training Transformation* and *Project Power for Joint Operations*. These two goals are followed by *Maintain Future and Joint Stationing Options*, *Achieve Cost Efficient Installations*, and *Enhance Soldier and Family Well-Being* which have a similar number of responses. Significantly less emphasis is placed on the primary goal *Support Army Materiel and Joint Logistics Transformation*. This is true despite the fact that several leaders and SMEs were interviewed from the logistics field as previously indicated in Figure 2 on page 6.

Concerning the sub-goal level, the three that receive the most emphasis from the interviewees are *Maneuver Land*, *Impact Area*, and *Deploy*. *Mobilization*, *C2 Admin*, and *Installation Facilities* are the next three sub-goals that receive a significant amount of emphasis. Conversely, the sub-goals *RDT&E*, *Maintenance*, *Supply*, and *Educate* receive the least number of responses from the interviewees.

These observations indicate that according to our interviewees, the attributes of an installation that pertain to size, location, ability to train, and ability to deploy troops are those that should receive the most attention in the MVA Model, while those attributes whose function can be enhanced more easily, such as constructing a new facility or adding more manpower, should be given less importance. Appendix G contains a brief description of each sub-goal shown in figure 5.

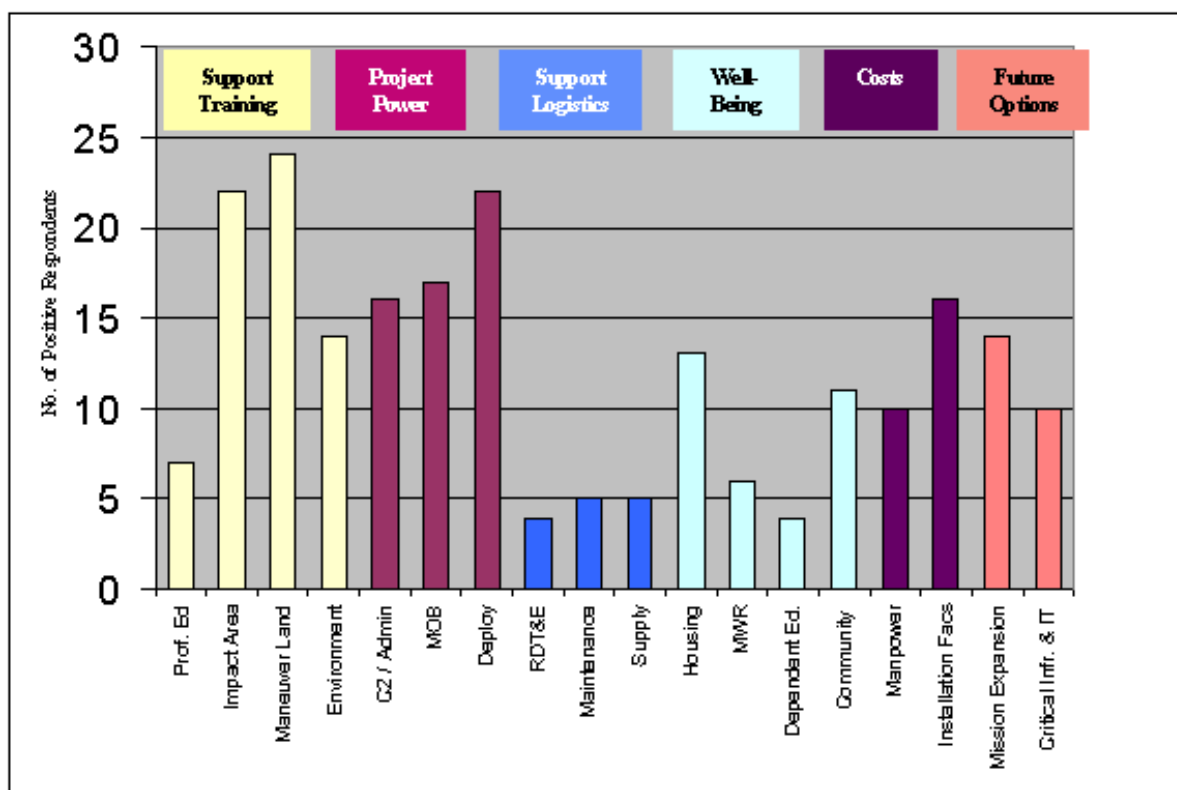


Figure 5. Goal/Sub-goal Matrix Bar Chart

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4 CONCLUSION

With a formalized interview process, we were able to develop a database of interview summaries that was helpful in the development of the MVA model. These summaries represent the insights and perspectives of over 30 senior Army leaders and over 30 subject matter experts. These summaries could play an influential role in determining the weighting of the attributes as the model nears completion.

We show from our analysis of the interviews that the model goals covering Training and Power Projection are of primary importance to the interviewees when considering installations in BRAC 05. The attributes that best support these goals and that therefore should have the most significance in the MVA model (according to our interviewees) are those that measure an installation's ability to achieve these goals.

Furthermore, after reviewing all of the interview summaries, we have determined that 32 of the 40 people interviewed believe that this round of BRAC should capitalize on Joint possibilities such as merging collocated installations or using other services' installations for training.

Two additional observations were made through analysis of the summaries. There is a concern among many of the interviewees that the Army will assemble the best possible BRAC package but the political process will overcome our efforts and cause the Army to submit a sub-optimal BRAC list. Also, there is overwhelming support for continuing with BRAC 05. Of the 40 principal interviewees, 22 of them stated that they were strong supporters of implementing BRAC 05, while only two interviewees were skeptical that we should be doing this (16 of the interviewees made no comment either way). These numbers are significant since the questionnaire contained no question that alluded to support for BRAC 05. This implies that the 22 staunch BRAC supporters volunteered their position without being prompted by the interviewer.

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APPENDIX A PROJECT CONTRIBUTORS

1. PROJECT TEAM

a. Project Director:

Mr. John M. Bott

b. Team Members:

MAJ Lee Ewing
Mr. Joe McGill

c. Other Contributors:

Ms. Linda Coblentz
Mr. Jeff Bassichis

2. PRODUCT REVIEWERS

Dr. Ralph E. Johnson, Quality Assurance

3. EXTERNAL CONTRIBUTORS

COL William Tarantino, TABS
Dr. Greg Parnell, USMA
Mr. Rob Dow, TABS
Mr. Daniel N. Finucane, TABS
LTC Michael Kwinn, USMA
LTC Willie McFadden, USMA
LTC Rich Hall, TABS
MAJ Adam Shepherd, TABS
MAJ Doug Tuttle, TABS
CPT John Harris, USMA
Ms. Peggy Mencl, TABS

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APPENDIX B REQUEST FOR ANALYTICAL SUPPORT

P Performing Division: RA **Account Number:** 2003139

A Tasking: **Mode (Contract-Yes/No):** In-house

R Acronym: DAS-B

T Title: Decision Analysis Support for BRAC

1 Start Date: 21-Apr-03 **Estimated Completion Date:** 31-Dec-03

Requestor/Sponsor (i.e., DCSOPS): ASA(IE) **Sponsor Division:** DASA (IA)

Resource Estimates: a. **Estimated PSM:** 15 b. **Estimated Funds:** \$7,000.00

c. **Models to be Used:** N/A

Description/Abstract: As a joint effort between the CAA stationing group and a research team from the Department of Systems Engineering at West Point, we create a Multi-Objective Military Value Model to support the TABS group. The development and implementation of this model will provide an objective, credible, and traceable methodology for the BRAC 2005 analysis. The estimated required funding is for TDY to support the data collection and interview process. The Infrastructure Military Value model will reside at CAA to enable follow-on support for BRAC 2005.

Study Director/POC Signature: *Original Signed* **Phone#:** 703-806-5669

Study Director/POC: Mr. John Bott

If this Request is for an External Project expected to consume 6 PSM or more, Part 2 Information is Not Required. See Chap 3 of the Project Directors' Guide for preparation of a Formal Project Directive.

P Background: As mandated by BRAC legislation and by guidance set out by the Secretary of Defense and Secretary of the Army, the TABS team must conduct an analysis of an installation's Military Value contributions to the Army or for potential joint uses. This model will fulfill this requirement by quantifying and comparing installations' qualitative assets.

A Scope: Conduct interviews with senior leaders and stakeholders, aid in the creation, development, and implementation of the Infrastructure Military Value model. Assist with VV&A and final documentation.

R Issues: What are the key BRAC infrastructure and installation transformation issues which drive the senior leader's decisions and address stakeholder's concerns? What are the qualitative factors that capture an installation's military value assets effectively?

T Milestones: IPR: October 2003. Final ARB: December 2003

2

Signatures: **Division Chief Signature:** *Original Signed and Dated* **Date:**

Division Chief Concurrence: Mr. David Russo

Sponsor Signature: *Original Signed and Dated* **Date:**

Sponsor Concurrence (COL/DA Div Chief/GO/SES) : COL Weaver, CoS DASA(IA)

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APPENDIX C LIST OF INTERVIEWEES

The following table lists the principals from the interviews. The names of the additional attendees are not included. The interviewees are listed alphabetically by organization.

Name	Organization
MG Larry Lust	ACSIM
Ms. Janet Menig (SES)	ACSIM
Mr. John Nerger (SES)	ACSIM
GEN Paul J. Kern	AMC
LTG Roger C. Schultz	ARNG
Mr. Claude Bolton (SES)	ASA-ALT
Mrs. Sandra Pack (SES)	ASA-FM&C
LTG Jerry Sinn	ASA-FM&C
MG Lynn Hartsell	ASA-FM&C
Ms. Barbara Bonessa (SES)	ASA-FM&C
Mr. Reginald Brown (SES)	ASA-M&RA
Mr. Daniel Denning (SES)	ASA-M&RA
MG Robert Armbruster	ATEC
LTG James J. Lovelace, JR	DAS
Mr. Walt Hollis (SES)	DUSA-OR
Mr. E. B. Vandiver (SES)	CAA
GEN Larry Ellis	FORSCOM
Ms. Karen Nolan	FORSCOM
Mr. Barry Holman	GAO
Mr. Mark Lewis (SES)	G-1
LTG Richard Cody	G-3
BG David Ralston	G-3 FM
Mr. George Wallace	G-3 FM
Mr. Peter Bechtel	G-3 SSW
LTC Andrew Straw	G-3 SSZ
Mr. Jim Gunlicks (SES)	G-3 TR
LTG Charles Mahan	G-4
LTG Claude V. Christianson	G-4
LTG Peter Cuiello	G-6/CIO
LTG Benjamin Griffin	G-8
MG James Grazioplene	G-8 FD
MG David Melcher	G-8 PAE

MG Anders B. Aadland	IMA
Mr. Philip Sakowitz (SES)	IMA
LTG James B. Peake	MEDCOM
MG Ann E. Dunwoody	MTMC
LTG James Helmly	OCAR
LTG Johnny Riggs	OFTF
Mr. Wm. Michael Hix	RAND
GEN Kevin Byrnes	TRADOC

APPENDIX D DOCUMENTS REVIEWED

This appendix includes summaries of selected documents that influenced the interview process and development of the MVA model. The documents are listed with their title, publication date, authorship, and a very brief comment on their subject matter, content, or impact on this project. This appendix provides a small representation of the key documents reviewed to support this project and is not meant as an exhaustive list of all of the documents reviewed by the contributors to this report.

Document Title: **DoD Transformation Planning Guidance**

Date Published: April 2003

Author: DoD (SECDEF signature)

Comments: This document provides guidance to DoD by defining critical transformational elements assigning roles and responsibilities and describes how DoD will organize to implement transformational capabilities. The transformational outcome is described as: fundamentally joint, network centric, distributed forces capable of rapid decision superiority, and massed effects across the battlespace. These transformed forces must be able to take action from a forward position and, rapidly reinforced from other areas, defeat adversaries. It states that the US is transitioning from an industrial age to an informational age military where the power of distributed, networked forces and shared situational understanding will transform warfare. Though this transformation guidance does not directly address installations, there are points from which priorities for that transformation can be inferred.

Document Title: **Joint Vision 2020**

Date Published: June 2000

Author: JCS Director for Strategic Plans and Policy, J5; Strategy Division

Comments: Joint Vision 2020 is conceptually general and provides a variety of comments that influence Military Value on topics such as information superiority, RC deployment, and well-being.

Document Title: **The Objective Force in 2015 White Paper (Final Draft)**

Date Published: 8 December 2002

Author: Objective Force Task Force (OFTF)

Comments: The Objective Force in 2015 White Paper (Final Draft) provides discussion on transforming installations over several operational areas including C4, deployment, mobilization, institutional training, collective training, and force protection.

Document Title: **Installations in 2020 White Paper (Draft)**

Date Published: Sep 2003

Author (POC): Mr. Ron Young, OFTF

Comments: Though in initial draft form, this document provides a vision of what transformation means to installations and the nature of their functions; both individually and for the army-wide portfolio of installations.

Document Title: **QDR 2001**

Date Published: 30 Sep 01

Author: DoD

Comments: This document provides broad Transformation concepts to include BRAC's role in Transformation, but does not provide insights on installation specific military value characteristics.

Document Title: **Concepts for the OF White Paper**

Date Published: undated

Author: OFTF

Comments: This document is an informative reference for Transformational trends from which military value attributes and guiding principles can be inferred. Much of the document's content was superseded/duplicated by the "Objective Force in 2015 White Paper" which is included above.

Document Title: **Concept for Future Joint Operations – Expanding Joint Vision 2010**

Date Published: May 97

Author: Joint Warfighting Center

Comments: An informative reference for Transformational trends from which military value attributes and guiding principles can be inferred. Much of the document's content was superseded/duplicated by the "Joint Vision 2020" which is included above.

Document Title: **CSA's 15 Immediate Focus Areas Briefing**

Date Published: Sep 2003

Author: Deputy Chief of Staff, G8

Comments: This document is an informative document that compliments the Transformational documents summarized above by adding a more "current" Army focus. It is a solid source for "guiding principles"; less so for installation MVA attributes.

Document Title: **The Army Plan 2005-2020**

Date Published: Jul 02

Author: Deputy Chief of Staff, G8

Comments: This document is largely a funding document with priorities for near and mid-term programs and initiatives. It provides potential guiding principle material (e.g. consolidate PERSCOMs) as well as specifying three primary tasks for installations: power projection, training support, and well-being.

Document Title: **GAO Report on DoD Approach to Managing Encroachment on Military Training**

Date Published: 2 Apr 03

Author: GAO

Comments: This document is an informative reference from which military value attributes and guiding principles can be inferred. It highlights the main sources of encroachment, both internal and external, as they pertain to military training.

Document Title: **GAO Report on Reserve Enclaves**

Date Published: Jun 03

Author: GAO

Comments: This document focuses on BRAC 95's failure to adequately plan for the enclaves that resulted from certain closure recommendations. It provides "lessons learned" for future scenario development, but not for stationing or assessing military value of RC enclaves.

Document Title: **GAO Report on Homeland Defense**

Date Published: Jul 03

Author: GAO

Comments: This document introduces potential DoD roles in HD/HS operations but indicates that the role would be more in the form of support to civil authorities and RC force structure changes instead of any significant AC stationing changes.

Document Title: **Defense Installations 2001**

Date Published: Aug 2001

Author: DoD Installations Policy Board

Comments: This document provides DoD's vision for installations, but is based more on changing/improving business practices (privatization) than on the characteristics of installations. It includes concepts for joint basing, well-being, RCI, and standardization throughout DoD.

Document Title: **Army Strategic Planning Guidance (Final Draft)**

Date Published: Nov 03

Author: Deputy Chief of Staff, G3

Comments: This document provides overarching guidance on the direction of the Army but not to the level of specificity that would add to the existing body of attribute development references. It specifically says that the RC will "lead our efforts to protect the homeland". It also provides a good description of the CSA's 15 Immediate Focus Areas and the Strategic Readiness System.

Document Title: **Draft Joint Pub 3-26, Homeland Security**

Date Published: 11 Sep 03

Author: Joint Staff

Comments: This document states that DoD's primary role in National Homeland Security Strategy is the protection of National Critical Infrastructure (NCI), Defense Critical Infrastructure (DCI) and civil support for domestic emergencies. It identifies examples of DCI but does not discuss or suggest ways in which installations can be reconfigured to support HD/HS.

Document Title: **Draft Future Combat System Order, Appendix F, System Training Plan**

Date Published: 16 Jan 03

Author: TRADOC

Comments: Most of this document is of little import to MVA but Section 3.5, Training Constraints, has good information on FCS-specific requirements/implications for maneuver areas and firing ranges.

Document Title: **Draft TRADOC Pam 525-4-0, Maneuver Sustainment Operations**

Date Published: 31 Jan 03

Author: TRADOC

Comments: This document discusses transformational changes in more detail than other publications and focuses on maneuver in the AOR vice installation-specific implications. It states that proximity to strategic force projection platforms (seaports, Air Force Bases) will remain important and that installations must be prepared for a rapid influx of RC units, and that certain installations will become Home Station Operations Centers for deployed forces.

Document Title: **Draft Objective Force Ranges White Paper**

Date Published: 30 Jul 03

Author: Deputy Chief of Staff, G3

Comments: This document has specific focus on ranges and is used in the development of guiding principles and attributes for ranges, but does not have a broad enough scope requiring a more detailed summary.

Document Title: **GAO Report DoD Chemical Weapons Destruction Program**

Date Published: Sep 03

Author: GAO

Comments: This document addresses programmatic execution problems. The report does not contain information on installation characteristics as they relate to the chem-demil mission, potential future basing, or MV assessments. It does, however, include dates for the potential closures of chem-demil activities, which could impact an installation's future missions.

Document Title: **4th Annual Report to the President and Congress on Terrorism and WMD**

Date Published: 15 Dec 02

Comments: This document is a National command-level review that focuses on challenges and critical areas but does not do so to the level of detail where installation specific characteristics or stationing requirements might be gleaned.

Document Title: **FY03 Army Well-Being Action Plan**

Date Published: 10 Oct 03

Author: Deputy Chief of Staff, G1

Comments: This document is a detailed plan for prioritizing and resourcing multiple aspects of well-being but with more emphasis on programs and policies than facility/installation-specific requirements. The TABS team uses it in the development of guiding principles and attributes for well-being.

Document Title: **Army Power Projection Master Plan**

Date Published: July 2002

Author: Deputy Chief of Staff, G4

Comments: This document largely focuses on systems development and procurement and also reflects the impacts of new deployment platforms on training requirements and facilities. The Master Plan is used in the development of guiding principles and attributes for training and power projection.

Document Title: **Draft TRADOC Pam 525-3-35, Force Projection**

Date Published: 31 Jan 2003

Author: TRADOC

Comments: This document provides specifics on deployment training and facilities requirements to include the need for a greater number of units and types of units to train to deploy from a greater number of nodes to include "brown water access points and dirt airstrips." The pamphlet is used in the development of guiding principles and attributes for training and power projection.

Document Title: **FM 1, The Army**

Date Published: 14 Jun 2001

Author: US Army

Comments: This is an overarching document focused largely on how the Army goes about fulfilling its Title 10 functions. There is no installation specific or inferred information.

Document Title: **FM 3-0, Operations**

Date Published: 14 Jun 2001

Author: US Army

Comments: This document provides the overarching doctrinal direction for the conduct of full spectrum operations detailed in other Army manuals. There is no installation specific or inferred information.

APPENDIX E INTERVIEW ATTENDEES BY RANK AND TITLE

The following two tables show the layout of all of the interview attendees by rank or title.

Military	
GEN	3
LTG	11
MG	8
BG	1
COL	8
LTC / MAJ	5
Total	36

Civilian	
DUSA	1
ASA	3
SES	11
Senior A/Os	17
Total	32

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APPENDIX F SIGNIFICANT QUOTES FROM THE INTERVIEW SUMMARIES

This appendix provides key statements from the interviews that support the findings. The findings are organized under the six primary MVA Goals with a seventh category for miscellaneous findings. Each finding has a series of quotes from the interview summaries. There are a total of 19 findings. These quotes represent only a small sample of the entire collective summaries.

1. Support Army and Joint Training Transformation

- 1.1 There are significant Joint training opportunities.
- 1.2 The Objective Force U/A will need more, not less, training land.

2. Project Power for Joint Operations

- 2.1 The Army should approach BRAC 2005 from a “Total Force” (AC/RC/NG) perspective.
- 2.2 Mobilization mission should be a significant BRAC consideration.
- 2.3 Power Projection is an increasingly important BRAC consideration.

3. Support Army Materiel and Logistics Transformation

- 3.1 The Industrial Base provides substantial BRAC opportunities.

4. Enhance Soldier and Family Well-Being

- 4.1 Soldier and family well-being is an important BRAC consideration.

5. Achieve Cost Efficient Installations

- 5.1 BRAC funding enhances installation transformation and may help to alleviate under-funded accounts such as BOS and SRM.
- 5.2 DoD installation management may be more cost efficient for geographic areas with multiple installations.

5.3 The Army should continue to capitalize on Joint stationing agreements and pursue additional efficiencies.

5.4 Privatization provides opportunities for BRAC.

5.5 Environmental costs have a major impact on BRAC funding and implementation.

5.6 MILCON funding is a concern.

6. Maintain Future Stationing Options

6.1 The Army must synchronize BRAC with major Army initiatives.

6.2 BRAC 2005 is the first OSD/Joint BRAC and this provides the Army an opportunity to capitalize on Joint opportunities.

6.3 The Homeland Security mission has not yet been clearly defined and requirements have not yet been established.

6.4 The Army must consider the expandability and flexibility of its installations.

7. Additional significant comments

7.1 There are concerns that the political process (internal and external to DoD) will interfere with the potential positives of BRAC.

7.2 Other significant comments.

1. Support Army and Joint Training Transformation

1.1 There are significant Joint training opportunities.

“More of Joint training will happen, not less.”

“For future training, we must eliminate these distinctions and move toward multi-use, multi-service Joint bases. Bases that can train, test, evaluate, and field all at the same time.”

“Institutional training provides good opportunities for Joint possibilities.”

“I think we will use more Joint training going forward – things like NTC and Twenty Nine Palms.”

“We are now looking into a JNTC, but we should think of it as a capability, not a ‘site.’ The other services do not have anything close to what we have (in terms of training land).”

“NTC along with Nellis AFB and Twenty Nine Palms provides for a good multi-service training environment. Ft. Bliss, along with the MacGregor Range Complex and White Sands Missile Range, also provides some good opportunities.”

“When you drive through any gate, you should ask yourself, ‘What makes this a keeper?’ We need to know what we need – all light force requirements, all Objective Force requirements, all MOU requirements, etc. Can we do 40% of tank training in a building? For training in the future, how much of it will be branch-specific?”

“Other than Armor, Infantry, Artillery, and Aviation; everything else can go anywhere.”

“We must worry about heavy maneuver training because you just can’t do that anywhere”

“An alternative to collocating within the Army would be to station Army elements with other Services. We could do more with situations like Pope-Bragg and McChord-Lewis. If you were to put TRADOC at an Air Force Base, we could utilize some of their commonalities, but we wouldn’t leverage the runway. The problem with Joint stationing maneuver brigades is that the Air Force and Navy don’t have the necessary footprint.”

“There is no reason we can’t have combined senior service schools. Places like Peterson AFB in Colorado have huge empty buildings. There’s no reason they can’t be used by other Services.”

“Collective training events – it’s where you develop leaders. Soldier skills you can pretty much do anywhere, the collective training environment is what you need to focus on: combined arms, Joint, etc. The admin staff can fit in the margins, make sure you get the Joint and collective training piece right.”

“Training should be Joint tonight! Look at Millennium Challenge 2002; we had four Services working four different boxes. The western confederation of training areas has so much potential: Fallon in north Nevada, Nellis, NTC, 29 Palms, China Lake NWC. Alaska could be confederated with it also.”

1.2 The Objective Force U/A will need more, not less, training land.

“My major concern is training areas, both maneuver land and ranges. We still have to have ranges; simulation will only get us so far. How else are we going to do collective training without land and ranges? Different caliber weapons, longer range weapons, and a more distributed battle space all indicate that we will be fighting in a larger area.”

“We must have the space to exercise our new systems.”

“The U/A maneuver box is significantly larger than the maneuver box for a traditional maneuver brigade. We will need additional maneuver space. As we transform, we will need installations that can grow.”

“In 2010 the first one (Stryker Brigade) comes online; these units require a much larger space than we first thought. How are we going to handle this? Maybe Stryker Brigades shouldn’t be stationed at installations without sufficient training areas.”

“Objective Force will require equal training capacity or more.”

“It is unrealistic to think that we are ever going to own a piece of land big enough to train the Objective Force.”

“We posture ourselves so that in the future we have the training land we need as well as other training enablers such as ranges and simulators. We can’t just go and buy land, so we need to look carefully at what land we own. In some cases we own land where the infrastructure (billeting, mess halls, etc) isn’t that great, so they may be looked at for BRAC, but we can never get the land back!”

“Objective Force is able to operate over a larger area, there is a requirement for more maneuver area. Simulators will help but there will still be the need for live training areas.”

“We won’t give up land-masses because we’ll never get it back.”

“RAND did a report and concluded that if we can buy a piece of land, we should. We should get all we can get our hands on. However, owning property is expensive so we should shrink it down.”

“Simulation has its place, but a real training capability is important.”

“I don’t think we have any major deficiencies as far as climate variation goes.” (One of the DoD Criteria)

“We need to keep a good mix of training environments - urban, desert, mountain, jungle.”

“Going forward, we will need a mix of land and simulators. We have little packets and parcels of land everywhere, but they are really draining off MILCON dollars. I do not know whether we need more, I do know that we will need some large parcels of land but not necessarily contiguous. There are 200 UAVs in a U/A; can you imagine the airspace needed for that? The U/A will have a front of 200-300 kms; we just don’t have that space. It will come down to grouping together (architecturally) a bunch of installations. A related small grouping of larger installations is the way to go.”

“If I were going to hedge, I would hedge on maneuver space, I don’t buy into the simulator concept. If I were going to be conservative on something, it would be maneuver space. GEN Reimer was very worried about bringing force structure back from Europe. The 3rd ACR was put at Carson so Bliss could receive future forces.”

“It is important that we have measures that look at the availability and use of training lands and how their use is restricted by environmental and encroachment regulations.”

“The environmental regulations definitely impact us. Ft. Hood has been shut down during certain periods because of restrictions on training lands.”

“Environmental restrictions are important when relevant to the mission. If you can’t do the mission because of restrictions then let’s get out of that installation. We should stop playing with the environmentalists and the communities that make it tough on us should be penalized.”

2. Project Power for Joint Operations

2.1 The Army should approach BRAC 2005 from a “Total Force” (AC/RC/NG) perspective.

“BRAC must have the ability to make sure we can service the Guard and Reserve, civilians, and the mobilization issue.”

“Total Army requirements should be much more significant this time around. Because of the ‘Alert, Train, Deploy’ construct, we can’t get people to the fight.”

“We must accommodate all components.”

“The AC/RC mix is an important factor. We need to look at this.”

“Not sure if we use property correctly. We have to watch what we do with the AC/RC training areas. How are these utilized? Ft. Dix, Ft. Chaffee, and Hunter-Liggett?”

“The Reserves can close installations outside of BRAC by using the land-swap program. I am rather proud of the fact that we are full partners with IMA.”

“How do we (ARNG) participate in BRAC? We have facilities we would like to get rid of or put on the candidate list.”

“BRAC is a great opportunity for USAR facilities to integrate with AC installations.”

“Whatever we do, the RC has to come out of this better off. You ought to go visit McClellan and Dix and see what we did to these places. It will make you puke.”

“The Guard has some nice training boxes that the AC should be looking at for its own use.”

“What about moving the Guard onto depots? Maybe it makes sense to close a bunch of scattered armories.”

2.2 Mobilization mission should be a significant BRAC consideration.

“We have leveled the World War II wood facilities. What if we had to mobilize a whole National Guard Division? We do not have that capability anywhere. Moving troops would stuff bases full and we would have no place to mobilize from. In winter 2002, we were mobilizing troops from tents at Ft. Drum.”

“We don’t have enough places to mobilize people from right now.”

“There is more work to do on MOB and Power Projection, World War II wood structures are going away.”

“Time at mobilization stations is important. We need sufficiently large cantonment areas. We also must have access to all four [transportation components]: land, sea, air, and rail.”

“We must improve our Power Projection capability. Ft. Bliss, Ft. Stewart, and Ft. Campbell are OK. We need to be able to mobilize the Guard and Reserves. We have to take a good look at PMMTCs – when divisions come back they will occupy space on the installations, but we will still need the Power Projection capability.”

“We have to be able to put these units where they can train and deploy.”

“A concern of mine is that we cite mobilization as a primary mission, but we don’t really fund it or appear to make it a priority. We need a larger focus on the mobilization mission. In the past round of mobilizations we had a major billeting issue. It is unrealistic to rely on the Active Component to have been deployed before the mobilization mission starts and assume their facilities will be available for the Reserves to use. We need to thoroughly examine the training lands and facilities for the mob mission. It is important that we have a standard for mobilizing RC Forces. We were using gymnasiums and everything else imaginable for billeting last time around. I am pushing for us to do mobilization better and would caution against doing it the way we do now.”

“My primary concern is that we maintain the capabilities, facilities, acreage, and infrastructure to conduct the training we need to do. That we also retain the billeting facilities capable of conducting the RC mobilization mission, this is something that nobody is looking at. We got rid of the World War II wood and didn’t replace it with anything, the result was we had soldiers sleeping in motor pools, tents, and everything else; we could have had a real problem. The mobilization capability must remain paramount. There is a great MOAT facility at Ft. Polk that is very unique, it needs to be replicated. Polk also has a great rail head, we need this at Irwin. We also need to take into account proximity to APODs and SPODs and the ability to rail head to get to them.”

“Re-deployment could become an issue, we need adequate facilities, such as medical and housing.”

“I am after the mobilization mindset. Units should be able to train, certify, and deploy locally. Maybe we should look at the big picture: Joint use - using other services facilities and land.”

“The AC did not depart in its entirety for Iraq. They were supposed to be gone for the RC to mobilize and use their empty barracks.”

“We need to segment the process. We can do more with the LTAs (Local Training Areas). Intense collective training requires ranges. We need to re-look the entire process and

have an AC/RC rebalance. We have a huge inventory of infrastructure that goes unused during mobilization.”

“We should be asking: What should our mobilization capacity be? Where should it exist? Where to train? Where do these functions exist? How does this factor into a model? Why do we put too much pressure on our Mob stations? During OIF-1, we overwhelmed them.”

“My main concern is that we will overreact to this and start a major campaign to construct new buildings. We don’t necessarily need that many new buildings; we can make changes in how we do things by changing our mobilization policy (e.g. – train, alert, deploy). We haven’t sized up Mob. What is the Mob formula? I am NOT an advocate of building a bunch of things.”

“I would urge you to think about the ‘what ifs’ for contingency operations and planning. Where do you house, feed, and support mobilized folks from the National Guard?”

“In mobilizing the 150,000 soldiers on active duty right now, the Army used 26 PPPs and PSPs, they were primarily manned by about 17,000 Army Reservists. It took that many to put 150,000 out the door. There were two conclusions drawn from this: 1) That is about the number needed to project that many soldiers, and 2) The geographic spread to do the job – *the number of Mob stations isn’t the issue, the location of them is.*”

“We must also keep in mind that until the Abrams Doctrine is changed, we will mobilize the Reserves and need these facilities. To execute almost any plan, we’ll need a big chunk of RC capabilities in a hurry.”

“My most important point is that we must fight to keep a good mobilization capability!”

“There have been some Reserve Mob issues. Their medical readiness is subject to debate. We put \$23 million into Reserve dental to make folks deployable, but 30% were non-deployable.”

“We filled virtually every installation we have to Mob for OIF. If we had cut everything that some people wanted us to cut (divisions, brigades, structure, etc.) we couldn’t have fought this war. I am just cautioning you against cutting stuff we need.”

“As for the impact on the Reserve Component, we need to look at the force mix and maybe move some more chem.-bio units to the Active Component, also some more Psyops and Civil Affairs units need to go AC. We need to get to a rapid, fully deployable Active Component so we don’t need to mobilize the RC to accomplish a mission. This would represent a shift from the Abrams Doctrine. You’re still going to have a need for Mob Stations but there will be less stress on them.”

2.3 Power Projection is an increasingly important BRAC consideration.

“Being near good transport is what’s important – the ability to project forces. A worst-case stationing scenario would be to have to put several brigades in an area that is not accessible. Reasonable proximity to a seaport or a place with good rail is what you want to keep.”

“Army Transformation will improve mobilization; it reduces what is needed to get to the fight. However, even though it is more mobile, we will still rely on sea transport to get most of the stuff there. We should continue to utilize pre-positioned stocks. We will depend more on air, less on sea, but we’re still limited by air.”

“BRAC should help with Army deployment but it probably won’t. Loss of normal transportation is a major factor in a worst-case scenario. We are tied to getting to APOD or SPOD in some way. The worst case is having an installation you can’t get to. Large airfields are more and more valuable and will be major in terms of the Objective Force. *The center of gravity is shifting to airfield structures.* Do not get hung up on ‘miles to port.’”

“We need some good Power Projection Platforms where we can perform that mission. Housing is needed to do this.”

“A deployment capability doesn’t necessarily mean railheads, but we have to be able to get the people where they need to be.”

“The Stryker brigades may be lighter but they’re not that much lighter, ships are still a good thing. The bulk of our most recent deployment was done by ship and it will continue to be done this way in the foreseeable future.”

“The ability to project power is becoming more and more important.”

“Installations must be power projection platforms, that is the only reason they exist! Everything else is ancillary. They should also have training facilities and be safe places. They should also serve as real communities for our families. Installations should blend with and enhance their environment and they ought to respect the Army’s traditions.”

“We have to be able to get out of town. You should go visit one of our new deployment facilities at Stewart, Bliss, Campbell, McChord, Hood, or Drum.”

“We have to look at encroachment and keep in mind that some places are more user-friendly than others. We have to posture ourselves for greater deployability. During Desert Storm, the boats were waiting for us, now we were waiting for the boats because we got to the ports quicker. We need to take another look at the ports; some are more friendly and accommodating than others. Charleston (SC) was friendly; Beaumont (TX) and Jacksonville (FL) were not. At some ports, the unions stood in the way of us moving out quicker. Union rules prevented soldiers from loading boats.”

“Something that needs to be looked at is which reserve units are going out of which ports; it is not done right currently. *80% of CONUS power generates from 12 PPPs.*”

“We need to make sure we do not eliminate our Power Projection Platforms [PPPs] and strategic ports. Proximity to a PPP is important when looking at installations and which ones will survive.”

3. Support Army Materiel and Logistics Transformation

3.1 The Industrial Base provides substantial BRAC opportunities.

“Some of the people over at AMC are doing a lot of work in this area, there is room for efficiencies. In my mind, the area that is ripe for consolidation is logistics. Private industry went to school on the military, now it’s our turn to go to school on private industry – Wal-Mart, Sears, etc. They have distribution systems that are efficient.”

“Industrial base (depots, ammo, and arsenals) is 50+ years old. We haven’t invested in it; we need to modernize it. We could give this to industry. There is a RAND study on how to dispose of these things which is good. However, there are things like links for ammo that we can’t privatize because no one wants to do it and there are others, like some material and packing fibers that no one else does. We must go outside the US to get these things. We would have to start a new industry, which is very costly. I am concerned about what we have left organically from the industrial base when this is over. The folks who say we should contract everything out or go to private industry have not looked at everything carefully enough. I have reviewed what General Kern and AMC have recommended and, by and large, I agree with it. They have a good plan to modernize and streamline the industrial base.”

“If you turned it (BRAC) over to the PMs, they would close everything and turn it over to contractors. Contractors can be more efficient but they have different motivations. What if one of them goes out of business or one of their suppliers goes out of business? Industry and government working together makes more sense than going one way or the other.”

“Measuring the military value for logistics is difficult. First, you have to define the mission. Capacity by itself doesn’t mean anything, what’s important is how it supports readiness. How about an attribute like ‘responsiveness’? Would it be proximity to a seaport? How about the network to get to the seaport?”

“Logistics are our most broke concept – I don’t know if we even have a concept for it, it bothers me. Is it ‘factory to foxhole’? Are we going to have a Joint logistics command? For stationing purposes, you need to know what your logistics footprint is.”

“I think you’ll come out of BRAC not recommending closing ammo plants. They have a high environmental clean-up cost, few employees, and a high PRV. Besides, you can close some of these outside of BRAC anyway. I would caution you to not get to wrapped up in the industrial base, they will eat up your up-front costs.”

4. Enhance Soldier and Family Well-Being

4.1 Soldier and family well-being is an important BRAC consideration.

“With the OPTEMPO of the Army, more units will be CONUS based; brigades will be together longer, families will be fixed. Quality of life issues become very important, for example child education should be a first priority and spousal employment opportunities a second priority. Medical facilities, favorable in-state tuition rates for military families, and a local community that cares – this is what’s important.”

“There are not enough brigades to do all that the Army wants to do and maintain a good quality of life. The Army is too busy right now.”

“We must maintain a quality force. To do this, we must address soldier well-being issues (e.g., housing).”

“Well-being should be addressed, even though it is not an OSD criteria.”

“We think a lot about units, people, and the mission, but then there’s the families. Some installations just don’t provide much for the families – spousal employment, good schools, etc. The Army suffers a lot by not taking advantage of spousal employment. We are going to have an Army that is 50% married. Some states offer in-state tuition to military personnel, but some still don’t, Virginia and Texas included. Georgia just authorized it.”

“I think we would like to man Korea on a rotation basis, six months at a time. Unit rotations and unit manning implies leaving families behind, this is a major consideration.”

“We need to look at the services we (the Army) offers and ask, ‘Who are they servicing?’ Things like child development, family assistance during deployment, etc.”

“We must look at the ability to maintain a healthy base – e.g., the community wants you there, there is a good work force, there is a reasonable cost of living.”

“Six-Month unaccompanied tours put more strain back at home stations – daycare, commissaries, etc.”

“By 2007 we want Soldiers to not have to pay for housing out of pocket. With that capital stream we’ll be able to improve the Army’s housing stock (the RCI Program: contractor owns the housing and leases it back to the Soldiers). We do not have enough money to just go out and build houses: The high BAH helps alleviate this. Investors are willing to buy into the capital stream.”

“Our installations need to be good homes for our families.”

“We are going to be a CONUS-based institution in the future. We will have less forward-deployed presence, there will be more overseas rotations which leave the families behind. Our soldiers will also be stationed in one place longer. When they leave their families behind, they need to be in good communities.”

“When it comes to closing bases, I think location is most important. I think you should think of property values (PRV) as sunk costs, they should be irrelevant. Location is key from a power projection and family perspective. We have to be near good air, sea, and rail transport, and we have to consider the attitude of the surrounding community. Local schools are important; how do they treat you? Do soldiers and their families get the in-state tuition rate? Families, kids, and schools should be a key consideration.”

5. Achieve Cost Efficient Installations

5.1 BRAC funding enhances installation transformation and may help to alleviate under-funded accounts such as BOS and SRM.

“We need to improve how we divest ourselves of property. We gave Ft. Ord away and didn’t get a dime for it, even though it was prime real estate and had two great golf courses.”

“Base operations and support accounts are not there, we can’t do it all with current budgets.”

“It also concerns me that this could be our last chance to get rid of some albatrosses but that we won’t. We’ve got too many little bases and labs.”

“We are too big, we have too many places, too much infrastructure. It shows in our ability to pay bills and keep our quality of life at sufficient levels. We have an infrastructure for a 780,000 person Army versus a 480,000-person Army. The excess installations are in the following areas: logistics, depots, arsenals, institutional training, National Guard.”

“Why have so much lease space? If you stacked up all the lease space and don’t consider costs and/or savings of moving them to installations, you’ve missed big things. The return on investment would be significant.”

“In terms of ranges, force protection will never be cheap because of so many small places.”

“There are a high number of small locations and facilities throughout the country, we are spending lots of money keeping them connected.”

“Bosnia and Kosovo were handled as supplementals but were eventually brought into the main budget which in turn made it bigger. I presume force protection will be the same.”

“The decision should not be based on cost, you’ll make a bad decision and leave it for other generations. Installations are under-funded. BOS is funded at 69%.”

“Funding concerns me the most. By 2011 we will be C3 and C4 in almost every category. Without better funding the safety and environmental guys will shut us down. Sewers are already red! We can’t have 181 installations. We have sufficient funding for only two-thirds of them.”

“It’s a hard question. People look at infrastructure and say. ‘We’ve got to get rid of stuff.’ It’s usually TRADOC and AMC posts that get looked at; FORSCOM is OK. I don’t have an answer for it, but the reason it’s so expensive to run an installation is because they have been so under-funded for 15-30 years. We put no money into them; the housing is poor, the water plants are poor, etc.”

“We can fit the existing Army into an institution with less infrastructure. We can put units at Ft. Riley and other installations. We have land we are not using. American companies close facilities all the time and increase production and jobs elsewhere. People can move; they have that freedom.”

“We have to understand that installations are central to readiness and should get part of the readiness budget. Having ‘good’ installations is not just about quality of life issues and well-being.”

5.2 DoD installation management may be more cost efficient for geographic areas with multiple installations.

“I’m afraid we won’t take advantage of all of our potential Joint opportunities. I’m not opposed to Joint bases, I think it’s a good thing.”

“Regionally, we can do a lot together. We all use utilities and companies; if we acted together we’d have a hell of a gain. Knowing where all skill-sets are along a broader base is worth its weight in gold.”

“We should look at situations like Ft. Bragg and Pope AFB, but we need to determine whether there is going to be a Joint installations command or whether we will give a particular Service the responsibility of running a mega-installation.”

“There could be some streamlining. We should join Ft. Bragg and Pope AFB. You could merge operations like housing, MWR, medical, AAFES functions, etc.”

“Opportunities for integration with other services include NTC, Twenty Nine Palms, and some Air Force Bases. There is a potential link-up for Stryker Brigades near Air Force installations; there’s a lot of value in being close to one.”

“What is gained by joining collocated bases? If something is gained by combining them, then fine. It is certainly something that needs to be looked into on a case-by-case basis.”

“I am a big believer that the Transformed Army must be ‘synergistic’ in terms of its stationing. Bases that are close together (such as White Sands and Ft. Bliss) should be consolidated into one base that can accomplish all the objectives for training the new Army.”

“When it’s logical, we should combine operations, e.g. admin facilities. Our biggest challenge is to change cultures – to get people to work, live, and think outside their stovepipe. Jointness provides that opportunity.”

“If we are going to fight Jointly we should live Jointly. Having things like combined messes and schools are good things, we should integrate infrastructure.”

“They tried this (Joint Installations) in San Antonio (SARPMA) and also a similar thing in Hawaii. The problem is that everyone wants their asset sitting there for them. When you start talking about Joint, it gets very hard. However I think a Dyn Corp could run a Pope-Bragg type situation. We just contracted out a lot of Ft. Bragg.”

“What you would have to do with Joint bases is give the command to a Service and make them the proponent, e.g., Army gets Pope-Bragg, Air Force gets McChord-Lewis, Navy gets Tidewater. If there were a DIMA, the services would just pay the bill to DIMA.”

“OSD will play a much greater role in training forces, so there are more opportunities to do Joint. McChord-Lewis, Pope-Bragg type situations – how much can we save? Medical, dining facilities, utilities?”

“I believe we need a DoD IMA. We (DoD) are a corporation that doesn’t do good corporate management. During the McNamara era we came up with PPBS systems that are terrible. IMA is all about getting away from decentralization – managing installations has become a core competency. Once you make the leap from AMC-, TRADOC-, and FORSCOM-run installations to Army-run installations, you can make the leap from Army, Air Force, and Navy-run installations to DoD-run installations. IMA was stood up in 6 months. This type of new construct would normally have taken the Army two years to get going. Pope-Bragg, McChord-Lewis, Dix-McGuire are no-brainers; they should be merged and run Jointly. I think it can be done and should be done.”

“I am concerned that DoD will take over running the installations. This would be OK for base support functions but not for training enablers. If DoD took over training enablers, they would suffer, but I don’t have an issue with them running security, mess halls, etc.”

“We need to look at regions not installations. What does the region have to offer?”

“Losing England AFB near Ft. Polk was a missed opportunity for the Army.”

“I can give examples of great relationships, e.g. Bragg-Pope, where you can’t have one without the other. I would think of it in terms of Power Projection Installations. If someone were to close down an installation, what impact would it have on a sister Service?”

“I’ve always thought we should have a DIMA. The mission commanders being a tenant makes sense to me, but the Installation Management Activity (IMA) cannot treat the mission commander poorly. IMA is not getting the money it needs to improve ranges, training areas, and everything else. In the past, if a mission commander wanted to keep a range open all weekend, he did it; maybe new roofs didn’t get put on buildings that needed them, but at least the range was open. Now the mission commander has to get permission from the post commander to keep ranges open and often times there’s no money for it. I think the IMA model can work.”

“We need to look at places like McChord and Lewis (collocated installations) for efficiencies.”

5.3 The Army should continue to capitalize on Joint stationing agreements and pursue additional efficiencies.

“I would be disappointed if we were not collocated at a number of areas. Why can’t we have an Air Force wing at Ft. Hood? Collocation of Air Force and Army assets gives you an advantage.”

“When there is a situation where it doesn’t really matter where a unit is stationed, then it should be Joint if possible.”

“There are existing Joint programs but we need to see how we can better collaborate. There are sprinkles of Jointness going on, but not enough.”

“Collocating will save money as well as enable us to protect all of our important assets as they are only in one place.”

“Looking at BRAC from an OSD perspective is a good thing, but we shouldn’t lose our Army perspective. This BRAC we need to look at Joint use of their existing active installations. We need to see if there are other Services’ lands we can use.”

“We are already doing some Joint operations; we use Corpus Christi AAP to share services. Helicopter, ammo, etc., are consolidated as a result of other BRACs. We share where there is an opportunity. We also partner with industry when feasible.”

“As for Joint basing and stationing, we are pushing more along these lines. We are putting forth the idea of a Joint Medical Command. We oppose a Defense Health Agency, but a JMC that understands military medicine is a good thing.”

“BRAC 05, if done right, will be beneficial to the Army. We need to get rid of places we don’t need. We have to have fewer walls, gates, and buildings. We need to have some mega-bases.”

“There are significant opportunities. The problem is getting everyone to agree on military value. OSD involvement in this BRAC has got to include defining what ‘Joint’ means up front. The issue is how we define Joint.”

“How many installations can we afford? We have 182 installations now. Germany is 25% more per Soldier; Korea is cheaper because of fewer families. DoD can’t pay the school bill. We should move to Romania or Poland. If we weren’t in Germany, it would be a lot cheaper.”

“I’m on about 104 pieces of real estate around the world. I probably need 50 of them at the most!”

“I totally support the Joint route, I think we need to consolidate what we can.”

“I was at Ft. Bragg for two-years, there shouldn’t be a fence between Pope and Bragg. A problem is the different standards. It makes all the sense in the world to combine them (contiguous installations), especially in the Norfolk area, and when you get into force protection and anti-terrorism, it must be done. This should lead to other consolidations such as budget systems, maintenance, etc.”

“There are major differences this time around. All of the easy, obvious, high payoff closures are gone. This next round will be much more costly up-front to do. It’s going to be tougher to do what’s right – cross-service and cross-MACOM consolidations. I think if the services don’t present a more ‘Joint’ package, that Mr. Rumsfeld will send us back to the drawing board. There are great economies to be made in more ‘Jointness’. There are a lot of operational efficiencies to be made in Joint stationing at places like Eglin.”

5.4 Privatization provides opportunities for BRAC.

“There ought to be an analysis of each installation to see if privatization is beneficial there. Maybe have a ‘score’ for each installation. Either way, a comprehensive cost-benefit analysis needs to be done.”

“We must continue to pursue privatization where economically sound. It reduces costs.”

“RCI has been a win-win for the Army, why not barracks? If it works for housing, why not have the same approach for dining facilities? You have to watch things like commissaries and PXs.”

“We have to be careful what we look at to contract out. My position is, you start with the combat force and say ‘This is non-negotiable!’ But we also need to keep in mind that we need military folks in analytical positions as well; not all of our analysts should be civilian or contracted out. Every time we contract out, we lose people. We need to be aware of more than just the bottom line each year. The same principle applies to installations.”

5.5 Environmental costs have a major impact on BRAC funding and implementation.

“The environmental costs worry me; define ‘pristine’ to me! The issue isn’t that nobody wants the land, it’s the condition that they want the land in that’s the problem.”

“Maybe we could give contaminated land to a Sierra Club-type organization instead of converting it to secondary use. Environmental remediation is too damn expensive!”

“We keep getting more environmental bills; the EPA keeps deciding things are bad for you. Earlier rounds did not consider environment as a part of cost.”

“Environmental issues are a big concern.”

“Environmental restrictions are the biggest problem. We spent \$5.3 billion in the past 4 BRACS ('88,'91,'93,'95) and \$3 billion of it was on environmental remediation. UXO [unexploded ordinance] takes up the biggest chunk of environmental costs. Colorado, Massachusetts, and California are the worst states to deal with.”

5.6 MILCON funding is a concern.

“MILCON bothers me. Once you put it somewhere, it's a 50-year decision. Let's not commit MILCON to places that are going away; let's be smart about it.”

“I am also concerned about IT MCA projects that are already programmed. I don't want to see us build something on an installation that we end up closing.”

“Should we be building more housing? BAH is better, this is a major change from BRAC 95. BAH has been leveled. There are incentives for contractors to build if we move troops to an installation – and they will.”

6. Maintain Future Stationing Options

6.1 The Army must synchronize BRAC with major Army initiatives.

“BRAC 05 is not an independent activity; to get BRAC 05 right, you must capture results from other major Army initiatives and studies. BRAC 05 is integral, but it is a function of all of the other things and must be done in partnership.”

“I fear all the stuff going on (size of force, composition of force, encroachment decisions) will not be synchronized.”

“We have a one-time shot to do everything synchronized and do it right. Everything seems to be tracking on its own lane – encroachment, Objective Force, moving forces from Europe; we need to synchronize.”

“Decreasing our footprint overseas, mainly in Europe, is another major movement. Are we going to put them in the States? We need to consider these things. If we move units back from Europe, we’ll certainly have to fund barracks and housing.”

“We have to keep in mind that the force we have now is the force we are going to have for a while. By 2010 we’ll only have 2 Stryker Brigades.”

“In 2020 we’re still going to have the Army looking very similar. We may have eight or ten U/As in the Objective Force. We need to consider this, ‘If things go well, what does the Army look like in 2025?’”

“We should ask, ‘If we move a division back from Europe, can its receiving base support it?’”

“Transformation will impact stationing, it’s got to because you’re doing things so differently. We have to deploy much quicker. If we have to move in 96 hours, we have to be able to. If you’re going to transform the Army, you have to get everyone on board.”

“A lighter force makes us more mobile but we still have to be trained in advance. Reach-back capability allows you to have a lighter footprint in the AOR. With the SBCTs you can put a force on the ground, get the job done, and come back. Airfields will become more important going forward. The mix of Legacy, Interim, and Objective Force puts more requirements on an installation.”

“As the team [TABS] approaches this, the starting point should be ‘What is the go-to-war requirement?’ Sometimes, to save spaces, the easiest place to go is the combat units, but we have to be careful we don’t go there. We should look at the TDA slots first.”

“Dr. College needs to be told how many brigades and divisions you’ll have. He needs to look at all installations and consolidate. We don’t need half the stuff we’ve got. We can do

things like have Marriott feed us, and other privatization measures. We went to five or six depots last time, there's plenty of land there, why not put HQs on depots?"

"It [BRAC] has to be related to the future. There has to be linkage between installations, stationing, infrastructure, institutions, equipping, and the RC. I have found that we have bunches of people working all of these issues separately; we have a stationing bunch, an infrastructure bunch, an equipping bunch – it has to be correlated. The stovepipe method to solving problems bothers me. We are now deciding where to put the U/As, but it has to be correlated with everything else."

"My primary concern is that the Army is in sync with all of the other SECDEF initiatives. Hopefully, with a new Secretary and Chief, we will get back in sync. I think Craig and his team have their heads in the right place, but it is very important to get with the new Chief and Secretary and make clear what must remain, what must endure, so that we have a 'go to war' capability. To get a training site in Poland may be a good thing, but we should try and maintain Graf and Hoenfels."

"My primary concern is that we get this thing right, and there are a lot of factors to consider. What does the Army look like 15 years from now? Transformation? Where are we positioned? Do we put troops somewhere else overseas or bring them home? Are we able to tackle the no-kidding tough political issues? Can we finally close the bases we just don't need? Have we got the depots about right? Have we got the ammo storage down right?"

6.2 BRAC 2005 is the first OSD/Joint BRAC, and this provides the Army an opportunity to capitalize on Joint opportunities.

"OSD is going to play in this one. In the past they just stamped what the Services did. The JCSGs are new, OSD is going to look at Joint and Joint will trump what the Services want. The Services have a tendency to not look across the fence. Last time OSD just put a cover sheet on what the Services did. This time OSD is driving the train."

"The functional JCSGs are a new approach which adds a new dimension to the analysis."

"In '95 we had 'Service BRACs,' we thought of it [BRAC] as 'What can we give up to save money?' This time around we must put up a united front. DoD must get the Services to have the same perspective. I think this time we have a more cohesive Department."

"We need to look at BRAC from a DoD/Joint standpoint. If the Army's desired outcome is not in sync with DoD's desired outcome it could cause problems. We need to ensure we are all in sync."

"We have an opportunity to do some consolidation overseas. We are politically more receptive to bringing stuff back."

“I think Mr. Rumsfeld has this right, we need to do this together, otherwise you end up with 4 ‘service BRACs’. At places like Pope-Bragg they shouldn’t be separated by a fence. I’ve seen in Texas and Hawaii where attempts were made to merge operations but it didn’t work because we didn’t do it right. We don’t need a bunch of small installations that take up people and resources.”

“The enduring installation is the installation which has no senior command brand on its front gate (‘Home of the Armor’, ‘Home of TRADOC’, etc.). Mr. Dubois once stated that the main gate sign should read, ‘US Army’, and on that installation will reside many Army elements and other Services’ as well, the Army would just to be the host. It could be that someday it will be a DOD installation. We’ve already proven with IMA that breaking down the walls is a good thing. Now, how do we take the next step?”

“Places like Ft. Bliss, White Sands, and Holloman need to be looked at as packages for BASOPS. We need to not care what MACOM owned it or whether it was a training, maneuver, or depot installation.”

“There are some issues beyond the control of the Army, for example the Joint piece. Networking installations means a new way of doing training and education, e.g. distance learning. This will impact how many and which installations we need. This is not completely under our control. With the proper equipment, you could do up to a division level exercise virtually. I don’t think we have a firm grasp on the mix between installations, institutions, and infrastructure. We are wed to brick and mortar. We need to define what we need, then let that drive our resources. The Army has always been 24% of the Defense budget. As long as we have a short range planning policy, we will never get beyond it.”

6.3 The Homeland Security mission has not yet been clearly defined and requirements have not yet been established.

“Homeland Security is more of an RC/NG role with the AC as a backup. The training requirements for it are a little different. We don’t need large land areas, but we do need regional MOUT sites.”

“If there has been any impact on installations from the Homeland Security mission, I’m not aware of it, other than the establishment of CBRN Teams and a heightened desire for force protection. If the Guard and Reserves are going to have a role in it, that needs to be taken into stationing considerations.”

“At our present level, we have 16,000 to 18,000 Guard and Reserve troops on duty for force protection including 8,500 Guardsmen being used to guard Air Force bases. We have had some weaknesses in Guard recruitment, but the Guard says they have a plan to make this up. There are 138,000 Reserve Component troops on duty right now, including 55,000 for Iraq.”

“A great number of Soldiers are locked up doing gate guard, we need to be able to contract out installation security; we’re tying up ‘go-to-war’ Soldiers doing this. Also, at

airports, weapons sites, etc. I can't tell you today what my requirements are for Homeland Defense, but we know it will increase across the board (the dollars tied to it)."

"We have to use contractors in the future to guard bases. The key to force protection is decentralization. Concentrated people become more of a target, however they are easier to defend (fewer places require fewer resources and the resources are less dispersed)."

"The biggest cost (for Homeland Defense) has been the mobilized Guard and Reserves. It is still too young to be able to budget for it. We don't know the extent of it; it is going to become an unpopular appropriation. There are about 8,000 Army National Guard troops on active duty guarding Air Force bases. Keeping the Guard and Reserves on active duty is going to exact a price on recruiting and retention.

"A lot of the Homeland Security mission will be for the National Guard and Army Reserve."

"You need to ask NORTHCOM what the stationing and Assembly Area requirements for these forces (HLS) will be."

"Force protection should not be a big issue for BRAC purposes, I wouldn't worry about protecting the critical nodes. We studied the problem and the National Guard has adequate coverage. It's more of something for the First Responders and the Guard to worry about."

"What I was most intrigued about from the TRADOC force protection report was that you can no longer do force protection at the front gate, it has to be done in the community. We know that Al-Qaeda had guys in the States taking flight lessons and there were even some who went on military installations! To really do FP, all of our installations have to be networked across the Services. We also have to be linked in with FEMA, the Intel community, and local law enforcement."

6.4 The Army must consider the expandability and flexibility of its installations.

"Having an expansion capability is critical."

"The criteria used last time had a lot to do with costs, e.g., buildings. This time you should look at the immovable aspects: acreage, geographic location (including climate, weather, terrain, resources, vegetation), and, finally, population and urbanization. Maybe stationing troops at Yakima or Pinion Canyon should be an option."

"The ability of the installations to be upgraded for new technologies, like communications, are also important. We are relying more and more on technology at the ports."

"Because of Transformation and deployability needs, you've got to build for flexibility and the unknown."

“In defining military value we have to put a lot of weight on expandability, flexibility, and adaptability. These terms are relatively esoteric and we need to spend some time defining them. OSD has to tell us what the major Power Projection Platforms (PPPs) will be, as well as the key airfields and seaports.”

“We should come out of BRAC 05 better positioned for the future. We have to think about collective training, maneuver space, and ranges. We also need to have a training capability at home station.”

7. Additional significant comments

7.1 There are concerns that the political process (internal and external to DoD) will interfere with the potential positives of BRAC.

“If we don’t get it right this time then we haven’t learned anything in ten years.”

“The process has got to be without prejudice and must be transparent; it should be above reproach. There cannot be mistrust in the process itself. When it comes to military value, it’s going to be subjective.”

“It’s going to be a political process; logic and military value won’t have much to do with it. What is important is how it plays out in Congress. Congress accepts that we have 25% excess, but it’s not in their backyard. My worst fear is that they will close the wrong places, but that’s a military perspective. We’re going to be jerked around here. We may close some of the wrong things. OSD will probably submit a plan with 40% on the table then compromise to 20%.”

“Previous BRAC rounds have taken the low hanging fruit, no matter what you choose this time around, there is going to be political wrangling. Just think about it – if you hypothetically say that you’re going to combine the ADA and Arty school, does that mean you close Ft. Bliss or Ft. Sill? If so, get ready for a political storm.”

“I worry that saving money will interfere with accomplishing the mission. I’m afraid we might close some great installations that we might need in the future. I’m afraid we might break faith with some of our retirees. I’m afraid we may add some turbulence to everything that is going on right now.”

“I’m concerned that the political environment will negate the good you do and that the Services might become too parochial and not think Jointly.”

“There’s too much we can’t control because of politics. Often times we transfer properties gratis, which cuts into our projected revenue.”

7.2 Other significant comments.

“Sometimes the reason the retiree community exists is because there is an installation there. I don’t know how much of an impact they should have on this process, but they shouldn’t be considered a driver.”

“We need to consider the retirees in the area.”

“DoD talks about transforming PPBS; there are a lot of taskers out there to do this which came out of the QDR. There were no 180-degree turns to come out of these things. There are

moves to possibly merge all components into one MILPER Budget (AC/RC/NG). If it works, OSD would possibly try it with the operating budgets as well. I think the Army has the best Transformation roadmap, better than any other Services' or DoD agencies'. What OSD would like to see us reform is echelonment. The importance OSD attaches to its pet projects detract from doctrine, training, equipping, and officer and NCO education."

"There are some potential positives; my worry is getting it right. I worry about our training base for medicine to support the warfighter. I worry about our power projection capabilities at our MTFs [Medical Treatment Facilities]. I worry less about delivering healthcare locally. I want our incoming surgeons to be able to work on more than just typical peacetime soldier injuries. They have to be able to ply their trades, we need skills maintenance."

"Do we have infrastructure that is of no value? Absolutely! Do we waste money on them? Absolutely! Keeping little places open will hurt us. Installations for the Objective Force are profound combat multipliers. They are the sustaining base for the fighting force in more ways than they used to be!" (emphasis not added by author)

"I think we need to use this BRAC to re-station TDA and TOE units. We are going to be a more stable force in the future; Soldiers will be at their first duty station for seven years, e.g., if we collocate the operational and infrastructure [Army], we can stabilize the force. For example, if you're an artilleryman (officer), you can spend a long time at Ft. Sill by going from assignment to assignment while staying on-post. You serve in the Corps Artillery as a Lieutenant, go to the Advanced Course, go to Battery Command, go to the schoolhouse, either Artillery, or local ROTC or NG. Then stay at Ft. Sill for Field Grade positions. If we also had a headquarters element there, like TRADOC, you could even do an assignment there. Conversely, if you were an armor officer or drill sergeant, you would only go to Ft. Knox for one assignment in a training unit. This is a good example as to why Headquarters elements should be near maneuver elements; Soldiers could do multiple assignments at one post."

"This is the critical BRAC in the Defense Department, and also the hardest. There are four main characteristics that make it different from other BRACS: 1) The Joint perspective, 2) force protection, 3) Moving to a distribution focus ('factory to foxhole'), and 4) Unit Manning (this is not just about 'people.')

"There is an optimal array of forces that in peacetime can contribute to training. BRAC can help pay for the re-stationing of these forces. No matter what installations you close, it will give us an opportunity to re-station more logically."

"If a blackout occurred here, we could be cut out of the loop with what's going on in Iraq and Afghanistan. We need backup power."

APPENDIX G MVA MODEL DEVELOPMENTAL GOAL AND SUB-GOAL DESCRIPTIONS

This appendix lists the six goals and eighteen sub-goals found in the MVA Model at the time of publication of this report. The sub-goals are subject to change as development of the model continues. Furthermore, the potential attributes listed for each sub-goal are strictly developmental and may or may not end up in the final MVA Model. The purpose of this appendix is to give the reader a general frame of reference for what the final model may look like and to put the results of the interview process, particularly the results shown in Figure 5 on page 13 of this report, in context.

Goal 1: Support Army and Joint Training Transformation

Sub-goal 1, “Professional Education”: This sub-goal covers necessary facilities to meet Army and Joint accession, branch, initial military and professional institutional training requirements. Attributes for this sub-goal may include *General Instructional Facilities* and *Applied Instructional Facilities*.

Sub-goal 2, “Impact Area”: This sub-goal covers capabilities to conduct live fire and simulated training requirements. Attributes for this sub-goal may include *MOUT Capabilities*, *Size and Dimensions of Impact Area*, *Simulators*, and *Range Capabilities*.

Sub-goal 3, “Maneuver Land”: This sub-goal covers land and air space for ground and air maneuver training requirements. Attributes for this sub-goal may include *Heavy Maneuver Acres*, *Light Maneuver Acres*, *Airspace Allowances*, and *Assault Landing Strips*.

Sub-goal 4, “Environmental Restrictions”: This sub-goal covers environmental restrictions which may limit or inhibit Army and Joint training on an installation. Attributes for this sub-goal may include *Noise Restrictions*, *Air Quality*, and *Soil Resiliency*.

Goal 2: Project Power for Joint Operations

Sub-goal 1, “C2/Admin”: This sub-goal covers facilities and support locations that enhance command and control and administrative functions. Attributes for this sub-goal may include *Operations/Administrative Space*, *Accessibility*, and *Proximity to Other Service Installations*.

Sub-goal 2, “Mobilize”: This sub-goal covers an installation’s mobilization capability. Attributes for this sub-goal may include *SRP Throughput* and *Mobilization Load*.

Sub-goal 3, “Deploy”: This sub-goal covers an installation’s rapid deployment capabilities and may include attributes for *Rail Movement*, *Air Movement*, and *Sea Movement*.

Goal 3: Support Army Materiel and Joint Logistics Transformation

Sub-goal 1, “Research, Development, Testing and Evaluation”: This sub-goal covers sufficient ranges and facilities for Army/Joint RDT&E capabilities. Attributes for this sub-goal may include *Laboratory Facility Space*, *Specialized Facilities*, and *Test Ranges*.

Sub-goal 2, “Maintenance/Production Capacity”: This sub-goal covers sufficient maintenance and production capacity. Attributes for this sub-goal may include *Capacity Indexes* for different activities for the installation’s facilities such as armament, arsenal, communications-electronic, wheeled/track vehicle, missile, ammunition and rotary wing,

Sub-goal 3, “Supply and Storage”: This sub-goal covers sufficient supply and storage capacity capabilities and may include attributes for *Supply and Storage Facilities* and *Ammunition Storage Facilities*.

Goal 4: Enhance Soldier and Family Well-being

Sub-goal 1, “Housing”: This sub-goal covers adequate housing for service members and their dependents. Attributes for this sub-goal may include *On-post Family Housing Units*, *Unaccompanied Soldier Barracks Space*, *Unaccompanied Soldier Barracks Space 1+1 Standard*, and *Cost of Living Index*.

Sub-goal 2, “MWR”: This sub-goal covers morale, welfare, and recreation opportunities to the Army family and may include attributes for *Physical Readiness Facilities* and *Other MWR Facilities*.

Sub-goal 3, “Dependent Education”: This sub-goal covers education and child development opportunities to the Army family. May include attributes for *Child Development Facilities*, *On-post Elementary Facilities*, *On-post Junior High School Facilities*, and *On-post High School Facilities*.

Sub-goal 4, “Community”: This sub-goal considers the quality of the external community environment for the Army family. Attributes for this sub-goal may include *Crime Index*, *Unemployment Rate*, and *In-state College Tuition Policies*.

Goal 5: Achieve Cost Efficient Installations

Sub-goal 1, “Manpower”: This sub-goal looks at minimizing the cost of manpower at an installation and may include an attribute for *Locality Pay Factor*.

Sub-goal 2, “Installation Facilities”: This sub-goal looks at minimizing the cost to bring all permanent facilities up to standard and may include attributes such as *Facilities Re-capitalization Requirement* and *Area Cost Factor*.

Goal 6: Maintain Future Joint Stationing Options

Sub-goal 1, “Mission Expansion”: This sub-goal covers the ability of an installation to accommodate future missions and/or facilities. Attributes for this sub-goal may include *Buildable Acres, Absorption, Brigade Capacity* and *Urbanization*.

Sub-goal 2, “Critical Infrastructure Protection and Information Technology”: This sub-goal covers the ability of an installation to contribute to homeland defense and provide for its own security. It will also include attributes that cover information technology issues. Attributes for this sub-goal may include *Critical Homeland Defense Facilities Within a Designated Radius, Medical Surge Capacity of the Surrounding Community, Local Security Agreements, Cost to Establish IT Backbone Consistent With I3MP/Gig-BE Requirement*, and *Terrestrial Bandwidth Availability*.

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Gross Buildable Acres and Facility Conversion

Richard L. Schneider

July 2004

Gross Buildable Acres and Facility Conversion

Richard L. Schneider

*Construction Engineering Research Laboratory
PO Box 9005
Champaign, IL 61826-9005*

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ABSTRACT: The Army Basing Study (TABS) Group asked the U.S. Army Corps of Engineers (USACE) to look at buildable acres and MILCON requirements and identify any references/rules to help better determine stationing possibilities with buildable acres. The intent of this work is to assist a TABS analyst in assessing whether buildable acres can handle a mission expansion.

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Conversion Factors

Non-SI* units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	0.00001638706	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	$(5/9) \times (^{\circ}\text{F} - 32)$	degrees Celsius
degrees Fahrenheit	$(5/9) \times (^{\circ}\text{F} - 32) + 273.15$	kelvins
feet	0.3048	meters
gallons (U.S. liquid)	0.003785412	cubic meters
horsepower (550 ft-lb force per second)	745.6999	watts
inches	0.0254	meters
kips per square foot	47.88026	kilopascals
kips per square inch	6.894757	megapascals
miles (U.S. statute)	1.609347	kilometers
pounds (force)	4.448222	newtons
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
square feet	0.09290304	square meters
square miles	2,589,998	square meters
tons (force)	8,896.443	newtons
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

* *Système International d'Unités* ("International System of Measurement"), commonly known as the "metric system."

Preface

This study was conducted for the Army Basing Study (TABS) Group under Reimbursable Project No. CFM-G364, Work Unit No. 962LBV, “General COG Technical Support for BRAC 2005 Analysis.” Technical oversight was provided by COL William Tarantino, SAIE-IA.

The work was performed by the Engineering Processes Branch (CF-N) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The Principal Investigator (PI) was Richard L. Schneider. Mr. William Goran serves as the Program Manager for ERDC support of the Army Basing Study. Martin J. Savoie is Chief, CEERD-CF-M, and L. Michael Golish is Operations Chief, CEERD-CF. The Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan, and the Director of ERDC is Dr. James R. Houston.

1 Introduction

Background

The Army Basing Study (TABS) Group asked the U.S. Army Corps of Engineers (USACE) to look at buildable acres and MILCON requirements and identify any references/rules to help better determine stationing possibilities with buildable acres. The intent of this work is to assist a TABS analyst in assessing whether buildable acres can handle a mission expansion.

Objectives

The primary objective of this work was to develop a quick and simple process for the determination of the rough capability for an installation to receive new missions/units with an acceptable level of accuracy, to support TABS analyst initial installation expansion capacity assessments. Where indicated by this preliminary assessment, further investigation will be necessary at the installation level. The “rough” estimate should include an outline of the process, information needed for determination of installation excess capacity, analyses to be accomplished, basic planning factors to be utilized, and references/resources for back-up.

Approach

- Background data gathering / review:
 - installation real property master planning regulations and guidance documents
 - real estate regulations and guidance documents
 - facilities standards
 - installation data types / availability
 - standard / future proposed unit configurations & facilities requirements
 - planning tools, applications and resources
- Establish /obtain unit configurations
 - sample unit configurations
 - representative facility requirements for sample units (direct and indirect)
 - establish footprint requirements for sample units” / facilities
- Establish buildable area assessment process to address:

- unit configurations and facilities requirements
 - unit configuration footprints total acreage and acreage by land use
 - unit moves
 - capacity assessment
- Establish facility conversion factors:
 - establish conversion potential for required facilities (for unit configurations)
 - establish rough process for conversion cost estimation.

Technology Transfer

A report will be provided to the Army Basing Study (TABS) Group on Gross Buildable Acres and Facility Conversion. The report will be backed up with a Microsoft® Excel® workbook containing worksheet tabs for:

1. *Organizational Footprints* for stationing action is gross acres
2. *Space Requirements* tables showing the derivation of stationing action footprints
3. worksheet tabs by facility type detailing calculations for key facilities
4. industrial installations and facilities data
5. Conversion Land Use Codes (LUCs), Facility Category Groups (FCGs), and Facility Category Codes (FCCs) presenting appropriate alternative FCGs and FCCs for conversion
6. a Land Use Compatibility Matrix.

Draft slides for training presentations will also be provided.

2 Buildable Acreage Assessment

Unit Configurations

Sample unit configurations were determined by the TABS office, and gross requirements provided: Brigade (UA) (Light & Heavy), Schools (Small & Large), and Admin Organization/Operations (Small & Large). [No sample unit configurations were provided for Depot Maintenance (Small, Medium & Large), Industrial (Small, Medium & Large), and Supply and Storage (S&S) (Small, Medium & Large), rather, footprints for these configurations were derived from data representing facility inventories for industrial type category codes at industrial type installations extracted from Headquarters Executive Information System (HQEIS) and maintenance and supply and storage facility standards].

Table 2.1. Sample unit configurations and gross requirements for Brigade (UA)—Light.

SRC	ALO	UA Population 3,311	Facility		UM
06365F000	1	155MM SP Bn Force XXI	HQ & Admin	346,000	SF
07245F100	1	Inf Bn Mech (FXXI)	Org Classroom	23,000	SF
11103F300	1	Initial Bde Sig Co	Avn Maint	26,000	SF
17285F000	2	Div Cav Sqdn (XXI)	Veh Maint	203,000	SF
17375F100	1	Armor Bn (FXXI)	Hardstand	185,000	SY
34393A100	1	MI Co, Sep Bde	Dining Facilities	30,000	SF
63115F600	3	FSB (1x2) FXXI (Pure)	Barracks	1,298	SP
87042F100	1	HHC Armor Bde (XXI)	Fitness Facilities	65,000	SF
			Child Dev Ctrs	30,000	SF
			Chapels	28,000	SF

Table 2.2. Sample unit configurations and gross requirements for Brigade (UA)—Heavy.

SRC	ALO	UA Population 3,971	Facility		UM
06365F000	1	155MM SP Bn Force XXI	HQ & Admin	404,000	SF
06367F000	1	155SP Btry, 1x6 Force XXI	Org Classroom	28,000	SF
07245F100	1	Inf Bn Mech (FXXI)	Avn Maint	26,000	SF
07245F100	1	Inf Bn Mech (FXXI)	Veh Maint	211,000	SF
11103F300	1	Initial Bde Sig Co	Hardstand	205,000	SY
17285F000	2	Div Cav Sqdn (XXI)	Dining Facilities	1,574	SP
17375F100	1	Armor Bn (FXXI)	Barracks	1,574	SP
34393A100	1	MI Co, Sep Bde	Fitness Facilities	65,000	SF
63115F600	3	FSB (1x2) FXXI (Pure)	Child Dev Ctrs	32,000	SF
87042F100	1	HHC Armor Bde (XXI)	Chapels	29,000	SF

Table 2.3. Sample unit configurations and gross requirements for Schools—Small.

SRC		Facility		UM
I685/Y	Students-NCO Academy Ft Campbell	Gen Instr Bldg	17,000	SF
W3Y8AA	NCO Acad Ft Campbell	HQ & Admin	9,000	SF
		Barracks- perm	8	SP
		Barracks-student	160	SP
		Dining Facilities	168	SP
		Fitness Facilities	28,000	SF

Table 2.4. Sample unit configurations and gross requirements for Schools—Large.

SRC		Facility		UM
I071/P	Inf School PCS students	Gen Instr Bldg	420,000	SF
I071/Y	Inf School TDY students	Applied Instr Bldgs	188,000	SF
I809/B	Basic Trainee students	HQ & Admin	796,000	SF
I809/R	Reception station students	Veh Maint	18,000	SF
I809/S	OSUT students	Hardstand	35,000	SY
W0U2NA	USA Inf Center & Ft Benning	Barracks- perm	609	SP
W0U2AA	USA Inf Center & Ft Benning	Dining Facilities	609	SP
W2L5AA	USA Inf School (2,357 SP)			
W2L5NA	USA Inf School (11,221 SP)	AIT/BCT Complex: BN Headquarters w/2 Classrooms Co Ops / Barracks Dining	348,485	SF
		Fitness Facilities	151,000	SF
		Child Dev Ctrs	30,000	SF
		Chapels	89,000	SF

Table 2.5. Sample unit configurations and gross requirements for Admin Organization—Small.

SRC		Facility		UM
	CAA at Ft Belvoir – 142 PN			
W3WCAA	CAA	Admin	23,000	SF
W3WCNA	CAA			

Table 2.6. Sample unit configurations and gross requirements for Admin Organization—Large.

SRC		Facility		UM
	HQ FORSCOM – Fort McPherson – 970 PN			
W3YBAA	HQ USA FORSCOM	Admin	152,000	SF
W3YBNA	HQ USA FORSCOM	Barracks	10	SP
		Fitness Facilities	28,000	SF
		Child Dev Ctrs	8,000	SF
		Chapels	5,000	SF

Table 2.7. Sample unit configurations and gross requirements for Depot Maintenance.

		Installation	UM	Facility	UM
Small	<200,000 SF Total Depot Facilities (Ex. Corpus Christi Army Depot)	200,000	SF		
	Small Depot Maintenance Facility			8,000	SF
Medium	~324,000 SF Total Depot Facilities (Ex. Tobyhanna Army Depot)	324,000	SF		
	Medium Depot Maintenance Facility			38,000	SF
Large	>8,850,000 SF Total Depot Facilities (Ex. Hawthorne Army Depot)	8,850,000	SF		
	Large Depot Maintenance Facility			75,000	SF

Table 2.8. Sample unit configurations and gross requirements for Industrial.

		Installation	UM	Facility	UM
Small	~1,500,000 SF Total Industrial Facilities, (Ex. Lake City AAP)	1,500,000	SF	NA	NA
Medium	~3,000,000 SF Total Industrial Facilities (Rock Island Arsenal)	3,000,000	SF	NA	NA
Large	>6,000,000 SF Total Industrial Facilities, Ex. (Red River Depot)	6,000,000	SF	NA	NA

Table 2.9. Sample unit configurations and gross requirements for Supply and Storage.

		Installation	UM	Facility	UM
Small	Small Storage GP Inst Facility	NA	NA	40,000	SF
Medium	Medium Storage GP Inst Facility	NA	NA	160,000	SF
Large	Large Storage GP Inst Facility	NA	NA	280,000	SF

Unit/LUC Acreage Footprints

Unit footprints in acres by Land Use Code (LUC) were determined by estimating the footprints for the various facilities types required for each sample unit configuration. Calculations for footprint estimates varied from facility type to facility type based on the data available. Some were “given,” for example, Chapels, as the standard designs for the facilities included actual site plans and site acreage. Others were estimated by various means, drawing from standard designs, design criteria, and existing examples. Acreage requirements determined for each facility type were totaled for each land use and for the total unit as defined:

Table 2.10. Unit footprints in acres by LUC—Brigade, Light.

	Footprint Acres	Brigade, Heavy	Footprint Acres
Total	187	Total	214
Administration LUC	72	Administration LUC	85
Industrial / Airfield Operations LUC	54	Barracks LUC	59
Barracks LUC	50	Industrial / Airfield Operations LUC	54
Community LUC	11	Community LUC	16

Table 2.11. Unit footprints in acres by LUC—School, Small.

	Footprint Acres	School, Large	Footprint Acres
Total	18	Total	791
Barracks LUC	15	Barracks LUC	645
Administration LUC	3	Administration LUC	128
		Community LUC	11
		Industrial LUC	7

Table 2.12. Unit footprints in acres by LUC—Administrative Organization, Small.

	Footprint Acres	Administrative Organization, Large	Footprint Acres
Total	7	Total	43
Administration LUC	7	Administration LUC	33
		Barracks LUC	6
		Community LUC	4

Table 2.13. Unit footprints in acres by LUC—Depot.

		Footprint Acres
Small	Industrial LUC	84
Medium	Industrial LUC	64
Large	Industrial LUC	1,361

Table 2.14. Unit footprints in acres by LUC—Industrial.

	Industrial	Footprint Acres
Small	Industrial LUC	344
Medium	Industrial LUC	689
Large	Industrial LUC	1,377

Table 2.15. Unit footprints in acres by LUC—Supply and Storage.

		Footprint Acres
Small	Storage GP Inst Facility—Industrial LUC	3
Medium	Storage GP Inst Facility—Industrial LUC	9
Large	Storage GP Inst Facility—Industrial LUC	15

Facility Requirements

Footprint Estimation Calculation Logic

See Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion, Appendix D, for a comparison of UA Footprint Facility Types, TABS Data Call Land Use Categories, and Army Master Planning Land Use Categories, Facility Category Groups (FCGs), and Facility Category Codes (FCCs). Facility footprints include all “primary” space requirements (facility footprint, parking, access roads/drives, and Anti Terrorism/Force Protection (AT/FP) setbacks).

HQ & Admin

(FCCs 14182 Headquarters Building, Brigade & 14183 Headquarters Building, Battalion)

Footprint calculated based on the Standard Design Configuration of 10,528 SF w/out Troop Aid; Rough approximation of facility footprint based on a rectangular facility, 12.5% greater in footprint area than an “ideal” square; AT/FP set-back of 82 feet/25 Meters for “primary gathering” facility with parking outside AT/FP perimeter, based on an allowance of 60% of assigned personnel.

Admin

(FCCs 14182 Headquarters Building, Brigade & 14183 Headquarters Building, Battalion)

Same as HQ & Admin.

Org Classroom

(FCC 17119 Organizational Classroom)

Footprint calculated based on the Standard Design Configuration derived from the Standard Design for Battalion HQ with classroom; Rough approximation of facility footprint based on a rectangular facility, 12.5% greater in footprint area than an “ideal” square; AT/FP set-back of 82 feet/25 Meters for “primary gathering” facility with parking outside AT/FP perimeter, based on an allowance of 38% of assigned instructors.

Applied Instr Bldgs

(FCC 17119 Organizational Classroom)

Same as Org Classroom

Gen Instr Bldg

(FCC 17119 Organizational Classroom)

Same as Org Classroom

Veh Maint

(FCC 21410 Vehicle Maintenance Shop)

Footprint calculated based on site dimensions for Tactical Equipment Maintenance Facility (TEMF) Standard Designs using 7,739 SF & 36,370 SF configurations, facility, site, hardstand, apron plus non-organizational vehicle

parking; Used AT/FP 10 meter standoff for “inhabited” facility in controlled perimeter; Assumed that AT/FP standoff distances would be met within measured site area given organizational vehicle parking and facility access aprons w/in existing site areas with appropriate location of hardstands, organizational vehicle parking and aprons; Non-Organizational vehicle parking outside of AT/FP perimeter, based on an allowance of 38% of assigned personnel or largest shift.

Avn Maint

(FCC 21110 Maintenance Hangar, Aircraft)

Same as Veh Maint in lieu of Aviation Maintenance Facility Standard Designs.

Hardstand

(FCC 85210 Organizational Vehicle Parking, Surfaced)

Converted given SY area requirements into acres.

Dining Facilities

(FCC 72210 Dining Facility)

Footprint calculated based on the Dining Facility Standard Designs for 150-250 PN/13,245 SF, 501-800 PN/27,550 SF and 801-1300 PN / 30257 SF facilities; Assumed single story facility; Rough approximation of facility footprint based on a rectangular facility, 12.5% greater in footprint area than an “ideal” square; AT/FP set-back of 82 feet/25 Meters for “primary gathering” facility with parking outside AT/FP perimeter, based on an allowance of 38% of assigned instructors, 38% of Employees + 8% 1 time seating capacity.

Barracks

(FCC 72111 Unaccompanied Personnel Housing, Enlisted)

Footprint calculated based on Barracks Standard Design Criteria allowance of 36 M²/Soldier (this allowance includes barracks common use and service-type facilities such as laundry rooms, lobbies, maid/janitor rooms and linen closets, electrical and communications closets, rest rooms, vending areas, etc., for a “high rise” configuration). Assumed a 300 PN Capacity 3-story barracks; Rough approximation of facility footprint based on a rectangular facility, 12.5% greater in footprint area than an “ideal” square; AT/FP set-back of 82 feet/25 Meters for “primary gathering” facility with parking outside AT/FP perimeter, based on an allowance of 70% of maximum utilization (Barracks are usually planned by complex to include Battalion Headquarters, Company Operations, Dining and Non-Organizational Vehicle Parking; Parking is “shared” between these facilities, with stalls dependant on location; authorizations increase for UOPH/unaccompanied Officer Personnel Housing to 100% and decrease for trainee barracks to 10% parking for the entire complex.

Barracks- Perm

(FCC 72111 Unaccompanied Personnel Housing, Enlisted)

Same as Barracks.

Barracks-Student**(FCC 72181 Basic Training Barracks Facilities)**

Standard design currently in development is for a 3-Story Combat Trainee (BCT) / One Station Unit Trainee (OSUT) Barracks; Facilities are to be planned/sited by complex; The complex includes five Combined Company Operations Facilities (COF) / Trainee Barracks Facilities, one Battalion Headquarters Facility and One Dining Facility, with an on site running track & PT areas; The draft standard is for a site area of 20 to 35 acres, depending on the site configuration; maximum of 35 acres assumed for planning purposes/development of foot-print; the site area includes 162 shared parking spaces and all AT/FP setbacks.

Barracks-BT**(FCC 72181 Basic Training Barracks Facilities)**

Same as Barracks-Student

Fitness Facilities**(FCC 74028 Fitness Facilities)**

Footprint calculated based on the Physical Fitness Facilities (PFF) Standard Designs for X-Small (27,771 SF) and Medium (64,799 SF) Facilities; Current standards are criteria based without site area sizes; evaluated old standards which contained site areas; revised site areas to allow AT/FP set back; AT/FP set-back of 82 feet/25 Meters for "primary gathering" facility with parking outside AT/FP perimeter, based on an allowance of 60% of maximum capacity; then derived a building footprint multiplier (ratio of facility gross area to site gross area) assuming similar facility functionality; and extrapolated new multipliers from those calculated for old standards.

Child Dev Ctrs**(FCC 74014 Child Development Centers)**

Footprint calculated based on the Child Development Centers (CDC) Facilities (PFF) Standard Designs for 99 Child (8,230 SF) and 198 Child (15,400 SF) Facilities; Current standards are definitive, but not current to AT/FP requirements; evaluated old standards which contained site areas; revised site areas to allow AT/FP set back; AT/FP set-back of 82 feet/25 Meters for "primary gathering" facility with parking outside AT/FP perimeter, based on an allowance of 1 Stall/4 children & 100% of Staff; assumed all outdoor play areas to be considered "primary gathering" spaces for estimation of AT/FP setback; then derived a building footprint multiplier (ratio of facility gross area to site gross area).

Chapels**(FCC 73017 Chapel)**

Obtained site area requirements from the Corps of Engineers Center of Expertise for Chapels from current standard designs; standards have been recently updated and include AT/FP setbacks.

Industrial

(FCGs F22400 Tank/Automotive Production Facilities & F22600 Ammunition Production Facilities)

The commercial industrial site planning convention is that 50 acres is the minimum practical size for an industrial site. Many companies consider the minimum site size to be 10 square feet of land for each square foot of building area. This rule of thumb is recommended for planning purposes in concert with the typical installation footprints determined from a review of Army industrial sites. It is a conservative estimate when compared with the facility footprint multipliers calculated for other facility types which ranged from a high of 19.4 X for child care centers with large outdoor play area and AT/FP setbacks and a low of 4.2 X for fitness centers. Footprints were estimated in acres for small, medium and large facilities installations, not UAs.

Depot Maintenance

(FCGs F21440 Depot Maintenance/Rebuild Shops, F21500 Depot Weapons Maintenance Shops, F21600 Depot Ammunition Maintenance Facilities & F21700 Communications /Electronics Repair Shops, Depot)

Depot maintenance and installation maintenance facilities can be considered the same for planning purposes. Depot facilities are larger in that they perform consolidated maintenance functions, at depot installations. Site footprint requirements are recommended to be calculated on the basis of the facility requirements for the unit moves using foot print multipliers for the TEMF facilities [Site area in SF = 18.4 X Bldg. Area in SF for a small facility, ~8,000 SF; 8.7 X for a medium sized facility, ~38,000 SF ; and 6.7 X for a large facility, ~75,000 SF]. The larger the facility, the more efficient the utilization of site area is. For facilities larger than 75K SF, the maximum size standard design, the multiplier may be extrapolated. As for the TEMF footprints, these areas include facility, site, hardstand, apron, non-organizational vehicle parking and AT/FP 10 meter standoff for "inhabited" facility in controlled perimeter. Footprints were estimated in acres for small, medium and large facilities, and small, medium and large installations, not UAs.

General Purpose Warehouse

(FCC 44220 General Purpose Storage Building, Installation)

Footprint calculated based on old standards, facilities incrementally sized in bay-widths, from 200 X 200 ft or 40,000 SF up to 200 X 1400 ft or 280,000 SF; Selected small, medium and large facility and established footprint based on loading dock access on both sides of a facility. Footprints developed for sample facility sizes, not UAs.

Land-Use Compatibility

Unit Facility Types were matched to acceptable land uses of "primary," "secondary" and "alternative" using the land definitions of the TABS data call. While there is not a 1:1 correspondence between defined Army master planning and TABS data

call land use categories, in definition or nomenclature, there is a match for the land uses needed for unit footprints. For the comparison, see Appendix B. It should be noted that there is no Army master planning land use equivalent for the data call “Waterfront Operations” land use, however, there are no unit footprint facilities required in this data call land use. Similarly, there is a distinct difference between the Army master planning “Open Space” and the data call “Undetermined Use” land uses. In the master planning sense, “open space” is preserved as open space for aesthetic, quality of life, and “buffer” purposes.

Develop a simple and quick process for the determination of the rough capability for an installation to receive new missions/units with an acceptable level of accuracy, to support TABS analyst initial installation expansion capacity assessments.

For the purposes of TABS analysis, some LUCs have been combined into a single LUC where similar or compatible land. This will add a more rapid determination of installation expansion capability. This is done with the caveat, however, that installation land uses are determined based on local facilities and land use compatibilities, functional relationships, land constraints, transportation and utilities networks, etc. Actual capabilities and conversion potential can only be determined on the site. With exceptions, most can be converted to another land use, but based on site-specific adjacencies and constraints than on current designations. While “Airfield Operations” might be rolled into the “Industrial” LUC, as the predominant facility type is a maintenance or storage type facility, albeit for aircraft, it may ultimately be more feasible to convert other land uses to “Industrial” based on location and adjacencies. For the purposes of these analyses, and the established facilities footprints, only four primary land use codes are required, Administrative, Barracks, Industrial, and Community:

- All training facilities have been grouped under “Barracks” land use in lieu of being classified as “Training Area/Ranges.” The predominant requirement for these facilities are at training installations. In addition, the facility standards used to develop the UA footprints were predominantly Battalion Headquarters facilities with training classrooms located in “Barracks” LUC. Stand alone General Instruction Buildings are a secondary requirement and could be alternatively located in “Barracks,” “Administrative” or “Training Area/Ranges” land uses;
- All airfield facilities have been grouped under “Industrial” land use in lieu of being classified as “Airfield Operations.” Airfield facilities are predominantly maintenance or storage facilities, albeit, located adjacent to airfields;
- While there are no medical facilities requirements in defined footprints, “Medical” LUC and “Community” LUCs are to be considered together in determination of “Community” LUC residual capacity. These facilities and land uses are similar in function and generally centrally located on the installa-

tion for ease in serving the entire installation. Similarly, “Administrative” requirements may be met by “Medical” LUC.

- See Appendix E, for a complete Land-Use Compatibility Matrix. This matrix is based on the Army [Master Planning Instructions \(MPI\)](#), 9 July 1993, however, it uses the defined TABS LUCs (Appendix B). Alternative Land Uses for TABS requirements are as follows in order of preference (other compatibilities are identified at Appendix E, however, discounted given conflicting requirements, ex. Barracks LUC is an alternative LUC for Administrative, however, Barracks is the predominant LUC required) :
 - Administrative—Undetermined, Community, Medical, and Outdoor Recreation.
 - Barracks—Undetermined, Community, Medical, and Outdoor Recreation.
 - Industrial—Undetermined, Airfield Operations, and Water-front.Q30: Engineering => Buildable Acres
 - Community—Undetermined, Medical, and Outdoor Recreation.

Buildable Acreage Capacity Assessment

The building acreage capacity assessment is a simple iterative process which first establishes the Unit of Action for a given scenario, the gross facility footprint required for that unit of action, in total and by LUC, and a determination of an installations capability to receive the unit of action.

Step 1—Stationing Action Determination

All capacity assessment will be based on the facility requirements and gross acreage needed for a given stationing action. That action will either be made up of the actual sample unit, be a grouping of actual sample unit(s) or where the stationing action varies from the set examples, a modified stationing action will be established for the purpose of determining the gross acreage required [Sample unit configurations and footprints are provided in Tables 2.1-2.9 above, and on the [TABS Buildable Acres Analysis 040519.xls](#) spreadsheet, “Organizational Footprints” Tab].

Establish Stationing Action Units

- List all stationing action units in the scenario by types, number, and size;
 - Brigade (Light, Heavy)
 - School (Large, Small)
 - Administrative Organization (Large, Small)
 - Industrial (Large, Medium, Small)
 - Depot (Large, Medium, Small)
 - Supply & Storage (Large, Medium, Small)

- Determine match or variance of the stationing action units from the sample units [tables 2.1-2.9, and TABS spreadsheet]
 - Calculate the % variance of each stationing action unit in strength from the size of the sample unit, plus or minus;

Step 2—Stationing Action Footprint

Once the stationing scenario has been established, the gross facility footprint can be calculated for that stationing scenario. The gross facility footprint is simply a sum of the footprints for all the units it contains as a total of all LUCs and by LUC. These gross facility footprints are either taken directly from the Unit/LUC Acreage Footprints (Tables 2.10-2.15 above, and *TABS Buildable Acres Analysis 040519.xls* spreadsheet, “Organizational Footprints” Tab) where there is a 1:1 match with sample units or derived from them when the actual units in the scenario vary from the sample units.

- Determine stationing action gross facility footprint for the defined stationing scenario of step one:
 - Determine the gross facility footprint in acres for each scenario unit [Tables 2.10-2.15, and TABS spreadsheet];
 - * Where there is a 1:1 match between the sample units and the stationing action units, use the gross facility footprint in acres for the sample units;
 - * Where actual scenario units vary from the sample units [Tables 2.1-2.9, and TABS spreadsheet] the gross facility footprint for that unit must be increased or decreased by the percent variance determined in step one above for that unit (by total and LUC). For example, if the stationing action has an Administrative Unit similar in staffing size but 15% larger than the staffing of the sample Small Administrative Unit [Table 2.5] the gross facility footprint for the sample unit would be increased by 15% to arrive at the required gross footprint in acres for that unit.**
- Sum up all the gross facility footprints in acres for all units in the defined stationing scenario (by total and LUC).

** It is understood that this process departs from the means by which the sample footprints were established. Footprints for the units were established in part on the basis of incremental sizes of standard facilities. This is particularly true for dining facilities and physical fitness centers, which are sized in increments according to the population served. This process will not result in a detailed estimate of the required acreage, however, it is considered to be accurate enough for gross planning purposes.

Step 3—Installation Capability Determination

Once the Unit of Action footprint is determined, the next step is to compare the UA area requirement in acres with the available unconstrained buildable acreage at each installation. A spreadsheet has been prepared compiling the results of Data Call Question 30 [*Q30 Q198 – Buildable Acres.040510.xls*], listing the “Buildable Acres” in total for the entire installation, and by the eleven TABS data call land uses (Appendix B). A more complete definition of “Buildable Acres “ may be found in Appendix C or in the Buildable Acres Spreadsheet; however, a brief definition follows:

Buildable acres are land acres(s) that are not already being used and are available to support new construction. A buildable acre must be free of environmental constraints to its use, e.g., historical use restrictions, contamination, wetlands, incompatible encroachment, and man-made constraints such as ESQD arcs, airfield safety zones, AT/FP setbacks, etc.

The screening process will first look at the installation level to determine if all moves are possible, then it will screen at the land use level and finally, where there is insufficient capacity at the land use level, alternative land uses will be considered in determination of excess capacity.

Step 3.1—Screen for Sufficient Total Capacity

Installation unconstrained buildable acreage contained in the Q30 spreadsheet can be sorted in multiple ways to support capacity assessment, but the first sort must be by total unconstrained buildable acreage. All installations falling below sufficient capacity to accommodate the total minimum UA scenario acreage requirement may be deleted from further consideration. Unit footprints are then compared with the total unconstrained buildable acreage. All installations with equal to or greater capacity pass the screening for further consideration.

Step 3.2—Screen for Sufficient Capacity By LUC

Further sorts may be accomplished by LUC as needed to determine candidates and ranking for UA moves by primary and secondary LUC requirements. For example, predominant requirement for sample UAs is Barracks LUC, and the second is for Administrative LUC. Sorting on unconstrained buildable acreage for these LUCs immediately displays installations with sufficient overall capacities by LUC. All installations with capacities equal to or in excess of requirements by land use receive further consideration. In addition they may be ranked by capacity in excess of requirements by LUC. These installations then need no further scrutiny.

Step 3.3—Screen for Sufficient Alternative LUC Capacity

Where Total Capacity is Sufficient, but One or More LUC Capacities is Insufficient, further evaluation of installation capacity is needed. For each LUC where capacity is insufficient, it will be necessary to evaluate the capacities in alternative LUCs to determine the feasibility of a unit move. Alternatives for each land use should be evaluated as follows in order of priority (See also Appendix E, and *TABS Buildable Acres Analysis 040519.xls* spreadsheet, “LU Compatibility Tab”):

Administrative—Requirements may be met by any of “Undetermined,” “Community,” “Medical,” or “Outdoor Recreation” land uses. Barracks LUC is also an alternative, however, this LUC should only be considered last since, UA footprint Barracks and Administrative requirements are predominant and of equal importance.

Barracks—Undetermined, Community, Medical, or Outdoor Recreation. Administrative LUC is also an alternative, however, this LUC should only be considered last since, UA footprint Barracks and Administrative requirements are predominant and of equal importance.

Industrial—Undetermined, Airfield Operations, or Waterfront.

Community—Undetermined, Medical, and Outdoor Recreation.

3 Facility Conversion Assessment

Facility Conversion and Master Planning

A principle tenet of the Army master planning real property investment strategy is to maximize facilities utilization. The principle, which strives to achieve the best allocation of existing facilities, and infrastructure, is based on “non-structural alternative solutions,” e.g. those that do not require new construction, the foremost being the conversion of existing facilities to meet requirements. New construction represents the “last resort” after alternatives such as reassignment, conversion, rehabilitation, and lease, have been examined. When conversion is planned as an option, planned conversions are contained in the installation Capital Investment Strategy (CIS).

Facility conversions must provide a complete and usable facility sized according to approved space planning criteria, to meet a demonstrated shortfall. Conversions are only permitted when a facility to be converted is determined to be in excess of valid requirements and compatible with the existing or future RPMP and inclusive Land Use Plan. Conversions result in a change of the design use (category code) and documented in the Real Property Inventory (RPI) even if the actual structure is not modified. In general, there are no restrictions on the facility types that may be converted; however, approval authorities vary by facility type. Installation commanders may approve facility conversions from design/current use for any purpose. Complete restrictions and approval authorities are listed in AR 405-70, subparagraph 3-6.d.

Master Planning Process and Conversion Potential

By definition, facility “conversion” is any change to interior or exterior facility arrangements so that the facility may be used for a new purpose. This includes installed equipment made a part of the existing facility. Conversion is by definition a “construction” activity. Conversion may, however, be simply require reclassification under a new facility category code. Conversion by reclassification versus through major facility reconfiguration or rehabilitation to accommodate new functions is dependant on an ability to match facility functional requirements to an installation’s current facilities portfolio. The basic questions that the planner asks are:

- What are the excess facilities by Facility Category Group (FCG) and Facility Category Code (FCC) in the target Land Use Category (LUC) and site location, ex. Facilities Administrative (FCG F60000), Administrative Building, General Purpose (FCC 61050), and Administrative (LUC)?
- Of those facilities in excess, which in the same FCG are of sufficient capacity to meet requirements?
- Of those not in the same FCG, which have characteristics allowing the least cost conversion to meet new requirements.

In general, the optimum is to select facilities for “conversion” of the same category code (FCC) or from the same or from the same facility category group (FCG). These facilities will share the same overall characteristics and restrict conversion cost to a minimum. In selecting potential facilities for conversion, it will not always be possible to remain within the FCG. If excess facilities are not available in the appropriate FCG, then selection should be made from a “family” of related FCGs with facilities sharing the same general characteristics. Potential FCGs for conversion listed based on shared characteristics, are listed in Appendix D. Lastly, Architect-Engineers like to believe that any facility type may be converted to another facility type, and depending on the function, that may be true, however, the limiting factor will be the cost for conversion.

Conversion Costs

Facility conversions are treated as “maintenance and repair” projects and the maximum cost is governed by regulatory limit. A comparison must be made between the costs for conversion (total or repair plus alteration cost) with the replacement value for a new facility. Conversion costs may not exceed 50 percent of the replacement value in accordance with AR 420–10. (See DA Pam 420-11, paragraph 3-4).

There are no rules of thumb for estimation rehabilitation-renovation costs. Cost estimates for the purpose of programming military construction projects, more specifically, the estimation of alteration projects, is accomplished using detailed cost estimation procedures on a facility-by-facility and project-by-project basis. The process is detailed in TM-5-800-4, *Programming Cost Estimates For Military Construction*. Alteration projects are basically estimated as a percentage of the cost/SF for the construction of a new facility, taking into account a range of adjustment variables (TM-5-800-4, paragraph 12). Facilities Unit Costs are updated regularly by the Headquarters, U.S. Army Corps of Engineers (Amitava Ghosh, CECW-EI, 202-761-7503 or DSN-763-5545; FAX 202-761-0623; and email: amitava.ghosh@usace.army.mil), and published on the PAX System and in EIRS Bulletins (Engineering Improvement Recommendation System).

In selection of potential facilities for conversion in a planning process, it is not possible to evaluate facilities and select them through cost estimation on a case-by-case basis. Assumptions have to be made. Simply, the more a required facility varies from the “design category code” the more costly the conversion cost and the likelihood that the 50% regulatory limit will be exceeded. The “Potential FCGs for conversion” listed in Appendix D, were selected only through review of facility types contained in DA Pam 415-28, based on a presumption of their similarities. Those excluded are assumed to be sufficiently dissimilar such that while conversion may be possible, conversion cost would exceed the 50% regulatory limit.

For the purposes of the TABS screening process, to confirm the above assumptions on cost for conversion, or to consider other excess facilities for conversion, Installation Status Report (ISR) cost data is to be utilized. Simply, conversion cost will be estimated as the cost to “upgrade” a facility from an ISR status as “Red,” to an ISR status of “Green.”

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[FPS \(Facility Planning System\)](#)

[Army Criteria Tracking System \(ACTS\)](#)

[Real Property Planning and Analysis System \(RPLANS\)](#)

[ProjNet](#)

Appendix A: DA Facilities Standardization Program Footprint Facilities

Brigade/Battalion Headquarters & Two Story Battalion Headquarters

U.S. Army Engineer District, Sacramento

ATTN: CESPK-ED-M (Mr. Shig Fujitani), 1325 J Street, Sacramento, CA 95814

Telephone: 916-5577412

Email: Shigeru.Fujitani@spk.usace.army.mil

Classroom 21, General Instruction Buildings (GIBs) & Enlisted Personnel Dining Facilities

U.S. Army Engineer District, Norfolk

ATTN: CENAO-TS-EA/TS-E (Mr. Terry Deglandon/Mr. Pete Reilly), 803 Front Street, Norfolk, VA 23510

Telephone: 757-441-7702/7698

Email: Terry.L.Deglandon@nao02.usace.army.mil

Email: Peter.G.Reilly@nao02.usace.army.mil

Tactical Equipment Maintenance Facilities (TEMF), Company Operations Facilities, & Unaccompanied Enlisted Personnel Housing (UEPH)

U.S. Army Engineer District Savannah

ATTN: CESAS-EN-E (Mr. Tom Brockbank), P.O. Box 889, Savannah, GA 31402

Telephone: 912-652-5212

Email: Thomas.R.Brockbank@sas02.usace.army.mil

Advanced Individual Training (AIT) Barracks Basic, Combat Trainee (BCT)/One Station Unit Trainee (OSUT) Barracks, Unaccompanied Officer Quarters, and Unaccompanied Officer Quarters, Transient

U.S. Army Engineer District, Tulsa

ATTN: CESWT-EC-D (Ms. Sandi Egan), 1645 S. 101st East Avenue, Tulsa, OK 74128

Telephone: 918-669-7033

Email: Sandra.Egan@swt02.usace.army.mil

Physical Fitness Facilities (PFF), and Child Development Centers (CDCs)

U.S. Army Engineering and Support Center, Huntsville

Attn: CEHNC-ED-CS-A (Mr. Jay Clark / Mr. Marcus Searles), P.O. Box 1600, Huntsville, AL 35807-4301

Telephone: 256-895-1673/1672

Email: James.T.Clark@hnd01.usace.army.mil

Email: Marcus.J.Searles@hnd01.usace.army.mil

Army Chapels, Chapel Family Life Centers, Religious Education Facilities, and Small Site Chapels

U.S. Army Engineer District, Omaha

ATTN: CENWO-ED-DG/PM-M (Mr. Rich Lewis / Mr. Bill Rafferty), 215 North 17th Street,
Omaha, NE 68102

Telephone: 402-221-4552/4434

Email: Richard.R.Lewis@nwo02.usace.army.mil

Email: WilliamE.Rafferty@nwo02.usace.army.mil

Central Issue Facility and General Purpose Warehouse

U.S Army Engineer District, Seattle

ATTN: CENWS-EC-DB-AS (Mr. John Maciejewski), 4735 E. Marginal Way, Seattle, WA
98124

Telephone: 206-764-3444

Email: John.J.Maciejewski@nws02.usace.army.mil

Appendix B: Master Planning Land Use Categories and TABS Data Call Land Use Types

TAB Data Call	Master Planning Instruction (MPI)
Airfield Operations – includes acreage that is appropriate for airfield pavements and lighting, air operations facilities, and supporting facilities such as aircraft maintenance hangars and shops.	Airfield. Includes landing and takeoff areas, aircraft maintenance areas, airfield operations and training facilities, and navigational and traffic aids.
Industrial – includes acreage that is appropriate for central utility plants, equipment/vehicle maintenance and production, supply and storage, and industrial type RDT&E facilities.	Maintenance. Facilities and shops for maintenance and repair of all types of Army equipment found at three organizational levels
	Industrial. This category includes activities for manufacturing Army equipment and materiel, utility plants and waste disposal facilities.
	Supply/Storage. Depot, terminal, and bulk-type storage for all classes of Army supply.
Administrative – includes acreage that is appropriate for headquarters and general office buildings, classroom training, and laboratories.	Administration. Headquarters and office buildings to accommodate offices, professional and technical activities, records, files and administrative supplies.
Training Area/Ranges – includes acreage that is appropriate for individual and unit training and range facilities, maneuver land, and weapon impact areas. Also includes acreage for RDT&E range operations.	Training/Ranges. Much like any large organization, the Army has academic training programs for entry level and continuing education. Unlike most organizations, the Army requires massive land areas to achieve and maintain soldier and unit proficiency in fire and movement/maneuver. While academic training can be integrated into the land use pattern of the built-up area, fire and maneuver training must occur a significant distance away from other installation and off-post land uses.
Barracks – includes acreage that is appropriate for unaccompanied personnel housing, dining, and associated supporting facilities.	Unaccompanied Personnel Housing (UPH). This category consists of unaccompanied enlisted barracks and officer personnel quarters, and includes dining, administration, supply, outdoor recreation, and community retail and service facilities.
Community – includes acreage appropriate for base supporting organizations such as exchanges, commissaries, security police, education facilities, etc.	Community Facilities. Commercial and service facilities, the same as are associated with towns in the civilian community.
Medical – includes acreage appropriate for medical, hospital and dental clinic uses.	Medical. Facilities providing for both inpatient and outpatient medical and dental care for active duty and retired personnel. This category may include veterinary and Red Cross facilities.
Outdoor Recreation – includes acreage appropriate for outdoor recreation such as ball fields, running tracks, and golf courses.	Outdoor Recreation. Outdoor athletic and recreational facilities of all types and intensities of use are included in this category.

TAB Data Call	Master Planning Instruction (MPI)
Family Housing – includes acreage that is appropriate for family dwellings, dependent schools, and associated supporting facilities.	Family Housing. Facilities to house military families, along with support and recreational facilities.
	Open Space. Safety clearances, security areas, utility easements, water areas, wetlands, conservation areas, forest stands, and grazing areas. The primary facility category groups associated with this land use are 91000 – Land.
Waterfront Operations – includes acreage that is appropriate for pier/wharf operations, ship maintenance or production, and associated supporting facilities.	
Undetermined Use – includes ONLY acreage for which there is no other primary use and for which any use may be appropriate	

Appendix C: Buildable Acres

As of: 26 Jul 04

1. **DEFINITION:** The gross number of buildable acres on an installation based on eleven different land use categories.
2. **PURPOSE:** Measures the degree of internal expansion available on an installation. This attribute demonstrates the degree to which an installation may expand given current physical, building, and land use constraints.
3. **SOURCE:** Installation Capacity Data Call, DoD Question #30
4. **METHODOLOGY:**

a. *Background*

- i. Buildable acres are land acres that are not already being used and are available to support new construction. A buildable acre must be free of environmental constraints (e.g., historical use restrictions, contamination, wetlands, incompatible encroachment, and man-made constraints such as ESQD arcs, airfield safety zones, AT/FP setbacks, etc.). Any facility to be constructed within buildable acreage must be "land use" compatible with location being considered (e.g., a playground is compatible with a family housing area and a vehicle maintenance facility is compatible with an industrial area).
- ii. Installations are generally required to have a current master plan/RSIP on hand to guide the orderly growth of the installation. Based on the master plan/RSIP, installations are to provide separate acre totals available for expansion for each of the eleven uses listed below. Each installation will report the total buildable acres by land use, and the number of land parcels. (A parcel has a distinct/contiguous perimeter.)

b. *Method*

- i. Each installation reports their buildable acres available for the following categories of land use.

A. Administrative - includes acreage that is appropriate for headquarters and general office buildings, training classrooms, and laboratories.

B. Airfield Operations - includes acreage that is appropriate for airfield

pavements and lighting, air operations facilities, and supporting facilities such as aircraft maintenance hangars and shops.

C. Barracks - includes acreage that is appropriate for unaccompanied personnel housing, dining, and associated supporting facilities.

D. Community - includes acreage appropriate for base-supporting organizations such as exchanges, commissaries, security police, education facilities, etc.

E. Family Housing - includes acreage that is appropriate for family dwellings, dependent schools, and associated supporting facilities.

F. Industrial - includes acreage that is appropriate for central utility plants, equipment/vehicle maintenance and production, supply and storage, and industrial type RDT&E facilities.

G. Medical - includes acreage appropriate for medical, hospital, and dental clinic uses.

H. Outdoor Recreation - includes acreage appropriate for outdoor recreation such as ball fields, running tracks, and golf courses.

I. Training Area/Ranges - includes acreage that is appropriate for individual and unit training and range facilities, maneuver land, and weapon-impact areas. Also includes acreage for RDT&E range operations.

J. Waterfront Operations - includes acreage that is appropriate for pier/wharf operations, ship maintenance or production, and associated supporting facilities.

K. Undetermined Use - includes ONLY acreage for which there is no other primary use and for which any use may be appropriate.

- ii. TABS combined the installation's data defined above in 4.b.i, excluding 4.b.i.I. "Training Area/Ranges." Training area and range acres are not used in calculating military value here, as training areas are typically separate and distinct from other areas, and their military value is captured in other attributes. TABS then calculated the military value of buildable acres using the equation in paragraph #8.

5. QUESTIONS THAT DEFINE DATA:

- a. Installation Capacity Data Call, DoD Question #30 states: "Complete the following table for all land owned or controlled by the base according to the land uses listed. "Controlled" includes land/property used by DoD under lease, license, permit, etc in excess of 10 years. DO NOT include easements as either owned or controlled. Include the main installation, ranges, auxiliary fields, and all outlying sites. Designate ranges, auxiliary fields, and outlying sites separately by name

and real property nomenclature (as appropriate). List each acre with its primary land use only and do not include any acre in more than one land use. Do not include developed land defined as those areas that are built-up (i.e., it consists of facilities and pavements). Do not include constrained land defined as those areas encompassing wetlands, flood plains, contaminated sites, RCRA/CERCLA contaminate sites, endangered species habitats, ESQD arcs, radiation safety zones, antenna field of view (or line of sight) clear zones, AT/FP setbacks and APZs."

- b. The table referenced in DoD Question #30 contains columns defined by elements A thru K from paragraph #4 above and rows for each named site/real property. The data for this attribute is taken from columns A thru H and J thru K.

6. REFERENCES: AR 210-20, Master Planning for Army Installations, dated 30 July 1993.

7. UNIT OF MEASURE: Acres

8. EQUATION:

$$\text{Gross Buildable Acres (GBA) Score} = A + B + C + D + E + F + G + H + J + K$$

9. MODEL REQUIREMENTS:

a. Model Input

- i. MVA calculates the GBA Score, the input data are: A, B, C, D, E, F, G, H, J, K.
- ii. Buildable acres are equally weighted.

b. Value Function

- i. The value function uses a single equation that measures the returns to scale of the attribute's score and returns the value of an installation's facilities. The curvature of the function is determined by TABS and coordinated by U.S. Army Corps of Engineers.
- ii. The Maximum value of 10 will be given to the installation with the highest number of GBA.
- iii. The Minimum value of 0 will be given to the installation with the lowest number of GBA.
- iv. Leases do not receive value for this attribute.

c. Assessment

This value function was assessed using the Midpoint Method, resulting in the curve below.

d. Model Output

- i. The value function provides the military value of the installation with regards to the Gross Buildable Acres score as measured by the number of buildable acres across the land use types described above.
- ii. Scores are normalized on a scale of zero to ten based on the value function.
- iii. This value function shows a concave curve, which equates to increasing returns to scale with diminishing marginal values. When acreage exceeds 2000 buildable acres, the military value tapers off at an increasing rate, as this approximates the ability to station numerous heavy brigades; beyond this point, significant additional constraints will limit the installation's ability to absorb forces.

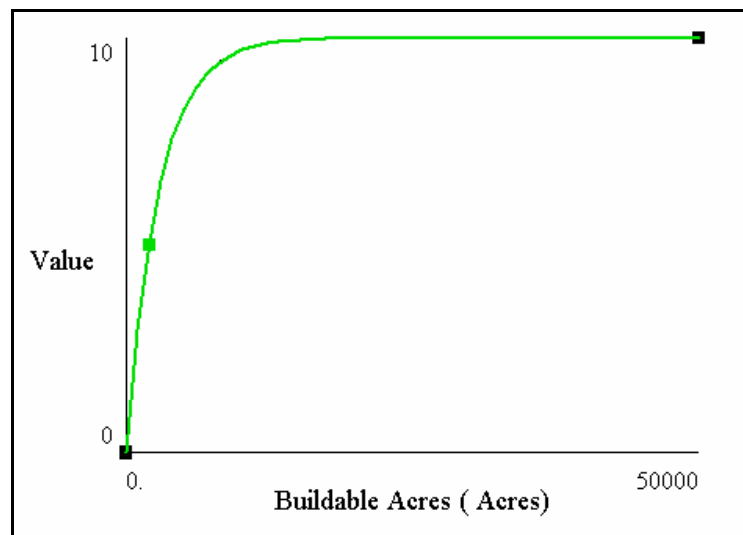


Figure C1. Sample buildable acres score.

Appendix D: Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion

Notes:

Stationing Action Required Facility Types—Facilities required for the sample stationing action;

Data Call LUC—Applicable Data Call Land Use Code for the Stationing Action Required Facility Types;

LUC (Primary, Secondary & Alternative)—Equivalent MPI (Army Master Planning) Land Use Codes;

14183	BN HQ Bldg
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-- Facility Category Code and Title for sample stationing action facility;

All FCGs and FCCs listed under “Recommended FCGs & FCCs,” are assumed to be convertible at less than 50% of the new construction cost for the required stationing action facility category code given their similarity of characteristics and function, determined solely on the basis of FCG and FCC assignment.

Unit Costs are taken from “Facilities Unit Costs – Military Construction, PAX Newsletter No. 3.2.2 – 09 January 2004. These costs reflect an escalation factor valid to 01 October 2006. Where Unit Costs were not listed in this resource for specific FCCs, they were derived through comparison with unit cost data from Unified Facilities Criteria (UFC) 3-701-03, *DoD Facilities Pricing Guide*, Version 5, February 2003, as noted following:

\$142.00	SF
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-- Unit Cost assigned from equivalent FCC established by comparison of UFC FACs and DA Pam FCCs. Example: FCC 61070 = FAC 6100, so the unit cost for FCC 61050 was assigned to FCC 61070;

\$142.00	SF
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-- Unit Cost assigned from comparison of FAC Unit Costs. Example: FAC Unit Costs for 6100 and 1431 were equal, so FCC Unit cost of \$142/SF assigned to FCC 15610;

\$142.00	SF
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-- FCC Unit Costs estimated based on inflating FAC unit costs by a factor of 5.91%. Percentage inflation based on inflation cost for similar facilities. Facility types evaluated: 21410, 21407, 21910, 21610, 21435 & 21632.

Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion															
TABS		Recommended LUCs, FCGs, and FCCs													
Stationing Action Rqd Facility Types	Data Call LUC	Land Use Code (LUC)			Real Property Management, DA PAM 415-28					Unit Cost					
		Primary	Secondary	Alternative											
					Facility Category Group (FCG)		Facility Category Code (FCC)		\$/UM	UM					
HQ & Admin Admin	Administrative	Administrative			F14182	Headquarters Buildings, Brigade	14182	BDE HQ Bldg	\$160.00	SF					
					F14183	Headquarters Buildings, Battalion	14183	BN HQ Bldg	\$153.00	SF					
					F14110	Operations Buildings, Airfield	14110	Afld Ops Bldg	\$221.00	SF					
					F14112	Aviation Unit Operations Buildings	14112	Avn Unit Ops	\$155.00	SF					
					F14114	CIDC Facilities	14114	CIDC Fld Ops Bd	\$146.00	SF					
					F14185	Headquarters Buildings, Company	14185	Co HQ Bldg	\$145.00	SF					
					F15600	Cargo Handling Buildings	15610	Cargo Handg Fac	\$142.00	SF					
					F60000	Administrative Facilities	61050	Admin Gen Purp	\$142.00	SF					
							61070	Red Cross Bldg	\$142.00	SF					
							61075	Courtroom	\$142.00	SF					
							F74033	Community Service Centers	74033	ACS Ctr	\$147.00	SF			
					Org Classroom Gen Instr Bldg Applied Instr Bldgs	Barracks Training Area /Ranges	Barracks	Administrative	Training Area /Ranges	F17119	Organizational Classroom	17119	Org Classroom	\$129.00	SF
										F17115	Band Training Facilities	17115	Band Train Bldg	\$129.00	SF
F17120	General Instruction Buildings	17120	Gen Inst Bldg	\$158.00						SF					
F17131	Compact Item Repair Instructional Facilities	17131	Comp Rep Inst	\$122.00						SF					
F17132	General Item Repair Instructional Facilities	17132	Gen Rep Inst	\$114.00						SF					
F17133	Vehicle Maintenance Instructional Buildings	17133	Veh Maint Inst	\$147.00						SF					
F17134	Aircraft Maintenance Instructional Buildings	17134	Acft Maint Inst	\$200.00						SF					
F17135	Laboratory Instructional Buildings	17135	Lab Inst	\$193.00						SF					
F17136	Automation-Aided Instructional Buildings	17136	Auto-Aid Inst	\$178.00						SF					
F17137	Material Handling Instructional Buildings	17137	Mat Hndl Inst	\$82.00						SF					
F17138	Limited Use Instructional Buildings	17138	Limit Use Inst	\$82.00						SF					
F17140	Training Centers-Reserves	17140	USAR Ctr	\$140.00						SF					
F17142	Training Centers-ARNG/USAR	17142	ARNG/USAR Ctr	\$140.00						SF					
F17180	Training Centers-National Guard	17180	ARNG Armory	\$140.00						SF					
Veh Maint	Industrial	Industrial			F21410	Vehicle Maintenance Shops	21410	Veh Maint Shop	\$152.00	SF					
							21411	Repair Bays	\$152.00	SF					
							21412	Maint Storage	\$152.00	SF					
							21414	Gen Item Repair	\$152.00	SF					
							21415	Comp Item Rep	\$152.00	SF					
							21416	Msl Maint Fac	\$152.00	SF					
							21417	Veh Pnt/Prep Sh	\$152.00	SF					
					F21110	Aircraft Maintenance Facilities	21110	Ac Maint Hgr	\$172.00	SF					
							21114	Ac Maint Bay	\$172.00	SF					
							21116	Hgr Shop Space	\$172.00	SF					
							21117	Avion Mnt Shp I	\$172.00	SF					
							21120	Ac Comp Maint	\$129.00	SF					
							21130	Ac Paint Shop	\$237.00	SF					
							21140	Ac Eng Tst Fac	\$146.00	SF					
					F21407	National Guard Maintenance Facilities	21407	ARNG Veh Maint	\$146.00	SF					
					F21409	Army Reserve Maintenance Facilities	21409	USAR Veh Maint	\$146.00	SF					
					F21885	Vehicle Maintenance DOL/DPW	21835	Repair Bays DOL	\$120.00	SF					
							21855	Veh Pnt/Prp DOL	\$120.00	SF					
							21882	Gen Itm Rep DOL	\$120.00	SF					
							21885	Mnt Gen Purp	\$120.00	SF					
							21887	Com Itm Rep DOL	\$120.00	SF					
					F21900	Installation Maintenance/Repair Facilities	21910	Eng/Housing Mnt	\$114.00	SF					
		21925	Engr Maint Fac	\$114.00	SF										
F73010	Fire and Rescue Facilities	73010	Fire Station	\$172.00	SF										

Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion											
TABS		Recommended LUCs, FCGs, and FCCs									
Stationing Action Rqd Facility Types	Data Call LUC	Land Use Code (LUC)			Real Property Management, DA PAM 415-28					Unit Cost	
		Primary	Secondary	Alternative							
					Facility Category Group (FCG)		Facility Category Code (FCC)		\$/UM	UM	
Hardstand	Industrial	Industrial			F85210	Parking-Organizational	85210	Org Park Surfac	\$48.00	SY	
							85211	Org Park Unsurf	\$7.00	SY	
					F85215	Parking-Nonorganizational	85215	Nonorg Pk Surfa	\$48.00	SY	
							85216	Nonorg Pk Unsur	\$7.00	SY	
					F11310	Parking, Fixed Wing Aircraft	11310	FW Pk Aprn Surf	\$97.00	SY	
							11311	FW Pk Aprn Uns	\$7.00	SY	
					F11320	Parking, Rotary Wing Aircraft	11320	RW Pk Aprn Surf	\$97.00	SY	
							11321	RW Pk Aprn Uns	\$7.00	SY	
					F11330	Maintenance Aprons, Aircraft	11330	Ac Mnt Apr Surf	\$97.00	SY	
							11331	Ac Mnt Apr Uns	\$7.00	SY	
					F11340	Access Aprons, Hangar	11340	Hgr Acc Apr Sur	\$97.00	SY	
							11341	Hgr Acc Apr Uns	\$7.00	SY	
					F11350	Holding Aprons, Aircraft	11350	Ac Hld Aprn Sur	\$97.00	SY	
							11351	Ac Hld Aprn Uns	\$7.00	SY	
F11370	Wash Aprons, Aircraft	11370	Ac Wsh Aprn Sur	\$97.00	SY						
		11371	Ac Wsh Aprn Uns	\$7.00	SY						
F11380	Loading Aprons, Aircraft	11380	Ac Ld Aprn Surf	\$97.00	SY						
		11383	Ac Ld Aprn Uns	\$7.00	SY						
Avn Maint	Airfield Operations	Industrial			F21110	Aircraft Maintenance Facilities	21110	Ac Maint Hgr	\$172.00	SF	
							21114	Ac Maint Bay	\$172.00	SF	
							21116	Hgr Shop Space	\$172.00	SF	
							21117	Avion Mnt Shp I	\$172.00	SF	
							21120	Ac Comp Maint	\$129.00	SF	
							21130	Ac Paint Shop	\$237.00	SF	
							21140	Ac Eng Tst Fac	\$146.00	SF	
Barracks- Perm	Barracks	Barracks	Administrative		F72100	Unaccompanied Personnel Housing, Enlisted Facilities	72111	Enlisted UPH	\$153.00	SF	
					F72120	Unaccompanied Personnel Housing, Enlisted Transient	72120	Transient UPH	\$150.00	SF	
					F72170	Unaccompanied Personnel Housing, SR NCO Facilities	72170	UPH Sr NCO	\$150.00	SF	
					F72400	Unaccompanied Personnel Housing, Officer Facilities	72410	UOQ Military	\$150.00	SF	
					F72411	Unaccompanied Personnel Housing, Transient Officer Facilities	72411	UOQ Transient	\$150.00	SF	
					F72412	Annual Training Officers Quarters	72412	AT Off Qtrs	\$150.00	SF	
					F74032	Guest House Facilities	74032	Guest House	\$143.00	SF	
Barracks- Student Barracks-BT	Barracks	Barracks	Administrative		F72181	Basic Training Barracks Facilities	72181	Trainee Bks	\$136.00	SF	
					F72114	Annual Training/Mobilization Barracks Facilities	72114	AT Enl Barracks	\$136.00	SF	
							72115	Mob Enl Brks	\$136.00	SF	
					F72121	Enlisted UPH, Student	72121	Trans UPH AIT	\$153.00	SF	
		72122	Trans UPH AST	\$153.00	SF						
Dining Facilities	Barracks	Barracks			F72200	UPH Dining Facilities	72210	Dining Facility	\$248.00	SF	
							74046	Consol Open Din	\$231.00	SF	
					F74046	Open Dining Facilities	74047	Enl Open Dining	\$231.00	SF	
							74048	Off Open Dining	\$231.00	SF	
Fitness Facilities	Barracks	Barracks	Community		F74028	Fitness Facilities	74028	Phys Fit Ctr	\$167.00	SF	

Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion											
TABS		Recommended LUCs, FCGs, and FCCs									
Stationing Action Rqd Facility Types	Data Call LUC	Land Use Code (LUC)			Real Property Management, DA PAM 415-28					Unit Cost	
		Primary	Secondary	Alternative	Facility Category Group (FCG)		Facility Category Code (FCC)		\$/UM	UM	
Chapels	Barracks	Barracks	Community		F73017	Religious Facilities	73017	Chapel	\$174.00	SF	
							73018	Relig Ed Fac	\$142.00	SF	
							73019	Fam Life Ctr	\$142.00	SF	
Child Dev Ctrs	Community	Community			F74014	Child Development Centers	74014	Child Dev Ctr	\$169.00	SF	
General Purpose Warehouse	Industrial	Industrial			F44210	Enclosed Storage, Installation	44220	Storage Gp Inst	\$87.00	SF	
							44271	Hsg Furn Str	\$87.00	SF	
							44288	Inst Str Other	\$87.00	SF	
					F14133	Storage Support Facilities	14133	Ship/Recv Fac	\$87.00	SF	
							14140	Care/Pres Shop	\$87.00	SF	
							14150	Box/Crate Shop	\$87.00	SF	
							14160	Block/Band Fac	\$87.00	SF	
							44224	Org Str Bldg	\$73.00	SF	
					F44228	Hazardous Storage, Installation	44228	Haz Mat Str Ins	\$118.00	SF	
							44240	Flam Mat Str In	\$118.00	SF	
							44260	Radioact Wh Ins	\$118.00	SF	
					F44230	Humidity Controlled Storage, Installation	44230	Cont Hum Wh In	\$81.00	SF	
							21840	RR EQ/EN Maint	\$114.00	SF	
							21850	Battery Shop	\$114.00	SF	
							21872	QA/CAL Gen Purp	\$114.00	SF	
							21879	Proc Maint Fac	\$114.00	SF	
					F21800	DOL/Procured Items & Equipment Maintenance Shops	21881	ABN EQ/Para Rep	\$163.00	SF	
							44110	Storage Gp Dep	\$87.00	SF	
							44182	Veh St Bd Dep	\$87.00	SF	
					F44130	Humidity Controlled Storage, Depot	44130	Cont Hum Wh Dep	\$81.00	SF	
F44135	Hazardous Storage, Depot	44135	Haz Mat Str Dep	\$123.00	SF						
		44150	Flam Mat Str D	\$118.00	SF						
		44160	Radioact Wh Dep	\$118.00	SF						

Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion											
TABS		Recommended LUCs, FCGs, and FCCs									
Stationing Action Rqd Facility Types	Data Call LUC	Land Use Code (LUC)			Real Property Management, DA PAM 415-28					Unit Cost	
		Primary	Secondary	Alternative						\$/UM	UM
					Facility Category Group (FCG)		Facility Category Code (FCC)				
Industrial	Industrial	Industrial			F22100	Aircraft Production Facilities	22110	Ac Eng Assem Pt	\$157.00	SF	
							22120	Airframe Assem	\$157.00	SF	
							22122	Acft QA/CAL Fac	\$157.00	SF	
					F22200	Guided Missile Production Facilities	22210	Gm Assem Pt	\$175.00	SF	
							22220	Gm Hand/Lch Pt	\$175.00	SF	
							22228	Msl QA/CAL Fac	\$175.00	SF	
					F22400	Tank/Automotive Production Facilities	22410	Cbt Veh Assem	\$175.00	SF	
							22412	Eng Test Fac	\$91.00	SF	
							22416	Heat Treat Shop	\$91.00	SF	
							22422	Plating Shop	\$91.00	SF	
							22430	Machine Shop	\$91.00	SF	
							22434	T/A QA/CAL Fac	\$91.00	SF	
							22510	Sm Arms Plant	\$91.00	SF	
					F22500	Weapons Production Facilities	22520	Light Gun Plant	\$91.00	SF	
							22525	Forge Shop	\$91.00	SF	
							22530	Heavy Gun Plant	\$91.00	SF	
							22532	Foundry	\$91.00	SF	
							22535	Welding Shop	\$91.00	SF	
							22537	Mach Shop Weap	\$91.00	SF	
							22548	Wpn QA/CAL Prod	\$91.00	SF	
					F22600	Ammunition Production Facilities	22610	Bag Chg Fil Pt	\$155.00	SF	
							22612	Acid Mfg Plant	\$155.00	SF	
							22614	Ld Azide Mfg Pt	\$155.00	SF	
							22616	Explos Mfg Pt	\$155.00	SF	
							22618	Cbr Plant	\$155.00	SF	
							22620	Case Ohaul & Tk	\$155.00	SF	
							22622	Pyro Production	\$155.00	SF	
							22624	Mtl Parts Prod	\$155.00	SF	
							22625	Sm Cal Ld <40mm	\$155.00	SF	
							22626	Bomb He Fil Pt	\$155.00	SF	
							22628	Mtl Parts Ld Pt	\$155.00	SF	
							22630	Ld Pt 40-75mm	\$155.00	SF	
							22632	Ammo Foundry	\$155.00	SF	
							22635	Ld Pt 76-120mm	\$155.00	SF	
							22638	Ammo Qa/Cal Pro	\$155.00	SF	
							22640	Ld Pt >120mm	\$155.00	SF	
							22645	Lg Rkt Mtr Ld	\$155.00	SF	
							22650	Md Rkt Mtr Ld	\$155.00	SF	
							22655	Cast He Fil Pt	\$155.00	SF	
							22660	Sp Weap Plant	\$155.00	SF	
							22665	Ammo Washout	\$155.00	SF	
							22670	Case Fil Plant	\$155.00	SF	
							22680	Propellant Pt	\$155.00	SF	
					F22800	Miscellaneous Production Facilities	22810	Lth/Tex/Clth Pt	\$162.00	SF	

Unit Footprint Facility Requirements and Potential FCGs/FCCs for Conversion											
TABS		Recommended LUCs, FCGs, and FCCs									
Stationing Action Rqd Facility Types	Data Call LUC	Land Use Code (LUC)			Real Property Management, DA PAM 415-28					Unit Cost	
		Primary	Secondary	Alternative							
					Facility Category Group (FCG)	Facility Category Code (FCC)				\$UM	UM
Depot Maintenance	Industrial	Industrial			F14129	Training Aids Spt Center	14129	Tng Aids Ctr		\$121.00	SF
					F21210	Guided Missile Maintenance Facilities, Depot Level	21210	Gm Mnt Fac Dep		\$163.00	SF
							21220	Gm Lch Eq Dep		\$163.00	SF
							21435	Maj End Itm Reb		\$152.00	SF
					F21440	Depot Maintenance/Rebuild Shops	21440	Comp Reb Dep		\$152.00	SF
							21441	Veh Mnt Fac, Dep		\$152.00	SF
							21445	T/A Pts Str Dep		\$152.00	SF
							21458	Stm Cln Bld Dep		\$152.00	SF
							21462	Stm Cln Fac Dep		\$152.00	SF
							21465	Drum Recon Plt		\$152.00	SF
					F21500	Depot Weapons Maintenance Shops	21510	Sm Arms Rep Dep		\$133.00	SF
							21512	Weap Demil Dep		\$913.00	SF
							21520	Lt Gun Depot		\$133.00	SF
							21522	Wpn Qa/Cal Dep		\$133.00	SF
							21530	Hvy Gun Depot		\$133.00	SF
							21540	Sp Weap Depot		\$204.00	SF
							21545	Wpns Repair fac		\$133.00	SF
					F21600	Depot Ammunition Maintenance Facilities	21610	Ammo Reno Depot		\$134.00	SF
							21612	Ammo Surv Dep		\$151.00	SF
							21620	Rkt Ohaul Depot		\$151.00	SF
							21622	Exp Rec/Ser Dep		\$151.00	SF
							21632	Ammo Demo Fac		\$151.00	SF
							21640	Dun Bldg Depot		\$151.00	SF
							21642	Comp Clean Dep		\$151.00	SF
							21650	Ammo Qa/Cal Dep		\$151.00	SF
					F21700	Communications /Electronics Repair Shops, Depot	21660	Ammo Mnt Fac		\$151.00	SF
							21840	RR EQ/EN Maint		\$151.00	SF
							21850	Battery Shop		\$114.00	SF
							21872	QA/CAL Gen Purp		\$114.00	SF
							21879	Proc Maint Fac		\$114.00	SF
					F21800	DOL/Procured Items & Equipment Maintenance Shops	21881	ABN EQ/Para Rep		\$114.00	SF
							21840	RR EQ/EN Maint		\$114.00	SF
							21850	Battery Shop		\$114.00	SF
							21872	QA/CAL Gen Purp		\$114.00	SF
							21879	Proc Maint Fac		\$114.00	SF
										21881	ABN EQ/Para Rep

Appendix E: TABS Land Use Compatibility Matrix

Land uses are listed in order of magnitude required for TABS UA footprints.	TABS LUC	Administrative	Barracks	Community	Medical	Industrial	Airfield Operations	Family Housing	Outdoor Recreation	Training Area/Ranges	Waterfront Operations	Undetermined Use
Headquarters and general office buildings, classroom training, and laboratories.	Administrative											
Unaccompanied personnel housing, dining, and associated supporting facilities.	Barracks											
Base supporting organizations such as exchanges, commissaries, security police, education facilities, etc.	Community											
Medical, hospital and dental clinic uses.	Medical											
Central utility plants, equipment/vehicle maintenance and production, supply and storage, and industrial type RDT&E facilities.	Industrial											
Airfield pavements and lighting, air operations facilities, and supporting facilities such as aircraft maintenance hangars and shops.	Airfield Operations											
Family dwellings, dependent schools, and associated supporting facilities.	Family Housing											
Outdoor recreation such as ball fields, running tracks, and golf courses.	Outdoor Recreation											
Individual and unit training and range facilities, maneuver land, and weapon impact areas. Also includes acreage for RDT&E range operations.	Training Area/Ranges											
Pier/wharf operations, ship maintenance or production, and associated supporting facilities.	Waterfront Operations											
No other primary use and for which any use may be appropriate	Undetermined Use											

Positive Compatibility Relationship

Neutral Compatibility Relationship

Negative Compatibility Relationship



DETERMINING A REHABILITATION CONSTRUCTION STANDARD FACTOR FOR COBRA

MAJ David A. Smith

1. Purpose: Determine the cost to rehabilitate existing military construction in the Cost of Base Realignment Actions (COBRA) model. Currently, the algorithm determines the cost for new construction and then multiplies the cost by a factor of 0.75 to arrive at a value for facility rehabilitation (Congress caps a rehabilitation at 75% of military construction (MILCON)). Intuitively this number seems too high and does not accurately reflect the potential savings from rehabilitating buildings. The purpose of this report is to develop a more accurate factor. Based on the information provided below, .47 or 47% is recommended as the new planning factor.

2. References:

- a. Appendix F, Building Systems Work Breakdown Structure (WBS), from TM 5-800-4, Programming Cost Estimates for Military Construction and the
- b. The Army Installation Status Report (FY 2002).

3. Definitions:

- a. Substructure – Includes all work below floor construction (usually slab on grade) and the enclosing horizontal and vertical elements required to form a basement, together with the necessary mass excavation and backfill.
- b. Superstructure – Includes all structural slabs, decks, and supports within the basements and above grade. Structural work includes both horizontal items and vertical structure components. Exterior load bearing walls are not included in the system.
- c. Roofing – Includes all waterproof roof coverings and insulation, together with skylights, hatches, ventilators, and all required trim. In addition to roof coverings, roofing includes all waterproof membrane and traffic toppings over below grade enclosed areas, balconies, etc.
- d. Exterior Closure – Consists of the exterior facing of the facility including all vertical and horizontal exterior closure features excluding the roof.
- e. Interior Closure – Construction inside the exterior wall or exterior skin. It does not include interior structural walls.
- f. Interior Finishes – Finishes applied to interior surfaces, including the interior skin of exterior walls.
- g. Specialties – Specialty items permanently fixed in place.
- h. Plumbing – Includes all water supply and waste items within the building.

- i. Heating, Ventilating, and Air Conditioning (HVAC) – Includes all equipment, distribution systems, controls, and energy supply systems required by HVAC systems.
- j. Special Mechanical – Includes standard fire protection and suppression systems.
- k. Electrical – Includes electric power and lighting.
- l. Special Electrical – Includes provisions for communications, security, and alarm systems.
- m. Equipment – Fixed and moveable equipment.
- n. Conveying Systems - Includes elevators, escalators, pneumatic tube systems, conveyors, chutes, and others.
- o. Amber Building – Army term for a building that will impair mission performance.
- p. Red Building – Army term for a building that will significantly impair mission performance.

4. Assumptions:

- a. Since the analysis uses data from the Army, I assume that installations in the other Services have buildings with similar Building System Work Breakdown Structure (COBRA is a joint analysis tool).
- b. I also assumed that the overall status of the other Services is similar to the overall status of all buildings in the Army.
- c. A building in a “red” condition only has an adequate substructure, superstructure, and exterior closure. All other parts of the structure need to be replaced.
- d. An “amber” condition has the same adequate systems as a “red” building, but it also has adequate roofing, plumbing, HVAC, and electrical.

5. Background:

- a. The Building Work Breakdown Structure (WBS) divides a building into 14 different “systems”. Each type of building has a different set of ratios of WBS system costs to facility costs. For example, the substructure of an administrative building has a ratio of 11.00, which means the substructure is 11% of the building’s total cost. The WBS in TM 5-800-4 contains 32 different building types. Thirteen of the 32 facility types matched the list of facilities that are included in the COBRA model. The list of COBRA facility types is found in Appendix 1. These 13 facility types make up 23.79% of the total DoD PRV. There are 398 other facility types that make up the other 76.21 % of PRV, so the

13 facility types chosen for analysis make up a large part of the total. The only facility not included in the WBS that has a significant PRV percentage is family housing with a PRV percentage of 7.41%.

b. The rehabilitation factor was determined using a two-step process. First, a factor to rehabilitate a “red” building for each facility type was calculated. Red buildings were assumed to have an adequate substructure, superstructure, and exterior closure. The cost factor was derived by adding the 11 system ratios together produced a percentage of facility cost required for repairing or replacing the remaining systems. A copy of the spreadsheet used to calculate the factors can be found in Appendix 1. The red factors are listed in Table 1.

Facility Type	Red Factor (%)
Administration Facility	59.28
Applied Instruction Building	67.87
Enlisted Barracks	72.10
Brigade Headquarters	59.24
Battalion Headquarters	59.08
General Instruction Building	63.65
General Purpose Warehouse	54.82
Physical Fitness Center	60.22
Aircraft Maintenance Hanger	60.80
Dining Facility	80.01
Health Clinic	87.28
Reserve Center	65.86
GS Vehicle Maintenance Shop	47.35

Table 1

Second, a similar method was used to find a factor for amber buildings. In addition to the adequate systems in a red building, an amber building also has adequate roofing, plumbing, HVAC, and electrical systems. The amber cost factor was derived by adding the remaining seven system ratios to produce a percentage of facility cost required to repair or replace the remaining systems derived the amber cost factor. The amber factors can be found in Table 2.

Facility Type	Amber Factor (%)
Administration Facility	28.80
Applied Instruction Building	27.08
Enlisted Barracks	39.30
Brigade Headquarters	26.19
Battalion Headquarters	24.07
General Instruction Building	29.48
General Purpose Warehouse	13.12
Physical Fitness Center	29.90
Aircraft Maintenance Hanger	27.93
Dining Facility	16.73
Health Clinic	12.41
Reserve Center	32.79
GS Vehicle Maintenance Shop	18.47


Table 2.

c. Because the COBRA model uses one factor to determine the costs to rehabilitate a building, we needed to reduce 26 different values down to 1. Calculating an overall red factor and amber factor for all buildings/facilities did this. Appendix 1 has the percent DoD PRV for all of the facilities included in the COBRA model. The total percent DoD PRV of the 13 building chosen for analysis was 23.79. To determine the red factor, a weighted average red factor was calculated by summing the products of the individual building red factors and the individual building percent DoD PRV, then dividing that sum by 23.79. The same method was used to find the amber factor. The red factor is 64.31 while the amber factor is 29.46 (see Appendix 1, weighted average).

d. The second step was to determine a single factor for rehab construction. COBRA does not delineate between red and amber buildings. The Army's Installation Status Report (ISR) was used to determine the weighted averages for the total square footage of Army Facilities that are considered red and amber (see Appendix 2). All of the possible square footage of red classified buildings was summed and divided by the total square footage of buildings in the Army. The same method was used to find the percentage of amber buildings. Twenty-four percent of the Army's square footage is red and 43% is amber. The remaining facilities are green and do not require rehab.

e. There are several concerns with using ISR data. First, the data is from fiscal year 2002, so may not include facilities upgrades over the past two years. Second, the ISR includes only buildings reported in units of square feet. Barracks and family housing are reported using different units. To account for these facilities a one to one ratio was used. This should produce a higher standard factor and simplify the calculation. The final factor is the average of the two factors. This gives a value of .46885, or 0.47.

6. Recommendation: Recommend that the JPAT change the rehab standard factor from 0.75 to 0.47. The 0.75 value was based on a statutory requirement with no structural analysis behind it. The 0.75 value is too conservative. If we use it, then the COBRA model could lose the potential savings involved in rehabbing buildings. The 0.47 value was determined using the most up to date technical manual published by the Army Corps of Engineers. The ISR data shows that using a one to one ratio is a conservative estimate. Finally, the 0.47 value is close to the 0.4 value recommended by the contractor R&K that resulted from their analysis.


DAVID A. SMITH
MAJ, AR
ORSA Analyst

Appendix 1:

Building Systems Work Breakdown Structure

WBS Description	ADMIN	AIB	BARRCK	BRDGHQ	BTTNHQ	CLSRM	GPWH	GYM	HANGR	KIT/DN	MEDCL	RESREV	SHOPGS
FAC	6100	1712	7210	6102	6101	1711	4411	7421	2111	7220	5500	1714	2141
% DoD PRV	4.9	0.99	6.26	0.76	1.41	0.97	0.88	0.68	2.21	0.89	0.46	1.94	1.44
Cat. Code	61050	17130	72211	61011	61012	17120	44110	740034	21110	72210	55030	17140	21420
1 Substructure	11.00	6.73	4.5	7.13	6.69	7.89	9.5	5.22	7.2	11.06	4.59	10.39	13.46
2 Superstructure	17.94	12.1	12.7	14.37	10.7	12.91	19.22	13.36	16.16	3.34	3.17	9.85	28.74
3 Roofing	4.06	5.23	2.3	3.2	2.83	5.56	12.1	5.49	13.88	3.63	2.28	10.19	5.75
4 Exterior closure	11.78	13.3	10.7	19.26	22.2	15.55	16.46	21.2	15.84	5.59	4.96	13.9	14.39
5 Interior construction	13.10	11.18	18.1	7.36	17.35	12.94	6.05	2.28	12.06	2.29	3.61	19.02	5.6
6 Interior finishes	9.73	10.73	18.6	10.83	5.87	8.98	1.82	12.9	7.86	12.84	3.57	11.32	2.13
7 Specialties	0.89	0.38	0	1.03	2.39	4.06	1.81	3.9	1.44	0.61	1.13	1.14	3.31
8 Plumbing	3.10	3.3	17.3	5.41	3.31	3.43	1.52	3.57	3.64	22.15	5.59	10.98	3.22
9 HVAC	13.86	8.28	5.2	17.71	17.62	15.45	16	11.42	6.59	21.12	4.7	1.76	7.89
10 Special mechanical	0.00	1.5	2.1	0	1.85	1.57	2.33	0	2.5	0	0	0	2.12
11 Electrical	9.46	23.98	8	6.73	8.46	9.73	12.08	9.84	8.76	16.38	62.3	10.14	9.25
12 Special electrical	3.48	3.29	0.5	6.97	0.67	1.93	1.11	0.93	2.32	0.99	2.4	1.31	1.02
13 Equipment	1.60	0	0	0	0	0	0	9.89	1.75	0	1.7	0	3.12
14 Conveying system	0.00	0	0	0	0	0	0	0	0	0	0	0	0
	100	100	100	100	99.94	100	100	100	100	100	100	100	100
RED	59.28	67.87	72.10	59.24	60.41	63.65	54.82	60.22	60.80	80.01	87.28	65.86	43.41
AMBER	28.80	27.08	39.30	26.19	28.19	29.48	13.12	29.90	27.93	16.73	12.41	32.79	17.30
	290.47	67.1913	451.346	45.0224	85.1781	61.741	48.24	40.95	134.368	71.209	40.149	127.7684	62.5104
	141.12	26.8092	246.018	19.9044	39.7479	28.596	11.55	20.332	61.7253	14.89	5.7086	63.6126	24.912

Weighted Average

64.15

29.63

46.89

Appendix 2- ISR Extract

FCG_Desc	FCG	Measure	Total_Assets	Red_Assets	Pct_Red	Amber_Assets	Pct_Amber
Information Sys Fac	F13115	Square Feet	5788569.84	1044584	18	2870951.54	50
Air Nav Aids Buildings	F13300	Square Feet	228784	42775	19	94807	41
Airfield Opns Buildings	F14110	Square Feet	631044	80408	13	284679	45
Aviation Unit Opns Bldgs	F14112	Square Feet	544180	150825	28	274207	50
CIDC Facilities	F14114	Square Feet	540312	120628	22	230862	43
Training Aids Spt Cntr	F14129	Square Feet	1367829	268802	20	735287	54
Storage Spt Facilities	F14133	Square Feet	4357338.02	494950.02	11	1950664	45
EOC / SCIF Facilities	F14161	Square Feet	1201805.54	159096	13	566641.54	47
Production Plt Spt Facs	F14169	Square Feet	22912	1890	8	843	4
Brigade HQ Bldgs	F14182	Square Feet	3294656.5	468890	14	1760674.5	53
Battalion HQ Buildings	F14183	Square Feet	7434357.3	1657938.3	22	3561500	48
Company HQ Buildings	F14185	Square Feet	19421984.08	4002069.5	21	9897604.58	51
Ship Opns Bldgs	F14310	Square Feet	199569.69	24105.38	12	65753	33
Band Training Facilities	F17115	Square Feet	491765	187789	38	244255	50
Organizational Classroom	F17119	Square Feet	2826122	466467	17	1263331	45
Gen Instruct Buildings	F17120	Square Feet	13779138.66	2878402	21	6149747.66	45
Indoor Firing Ranges	F17121	Square Feet	508839	283805	56	89239	18
Physical Educ Trng Bldgs	F17125	Square Feet	583222	514234	88	11888	2
Compact Item Rpr Instruct	F17131	Square Feet	770560	12419	2	487070	63
Gen Item Repair Instruction	F17132	Square Feet	777994	214645	28	418862	54
Vehicle Maint Instruction	F17133	Square Feet	1904861	384884	20	770474	40
Aircraft Maint Instruction	F17134	Square Feet	874910	6762	1	818282	94
Lab Instruction	F17135	Square Feet	388990	226680	58	124348	32
Automation-Aided Instruct	F17136	Square Feet	1185736	218170	18	593673	50
Material Handling Instruct	F17137	Square Feet	62719	0	0	53945	86
Limited Use Instruction	F17138	Square Feet	2058339	582030	28	694998	34
USAR Center	F17140	Square Feet	22342328.02	5335724.34	24	11736304.15	53
Training Centers - NG/AR	F17142	Square Feet	1791363	222997	12	793849	44
Training Centers - ARNG	F17180	Square Feet	60436931.88	29015541.02	48	23227670.9	38
Simulator Facilities	F17200	Square Feet	3323421.9	377916	11	1552652	47
Aircraft Maint Facilities	F21110	Square Feet	14616429.39	4598087.96	31	6481369.21	44
Guided Missile Maint Bldg	F21210	Square Feet	636139	39029	6	95174	15
Ship Maint Facilities	F21310	Square Feet	170392	23483	14	63709	37
National Guard Maint Fac	F21407	Square Feet	7182865.84	2561208.94	36	2697493	38
Army Reserve Maint Fac	F21409	Square Feet	5388008.29	1713574.2	32	2288067.09	42
Vehicle Maint Shops	F21410	Square Feet	20745647.57	5869218.76	28	9919243.81	48
Depot Maint / Rebid Shops	F21440	Square Feet	4002726.5	337940.5	8	1327510	33
Depot Wpns Maint Shops	F21500	Square Feet	424667	8936	2	196575	46
Depot Ammo Maint Fac	F21600	Square Feet	1120754	223434	20	510329	46
Ammunition Repair/Inst	F21670	Square Feet	21871	17071	78	0	0
Depot Comm - Elect Shops	F21700	Square Feet	2771633	112101	4	1166517	42
DOL/Proc Item & Equip Maint	F21800	Square Feet	1465784	351525	24	417484	28
Vehicle Main DOL/ DEH /DPW	F21885	Square Feet	10495513.88	2285203.88	22	4220976	40
Install Maint/Repair Facs	F21900	Square Feet	5384130.77	865636	16	2948921.77	55
Aircraft Prod Facilities	F22100	Square Feet	1626	1626	100	0	0
Guided Missile Prod Fac	F22200	Square Feet	137495	6439	5	76367	56
Tank / Automotive Prod Fac	F22400	Square Feet	189199	95940	51	10048	5
Wpns Prod Facilities	F22500	Square Feet	2951641	356660	12	2491251	84
Ammunition Prod Fac	F22600	Square Feet	2259408	681501	30	422898	19
Misc Prod Facilities	F22800	Square Feet	92254	7255	8	74469	81
Install Support Prod Bldg	F22960	Square Feet	3786	3281	87	0	0
RDT&E Laboratories	F31000	Square Feet	3712376.23	953279.23	26	1030049	28
Aircraft RDT&E Facilities	F31100	Square Feet	432858	34483	8	380403	88
Missile / Space RDT&E Fac	F31200	Square Feet	1671905	414681	25	840673	50
Tank / Automotive RDT&E Fac	F31400	Square Feet	714854	60234	8	403235	56

MEMORANDUM FOR RECORD

Subject: Determining correlation between installation assessment criteria

Summary: The Military Value Analyzer (MVA) is considering the following installation assessment factors; Construction Area Cost Factor (ACF), Basic Allowance for Housing (BAH), the Cost of Living Index (CLI), and the Locality Pay Percentage (LPP). Since these cost factors are based on installations economic conditions, there could be a relationship between one or more of the factors. TABS can use the correlation coefficients to determine whether two ranges of data move together, that is, whether large values of one set are associated with large values of the other (positive correlation), whether small values of one set are associated with large values of the other (negative correlation), or whether values in both sets are unrelated (correlation near zero).

Since there is a high positive correlation between BAH and CLI and BAH and LPP, TABS could remove CLI and LPP from the model and not lose the representation of these two factors; recommend removal from the MVA.

REFERENCES:

1. The Construction Area Cost Factors were found in the DoD Facilities Pricing Guide dated March 2003.
2. The Basic Allowance for Housing is the rate for an O-3 using the 2004 with dependents rate found on the Per Diem, Travel, and Transportation Committee web page.
3. The Cost of Living Index was for 2002 and found on the American Chamber of Commerce Research Association web page.
4. The Locality Pay Percentages are for 2002 and found on the Office of Management and Budget web page.

ASSUMPTIONS: The data references used in this report come from different years. I assumed that, although the values might change, that the ranges of data would still move together with a similar correlation.

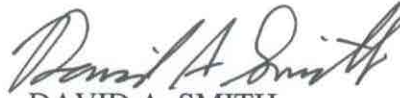
SOLUTION: Using the above-mentioned references we found four ranges of data. We then found 35 common locations that were contained in each data set. These 35 locations became our data points for comparison. The list of data can be found in the attached appendix. We then used the Correlation Data Analysis Tool in Excel to find the correlation coefficient between each of the criteria factors. If there is a high correlation coefficient (~0.80) between the criteria factors then we could eliminate one or more of the factors because they show the same trend and their continued use would be redundant. Table 1 shows the results from the Correlation Data Analysis Tool.

	ACF	BAH	CLI	LPP
ACF	1.00			
BAH	0.63	1.00		
CLI	0.74	0.86	1.00	
LPP	0.43	0.83	0.79	1.00

Table 1. Correlation Coefficients

The results from Table 1 show a strong correlation between the BAH and the CLI and LPP; therefore TABS could limit its review to BAH and still capture the trend in all three factors. BAH is open source data published by DoD. Also, there is a specific BAH rate associated with each installation while CLI rates are associated with metropolitan areas. Most of the LPP rates are the same and only high cost areas, such as New York City, have higher LPP rates. The results from Table 1 show a poor correlation between ACF and the rest of the factors; therefore, we should leave the ACF in the model. The ACF is also open source data published by DoD.

RECOMMENDATION: There is a strong correlation between the BAH and the CLI and LPP and BAH is open source data published by DoD. ACF has a poor correlation between the rest of the factors and it is also open source data published by DoD; therefore I recommend eliminating the Cost of Living Index and the Locality Pay Percentage from the Military Value Assessment Model.


 DAVID A. SMITH
 MAJ, AR
 ORSA Analyst

Appendix A

Metropolitan Area	ACF	BAH	CLI	LPP
MONTGOMERY	0.81	1137	90.8	8.64
PHOENIX	1.00	1197	96.2	8.64
SAN DIEGO	1.17	1882	137.8	12.7
SAN FRANCISCO	1.23	2861	184.1	19.04
LOS ANGELES	1.13	2039	135.2	16.05
COLORADO SPRINGS	1.11	1166	98.2	8.64
DENVER	1.03	1464	102.9	13.34
JACKSONVILLE	0.93	1074	96	8.64
ATLANTA	0.93	1385	97.7	9.74
HONOLULU	1.66	2089	144.5	8.64
CHICAGO	1.29	1872	135.7	14.58
DES MOINES	0.96	1039	91.4	8.64
NEW ORLEANS	0.96	1133	107.1	8.64
BALTIMORE	0.89	1579	93.6	8.64
BOSTON	1.16	2359	135.5	13.57
MINNEAPOLIS	1.11	1503	106.1	11.56
ST LOUIS	1.09	1251	100.7	8.98
BILLINGS	1.12	937	95.3	8.64
OMAHA	0.99	1115	89.2	8.64
LAS VEGAS	1.24	1307	104.8	8.64
ALBUQUERQUE	0.99	1217	99.7	8.64
BUFFALO	1.12	1218	102.3	8.64
NEW YORK CITY	1.49	2240	218.3	15.23
OKLAHOMA CITY	0.91	863	89.3	8.64
PORTLAND	1.06	1205	111.7	11.64
PHILADELPHIA	1.10	1616	120.2	12.11
MEMPHIS	0.92	1176	92.2	8.64
SAN ANTONIO	0.82	1138	85.3	8.64
DALLAS	0.90	1307	98	10.9
EL PASO	0.92	1031	93.1	8.64
SALT LAKE CITY	1.02	1029	99	8.64
RICHMOND	0.91	1170	102	9.67
WASHINGTON	1.00	2006	133.2	11.48
MILWAUKEE	1.08	1208	99.6	10.05
CHEYENNE	1.00	1160	102.7	8.64



DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

SFIM-AEC-TSR

MEMORANDUM FOR HQDA (DASA-IAWILLIAM TARANTINO), 1400 KEY
BOULEVARD, NASH BUILDING, SUITE 200, ARLINGTON, VA 22209

SUBJECT: Transmittal of the Final Values and Supporting Information for the Soil
Resiliency Attribute of the Military Value Index (MVI) for the 2005 Base Realignment
and Closure process

1. References:

a. Memorandum for Record, DAIM-ED, ODEP, 13 July 2004, subject: Concurrence
with 2005 Base Realignment and Closure Military Value (MV) Model attribute.

b. Soil Resiliency Attribute definition, as of 11 Aug 04, for TABS Military Value
Analysis (MVA).

c. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the
Universal Soil Loss Equation, US Department of Agriculture Handbook 703.

d. National Food Security Act Manual, 4th Edition, Part 511, Highly Erodible Land
Determinations.

e. Interactive C-value map at NRCS National Cartography and Geospatial Center

f. Food Security Act of 1985.

g. Food, Agriculture, Conservation; Trade Act of 1990

2. Reference 1a is a concurrence from the Office of the Director of Environmental
Programs for the soil resiliency attribute methodology. Reference 1b provides the
framework and general methodology for the determination of a soil resiliency value. In
general, soil resiliency is derived from the soil's erodibility land class. References 1c,
1d, and 1e provide supporting documentation and data and/or data sources for the
determination of a soil's erodibility land class. References 1f and 1g provide support for
the validity of a soil's erodibility land class by using the land class in support of the US
Department of Agriculture Farm programs.

3. The enclosed spreadsheet (encl 3) lists all Army installations and some additional
other service installations provided by the Total Army Basing Study (TABS) office. Only
those installations with a "Y" in the Range Acreage Reported field and the other service

SFIM-AEC-TSR

SUBJECT: Transmittal of the Final Values and Supporting Information for the Soil Resiliency Attribute of the Military Value Index (MVI) for the 2005 Base Realignment and Closure process

installations had the Highly Erodible Land Class acres reported, with two exceptions. These exceptions are noted in encl 2 (Methods for Highly Erodible Land Class Determination). Some installations in encls 2 and 3 are identified by the word 'Complex' after their traditional name. This indicates that more than one 'traditional' installation is rolled up in their Highly Erodible Land Class determination, e.g., Fort Carson Complex includes Fort Carson proper and Pinon Canyon Maneuver Area. The installations that make up a "Complex" are then listed by their "traditional" name.

4. The data taken directly from the open sources listed in the Soil Resiliency Determination (encl 1), and not changed from the sources, are certified as to the sources. The data derived from data taken from the open sources listed in encl 1 are certified as accurate and correct to the best of my knowledge.

5. A copy of all enclosures, supporting data and documentation will be retained and available through the US Army Environmental Center's Technical Information Center. The US Army Environmental Center POC is Mr. George Teachman, 410-436-1561.

3 Encls
as



TONY R. FRANCIS
Colonel, CM
Commanding

ROADMAP FOR SOIL RESILIENCY ATTRIBUTE DETERMINATION A TECH NOTE

The Soil Resiliency Attribute used in the Military Value Index model is made up of two general classes of data; 1) data attributes that are used to determine a soil mapunit's highly erodible class and 2) the number of acres (or spatial data) of the installation that are in the Not Highly Erodible Land Class.

There are several methods of determining the Highly Erodible Land (HEL) Class for a soilmap unit. Depending on the quality of the existing data used to determine the HEL class, a professional judgment was made as to which method was followed to derive the value used in the Military Value Index. What follows is roadmap of how the number of acres of Not highly erodible land was determined.

a. When available, HEL classification was taken from the NRCS (National Resources Conservation Service) NASIS (National Soil Information System) database. Information on NASIS can be found at <http://nasis.nrcs.usda.gov/>. Attribute data can be downloaded on a soil survey area basis from the NRCS Soil Data Mart at <http://soildatamart.nrcs.usda.gov/>.

b. Spatial data was taken from NRCS maps. For most installations, this consists of SSURGO certified digital maps. SSURGO certification specifies that digital data meet all requirements in the NRCS National Soil Survey Handbook (NSSH). SSURGO certified data is available from the NRCS Soil Data Mart at <http://soildatamart.nrcs.usda.gov/>. Where no SSURGO certified spatial data is available, STATSGO maps (less detail) were used. STATSGO data is available from the NRCS National Cartography and Geospatial Center found at <http://www.ncgc.nrcs.usda.gov/branch/ssb/products/statsgo/>. Where digital maps were not available, NRCS hard copy maps were used. The official copy of the hard copy NRCS maps are available at the NRCS field office(s) serving the area covered by the installation. Alternatively, the hard copy maps are available from the appropriate NRCS State Office. Hard copy maps used in this project were previously obtained from the NRCS and are available in the US Army Environmental Center Technical Information Center library.

In two instances SSURGO level data, while existing, was not available for use in short time frame allowed for the project. However, these two installations are small and/or located in areas unsuited to maneuver training. These are annotated later in this document.

c. When HEL classification was not available, appropriate methodology was followed, and the data required for deriving HEL classification equation values were used from the following sources:

(1) Slope. LS factor from (Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook No. 703.

(2) Climate. R factor from Agricultural Handbook No. 703.

(3) Erosivity. K factor from NASIS.

(4) Water, Wind. T factor from NASIS;

(5) C factor (wind) from interactive C-value map at NRCS National Cartography and Geospatial Center found at

ROADMAP FOR SOIL RESILIENCY ATTRIBUTE DETERMINATION A TECH NOTE

- <http://nm6.ftw.nrcs.usda.gov/website/>. C was then expressed as a percent. E.g. C of 30 from the C-value map would be .30
- (6) I factor (wind) from NASIS as WEI (wind erodibility index)
- d. When deriving HEL class from data, the following formulas were used.
- (1) For Water erosion
 - If $LS > 8T/RK$ then it was designated as Highly erodible land
 - (2) For Wind erosion
 - If $CI/T > 8$ then it was designated as Highly erodible land
- e. Where I felt additional information was warranted to describe the reasoning behind the methodology, I provided extra comments.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HEL Class Determination Method by Installation

Installation: ABERDEEN PROVING GROUND

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

Obtained directly from NASIS database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION
INSTALLATION METHODOLOGY

Installation: ANNISTON ARMY DEPOT

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

Obtained directly from NASIS database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: DESERET CHEMICAL DEPOT

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From UT611 soils database.

Slope Length: From UT611 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From UT611 soils database

I Factor: From UT611 soils database

K Factor: From UT611 soils database

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation Interactive Maps from National Cartography and Geospatial Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for Tooele Area, Utah - Tooele County and Parts of Box Elder, Davis and Juab Counties (NRCS Soil Survey Area Symbol UT611).

Average annual C value is 30 for eastern Tooele County, UT.

The spreadsheet "Tooele HEL Computation – With 30 C Factor" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated in the soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: DUGWAY CHEMICAL DEPOT

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From UT611 soils database.

Slope Length: From UT611 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From UT611 soils database

I Factor: From UT611 soils database

K Factor: From UT611 soils database

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation Interactive Maps from National Cartography and Geospatial Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for Tooele Area, Utah - Tooele County and Parts of Box Elder, Davis and Juab Counties (NRCS Soil Survey Area Symbol UT611).

Average annual C value is 80 for western Tooele County, UT.

Spreadsheet "DUGWAY HEL COMPUTATION WITH 80 C FACTOR" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated in the soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT AP HILL

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT BELVOIR

HEL Class Determination Method:

HEL class was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From Virginia STATSGO tabular data.

Slope Length: Derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From Virginia STATSGO tabular data

I Factor: From Virginia STATSGO tabular data

K Factor: From Virginia STATSGO tabular data

R Factor: From Figure 2-1 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

The above data was retrieved from the NRCS Virginia STATSGO tabular data.

Average annual C Value is 3 for Fairfax County, VA.

Spreadsheet "Belvoir HEL computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. A HEL CLASS (HELCL) field was added as an attribute to the soil data layer covering the installation. The HEL CLASS field was then updated so the appropriate MAPUNIT records were labeled as "Highly erodible land".

Acreage Determination Method:

ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The STATSGO spatial data was obtained from NRCS.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT BENNING

HEL Class Determination Method:

HEL Class obtained from the NRCS HEL Class Report, hardcopy.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT BRAGG

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from Fort Bragg and not SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION
INSTALLATION METHODOLOGY

Installation: FORT BLISS

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

Obtained directly from NASIS database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION
INSTALLATION METHODOLOGY

Installation: FORT CAMPBELL

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

Obtained directly from NASIS database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT CARSON COMPLEX
FORT CARSON
PINON CANYON MANEUVER AREA

HEL Class Determination Method:

HEL Class obtained from NRCS State Office.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands for each installation separately. These layers were then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands for each installation. ArcGIS 8.3 was then used to determine the acreage of each HEL class for each installation. Spatial data obtained from NRCS and is SSURGO certified.

The records for each installation were then rolled up to give a single record for the range complex.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT DIX

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT DRUM

HEL Class Determination Method:

HEL Class obtained NRCS field office.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from Fort Drum and not SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT EUSTIS

HEL Class Determination Method:

HEL class was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From Virginia STATSGO tabular data.

Slope Length: Derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From Virginia STATSGO tabular data

I Factor: From Virginia STATSGO tabular data

K Factor: From Virginia STATSGO tabular data

R Factor: From Figure 2-1 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

The above data was retrieved from the NRCS Virginia STATSGO tabular data.

Average annual C value is 3 for Newport News, VA.

Spreadsheet "Eustis HEL Computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. A HEL CLASS (HELCL) field was added as an attribute to the soil data layer covering the installation. The HEL CLASS field was then updated so the appropriate MAPUNIT records were labeled as "Highly erodible land".

Acreage Determination Method:

ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The STATSGO spatial data was obtained from NRCS.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT GORDON

HEL Class Determination Method:

HEL Class obtained NRCS State Office.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT HOOD

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT HUACHUCA

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT JACKSON

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT LEONARD WOOD

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT SAM HOUSTON COMPLEX
FORT SAM HOUSTON
CAMP BULLIS

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands for each installation separately. These layers were then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands for each installation. ArcGIS 8.3 was then used to determine the acreage of each HEL class for each installation. Spatial data obtained from NRCS and is SSURGO certified.

The records for each installation were then rolled up to give a single record for the range complex.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: LETTERKENNY ARMY DEPOT

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: PICATINNY ARSENAL

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: SCHOFIELD BARRACKS COMPLEX
POHOCKOLUA TRAINING AREA
DILLINGHAM
KAHUKU
KAWAILOA
MAKUA
SCHOFIELD BARRACKS
WHEELER ARMY AIR FIELD

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands for each installation separately. These layers were then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands for each installation. ArcGIS 8.3 was then used to determine the acreage of each HEL class for each installation. Spatial data obtained from NRCS and is SSURGO certified.

The records for each installation were then rolled up to give a single record for the range complex.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT STEWART COMPLEX
FORT STEWART
HUNTER ARMY AIRFIELD

HEL Class Determination Method:

HEL Class obtained from the NRCS HEL Class Report, hardcopy.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from Fort Stewart and not SSURGO certified.

Hunter Army Airfield is in Chatham County, GA. This county is in the Bryan and Chatham Counties, GA Soil Survey. For this survey, NRCS hardcopy maps from the soil survey report were used. Individual delineations were identified as highly erodible, if appropriate. Acreage of highly erodible soils estimated by accepted NCSS¹ practices. In this case, no areas of highly erodible soils were found so no estimation of acres was needed.

¹ NCSS – National Cooperative Soil Survey – a diverse group of federal, state, and local agencies, and private groups that oversees the development of soil survey methodologies and procedures in the United States.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT POLK COMPLEX
FORT POLK
PEASON RIDGE

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from Fort Polk and not SSURGO certified.

Comments: The Fort Polk Complex was all one soil survey, so there was no need to determine HEL acreage by individual installation.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT RUCKER

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: KANSAS ARMY AMMUNITION PLANT

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: RED RIVER ARMY DEPOT

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: PUEBLO CHEMICAL DEPOT

HEL Class Determination Method:

HEL Class obtained from NRCS State Office.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION
INSTALLATION METHODOLOGY

Installation: PINE BLUFF ARSENAL

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

Obtained directly from NASIS database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION
INSTALLATION METHODOLOGY

Installation: REDSTONE ARSENAL

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

Obtained directly from NASIS database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: UNITED STATES MILITARY ACADEMY

HEL Class Determination Method:

HEL Class obtained NRCS field office.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from New York State GIS Clearinghouse and is not SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT LEE

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT MCCOY

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT KNOX

HEL Class Determination Method:

HEL Class obtained directly from NASIS database.

Acreage Determination Method:

For Bullitt County, KY the NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

For Hardin County, KY NRCS hardcopy maps from the Hardin and Larue Counties Soil Survey were used. Individual delineations were identified as highly erodible. Acreage of highly erodible soils estimated by accepted NCSS² practices.

² NCSS – National Cooperative Soil Survey – a diverse group of federal, state, and local agencies, and private groups that oversees the development of soil survey methodologies and procedures in the United States.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT RICHARDSON

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT RILEY

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT SILL

HEL Class Determination Method:

HEL Class obtained NRCS field office electronic Field Office Tech Guide Highly Erodible Land Class Report.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from Fort Sill and not SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: IOWA ARMY AMMUNITION PLANT

HEL Class Determination Method:

HEL Class obtained directly from NASIS database.

Acreage Determination Method:

NRCS hardcopy maps from the Des Moines County Soil Survey were used. Individual delineations were identified as highly erodible. Acreage of highly erodible soils estimated by accepted NCSS³ practices.

³ NCSS – National Cooperative Soil Survey – a diverse group of federal, state, and local agencies, and private groups that oversees the development of soil survey methodologies and procedures in the United States.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: MCALESTER ARMY AMMUNITION PLANT

HEL Class Determination Method:

HEL Class obtained NRCS field office electronic Field Office Tech Guide Highly Erodible Land Class Report.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from NRCS and SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: MILAN ARMY AMMUNITION PLANT

HEL Class Determination Method:

HEL Class obtained directly from NASIS database.

Acreage Determination Method:

NRCS hardcopy maps from the Carroll County Soil Survey were used. Individual delineations were identified as highly erodible. Acreage of highly erodible soils estimated by accepted NCSS⁴ practices.

⁴ NCSS – National Cooperative Soil Survey – a diverse group of federal, state, and local agencies, and private groups that oversees the development of soil survey methodologies and procedures in the United States.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: NTC AND FORT IRWIN

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From soils database.

Slope Length: From soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From soils database

I Factor: From soils database

K Factor: From soils database

R Factor: From Figure 2-3 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation Interactive Maps from National Cartography and Geospatial Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for National Training Center, Fort Irwin, California soil survey.

Average annual C value is 200 for southeastern San Bernardino County, CA.

Spreadsheet "Irwin_hel_computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: TOOELE ARMY DEPOT

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From UT611 soils database.

Slope Length: From UT611 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From UT611 soils database

I Factor: From UT611 soils database

K Factor: From UT611 soils database

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation Interactive Maps from National Cartography and Geospatial Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for Tooele Area, Utah - Tooele County and Parts of Box Elder, Davis and Juab Counties (NRCS Soil Survey Area Symbol UT611).

Average annual C value is 30 for eastern Tooele County, UT.

Spreadsheet "Tooele HEL Computation – With 30 C Factor" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated in the UT611 soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: MARINE CORPS AIR GROUND COMBAT CENTER AT
TWENTYNINE PALMS, CALIFORNIA

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From CA699 soils database.

Slope Length: From CA699 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From CA699 soils database

I Factor: From CA699 soils database

K Factor: From CA699 soils database

R Factor: From Figure 2-3 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for CA699 MARINE CORPS AIR GROUND COMBAT CENTER AT TWENTYNINE PALMS, CALIFORNIA soil survey.

Average annual C value is 200 for southcentral San Bernardino County, CA.

Spreadsheet "29 Palms HEL computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: MARINE CORPS BASE CAMP PENDLETON, CALIFORNIA

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From CA638 soils database.

Slope Length: From CA638 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From CA638 soils database

I Factor: From CA638 soils database

K Factor: From CA638 soils database

R Factor: From Figure 2-3 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for CA638, SAN DIEGO COUNTY AREA, CALIFORNIA soil survey.

Average annual C value is 15 for coastal San Diego County, CA.

Spreadsheet "Pendleton HEL computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: SIERRA ARMY DEPOT

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From CA608 soils database.

Slope Length: From CA608 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From CA608 soils database

I Factor: From CA608 soils database

K Factor: From CA608 soils database

R Factor: From Figure 2-3 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation Interactive Maps from National Cartography and Geospatial Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for CA608, SUSANVILLE AREA, PARTS OF LASSEN AND PLUMAS COUNTIES, CALIFORNIA soil survey.

Average annual C value is 10 for eastern Lassen County, CA.

Spreadsheet "Sierra AD HEL computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: UMATILLA CHEMICAL DEPOT

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: EGLIN AIR FORCE BASE

HEL Class Determination Method:

HEL Class obtained NRCS field office electronic Field Office Tech Guide Highly Erodible Land Class Report.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The spatial data was obtained from NRCS and SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: NAVAL AIR STATION FALLON COMPLEX

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From NV602 and NV770 soils databases.

Slope Length: From NV602 and NV770 soils databases, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From NV602 and NV770 soils databases

I Factor: From NV602 and NV770 soils databases

K Factor: From NV602 and NV770 soils databases

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS databases for NV602, LOVELOCK AREA, NEVADA, PARTS OF PERSHING AND CHURCHILL COUNTIES, NEVADA AND NV770, CHURCHILL COUNTY AREA, NEVADA, PARTS OF CHURCHILL AND LYON COUNTIES soil surveys.

Average annual C value is 50 for Churchill County, NV.

Spreadsheet "NAS Fallon HEL computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils database.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT LEWIS COMPLEX
FORT LEWIS
YAKIMA TRAINING CENTER

HEL Class Determination Method:

HEL Class obtained from NRCS field office for Fort Lewis. HEL class for Yakima Training Center was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From WA681 soils database.

Slope Length: From WA681 soils database, where populated. Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From WA681 soils database

I Factor: From WA681 soils database

K Factor: From WA681 soils database

R Factor: From Figure 2-4 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS databases for WA681, YAKIMA TRAINING CENTER, PARTS OF KITTITAS AND YAKIMA COUNTIES, WASHINGTON soil survey.

Average annual C value 50 is for Yakima/Kittitas Counties, WA.

Spreadsheet "YTC HEL Computations" was used for to determine soil mapunits that fall in the "Highly erodible land" class for YTC. The HEL CLASS field in the MAPUNIT table was then updated soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands for Fort Lewis. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class for Fort Lewis. The spatial data obtained for Fort Lewis was obtained from Fort Lewis and is not SSURGO certified.

Spatial data not needed for Yakima Training Center. Data obtained from NASIS database.

The records for each installation were then rolled up to give a single record for the range complex.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: WHITE SANDS MISSILE RANGE

HEL Class Determination Method:

HEL class was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From New Mexico STATSGO tabular data.

Slope Length: Derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From New Mexico STATSGO tabular data

I Factor: From New Mexico STATSGO tabular data

K Factor: From New Mexico STATSGO tabular data

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

The above data was retrieved from the NRCS New Mexico STATSGO tabular data.

Average annual C value is 120 for WSMR Area.

Spreadsheet "WSMR HEL Computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. A HEL CLASS (HEL) field was added as an attribute to the soil data layer covering the installation. The HEL CLASS field was then updated so the appropriate records were labeled as "Highly erodible land".

Acreage Determination Method:

ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The STATSGO spatial data was obtained from NRCS.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: LUKE AIR FORCE BASE COMPLEX
LUKE AIR FORCE BASE
LUKE AUXILIARY LANDING FIELD
BARRY GOLDWATER BOMBING RANGE

HEL Class Determination Method:

HEL class was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From Arizona STATSGO tabular data.

Slope Length: Derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From Arizona STATSGO tabular data

I Factor: From Arizona STATSGO tabular data

K Factor: From Arizona STATSGO tabular data

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

The above data was retrieved from the NRCS Arizona STATSGO tabular data.

Average annual C Value is 100 for the Luke Air Force Range Complex area.

Spreadsheet "Luke HEL Computation – Surface Only" was used to determine soil mapunits that fall in the "Highly erodible land" class. A HEL CLASS (HELCL) field was added as an attribute to the soil data layer covering the installation. The HEL CLASS field was then updated so the appropriate MAPUNIT records were labeled as "Highly erodible land".

Acreage Determination Method:

ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands for each installation. ArcGIS 8.3 was then used to determine the acreage of each HEL class for each installation. The STATSGO spatial data was obtained from NRCS.

The records for each installation were then rolled up to give a single record for the range complex.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: HILL AIR FORCE BASE COMPLEX
UTAH TESTING AND TRAINING RANGE
HILL AIR FORCE BASE

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From UT611/UT607 soil databases.

Slope Length: From UT611/UT607 soil databases, where populated.
Where not populated, derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From UT611/UT607 soils databases

I Factor: From UT611/UT607 soils databases

K Factor: From UT611/UT607 soils databases

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS database for UT611, TOOELE COUNTY AREA, UTAH and UT607, DAVIS-WEBER AREA, UTAH soil surveys.

Average annual C value is 80 for western Tooele County, UT and is used in the computations for the Utah Testing and Training Range. Average annual C value for the area covering Hill Air Force Base and the Little Mountain Test Center in Weber and Davis Counties, UT is 30.

The Hill AFB Range Complex was analyzed in two pieces. One composed of Hill AFB proper and the Little Mountain Test Site. The other piece was composed of the Utah Testing and Training Range.

Spreadsheets "Hill_HEL_Computation_Davis_Part", "Hill_HEL_Computation_Tooele_Part", and "UTTR HILL PART HEL Computation C=80" were used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils databases.

Acreeage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands for each of the two pieces described above. These layers were then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands for each of

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

the two pieces described above. ArcGIS 8.3 was then used to determine the acreage of each HEL class for each installation. Spatial data obtained from NRCS and is SSURGO certified.

The records for each installation were then rolled up to give a single record for the range complex.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: HAWTHORNE ARMY DEPOT

HEL Class Determination Method:

HEL class derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From NV799 soils database.

Slope Length: derived from Default
Slope Length for Each Increment of Slope Steepness by
Lightle and Weesies 10/1/96.

T Factor: From NV799 soils database

I Factor: From NV799 soils database

K Factor: From NV799 soils database

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

From NASIS databases for NV799, HAWTHORNE AMMUNITION PLANT,
NEVADA, PART OF MINERAL COUNTY soil survey.

Average annual C Value is 50 for Mineral County, NV.

Spreadsheet "Hawthorne HEL Computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. The HEL CLASS field in the MAPUNIT table was then updated soils database.

Acreage Determination Method:

NRCS Soil Data Viewer Version 3.0 extension to ArcView 3.2 was used to create a map of Highly Erodible Lands. This layer was then brought into ArcGIS 8.3 and registered to the appropriate projection. ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. Spatial data obtained from NRCS and is SSURGO certified.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: YUMA PROVING GROUND

HEL Class Determination Method:

HEL class was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From Arizona STATSGO tabular data.

Slope Length: Derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From Arizona STATSGO tabular data

I Factor: From Arizona STATSGO tabular data

K Factor: From Arizona STATSGO tabular data

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

The above data was retrieved from the NRCS Arizona STATSGO tabular data.

The average annual C Value is 300 for Yuma County, AZ.

Spreadsheet "YPG HEL Computation – Surface Only" was used to determine soil mapunits that fall in the "Highly erodible land" class. A HEL CLASS (HELCLA) field was added as an attribute to the soil data layer covering the installation. The HEL CLASS field was then updated so the appropriate MAPUNIT records were labeled as "Highly erodible land".

Acreage Determination Method:

ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The STATSGO spatial data was obtained from NRCS.

Comments: The HEL computation was performed using both installation supplied data and then again with NRCS STATSGO data, as reported here. There was little difference in the results. However, to ensure as much consistency as possible, the SME went with the NRCS STATSGO method to be consistent with the method used on the LUKE AIR FORCE BASE / BARRYING GOLDWATER BOMBING RANGE. It should be noted, the SME is not entirely comfortable with the results because wind erosion modeling was evaluated at this installation for another project, precisely because wind erosion appeared to be a problem. This is likely a result of the poor quality of the data available.

HIGHLY ERODIBLE LAND CLASS DETERMINATION
INSTALLATION METHODOLOGY

Installation: MARINE CORP BASE CAMP LEJEUNE

HEL Class Determination Method:

HEL Class obtained directly from the NASIS database.

Acreage Determination Method:

The NRCS database indicated no Highly erodible land, thus no spatial data was needed.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT WAINWRIGHT / DONNELLY TRAINING AREA

HEL Class Determination Method:

No published data available for use. NRCS is currently creating the NASIS database for these installations. Personal communication with NRCS State Office provided estimates.

Acreage Determination Method:

Personal communication with NRCS State Office provided estimates.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: TOBYHANNA ARMY DEPOT

HEL Class Determination Method:

No published data available for use. Installation location and size appear to be too small to support training that would be impacted by the Highly Erodible Land classification.

Acreage Determination Method:

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: FORT MCPHERSON

HEL Class Determination Method:

No data published available for use. Installation location and size appear to be too small to support training that would be impacted by the Highly Erodible Land classification.

Acreage Determination Method:

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Installation: CANNON AIR FORCE BASE COMPLEX
CANNON AIR FORCE BASE
MELROSE BOMBING RANGE

HEL Class Determination Method:

HEL class was derived from NRCS provided data in accordance with National Food Security Manual Section 511.03.

HEL Class Attributes Sources:

Slope Gradient: From New Mexico STATSGO tabular data.

Slope Length: Derived from Default Slope Length for Each Increment of Slope Steepness by Lightle and Weesies 10/1/96.

T Factor: From New Mexico STATSGO tabular data

I Factor: From New Mexico STATSGO tabular data

K Factor: From New Mexico STATSGO tabular data

R Factor: From Figure 2-2 Agricultural Handbook 703

C Factor: From Annual "C" values of the Wind Erosion Equation
Interactive Maps from National Cartography and Geospatial
Center web site <http://nm6.ftw.nrcs.usda.gov/website/>

LS Factor: Derived from Table 4-2 Agricultural Handbook 703

The above data was retrieved from the NRCS New Mexico STATSGO tabular data.

Average annual C value is 120.

Spreadsheet "CANNON AND MELROSE HEL Computation" was used to determine soil mapunits that fall in the "Highly erodible land" class. A HEL CLASS (HEL) field was added as an attribute to the soil data layer covering the installation. The HEL CLASS field was then updated so the appropriate records were labeled as "Highly erodible land".

Acreage Determination Method:

ArcGIS 8.3 was then used to create a data layer containing only Highly Erodible Lands and Not Highly Erodible Lands. ArcGIS 8.3 was then used to determine the acreage of each HEL class. The STATSGO spatial data was obtained from NRCS.

Comments: I do not have a high confidence factor in the determination for this Complex. Installation boundaries and area received from IVT were contradictory. Information from Cannon AFB web site and other sources indicates more area used for training than was recorded in the IVT. No responses were received from Air Force after multiple requests for clarification.

HIGHLY ERODIBLE LAND CLASS DETERMINATION INSTALLATION METHODOLOGY

Appendix A – R Factor Maps

[AH-703 Fig 2-1.pdf](#)

[AH-703 Fig 2-2.pdf](#)

[AH-703 Fig 2-3.pdf](#)

[AH-703 Fig 2-4.pdf](#)

Appendix B – Default Slope Length Table

[Default Slope Length Table.pdf](#)

Appendix C – LS Factors Table

[AH-703 Table 4-2.pdf](#)

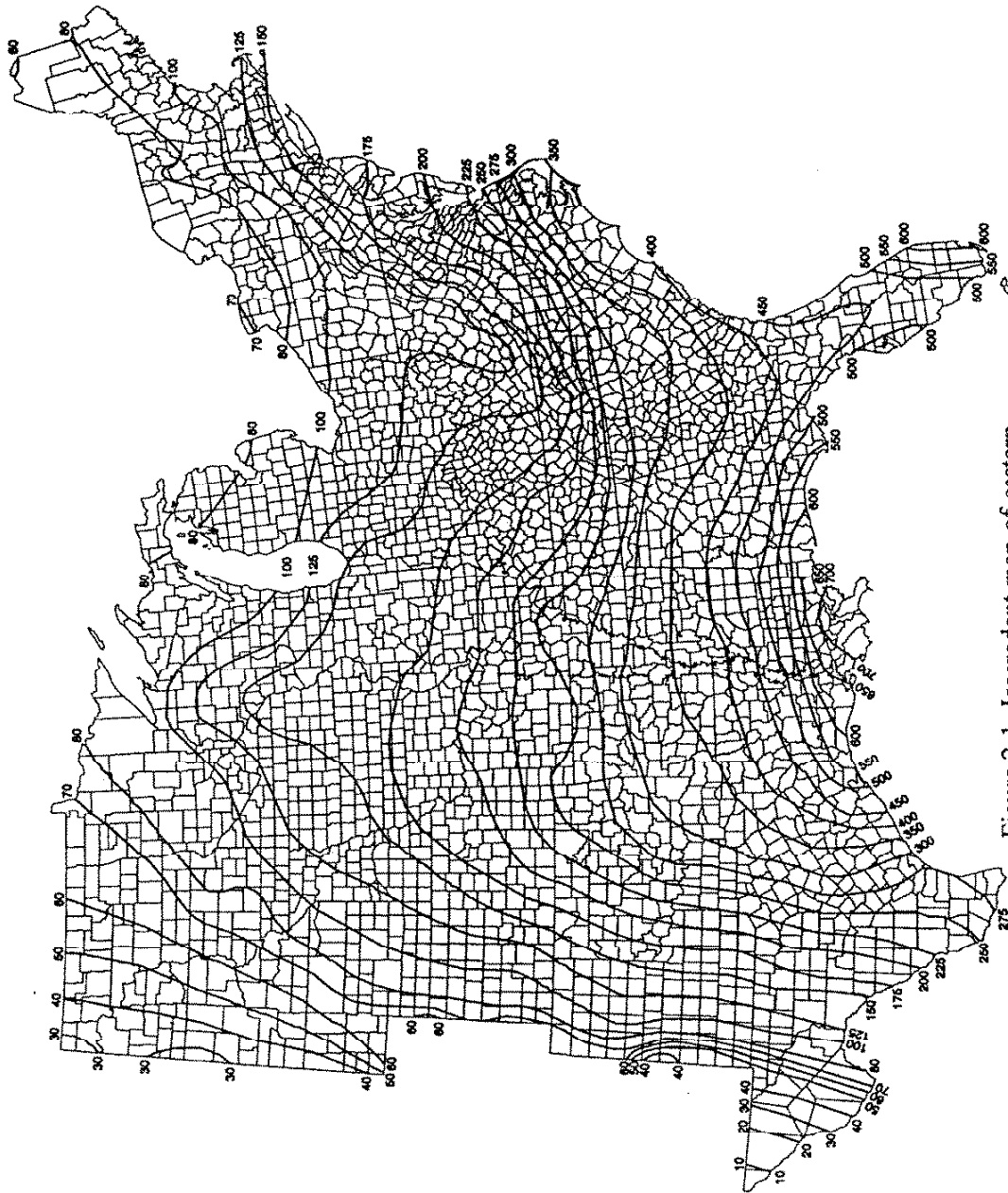


Figure 2-1. Isoerodent map of eastern United States. Units are hundreds ft-tonf/in(ac·h·yr)⁻¹.

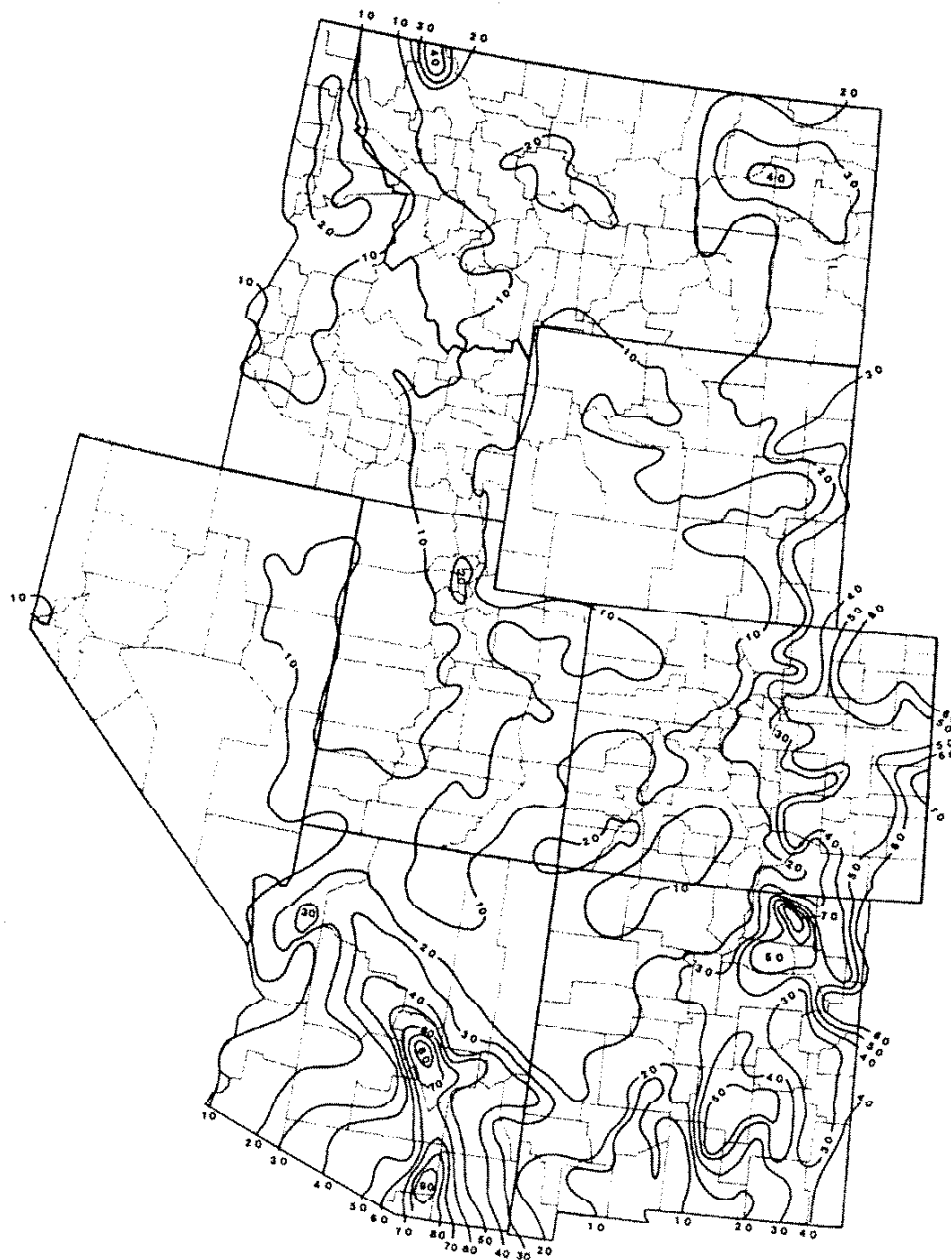


Figure 2-2. Isoerodent map of western United States. Units are hundreds $\text{ft} \cdot \text{tonf} \cdot \text{in}(\text{ac} \cdot \text{h} \cdot \text{yr})^{-1}$.

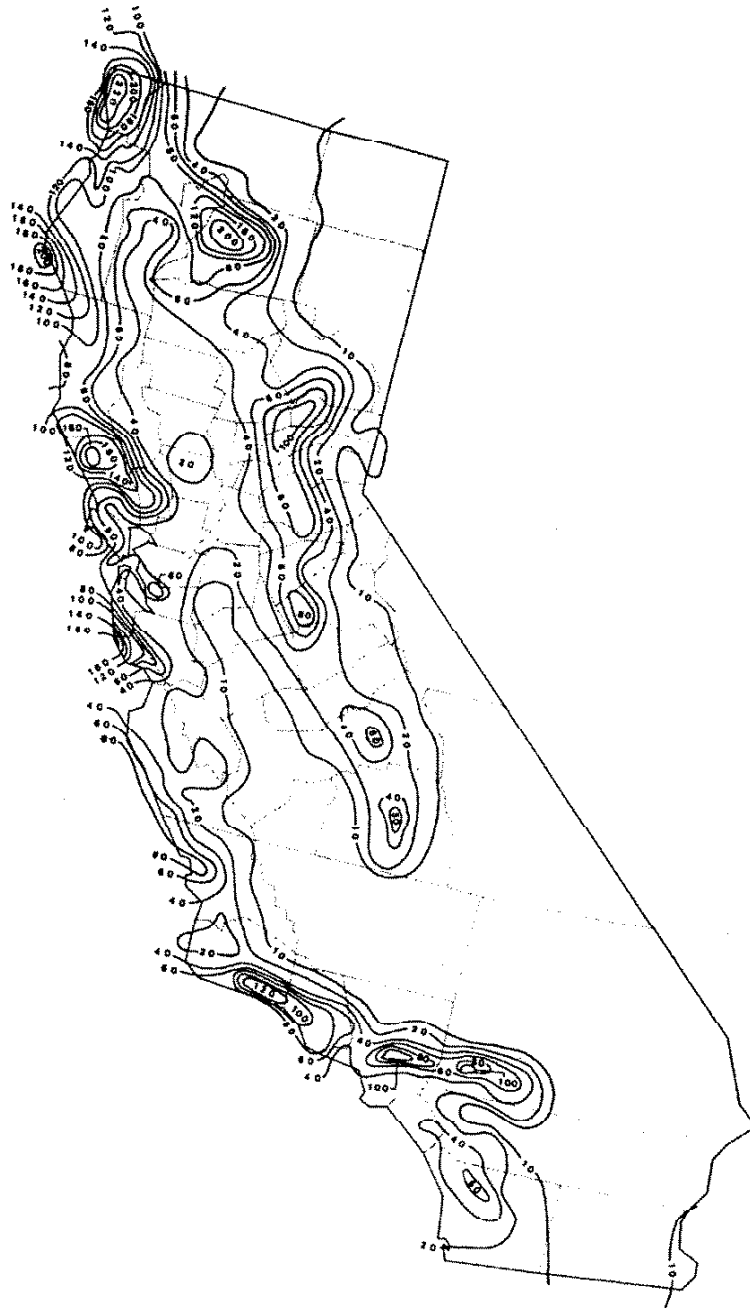


Figure 2-3. Isoerodent map of California. Units are hundreds $\text{ft} \cdot \text{tonf} \cdot \text{in}(\text{ac} \cdot \text{h} \cdot \text{yr})^{-1}$.

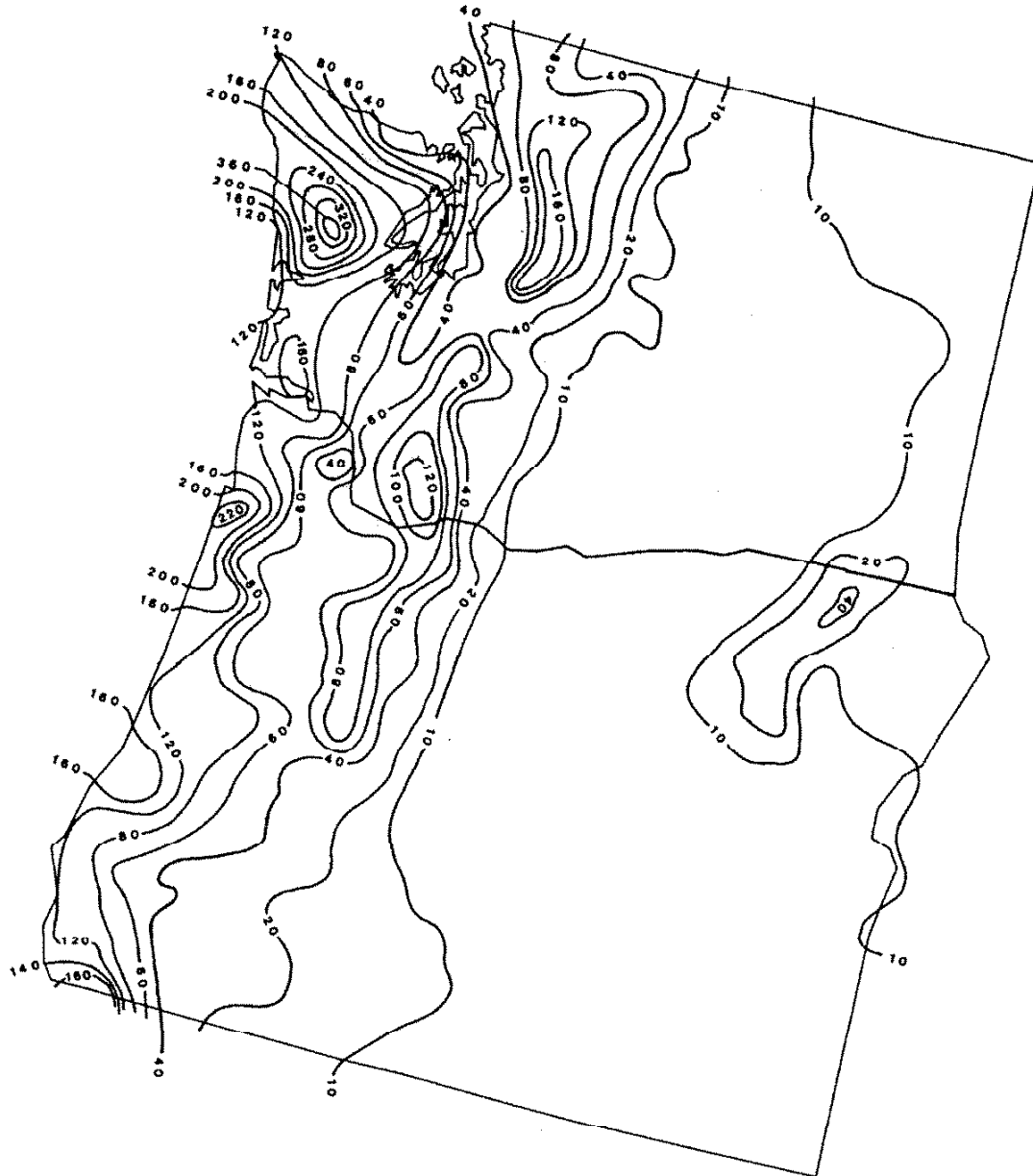


Figure 2-4. Isoerodent map of Oregon and Washington. Units are hundreds $\text{ft} \cdot \text{tonf} \cdot \text{in} (\text{ac} \cdot \text{h} \cdot \text{yr})^{-1}$.

Default Slope Length for each Increment of Slope Steepness
For use in all areas of the US except the "Palouse"

Slope	Length
0.5	100
1.	200
2.	300
3.	200
4.	180
5.	160
6.	150
7.	140
8.	130
9.	125
10.	120
11.	110
12.	100
13.	90
14.	80
15.	70
16.	60
17.	60
18.	50
19.	50
20.	50
21.	50
22.	50
23.	50
24.	50

Slope steepness is the average of the map unit slope range

By Lightle and Weesies 10/1/96

The following slope lengths for the "Palouse" (MLRA B 9) area were determined by Tom Gohlke in consultation with Don McCool, ARS and Harry Riehle. Tom says, "Keep in mind that many real LS's in the field are complex slopes and consist of combinations of these slopes. For instance, it is common to find an "L" beginning on a 2%-5% slope and extending onto and ending on a 21%-25% slope. The total "L" may be less than the sum of the values for these two segments as shown in the following table."

Default Slope ranges for Use in the "Palouse"

slope range	length
2-5%	350 ft.
6-10%	275 ft.
11-15%	225 ft.
16-20%	175 ft.
21-25%	150 ft.
26-35%	125 ft.
36-45%	100 ft.

Table 4-2.
Values for topographic factor, LS, for moderate ratio of till to interrill erosion.¹

Slope (%)	Horizontal slope length (ft)															
	3	6	9	12	15	25	50	75	100	150	200	250	300	400	600	1000
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06
0.5	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10
1.0	0.11	0.11	0.11	0.11	0.11	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.17	0.18	0.19	0.20
2.0	0.17	0.17	0.17	0.17	0.17	0.19	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.41	0.47
3.0	0.22	0.22	0.22	0.22	0.22	0.25	0.32	0.36	0.39	0.44	0.48	0.52	0.55	0.60	0.68	0.80
4.0	0.26	0.26	0.26	0.26	0.26	0.31	0.40	0.47	0.52	0.60	0.67	0.72	0.77	0.86	0.99	1.19
5.0	0.30	0.30	0.30	0.30	0.30	0.37	0.49	0.58	0.65	0.76	0.85	0.93	1.01	1.13	1.33	1.63
6.0	0.34	0.34	0.34	0.34	0.34	0.43	0.58	0.69	0.78	0.93	1.05	1.15	1.25	1.42	1.69	2.11
8.0	0.42	0.42	0.42	0.42	0.42	0.53	0.74	0.91	1.04	1.26	1.45	1.62	1.77	2.03	2.47	3.15
10.0	0.46	0.48	0.50	0.51	0.52	0.67	0.97	1.19	1.38	1.71	1.98	2.22	2.44	2.84	3.50	4.56
12.0	0.47	0.53	0.58	0.61	0.64	0.84	1.23	1.53	1.79	2.23	2.61	2.95	3.26	3.81	4.75	6.28
14.0	0.48	0.58	0.65	0.70	0.75	1.00	1.48	1.86	2.19	2.76	3.25	3.69	4.09	4.82	6.07	8.11
16.0	0.49	0.63	0.72	0.79	0.85	1.15	1.73	2.20	2.60	3.30	3.90	4.45	4.95	5.86	7.43	10.02
20.0	0.52	0.71	0.85	0.96	1.08	1.45	2.22	2.85	3.40	4.36	5.21	5.97	6.68	7.97	10.23	13.99
25.0	0.56	0.80	1.00	1.16	1.30	1.81	2.82	3.65	4.39	5.69	6.83	7.83	8.86	10.65	13.80	19.13
30.0	0.59	0.89	1.13	1.34	1.53	2.15	3.39	4.42	5.34	6.98	8.43	9.75	11.01	13.30	17.37	24.31
40.0	0.65	1.05	1.38	1.68	1.95	2.77	4.45	5.87	7.14	9.43	11.47	13.37	15.14	18.43	24.32	34.48
50.0	0.71	1.18	1.59	1.97	2.32	3.32	5.40	7.17	8.78	11.66	14.26	16.67	18.94	23.17	30.78	44.02
60.0	0.76	1.30	1.78	2.23	2.65	3.81	6.24	8.33	10.23	13.65	16.76	19.64	22.36	27.45	36.63	52.70

¹Such as for row-cropped agricultural and other moderately consolidated soil conditions with little-to-moderate cover (not applicable to thawing soil)

SOIL RESILIENCY ATTRIBUTE

OrgCode	OrgName	Range Acreage Reported?	Not HEL	HEL	Total Acres
24011	ADELPHI LABORATORY CENTER	N			
21081	BLUE GRASS ARMY DEPOT	N	2,461	11,681	14,142
42116	CARLISLE BARRACKS	N			
42624	CHARLES E KELLY SPT FAC	N			
48186	CORPUS CHRISTI ARMY DEPOT	N			
18174	CRANE ARMY AMMUNITION ACTIVITY	N			
26221	DETROIT ARSENAL	N			
RQ137	FORT BUCHANAN	N			
24226	FORT DETRICK	N			
13048	FORT GILLEM	N			
02347	FORT GREELY	N			
36352	FORT HAMILTON	N			
20491	FORT LEAVENWORTH	N			
11564	FORT MCNAIR	N			
24571	FORT MEADE	N			
34558	FORT MONMOUTH	N			
51585	FORT MONROE	N			
51602	FORT MYER	N			
15788	FORT SHAFTER	N			
47408	HOLSTON AAP	N			
29494	LAKE CITY AAP	N			
39462	LIMA ARMY TANK PLT	N			
48513	LONE STAR AAP	N			
22543	LOUISIANA AAP	N			
37841	MILITARY OCEAN TML SUNNY POINT	N			
28560	MISSISSIPPI AAP	N			
18611	NEWPORT CHEM DEPOT	N			
06581	PRESIDIO OF MONTEREY	N			
51724	RADFORD AAP	N			
06742	RIVERBANK AAP	N			
17755	ROCK ISLAND ARSENAL	N			
42783	SCRANTON AAP	N			
25526	SOLDIER SYSTEMS CENTER	N			
15875	TRIPLER ARMY MEDICAL CENTER	N			
26832	US ARMY GARRISON SELFRIDGE	N			
11933	WALTER REED ARMY MEDICAL CENTER	N			
36939	WATERVLIET ARSENAL	N			
24004	ABERDEEN PROVING GROUND	Y	54,399	526	54,925
01035	ANNISTON ARMY DEPOT	Y	3,157	12,122	15,279
49173	DESERET CHEMICAL DEPOT	Y	18,958	-	18,958
49191	DUGWAY PROVING GROUND	Y	11,272	788,224	799,496
51389	FORT A P HILL	Y	30,146	39,806	69,952
51062	FORT BELVOIR	Y	5,950	3,020	8,970
13077	FORT BENNING	Y	93,060	89,430	182,490
48083	FORT BLISS	Y	31,073	1,068,441	1,099,514
37099	FORT BRAGG	Y	154,573	607	155,180
21128	FORT CAMPBELL	Y	32,452	71,417	103,869

SOIL RESILIENCY ATTRIBUTE

OrgCode	OrgName	Range Acreage Reported?	Not HEL	HEL	Total Acres
	FORT CARSON COMPLEX		109,141	261,437	370,578
08135	FORT CARSON	Y	108,799	26,756	135,555
	PCMA		342	234,681	235,023
34201	FORT DIX	Y	30,801	42	30,843
36216	FORT DRUM	Y	90,176	67,344	157,520
51281	FORT EUSTIS	Y	7,991	-	7,991
13355	FORT GORDON	Y	50,087	5,199	55,286
48396	FORT HOOD	Y	193,219	25,830	219,049
04289	FORT HUACHUCA	Y	56,276	24,572	80,848
45404	FORT JACKSON	Y	31,034	20,831	51,865
21478	FORT KNOX	Y	31,190	77,208	108,398
51484	FORT LEE	Y	4,852	482	5,334
29977	FORT LEONARD WOOD	Y	9,249	45,644	54,893
53456	FORT LEWIS COMPLEX		150,842	282,224	433,066
	FORT LEWIS	Y	102,969	4,481	107,450
	YAKIMA TRAINING CENTER		47,873	277,743	325,616
55533	FORT MCCOY	Y	49,460	9,546	59,006
13049	FORT MCPHERSON	Y			
22722	FORT POLK COMPLEX	Y	163,905	51,480	215,385
	FORT POLK				
	PEASON RIDGE				
02736	FORT RICHARDSON	Y	10,668	51,156	61,824
20736	FORT RILEY	Y	52,490	49,098	101,588
01767	FORT RUCKER	Y	18,986	40,700	59,686
48399	FORT SAM HOUSTON COMPLEX	Y	15,337	14,922	30,259
	FORT SAM HOUSTON		2,925	301	3,226
	CAMP BULLLIS		12,412	14,621	27,033
40801	FORT SILL	Y	49,950	44,608	94,558
13834	FORT STEWART COMPLEX	Y	307,176	236	307,412
	FORT STEWART		301,766	236	302,002
	HUNTER ARMY AIRFIELD		5,410	-	5,410
02955	FORT WAINWRIGHT COMPLEX	Y	1,008,045	542,793	1,550,838
	FORT WAINWRIGHT				
	DONNELLY TRAINING AREA				
3235L	HAWTHORNE ARMY DEPOT	Y	13,602	129,944	143,546
19422	IOWA AAP	Y	11,902	7,141	19,043
20450	KANSAS ARMY AMMUNITION PLANT	Y	12,835	1,061	13,896
42461	LETTERKENNY ARMY DEPOT	Y	13,235	2,164	15,399
40549	MCALESTER AAP	Y	28,858	12,920	41,778
47579	MILAN AAP	Y	2,690	12,409	15,099
06419	NTC AND FORT IRWIN CA	Y	-	636,083	636,083
34693	PICATINNY ARSENAL	Y	4,731	1,965	6,696
05698	PINE BLUFF ARSENAL	Y	12,297	1,039	13,336
08728	PUEBLO CHEM DEPOT	Y	22,808	-	22,808
48733	RED RIVER ARMY DEPOT	Y	17,273	937	18,210
01750	REDSTONE ARSENAL	Y	23,299	6,748	30,047
15776	SCHOFIELD BARRACKS COMPLEX	Y	27,990	156,783	184,773
	PTA		13,688	118,850	132,538

SOIL RESILIENCY ATTRIBUTE

OrgCode	OrgName	Range Acreage Reported?	Not HEL	HEL	Total Acres
	DILLINGHAM		614	-	614
	KAHUKU		4,352	4,478	8,830
	KAWAIOLOA		265	23,132	23,397
	MAKUA		3431	818	4,249
	SCHOFIELD BARRACKS		5341	8353	13,694
	WHEELER ARMY AIR FIELD		299	1,152	1,451
06821	SIERRA ARMY DEPOT	Y	30,557	-	30,557
42877	TOBYHANNA ARMY DEPOT	Y			
49878	TOOELE ARMY DEPOT	Y	15,979	7,309	23,288
41899	UMATILLA CHEM DEPOT	Y	105	15,901	16,006
36953	WEST POINT MIL RESERVATION	Y	2,296	13,784	16,080
35970	WHITE SANDS MISSILE RANGE	Y	493,934	1,482,763	1,976,697
04991	YUMA PROVING GROUND	Y	798,305	38,227	836,532
	MCB CAMP LEJEUNE		151,500	-	151,500
	MCARCC 29 PALMS		219,487	376,513	596,000
	MCB CAMP PENDLETON		49,079	72,510	121,589
	NAS FALLON COMPLEX		153,758	85,977	239,735
	NAS Fallon includes cantonment and 4 ranges				
	CANNON AFB COMPLEX		28,485		28,485
	CANNON AFB				
	MELROSE BOMBING RANGE				
	EGLIN AFB		421,152	38,003	459,155
	HILL AFB COMPLEX		85,740	875,765	961,505
	Hill includes Hill AFB (2 parcels) and the Utah Testing and Training Range (Hill Bombing Range, former Wendover AFB, and former Wendover Bombing Range)				
	LUKE AFB COMPLEX		959,909	775,880	1,735,789
	Luke includes Luke AFB, Luke Auxiliary Landing Field, and Barry Goldwater Bommbing Range				

HQDA, ACSM
ATTN: DAIMEB
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600
(703) 693-0078
FAX (703) 697-2808

**ENVIRONMENTAL
PROGRAMS
DIRECTORATE**

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Vic Diersing



DEPARTMENT OF THE ARMY
OFFICE OF ECONOMIC & MANPOWER ANALYSIS
UNITED STATES MILITARY ACADEMY
WEST POINT, NY 10996

REPLY TO
ATTENTION OF

MADN-OEMA

3 June 2004

MEMORANDUM FOR RECORD

SUBJECT: BRAC Data Certification

1. FACTORS: Installation Local Labor Supply Attribute

2. DESCRIPTION: This metric represents the available labor supply of individuals ages 25 and older within a 50 mile radius of each installation by education category (high school drop-outs, high school graduates, some college, college graduates, and post college degrees) and weighted by cost of living adjusted median annual earnings by education category.

3. DATA SOURCES: There were three primary data sources used to calculate this attribute.

a. GeoLytics Data: GeoLytics stratifies the U.S. Census 2000 Long Form data into finely graded geographical regions. We use this to determine the number of people ages 25 and older by education category who live within a 50 mile radius of each installation. The Total Army Basing Study provided the longitude and latitude used for each location. See www.geolytics.com for more information on the data. Note, Puerto Rico is not contained in this data. Therefore, we used 2000 Census data to determine population by education category for Fort Buchanan. Since approximately 70 percent of the island's population lives within 50 miles of Fort Buchanan, we impute populations as 70 percent of the island total within each education category.

b. 2000 Census Data: GeoLytic data does not contain median earnings by education category, so we use the 2000 U.S. Census data to determine median earnings by education category for each state. See www.census.gov/hhes/income/earnings for more information. Note, median earnings by education category is not available in the 2000 Census Data for Puerto Rico. Therefore, we impute median earnings by education category using median earnings by occupation category for Fort Buchanan.

c. Missouri Economic Research and Information Center (MERIC) Data: Since there is no widely accepted state-level cost of living adjustment factor, we use the MERIC Data because it focuses on state-level comparisons and incorporates a wide range of goods and services: groceries, utilities, healthcare, housing, transportation, and other miscellaneous items for 2003. See www.ded.mo.gov/business/researchandplanning/indicators/cost_of_living/index for more information.

4. METHODOLOGY: Ascertaining available labor supply in a region involves a measure of both quality and quantity. We assess quantity by determining populations within a 50 mile radius of each installation by the five education categories listed above using the Geolytic Geographical 2000 Census data. We capture quality by matching cost of living adjusted state-level annual median earnings by education category to each installation. To create a comparable index for each installation, we use a four step process illustrated below by Fort Monmouth, New Jersey.

MADN-OEMA

SUBJECT: BRAC Data Certification

	Population	Median Earnings	COLA
High School Drop-outs	2,482,522	\$24,329	111.6
High School Graduates	2,959,063	\$32,389	111.6
Some College	2,431,979	\$38,429	111.6
College Graduates	1,980,290	\$51,657	111.6
Post College Degrees	1,366,125	\$69,597	111.6

a. Step 1. We normalize median annual earnings within states by high school graduate median annual earnings. For example, Fort Monmouth has median annual earnings of \$24,329 for high school drop-outs and \$32,389 for high school graduates. Therefore, we divide both by \$32,389 to get a high school normalized earnings index of .7511 for high school drop-outs and 1.0 for high school graduates.

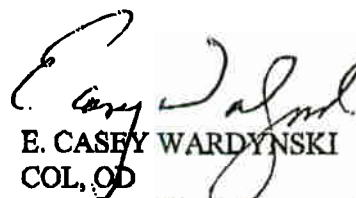
b. Step 2. We adjust this factor so that earnings are comparable across states by dividing by the state level cost of living (COLA) index, which we normalize by the State of Texas. An example of how we normalized the COLA is as follows. Since Texas has a COLA index of 90.3 and New Jersey has a COLA index of 111.6, we divide both by 90.3 and get a Texas normalized index of 1.0 for Texas and 1.236 for New Jersey. Therefore, a high school drop-out at Fort Monmouth has a COLA adjusted weight of .6078 (.7511/1.236).

c. Step 3. We multiply the COLA adjusted state-level median annual earnings index for each education category by the population in each education category and sum them for each installation to create a comparable measure of available labor supply within a 50 mile radius of each post. High school drop-outs at Fort Monmouth contribute 1,508,841 to the total Fort Monmouth labor supply metric of 11,168,696.

d. Step 4. We normalize the labor supply measures by the installation with the largest labor supply (Fort Monmouth) so that each installation has a labor supply measure that ranges from zero to one. A one denotes the installation with the largest labor supply.

5. The data used in this analysis is found in the accompanying excel file: BRAC-output-oema-v2.0.

6. I certify that the information supplied is accurate and complete to the best of my knowledge and belief.



E. CASEY WARDYNSKI
COL, OD

Director, Office of Economic & Manpower Analysis

Final Report

**FINAL REPORT:
METHODOLOGY FOR ASSESSING ARMY
INSTALLATIONS' ENVIRONMENTAL
RESOURCE ELASTICITY
AND MODEL OUTPUTS**

Draft as of: February 3, 2005

PREFACE

SPONSORSHIP

This project was sponsored by the Army Environmental Policy Institute (AEPI) and The Army Basing Study Office (TABS).

PROJECT TEAM

The project was led by Steve Siegel of the Energy and Security Group (ESG). The primary project team consisted of Dave Dutton, Paul Booth and Dawn Wray from CALIBRE; Steve Bell of ESG; Phil Huber and James Wolf as consultants to ESG, and Stuart Foltz, Richard Scholze, William Taylor, Elizabeth Jenicek, Alan Anderson, and Deb Curtin from the Engineer Research Development Center's Construction Engineering Research Laboratory (ERDC-CERL).

ACKNOWLEDGEMENTS

The project team would like to thank Rich Pedersen from the Center for Army Analysis; Dave Eady from the Army Environmental Policy Institute; and Colonel William Tarantino, Colonel Tom Crabtree and Lieutenant Colonel Greg Fleming from The Army Basing Study Office for their assistance and support throughout the project.

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EXECUTIVE SUMMARY

An assessment of *both* the capacity and the cost to provide the needed environmental resources to support personnel at an installation is a key component of the Army's stationing process and military value analysis.

This project developed a methodology to assess in a consistent, comprehensive way the relationships between capacity to support personnel and the costs for specified environmental resources. The results of applying the methodology are a reflection of the environmental elasticity of an installation: the overall ability to station personnel considering the physical capacity and costs of these resources. These results may then be used to assess the military value of the installation for its environmental attributes in a consistent, understandable fashion.

Four environmental resources were examined. They are: 1) energy- both electricity and natural gas, 2) potable water, non-potable water and wastewater- both industrial and municipal, 3) solid waste disposal, and 4) maintained training land. The physical capacity of each resource is deemed the "capacity threshold" for that resource. At its capacity threshold, the resource can support a certain number of personnel depending on the usage per person of that resource. For an installation as a whole, the cap or amount of personnel that can be supported by the most constraining resource is the effective cap on personnel for the installation as a whole.

The analysis proceeded in stages. First, the "capacity threshold" of each resource was determined - that is, what in physical terms is the limit of each resource without significant new investment in infrastructure. Second, the current usage and cost per person for each resource was assessed. Third, it was calculated how many personnel could be supported at the capacity threshold for each resource. Fourth, it was determined what the constraining resource for the installation as a whole was in terms of supporting personnel. Finally, it was determined what would be the total annual costs for all resources at the maximum level of personnel the installation could support.

The potential capacity restriction was evaluated in terms of peak usage and peak physical limitations of the system - not a consumption limitation metric. Upon evaluating the resources, it was determined that the "constraining" resources in terms of physical limits that would be analyzed for peak restrictions were energy (electricity and natural gas), water (potable and non-potable) and wastewater (industrial and municipal). For energy, it is assumed that off-installation supply is unlimited but there are capacity threshold restrictions due to limits on distribution for electric substations and transmission lines and natural gas pipelines. For water supply and wastewater treatment, capacity threshold restrictions may be due to treatment plant size, distribution limits, or permit restrictions.

For solid waste, it is assumed that off-post disposal is unlimited and there is no capacity threshold limit; this project focused on the costs of disposal. For training land, other projects underway determine the capacity threshold and this project focused on the costs of maintaining the training land.

The data used for the analysis is from two data calls from installations conducted by the Army Basing Study Office (TABS). The data were evaluated and compared to reliable, certifiable secondary sources. The results presented in this report are from the data for all 88 installations specified for evaluation by TABS.

The methodology produces a metric for each installation that reflects an installation's environmental elasticity: the overall ability of an installation to station personnel at its physical capacity limit for the capacity constrained resources of energy, and water and wastewater treatment in relation to the costs of four environmental resources -- energy, water and wastewater treatment, solid waste management, and maintenance of training land. The metric is a comparison between 1) the total costs for all resources at the maximum number of personnel that can be supported by these resources at an installation, and 2) the number of people that can be supported at this maximum level. These values are the primary inputs for an installation's environmental elasticity into the military value assessment being conducted by TABS.

Table A presents the results of the model run for all 88 installations listing their total annual costs and personnel at capacity threshold, with the rankings in descending order of personnel at capacity threshold.

Table A
Personnel and Total Annual Costs at Capacity Threshold

Installation Name	Cost (\$K)	Personnel
Fort Sam Houston	111,879	176,893
Fort Jackson	16,632	78,197
Fort Benning	1,210,219	76,956
Fort Hood	44,943	75,037
Fort Bragg	40,166	73,175
Fort Lewis	41,742	70,532
Fort Campbell	42,554	62,599
Fort Knox	29,242	59,027
Aberdeen Proving Gnd	63,667	55,177
Fort Sill	17,964	52,962
Fort Bliss	27,357	50,840
Fort Leonard Wood	16,222	49,304
Fort Gillem	17,008	45,605
Fort Meade	8,180	44,976
Schofield Barracks	27,177	43,900
Redstone Arsenal	41,010	42,576
Fort Drum	30,137	40,612
Fort Rucker	22,461	38,673
Fort Stewart	31,563	36,269
Fort Gordon	13,637	36,184
Fort Eustis	16,913	35,418
Fort McPherson	14,911	34,695
Fort Huachuca	17,807	34,046
Fort Lee	12,461	30,838
Fort Dix	45,820	26,765
Fort Carson	20,906	25,681
Fort Leavenworth	16,142	23,803

Table A (continued)

Installation Name	Cost (\$K)	Personnel
NTC and Fort Irwin	28,111	20,175
West Point Mil Res	19,714	17,441
Fort Shafter	9,302	15,612
White Sands Missile Rng	18,029	15,057
Fort Monmouth	13,139	10,705
Fort McNair	7,650	10,504
Fort Richardson	9,657	10,310
Fort McCoy	14,800	9,312
Fort Detrick	13,066	8,765
Fort Polk	6,197	8,676
Fort Buchanan	6,444	6,843
Picatinny Arsenal	14,417	6,610
Detroit Arsenal	3,695	6,475
Watervliet Arsenal	26,169	6,222
Anniston Army Depot	15,539	6,102
Fort Wainwright	2,017	5,995
Rock Island Arsenal	2,525	5,857
Military Ocean Tml	3,096	5,643
Fort Hamilton	5,349	5,553
Tobyhanna Army Depot	9,064	5,536
Lake City AAP	34,972	5,416
Presidio of Monterey	2,321	5,091
Charles E Kelly Spt Fac	3,156	4,685
Letterkenny Army Depot	6,126	4,652
Tripler Army Medical Center	6,276	4,646
Carlisle Barracks	4,522	4,597
Riverbank AAP	16,173	4,328
Corpus Christi	6,653	4,225
Yuma Proving Ground	2,484	4,194
Sierra Army Depot	11,023	4,124
Red River Army Depot	7,240	3,748
Pine Bluff Arsenal	9,646	3,601
Soldier Systems Ctr	3,896	3,074
Dugway Proving Ground	2,567	2,758
US Army Garrison S	2,944	2,705
McAlester AAP	3,765	2,694
Lima Army Tank Plt	8,764	2,424
Deseret Chem Depot	2,838	1,978
Tooele Army Depot	1,746	1,968
Walter Reed AMC	4,294	1,699
Adelphi Laboratory	4,858	1,532
Fort Riley	678	1,428
Fort Belvoir	739	1,396
Newport Chem Depot	831	1,295
Blue Grass Army De	1,492	1,265
Pueblo Chem Depot	1,049	1,113
Fort A P Hill	2,024	1,101
Fort Monroe	555	929
Hawthorne Army Depot	1,010	805
Lone Star AAP	2,115	589

Table A (continued)

Installation Name	Cost (\$K)	Personnel
Kansas AAP	2,784	532
Fort Myer	545	529
Scranton AAP	5,004	464
Milan AAP	993	387
Mississippi AAP	4,491	291
Crane AAP	3,418	201
Umatilla Chem Depot	690	194
Radford AAP	856	188
Iowa AAP	244	143
Holston AAP	1,275	105
Louisiana AAP	2	2

Table B shows which resource was the constraining resource for the installations studied. This table shows the constraining resource in the left column, the number of installations constrained by the resource in the middle column and the percentage of total installation in the right column. For example the table illustrates that over half of the installations studied were constrained by either potable water (31%) or electricity (27%) resources.

Table B. Summary of Installation Resource Constraints

Constraining Resource	Number of Installations	Percent of Installations Studied
Potable Water	27	31%
Electricity	24	27%
Municipal Waste Water	18	20%
Natural Gas	11	13%
Industrial Waste Water	8	9%
Total	88	100%

The results developed in this project for personnel at capacity threshold and total annual costs at capacity threshold are the environmental elasticity inputs to the model for military value that will be developed by TABS. The Maximum value of 10 will be given to the installations with the largest populations at the lowest total annual costs. The Minimum value of 0 will be given to the installations with the smallest populations at the highest total annual costs.

In addition to the outputs required to conduct the Military Value Analysis, the IREM model has the ability to generate multiple outputs depending on the analytical requirement. This model can provide: an assessment of the costs and amount of additional personnel that may be added to an installation, traditional elasticity measurements for resources whose costs are not linear, derived unit resource costs, per person resource costs, specifications for which resource is restricting installation expansion, capacity factors for each resource, and assessments for other environmental resources. Given the availability of input data, the model has the capability to

estimate the number of additional personnel that can be absorbed by an installation by increasing capacity through initiatives such as low cost efficiency or conservation programs. For example, an installation constrained by potable water may be able to increase its capacity to support additional personnel through various water conservation measures.

I. Project Objective and Background

An assessment of *both* the capacity and the cost to provide the needed environmental resources to support personnel at an installation is a key component of the Army's stationing analysis process and military value analysis.

The methodology developed assesses in a consistent, comprehensive way the relationships between capacity to support personnel (as benefits) and the costs for specified environmental resources. The results of applying the methodology are a reflection of the environmental elasticity of an installation: the overall ability to station personnel considering the physical capacity and costs of these resources. These results may then be used to assess the military value of the installation for its environmental attributes in a consistent, understandable fashion.

Four environmental resources were examined in this project. They are: 1) energy- both electricity and natural gas, 2) water- both potable and non-potable and wastewater- both industrial and municipal, 3) solid waste disposal, and 4) maintained training land.

The data for the analysis was from two data calls from installations conducted by TABS. The uses and limitations of the data are discussed in detail later in this report.

II. Environmental Elasticity

A. Figures of Merit Considered

The environmental resources at an installation affect stationing decisions and military value analysis in two primary ways. First, the physical capacity of the resources may put an effective cap on how many personnel may be stationed at an installation without significant new investment in infrastructure. Second, the costs of these resources will vary installation by installation so the total annual costs to station personnel will accordingly vary.

The physical capacity of each resource is what is deemed the “capacity threshold” for that resource. At its capacity threshold, the resource can support a certain number of personnel depending on the usage per person of that resource. For an installation as a whole, the cap or amount of personnel that can be supported by the most constraining resource is the effective cap on personnel for the installation as a whole.

The environmental elasticity of an installation could reflect many different attributes that might be relevant to the stationing process and military value analysis. Accordingly, many different figures of merit were initially considered and rejected. These included:

- The costs and ability of an installation to *add* personnel from the number currently stationed there.
- The *cost per person* of the evaluated resources up to the installations capacity threshold.
- A calculation of the *total annual costs* for all resources at the installation’s physical capacity threshold for the maximum number of personnel.
- A comparison of the *percentage increase in total costs relative to the percentage increase in personnel* from the current stationing to the capacity threshold level – a “classical elasticity” measure in percentage terms
- A comparison of the *absolute amount of increase in costs relative to the absolute amount of increase in personnel* from the current stationing to the capacity threshold level – another “classical” elasticity measure in absolute terms
- A calculation of the overall ability of an installation to station personnel in relation to the total costs per person of the resources.

Each of these was considered and rejected as the sole reflection of environmental elasticity. The costs and ability to *add* personnel was deemed less important than the overall ability of an installation to *station* personnel in terms of military value. The cost per person was deemed a relevant attribute, but one that would be better suited as an input to the total annual costs to station personnel. In addition, it did not reflect the number of additional or total personnel that could be stationed. Similarly, the total annual costs for all resources at the capacity threshold was

deemed very important, but as a single figure of merit it did not directly reflect the number of personnel that could be stationed.

The percentage increase in costs relative to the percentage increase in personnel was rejected as a figure of merit because all installations had a value of 1 when the calculations were performed. This is the result, as is discussed more below, of the assumption that the costs of adding additional personnel at an installation is a liner extrapolation from the current costs per person of those stationed there.

Similarly, the absolute increase in costs relative to the absolute increase in personnel was also rejected as a figure of merit. Because of the linearity assumption regarding costs, this figure just became the cost per person of adding more personnel. This figure of merit was not deemed sufficient because of the reasons stated above regarding cost per person limitations.

It was decided that one “figure of merit” did not adequately reflect an installation’s environmental elasticity. Accordingly, it was decided to present the two most relevant figures and graph them to show their relationship. These are 1) the total number of personnel that can be stationed at an installations capacity threshold, and 2) the total annual costs that would be borne to support this number of personnel at that installation.

B. Resources Examined

In this project, four environmental resources were determined to be of primary interest for the military value analysis. These are:

- Energy (both natural gas and electricity)
- Water (both potable and non-potable) and wastewater treatment (both municipal and industrial)
- Solid Waste (non- hazardous) and
- Maintained training land.

The objective was to determine first what the “capacity threshold” was for each of these resources- what in physical terms was the limit of these resources without significant new investment in infrastructure. Second, it was determined how many personnel could be supported at this threshold for each resource and what was the constraining resource for the installation as a whole in terms of supporting personnel. Finally, it was determined what would be the total annual costs for each resource at the maximum level of personnel the installation could support.

C. Resource Capacity Restrictions

The potential capacity restriction was evaluated in terms of peak usage and peak physical limitations of the system - not a consumption limitation metric. Upon evaluating the resources, it was determined that the “constraining” resources in terms of physical limits that would be analyzed for peak restrictions were energy (electricity and natural gas), water (potable and non-potable) and wastewater (industrial and municipal). For energy, it is assumed that off-installation supply is unlimited but there are capacity threshold restrictions due to limits on distribution for electric substations and transmission lines and natural gas pipelines. For water supply and wastewater treatment, capacity threshold restrictions may be due to treatment plant size, distribution limits, or permit restrictions.

For solid waste, it is assumed that off-post disposal is unlimited and there is no capacity threshold limit; this project focused on the costs of disposal. For training land, other projects underway determine the capacity threshold and this project focused on the costs of maintaining the training land. The limitations of some of the assumptions made regarding the costs of these and the other resources are discussed below in the data limitations and assumptions section.

Graphical representations of the infrastructure and processing for each of the resources examined are in Appendix A.

III. Methodology

A. Installation Resource Elasticity Methodology (IREM) Model Description

To construct the model used for the analysis, the project followed several stages:

- First, the analytical constructs needed to evaluate the concepts were developed- e.g. what precisely was meant to be evaluated by environmental elasticity, how to measure peak capacity, etc.
- Second, the data from the initial data call conducted by TABS was reviewed to determine what data was available and what additional data would be needed for the approach developed.
- Third, questions were drafted for a new data call based on the needed data and given to TABS.
- Fourth, an excel spreadsheet was developed to reflect the analytical constructs and easily manipulate the data collected.
- Fifth, data was “scrubbed and reviewed” as it was available to flag potential problems.
- Sixth, initial runs of the model were conducted- this flagged some additional data issues.
- Seventh, TABS sought confirmation or changes from installations where there were identified data issues.
- Eighth, the new data was run for the final presentation of results as of February 3, 2005.
- Ninth, this report presents that final data run and the issues remaining concerning the approach, methodology and results.

Throughout the project, there were ongoing meetings and consultations with TABS and the Army Environmental Policy Institute (AEPI).

The four resources decided to be evaluated are: 1) Energy (electricity and natural gas), 2) Water (potable and non-potable) and Wastewater (municipal and industrial) treatment, 3) Solid Waste Management and 4) Maintenance of Training Land. Data used for this analysis is obtained from TABS data calls and other authoritative sources. The data reported from the TABS data calls are reviewed to identify potential anomalies. Those cases with apparent anomalies were flagged and further examined by TABS. The reported data were either verified or updated by the reporting installations..

The physical capacity of these resources puts an effective cap on the total number of personnel that may be stationed at an installation without any additional investment. The physical capacity limit of each of these resources is determined based on information from data calls concerning plant sizes, permit limits, etc.

Appendix B presents how the capacity threshold restrictions were calculated for each capacity constrained resource. Appendix C presents the questions in both TABS Data Call 1 and Data Call 2 that were used in this analysis.

The per person usage and costs for each of these resources at existing installations is computed based on existing stationing and cost data. The usage data is then used to calculate how many persons may be stationed at an installation until the *physical* “capacity threshold” for that resource is reached; the cost data is used to determine how much the resources needed for the population at the capacity threshold would cost the installation.

The methodology identifies the “capacity threshold” for energy, water and wastewater. For energy, it is assumed that off-installation supply is unlimited but there are capacity threshold restrictions due to limits on distribution for electric substations and transmission lines and natural gas pipelines. For water supply and wastewater treatment, capacity threshold restrictions may be due to treatment plant size, distribution limits, or permit restrictions.

For training land, other projects underway determine the capacity threshold. For solid waste, it is assumed that off-post disposal is unlimited and there is no capacity threshold limit.

To determine costs, a linear extrapolation of costs for additional personnel is utilized based on current per person usage and cost parameters until the capacity threshold is reached¹. Once a capacity threshold for energy or water is reached, new cost parameters for personnel absorption are applicable.

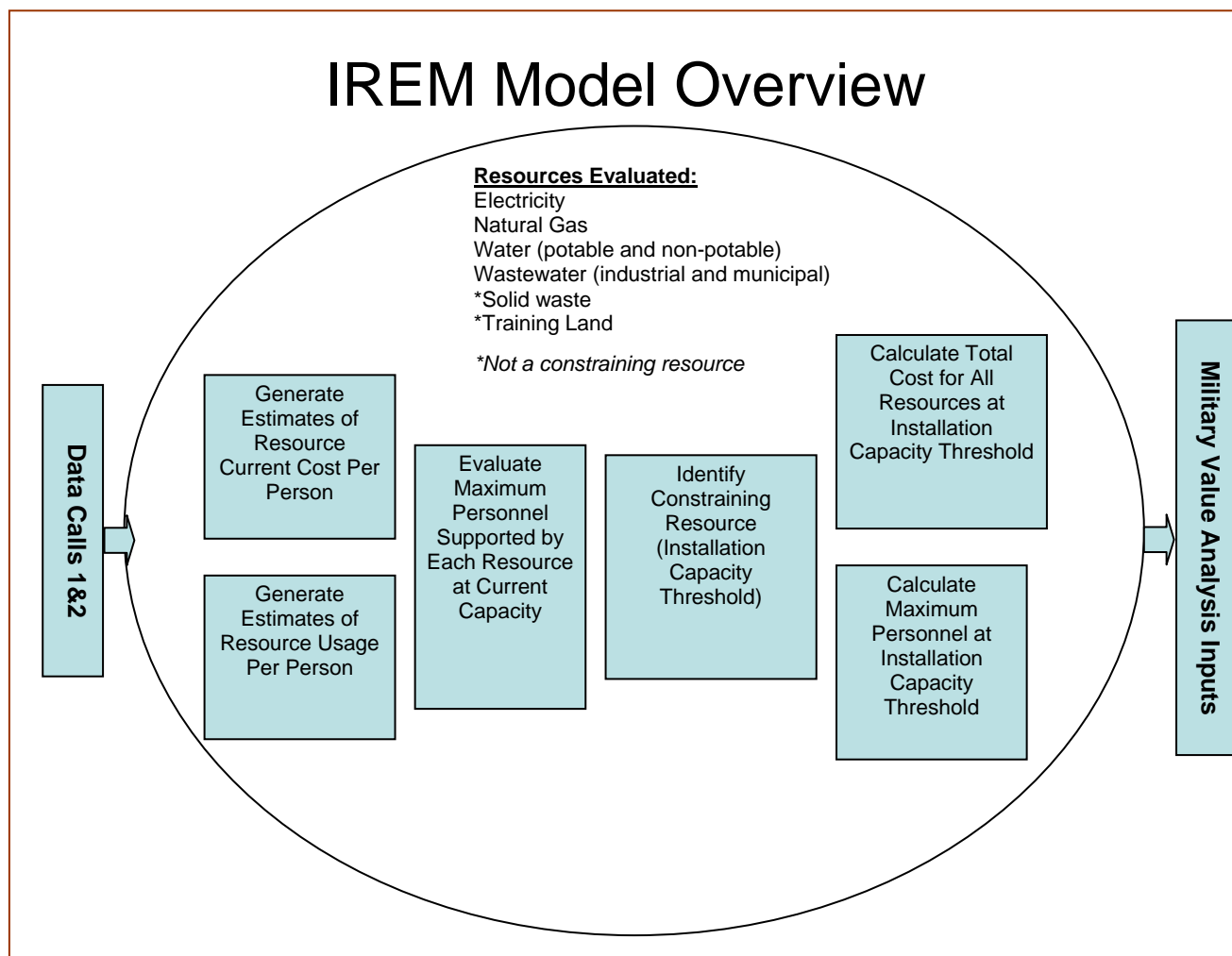
The methodology produces a metric for each installation that reflects an installation’s environmental elasticity: the overall ability of an installation to station personnel at its physical capacity limit for the capacity constrained resources of energy, and water and wastewater treatment in relation to the costs of four environmental resources -- energy, water and wastewater treatment, solid waste management, and maintenance of training land.

A comparison between the total costs for all resources at the maximum number of personnel that can be supported by these resources at an installation, and the number of people that can be supported at this maximum level is presented. These values are primary inputs into the military value assessment.

¹ Individual contracts will not be examined to determine where cost rate increases may be imposed by contract due to increased usage.

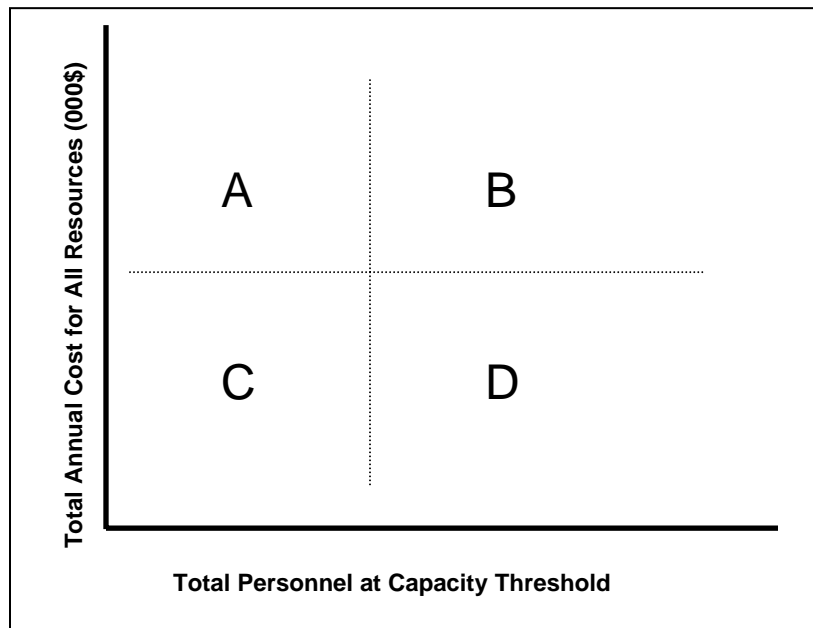
A graphical representation of this process is as follows. This representation shows the key steps in the IREM model process from the raw data inputs on the left hand side through the model outputs on the right hand side.

Figure A
IREM Model Overview



This comparison is based on calculations from the following steps: a calculation of the maximum number of people at an installation's physical capacity threshold (Step vi), and the total annual costs for all the resources at this level of personnel (Step x). This result has been graphed for all installations, with people at the installation's capacity threshold limit on the Y axis and total annual costs for all resources on the X axis. **Figure B** illustrates an example of these graphs. The installations with the most military value would be those in the lower right quadrant (quadrant D in the example below) – the most people at lowest total annual cost; the installations with the least military value would be those in the upper left quadrant (quadrant A in the example - fewest people and highest annual cost. The installations in quadrants B and C would fall in between these in terms of military value.

Figure B
IREM Model Output Analysis



Steps:

- i. Number of Personnel: Data was provided by TABS on the number of personnel (PO) including Soldiers, civilians, dependents and contractors that are currently stationed at an installation.
Result: (PO) number of personnel.
- ii. Peak day or highest monthly usage: Identify by installation, electricity demand for the peak day or the highest monthly usage (from recent FY) for natural gas, potable and non-potable water, and industrial and municipal wastewater treatment resources using responses from Data Call 2 questions 815 (electricity), 818 (natural gas), 822 (municipal and industrial wastewater), 823 (potable water), and 824 (non-potable water).
Result: Usage metric (UO)

- iii. Peak day or highest monthly usage per person: Calculate by installation, peak demand for electricity and highest monthly usage for natural gas, potable and non-potable water, and industrial and municipal wastewater treatment resources per person. Divide peak/highest usage by current population: UO/PO.
Result: usage metric/ person
- iv. Capacity threshold: Determine the capacity threshold in physical terms for the electricity, natural gas, potable and non-potable water, and industrial and municipal wastewater treatment resources using Data Call 1 questions 282 (industrial wastewater), 287 (non-potable water), 291 (potable water), 297 (municipal wastewater) and Data Call 2 questions 816 and 817 (electricity), and 819 (natural gas). Appendix B explains how the capacity threshold is determined for each resource.
Result: usage metric
- v. Maximum number of personnel by resource at the resource's capacity threshold: Calculate maximum number of personnel, by installation, which can be supported at the capacity threshold for electricity (PP_E), natural gas (PP_{NG}), potable (PP_{PW}) and non-potable water (PP_{NPW}), and industrial (PP_{IW}) and municipal wastewater (PP_{MW}) treatment. For each resource, divide the capacity threshold by peak usage per person: Step iv/Step iii.
Result: number of personnel.
- vi. Maximum number of personnel at installation at capacity threshold: Identify the maximum number of personnel the installation as a whole can support (PP_{IT}) by selecting the lowest population from Step v.
Result: number of personnel.
- vii. Total annual costs for each resource from one of the recent FY: Identify for electricity, natural gas, potable and non-potable water, and industrial and municipal wastewater treatment resources, the year with the highest monthly usage or peak. For that year select the total annual costs by installation for these resources from Data Call 2 questions 815 (electricity: AO_E), 818 (natural gas: AO_{NG}), 822 (industrial and municipal wastewater treatment: AO_{IW}, AO_{MW}), 823 (potable water: AO_{PW}), and 824 (non-potable water: AO_{NPW}). For training land maintenance identify the annual cost from Data Call 2 question 821 (AO_{TL}). For solid waste management select the year with the highest annual cost and identify that cost from Data Call 2 question 820 (AO_{SW}).
Result: dollars.
- viii. Cost per person for each resource up to its capacity threshold: Calculate the cost per person for electricity (CP_E), natural gas (CP_{NG}), potable water (CP_{PW}), non-potable water (CP_{NPW}), industrial wastewater (CP_{IW}), municipal wastewater (CP_{MW}), solid waste (CP_S), and training land maintenance (CP_{TL}) by installation at current stationing levels up to the capacity threshold for that resource. Divide total annual recent costs for each resource by current population: Step vii/PO.
Result: \$/person.

- ix. Total cost per person up to installation's capacity threshold: Calculate the total resource cost per person (CP_{IT}) at the capacity threshold the installation as a whole can support. $CP_{IT} = CP_E + CP_{NG} + CP_{PW} + CP_{NPW} + CP_{IW} + CP_{MW} + CP_{SW} + CP_{TL}$.
Result: \$/person
- x. Total annual cost at an installation's capacity threshold: Calculate the total annual cost for all resources at an installation's capacity threshold (AP_{IT}). Multiply the total cost per person by the maximum number of persons that can be supported at an installation's capacity threshold. $AP_{IT} = (CP_{IT}) \times (PP_{IT})$.
Result: dollars
- xi. Review of Data Integrity: The data reported from the TABS data calls and preliminary results of applying the methodology are reviewed to identify potential anomalies. Those cases with anomalies are flagged to enable TABS to further examine and verify the reported data.

B. Data review process

There was a multi-step process used to review and “scrub” the data that came in from the data calls. The first focused on the inputs - the data was reviewed for completeness and reasonableness. The data was checked by comparing it with the reliable, certifiable secondary sources detailed below.

The second stage focused on the outputs from the evaluation using the data – if the calculations produced a result where the personnel currently stationed at an installation exceeded what was determined to be the maximum at the capacity threshold – there a problem but the cause of it was not readily apparent.

After going through these first two steps with the results from the initial data call, data was coded and flagged to TABS so that the data could be checked, changed or verified at the installation level. This initial data screen produced the following results: the data was coded using 1-5 based on the following criteria:

Data Used (0) – All cells contained data that were supported by alternative sources or that appeared reasonable relative to other reported values.

Data Apparently Too High (1) or Too Low (2) – The reported value was 20 percent higher or lower than values shown in alternative sources.

Should Not Be Zero (3) – Based on an evaluation of alternative data sources, a data element contained a zero and should contain a value.

Scale Issue (4) – Based on an evaluation of alternative data sources, the value was reported with an incorrect unit of measure (i.e. millions instead of thousands).

Data Call 1 does not agree with Data Call 2 (5) – For the same data element different data values were reported for Data Call #1 and Data Call #2.

The data was compared against available, defensible sources. The sources used for comparison were: IFS, ISR, DUERS, and ITAM.

IFS: Integrated Facilities System –

This system is the official inventory for all Army real property. Data was used to validate existence or non-existence of utility systems and their relative size at individual installations.

ISR: Installation Status Report -

This annual report provides a systematic process of evaluating the status of installations by measuring their performance against a set of Army-wide standards. It also assists in justifying and allocating resources, both now and in the future. The ISR consists of three parts: Infrastructure, Environment and Services.

Only ISR Services was used for the data validation. System capacity data was used to compare the relative size of the system with the capacity data provided by the data calls.

DUERS: Defense Utility and Energy Reporting System –

This annual report provides information on energy usage by individual installation. This data was used for comparison with the data provided by the data calls.

ITAM: Integrated Training Area Management -

ITAM establishes a systematic framework for decision-making and management of Army training lands. It integrates elements of operational, environmental, master planning, and other programs that identify and assess land use alternatives. There are four components of ITAM: Land Condition Trend Analysis (LCTA), Training Requirements Integration (TRI), Land Rehabilitation and Maintenance (LRAM), and Sustainable Range Awareness (SRA).

After this initial evaluation was completed, each installation's data condition was coded by a red, green, amber, or yellow condition code. While this coding is still contained in the IREM model, the final model outputs contain all installations regardless of data condition. Of the 88 installations reviewed, they were initially coded as follows:

- 56 were coded red:. These installations had either a) missing cost, usage or capacity data and there was no defensible secondary source to use; or b) the reported data was significantly different than the expected range and no defensible secondary source was available.
- 8 were coded green: These installations had both a) complete and apparently reasonable reported cost and usage data, and b) the capacity threshold analysis performed indicated no apparent problems with the data. (The threshold analysis concluded that more soldiers could be stationed at the capacity threshold than are currently there.)

- 10 were coded amber: These installations had both a) reported data that appeared to have problems but could be addressed by changes to scale or use of defensible secondary sources, and b) the capacity threshold analysis performed indicated no apparent problems with the data.
- 14 were coded yellow: These installations had a) reported data that appeared reasonable or b) defensible secondary sources were available for the reported data that appeared questionable or was missing but c) the installations failed the capacity threshold analysis - the analysis indicated that the personnel stationing capability at the capacity threshold would be *lower* than the current stationing. Some not readily apparent data problem is revealed by the analysis.

After this initial screening was done, the problems were reported to TABS who flagged these issues to the installations and sought confirmation, changes or explanation of the apparent data problems. The certified data were updated and the results of this new data inquiry were incorporated into the model and used for the final analysis. Note that there are no amber or red installations contained in the final assessment. Based on the updated data, the state of the installations using the color coding system is:

- 0 were coded “red”.
- 66 were coded “green”:
- 22 were coded “yellow”:

This is the state of the data for the final runs presented in this report in the next section. The date of the runs is February 3, 2005 and the data were pulled from Data Call 1 and Data Call 2 on January 6, 2005. Appendix D lists the installations with their color coding for data condition as of February 3, 2005.

IV. IREM Model Outputs and Results

A. Model Results

The IREM model is a Microsoft Excel spreadsheet model that uses data provided by TABS. The data used to generate the outputs in this analysis were pulled from the Data Call 1 (DC1) and Data Call 2 (DC2) database on January 6, 2005. These results were generated for all installations where data was provided. As noted, Appendix D details the color coding of the installations for their data condition used for this run.

The model uses the data from DC1 and DC2 and:

- 1) Calculates each resource's costs per person
- 2) Calculates each resource's usage per person
- 3) Calculates the maximum number of personnel supported by each resource
- 4) Selects the constraining resource and determines the maximum personnel supported at the installation
- 5) Calculates the total cost per person for all resources
- 6) Calculates the total annual costs for the maximum number of personnel that the installation can support.

The outputs are generated for 88 installations and include the annual resource cost per person at an installation's capacity threshold and the total the number of personnel at capacity threshold. These outputs may then be used to conduct further analysis.

The following Table A shows the calculated the Maximum Number of Personnel at Capacity Threshold, and the Total Annual Costs at Capacity Threshold for each installation. These are sorted in descending order ranked by the maximum number of personnel.

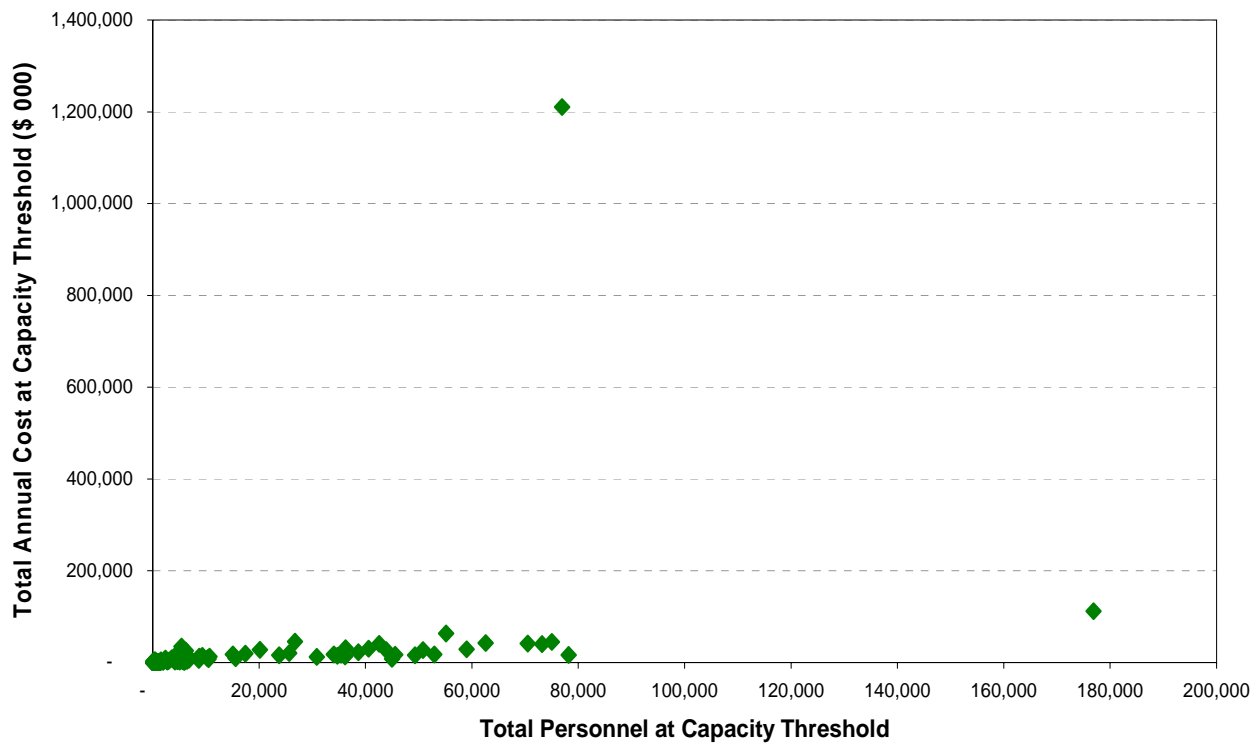
TABLE C
Maximum Personnel and Total Annual Costs at Capacity Threshold

Installation Name	Cost (\$K)	Personnel
Fort Sam Houston	111,879	176,893
Fort Jackson	16,632	78,197
Fort Benning	1,210,219	76,956
Fort Hood	44,943	75,037
Fort Bragg	40,166	73,175
Fort Lewis	41,742	70,532
Fort Campbell	42,554	62,599
Fort Knox	29,242	59,027
Aberdeen Proving Gnd	63,667	55,177
Fort Sill	17,964	52,962
Fort Bliss	27,357	50,840
Fort Leonard Wood	16,222	49,304
Fort Gillem	17,008	45,605
Fort Meade	8,180	44,976
Schofield Barracks	27,177	43,900
Redstone Arsenal	41,010	42,576
Fort Drum	30,137	40,612
Fort Rucker	22,461	38,673
Fort Stewart	31,563	36,269
Fort Gordon	13,637	36,184
Fort Eustis	16,913	35,418
Fort McPherson	14,911	34,695
Fort Huachuca	17,807	34,046
Fort Lee	12,461	30,838
Fort Dix	45,820	26,765
Fort Carson	20,906	25,681
Fort Leavenworth	16,142	23,803
NTC and Fort Irwin	28,111	20,175
West Point Mil Res	19,714	17,441
Fort Shafter	9,302	15,612
White Sands Missile Rng	18,029	15,057
Fort Monmouth	13,139	10,705
Fort McNair	7,650	10,504
Fort Richardson	9,657	10,310
Fort McCoy	14,800	9,312
Fort Detrick	13,066	8,765
Fort Polk	6,197	8,676
Fort Buchanan	6,444	6,843
Picatinny Arsenal	14,417	6,610
Detroit Arsenal	3,695	6,475
Watervliet Arsenal	26,169	6,222
Anniston Army Depot	15,539	6,102
Fort Wainwright	2,017	5,995
Rock Island Arsenal	2,525	5,857

Installation Name	Cost (\$K)	Personnel
Military Ocean Tml	3,096	5,643
Fort Hamilton	5,349	5,553
Tobyhanna Army Depot	9,064	5,536
Lake City AAP	34,972	5,416
Presidio of Monterey	2,321	5,091
Charles E Kelly Spt Fac	3,156	4,685
Letterkenny Army Depot	6,126	4,652
Tripler Army Medical Center	6,276	4,646
Carlisle Barracks	4,522	4,597
Riverbank AAP	16,173	4,328
Corpus Christi Arm	6,653	4,225
Yuma Proving Gnd	2,484	4,194
Sierra Army Depot	11,023	4,124
Red River Army Depot	7,240	3,748
Pine Bluff Arsenal	9,646	3,601
Soldier Systems Ctr	3,896	3,074
Dugway Proving Gnd	2,567	2,758
US Army Garrison S	2,944	2,705
McAlester AAP	3,765	2,694
Lima Army Tank Plt	8,764	2,424
Deseret Chemical Depot	2,838	1,978
Tooele Army Depot	1,746	1,968
Walter Reed AMC	4,294	1,699
Adelphi Laboratory	4,858	1,532
Fort Riley	678	1,428
Fort Belvoir	739	1,396
Newport Chem Depot	831	1,295
Blue Grass Army Depot	1,492	1,265
Pueblo Chem Depot	1,049	1,113
Fort A P Hill	2,024	1,101
Fort Monroe	555	929
Hawthorne Army Depot	1,010	805
Lone Star AAP	2,115	589
Kansas AAP	2,784	532
Fort Myer	545	529
Scranton AAP	5,004	464
Milan AAP	993	387
Mississippi AAP	4,491	291
Crane AAP	3,418	201
Umatilla Chem Depot	690	194
Radford AAP	856	188
Iowa AAP	244	143
Holston AAP	1,275	105
Louisiana AAP	2	2

Graph A is a graphical representation of the model outputs with total annual costs on the Y axis, and maximum number of personnel on the X axis. Graph A shows all installations regardless of data condition.

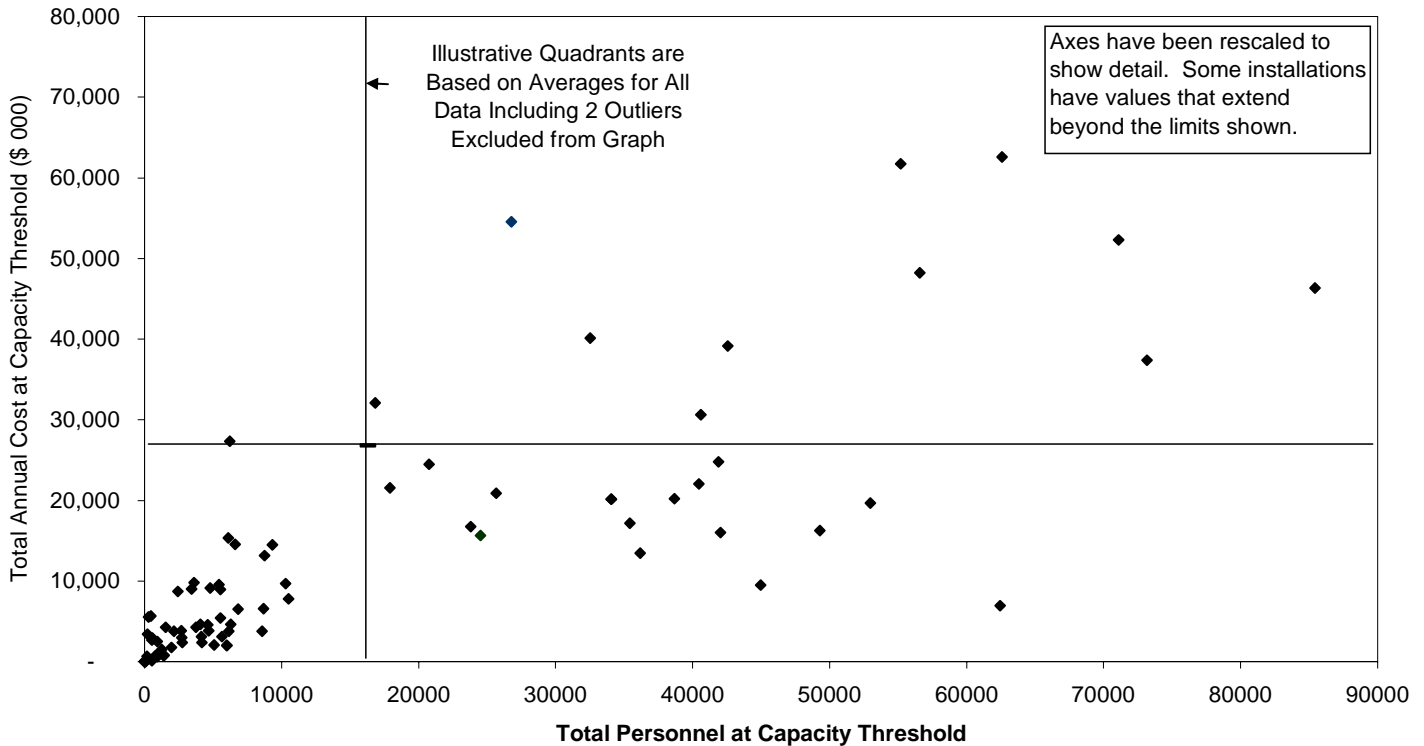
Graph A:
Maximum Personnel at Capacity Threshold and Total Annual Costs at Capacity Threshold (all installations)



Graph B shows the same data but with two outliers removed for display purposes. The two installations removed are Fort Benning and Fort Sam Houston. Graph B also includes an overlay that depicts four notional quadrants. These quadrants were defined by the average value for both the maximum number of personnel and the total annual cost at capacity. Using these notional quadrants, the graph illustrates that the installations with the most military value would be those in the lower right quadrant – the most people at lowest total annual cost; the installations with the least military value would be those in the upper left quadrant - fewest people and highest annual cost.

Graph B

Maximum Personnel at Capacity Threshold and Total Annual Costs at Capacity Threshold (2 outlier installations removed and notional quadrants inserted)



B. Results Analysis

The IREM model allows for analysis of statistics both across and within installations. An example of the type of data that can be generated is an analysis of constraining resources across installations. Table D shows a summary of constraining resources for the installations studied. This table depicts the constraining resource in the left column, the number of installations constrained by the resource in the middle column and the percentage of total installation in the right column. For example the table illustrates that over half of the installations studied were constrained by either electricity (31%) or potable water (27%) resources.

Table D. Summary of Installation Resource Constraints

	Number of Installations	Percent of Installations Studied
Potable Water	27	31%
Electricity	24	27%
Municipal Waste Water	18	20%
Natural Gas	11	13%
Industrial Waste Water	8	9%
Total	88	100%

C. Data limitations and assumptions

In constructing the methodology, several assumptions were made about the data and how it would be used. No assumption or data limitation fundamentally affects the initial conclusions, but there are facets of the assumptions and results that should be explored in further detail in the scenarios. The following are the assumptions about the data that might be relevant to the scenario evaluation.

- First, no individual contracts were examined so the costs for a resource were all based on a linear extrapolation of costs from the average cost. Many contracts may contain “ratchet” clauses that increase prices if more than a specified amount of a resource- e.g. electricity, is used.
- Second, the peak usage per person may be different than that calculated. For the purposes of this calculation, the number of personnel at an installation is based on the current number of personnel. The peak usage of the resource was selected from the highest of the last 3 reported years. If the peak usage was three years ago, there may have been a different number of personnel on the base at that time, and accordingly the peak use per person may in fact have been different.

In addition, the methodology assumes that the resource use per person for additional personnel remains the same as for existing personnel. This assumes that the type of function performed on the installation by the new or added personnel is consistent with that being performed currently.

- Third, the total annual costs may be different than that calculated. The methodology chose the costs from the peak year that was evaluated to determine cost per person for the resource. If that peak year was three years ago, there may have been significant rate increases since that time.
- Fourth, it was assumed for purposes of electricity, natural gas and water that the installation was “networked”. All substations that served an installation, or transmission lines or pipelines that came into it, were summed to determine the entire installation capacity threshold. It was assumed that these could serve anywhere on the installation.
- Fifth, for a few installations, there was an apparent “unconstrained” resource because no resource use, costs or capacity restriction was reported due to their relationship with a larger entity- such as another base. This other base was the reporting entity for the resource - and there may indeed be capacity restrictions on it.
- Sixth, the actual costs for some resources such as those for electricity, (MW), and natural gas, (MCF), reflect a blend of the costs for both peak use and consumption. In the analysis, all these costs were assigned to the peak usage. The costs presented therefore may not correspond to actual costs on billing information.
- Seventh, the hard capacity constraint presented is a real one. However, it is recognized that a small amount of additional personnel may be added by “stretching” the capacity of the resource to support additional personnel through low cost measures- such as additional efficiency improvements for electricity use; or perhaps obtaining additional permits for water use. The amounts and costs of this “stretch” capacity were not evaluated.
- Eighth, training land and solid waste are not considered as constrained resources. It is recognized that training land in particular is an environmental resource that is critically important to the Army that is realistically constrained. However, other projects underway are designed to address this. In addition, training land was only analyzed for maintenance costs, and the costs evaluated were only current expenditures - not the amount of money need to bring the land up to specified conditions. For solid waste, the assumption of a linear extrapolation of costs should be noted. If the material must be hauled much further than it currently is, costs may be higher than currently paid and a linear extrapolation would be incorrect.

V. IREM Model Input to Military Value Analysis

The results developed in this project are the environmental elasticity inputs to the model for military value that will be used by TABS.

The calculated results and inputs to the military value model for each installation are the Maximum Number of Personnel at Capacity Threshold (PPIT), and the Total Annual Cost at Capacity Threshold (APIT).

Value Function

The value function plots Maximum Number of Personnel at Capacity Threshold and Total Annual Costs at Capacity Threshold into the matrix below resulting in a military value for the installation. The matrix below is illustrative – the actual breakpoint values for the columns and rows will be established after reviewing the output data.

Cost (\$K)	Capacity Threshold (Persons)		
	<=1000	<=20000	>20000
>10000	Label 1	Label 2	Label 3
<=10000	Label 4	Label 5	Label 6
<=2500	Label 7	Label 8	Label 9

The Maximum value of 10 will be given to the installations with the largest populations at the lowest total annual costs. The Minimum value of 0 will be given to the installations with the smallest populations at the highest total annual costs.

The assessment of the function is determined by TABS and coordinated with the Army Environmental Policy Institute (AEPI).

The value function will provides the military value of the installation with regards to the environmental elasticity. The scores will be normalized on a scale of zero to ten based on the value function.

VI. IREM Model Additional Capabilities

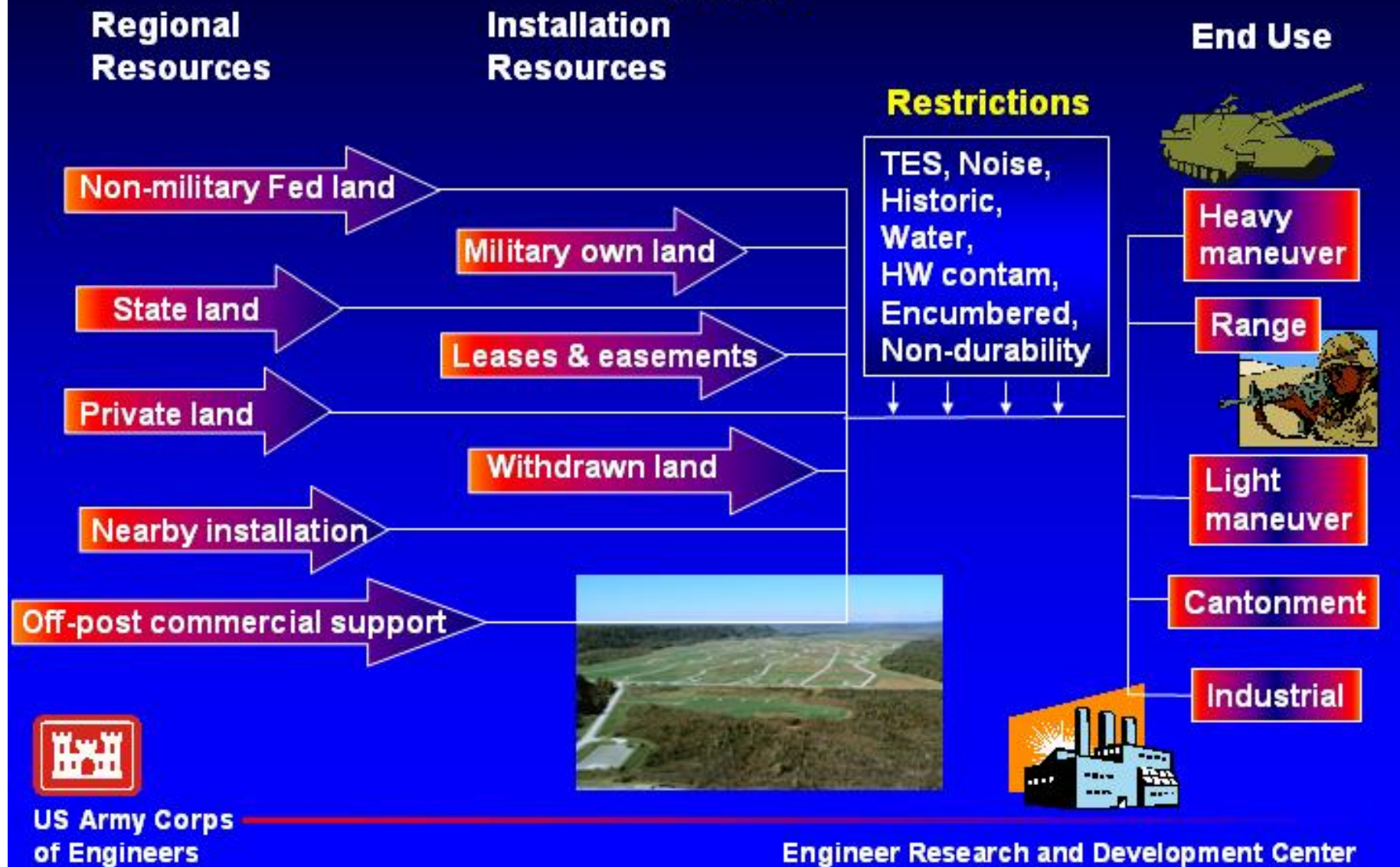
In addition to the outputs required to conduct the Military Value Analysis, the IREM Model has the ability to generate multiple outputs depending on the analytical requirement. This model can provide:

- **Additional Personnel Assessment (APA):** The Additional Personnel Assessment Metric measures an installation's average resource cost per person at its capacity threshold compared to the number of additional personnel that can be added from the current population until the capacity threshold is reached.
- **Traditional Elasticity Measurements.** The total annual costs at the capacity threshold minus the total annual current costs divided by the number of personnel at the capacity threshold minus the current personnel. This metric was investigated but discarded since there is a linear relation between additional personnel and additional costs. This metric can be used and is useful for all non-linear input data.
- **Derived Unit Resource Costs.** A calculation of the costs *per physical unit* for each capacity constrained resource up to the resource's individual physical capacity threshold. These measures show the derived costs for each (constrained) resource and the number of personnel supported at each resource's capacity threshold. The resource costs are expressed in terms of \$ per resource metric (e.g., \$/kW) for each installation.
- **Per Person Resource Costs.** A calculation of the annual costs *person* for each capacity constrained resource up to the resource's individual physical capacity threshold
- **Resource Constraints and Capacity Factors.** An indicator of the binding resource constraint at each installation. This measure can show the resource surpluses by installation (measured in units or people) and the percentage of the resource currently being utilized.
- **New Resource Assessments.** This project evaluated only four specified resources – 1) energy (electricity and natural gas); 2) water (potable and non-potable) and wastewater (industrial and municipal); 3) solid waste and 4) maintained training land. Only two of these - energy, and water and wastewater - were deemed to have capacity restrictions. The model may evaluate other resources - which could include a capacity constrained land resource or other resources such as regional air quality emission restrictions.
- **Stretch Capacity Assessment.** The model also has the capability to estimate the number of additional personnel that can be absorbed by an installation by stretching or increasing capacity through initiatives such as low cost efficiency or conservation programs. For example, an installation constrained by potable water may be able to increase its capacity to support additional personnel through various water conservation measures. No data was collected during the course of this project to calculate or analyze increases in resource capacities.

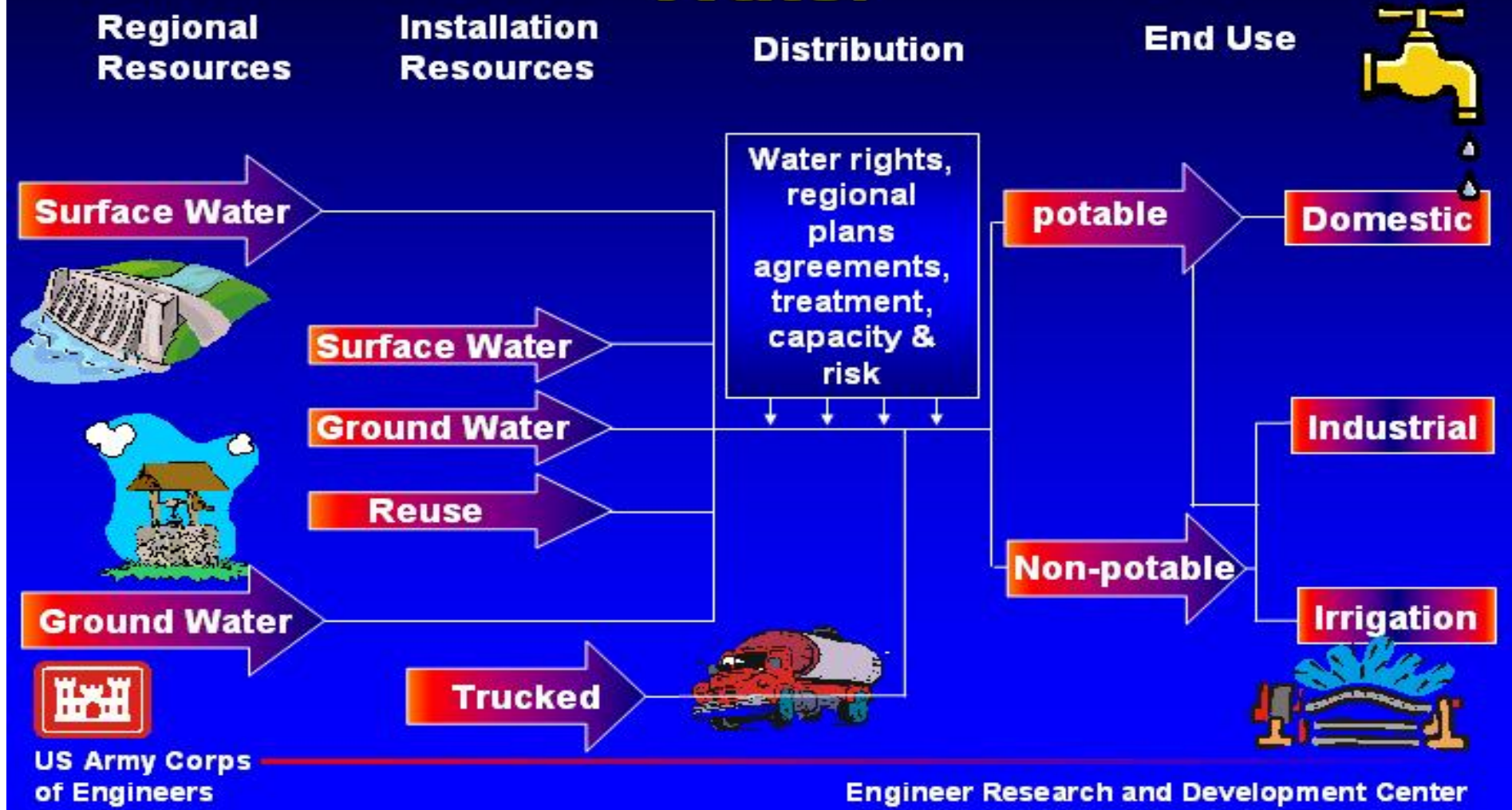
Appendix A

Resource Infrastructure and Processing Process Flows

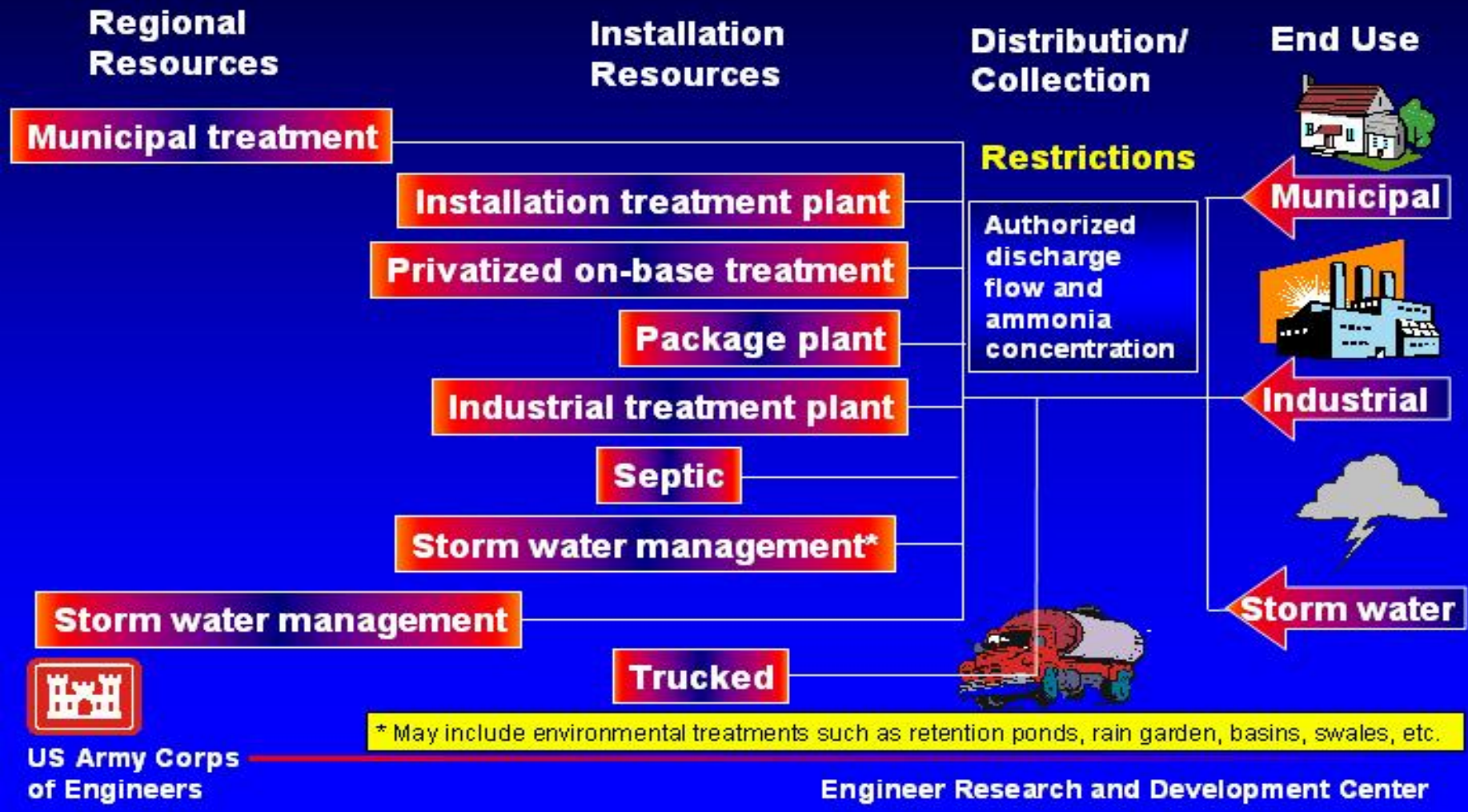
Installation Resource Architecture: Land



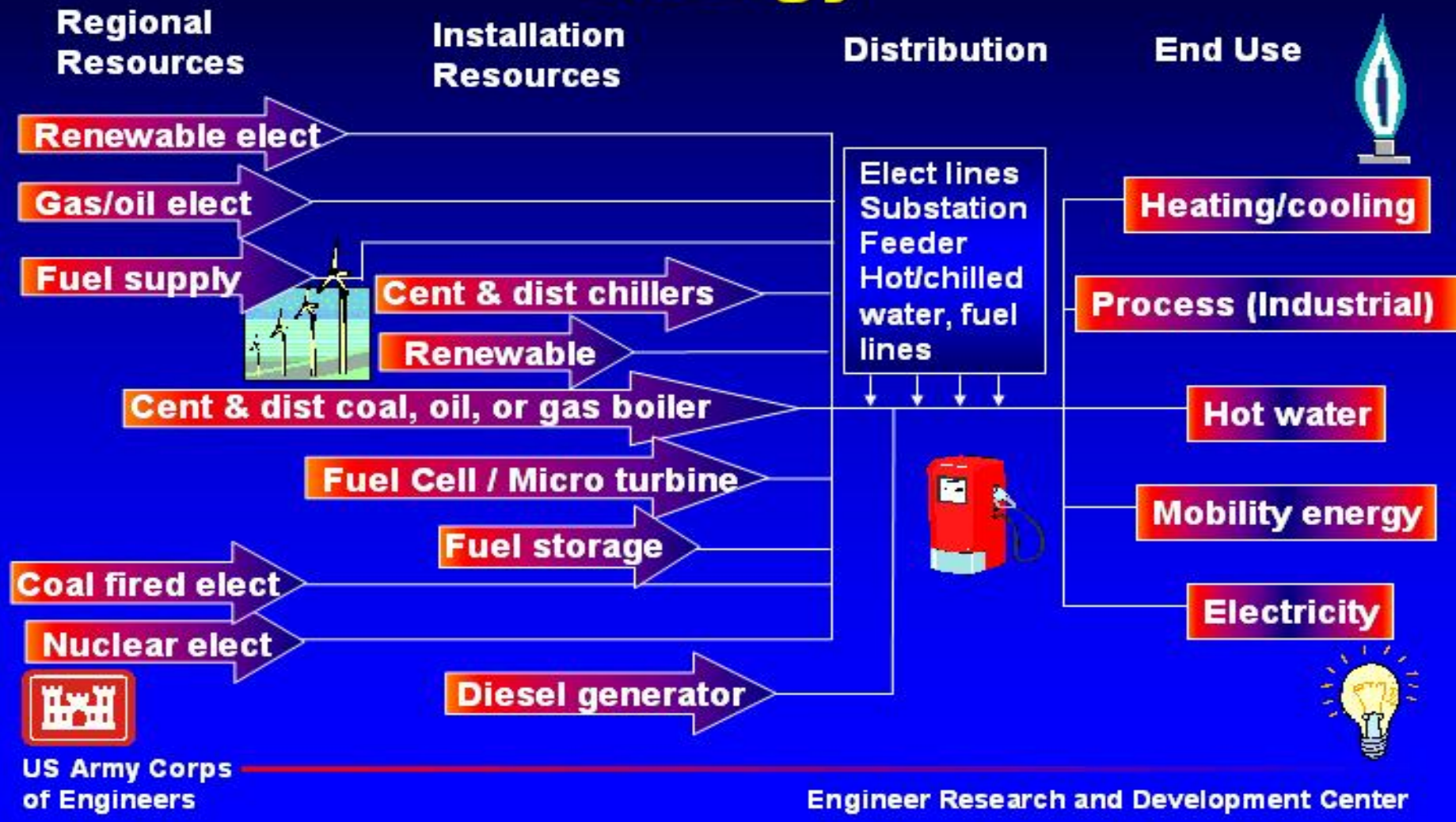
Installation Resource Architecture: Water



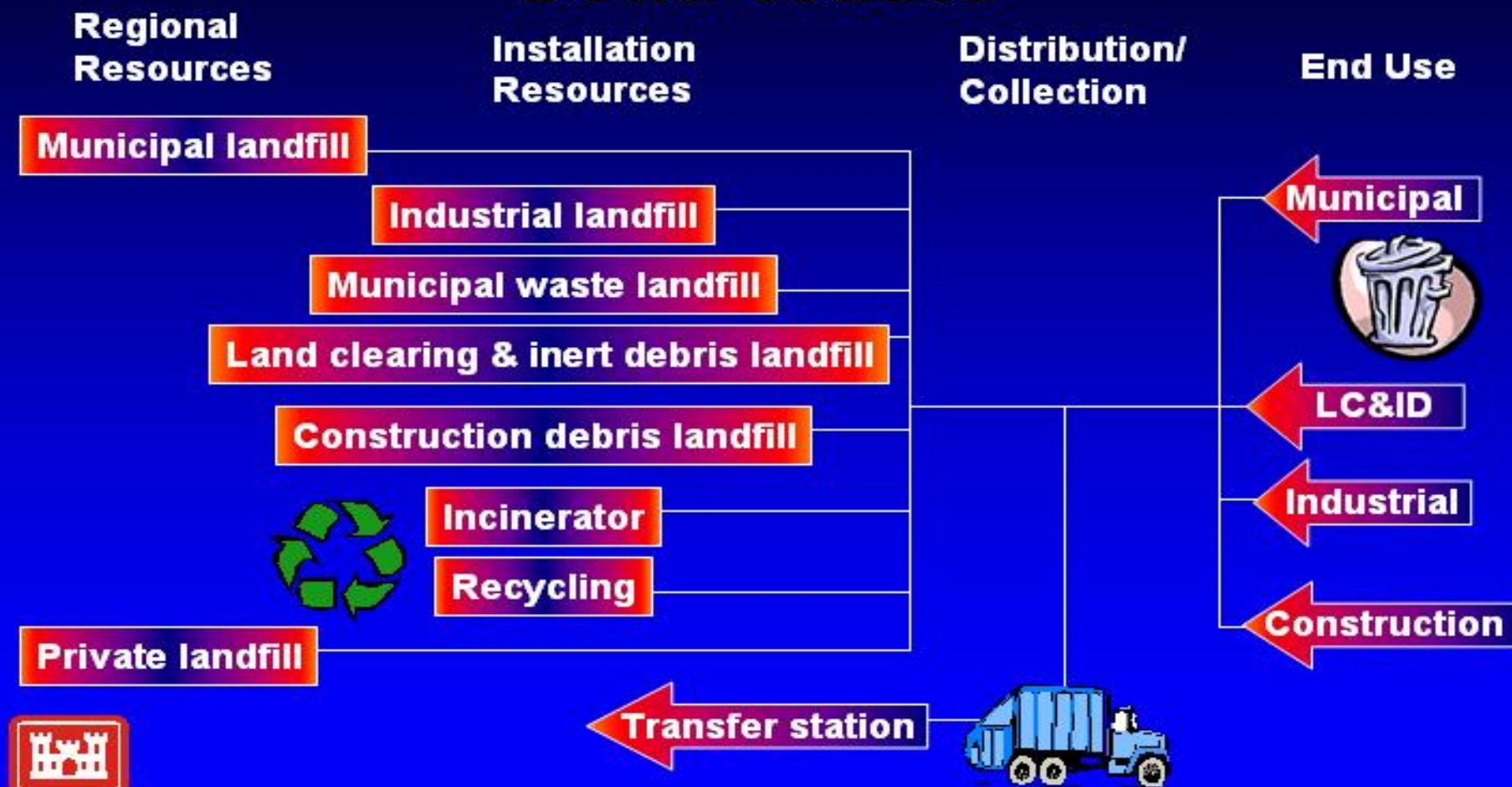
Installation Resource Architecture: Wastewater



Installation Resource Architecture: Energy



Installation Resource Architecture: Solid Waste



US Army Corps
of Engineers

Engineer Research and Development Center

Appendix B

Calculations for Physical Capacity Thresholds

Energy

Electricity

1) Dedicated Substations

From Q 816: add the KW for all dedicated substations serving the whole installation.

From Q 816: add the KW for all transmission lines listed for each dedicated substation.

The lower of these numbers is the capacity limit of the dedicated substations serving the installation.

2) Non Dedicated Substations

From Q 817: for the year with the highest peak day, subtract the KW peak demand from the KW capacity rating for each substation listed. Add the differences for each non-dedicated substation listed.

3) Add results from 1) and 2) to determine the physical capacity threshold for electricity.

Natural Gas:

From Q819 sum the capacity of all the natural gas pipelines servicing the whole installation to determine the capacity threshold.

Water

Potable:

From Q 291 for each water source select the lowest of either design or permitted maximum daily production capacity. Add the selected maximum daily production capacity from each water source to establish the installation capacity threshold for potable water.

Non-potable:

From Q 287 sum the maximum daily production capacity from each water source to establish the installation capacity threshold for non-potable water.

Wastewater

Municipal (sanitary sewage):

From Q297 for each plant or system select the lowest of either design or permitted maximum daily treatment processing capacity. Add the selected maximum daily treatment processing capacity from each plant or system to establish the installation capacity threshold for municipal wastewater.

Industrial:

From Q282 for each plant or system select the lowest of either design or permitted maximum daily treatment processing capacity. Add the selected maximum daily treatment processing capacity from each plant or system to establish the installation capacity threshold for industrial wastewater.

Appendix C

Questions that Define Data

Data Call # 1:

DOD #282: Industrial Wastewater Treatment System (Final #601)

DOD #283: Largest Peak Monthly Outflow for Industrial Wastewater (Final #576)

DOD #287: Non-Potable Water Use (Final #557)

DOD #288: Peak Monthly Consumption of Non-Potable Water (Final #558)

DOD #291: Potable Water Production (Final #562)

DOD #292: Potable Water Consumption Peak Month (Final #573)

DOD #297: Sanitary Sewage Treatment System / Plant (Final #564) (referred to as Municipal Wastewater Treatment)

DOD #298: Largest Peak Flow for Sanitary Sewage (Final #574) (referred to as Municipal Wastewater Treatment)

Data Call #2:

Reference #815: Electricity Peak Demand and Total Annual Cost

Reference #816: Distribution Capacity Rating for Dedicated Substation(s) and Transmission Line(s)

Reference #817: Distribution Capacity Rating and Peak Demand for Non-dedicated Substation(s)

Reference #818: Natural Gas: Highest Monthly Usage and Total Annual Cost

Reference #819: Natural Gas Pipeline Capacity

Reference #820: Total Annual Cost of Solid Waste Collection and Disposal

Reference #821: Total Annual Cost of Training Range Maintenance and Repair

Reference #822: Wastewater Treatment: Highest Monthly Usage and Total Annual Operational Cost

Reference #823: Potable Water: Highest Monthly Usage and Total Annual Cost

Reference #824: Non-Potable Water: Highest Monthly Usage and Total Annual Cost

DOD #282: Industrial Wastewater Treatment System (Final #601)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Industrial Wastewater

Sub Group: Environmental

Theme: Environment

Question: If the installation has an industrial wastewater treatment system, complete the table for FY 2003:

Amplification: permitted capacity = NPDES or other applicable permit

Provide the peak monthly outflow/amount treated as derived in each applicable category (government owned plant/wells, privatized plant/wells, and/or publicly owned/commercial source).

For treatment/processing purchased from off-base resources or accomplished from on-base privatized resources, "Permitted Daily Treatment/System Capacity " is the maximum daily volume of industrial wastewater that can be treated/accepted without additional cost over the basic rate or without violating a permit.

For industrial wastewater treated/processed by government-owned plants, "Maximum Daily treatment/System Capacity (Design)" is the maximum sustained volume of sewage the plant can process/treat per day. DO NOT consider manpower limitations; rather consider plant/physical limitations only.

For off-base treatment facilities, "Maximum Daily Treatment/System Capacity (design)" the design capacity of the sewer at the service connection.

Column Headings for this question

Column names	Data Type	Source/Reference	Amplification
Name (System Identifier) (Text)	string50		
Location (List) (List Values: On Military Installation Govt Owned Plant, On Military Installation Govt Privatized Plant, Off Military Installation Publicly Owned Plant, Off Military Installation Commercial Source)	multiple choice		
Peak Monthly Outflow/Treated (MGM)	numeric		
Maximum Peak Daily Outflow/Treated (MGD)	numeric		
Permitted Daily Treatment/System Capacity (MGD)	numeric		
Maximum Daily Treatment/System Capacity (Design) (MGD)	numeric		

DOD #283: Largest Peak Monthly Outflow for Industrial Wastewater (Final #576)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Industrial Wastewater

Sub Group: Environmental

Theme: Environment

Question: For the period FY 1999-2003, provide the month, year and volume of largest peak monthly outflow of Industrial Wastewater.

Source / Reference: Installation DUERS Report. For Air Force installations, an additional source may be AF Form 3552

Amplification: GENERAL NOTE: Include utilities data for the entire installation, including service to military family housing (MFH). Consult with the Maintenance Engineer and/or Utilities Engineer in the host Civil Engineer squadron for data.

Example of how your grid will look

Peak	Date (MM/YY)	Peak (MGM)
Largest Peak Monthly Outflow		

DOD #287: Non-Potable Water Use (Final #557)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Non-Potable Water

Sub Group: Environmental

Theme: Utilities

Question: If the military installation has a non-potable water system, complete the following table for FY 2003 Non-Potable Water:

Non-Potable Water (includes gray water, recycled wastewater, industrial water, untreated ground/surface water, etc.). Potable water consumed for industrial sources (such as for irrigation) should be included in the potable water data.

Source / Reference: Installation DUERS Report. For Air Force installations, an additional source may be AF Form 3552.

Amplification: NOTES:

(7) Provide the peak monthly consumption derived from each applicable category (government owned plant/wells, privatized plant/wells, and/or publicly owned/commercial source).

(8) For water purchased from off-base resources or produced from on-base privatized resources, "maximum daily production" is the maximum daily volume of non-potable water, stipulated in the contract, that the supplier will provide without additional cost over the basic rate. For water received from government-owned plant/wells, "maximum daily production" is the maximum sustained volume of non-potable water the plant/well can produce per day. DO NOT consider manpower limitations; rather consider plant/physical limitations only.

Non-Potable Water (includes gray water, recycled wastewater, industrial water, untreated ground/surface water, etc.). Potable water consumed for industrial sources (such as for irrigation) should be included in the potable water data.

GENERAL NOTE: Include utilities data for the entire installation, including service to military family housing (MFH). Consult with the Maintenance Engineer and/or Utilities Engineer in the host Civil Engineer squadron for data. The term "implemented" implies any actions either voluntary or directed which the base personnel took to change their procedures.

Example of how your grid will look

FY 2003

	Peak monthly consumption (7) (MGM)	Maximum daily production capacity (8) (MGD)
On-Base Resources / Government Owned Plant		
On-Base Resources / Privatized Plant		
Off-Base Resources / Publicly Owned / Commercial Source		

DOD #288: Peak Monthly Consumption of Non-Potable Water (Final #558)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Non-Potable Water

Sub Group: Environmental

Theme: Utilities

Question: For the period FY 1999-2003, provide the month, year and volume of largest peak monthly consumption of Non-Potable Water.

Source / Reference: Installation DUERS Report. For Air Force installations, an additional source may be AF Form 3552.

Amplification: Non-Potable Water (includes gray water, recycled wastewater, industrial water, untreated ground/surface water, etc.). Potable water consumed for industrial sources (such as for irrigation) should be included in the potable water data.

GENERAL NOTE: Include utilities data for the entire installation, including service to military family housing (MFH). Consult with the Maintenance Engineer and/or Utilities Engineer in the host Civil Engineer squadron for data. The term "implemented" implies any actions either voluntary or directed which the base personnel took to change their procedures.

Example of how your grid will look

Peak	Date (MM/YY)	Volume (MG)
Largest Peak Monthly Consumption		

DOD #291: Potable Water Production (Final #562)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Potable Water

Sub Group: Environmental

Theme: Utilities

Question: Complete the table for FY 2003 for each potable water system / treatment facility.

Source / Reference: Installation DUERS Report. For Air Force Installations, an additional source may be AF Form 3552

Amplification: Provide the peak monthly consumption derived from each applicable category (government owned plant/wells, privatized plant/wells, and/or publicly owned/commercial source).

“Permitted daily production capacity” is the maximum daily volume of potable water, stipulated in the contract or permit, that can be provided without additional cost over the basic rate or without violating the permit or contract.

“Maximum daily production (design)” is the maximum sustained volume of water the plant/well can produce per day. DO NOT consider manpower limitations; rather consider plant/physical limitations only. For off-base sources, provide the design capacity at the service connection.

Column Headings for this question

Column names	Data Type	Source/Reference	Amplification
Name (System Identification) (Text)	string50		
Location (List) (List Values: On Military Installation Govt Owned Plant, On Military Installation Govt Privatized Plant, Off Military Installation Publicly Owned, Off Military Installation Commercial Source)	multiple choice		
Peak Monthly Consumption (MG per month) (MGM)	numeric		
Maximum Peak Daily Consumption (if available) (MGD)	numeric		
Permitted Daily Production Capacity (MGD)	numeric		
Maximum Daily Production Capacity (Design) (MGD)	numeric		

DOD #292: Potable Water Consumption Peak Month (Final #573)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Potable Water

Sub Group: Environmental

Theme: Utilities

Question: For the period FY 1999-2003, provide the month, year and volume of largest peak monthly consumption of Potable Water.

Source / Reference: Installation DUERS Report. For Air Force installation, an additional source may be AF Form 3552.

Amplification: GENERAL NOTE: Include utilities data for the entire installation, including service to military family housing (MFH). Consult with the Maintenance Engineer and/or Utilities Engineer in the host Civil Engineer squadron for data. The term "implemented" implies any actions either voluntary or directed which the base personnel took to change their procedures.

Example of how your grid will look

Peak	Date (MM/YY)	Volume (MGM)
Largest Peak Monthly Consumption		

DOD #297: Sanitary Sewage Treatment System / Plant (Final #564)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Sanitary Sewage Treatment

Sub Group: Environmental

Theme: Utilities

Question: Complete the following table for FY 2003 for each sanitary sewer system / treatment plant for the military installation.

Source / Reference: Installation DUERS Report. For Air Force installations, also use AF Form 3552.

Amplification: Provide the peak monthly outflow/amount treated as derived in each applicable category (government owned plant/wells, privatized plant/wells, and/or publicly owned/commercial source). Peak monthly outflow/treated equals the largest monthly total for the period of FY2003.

“Permitted daily treatment/processing capacity” is the maximum daily volume of sanitary sewage, stipulated in the contract or permit, that may be treated/processed without additional cost over the basic rate and without violating the permit/contract.

“Maximum daily treatment/processing capacity” is the maximum sustained volume of sewage the plant or system can process/treat/deliver per day. DO NOT consider manpower limitations; rather consider plant/physical limitations only. If the treatment plant is located off of the military installation, use the design capacity of the sanitary sewer at the service connection.

Column Headings for this question

Column names	Data Type	Source/Reference	Amplification
Name (Site ID) (Text)	string50		
Location (List) (List Values: On Military Installation Govt Owned Plant, On Military Installation Privatized Plant, Off Military Installation Publicly Owned Plant, Off Military Installation Commercial Source)	multiple choice		
Peak Monthly Outflow/Treated (MG per mont) (MGM)	numeric		
Maximum Peak Daily Outflow/Treated (MGD)	numeric		
Permitted Daily Treatment/Processing Capacity (MGD)	numeric		
Maximum daily treatment/processing capacity (Design) (MGD)	numeric		

DOD #298: Largest Peak Flow for Sanitary Sewage (Final #574)

JCSG: Environment

Index: Environment and Encroachment: Environment: Water Resources: Sanitary Sewage Treatment

Sub Group: Environmental

Theme: Environment

Question: For the period FY 1999-2003, provide the month, year, and volume of largest peak monthly outflow of sanitary sewer wastewater.

Source / Reference: Installation DUERS Report. For Air Force installation, an additional source may be AF Form 3552.

Amplification: GENERAL NOTE: Include utilities data for the entire installation, including service to military family housing (MFH). Consult with the Maintenance Engineer and/or Utilities Engineer in the host Civil Engineer squadron for data. The term "implemented" implies any actions either voluntary or directed which the base personnel took to change their procedures.

Example of how your grid will look

Peak	Date (MM/YY)	Volume (MGM)
Largest Peak Monthly Outflow		

Reference #815: Electricity Peak Demand and Total Annual Cost

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the highest kW demand for electricity on the installation on the peak day during each of the fiscal years: FY01, FY02, and FY03? What was the total annual electric cost in Thousands of Dollars for FY01, FY02, and FY03?

Source / Reference: Local records.

Amplification: Report Actual Dollars paid to the utilities supplier, do NOT adjust for inflation. Do NOT include any costs associated with the utility privatization process, or electricity from on-site generation.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Peak Demand Day (KiloWatts) numeric	Total Annual Cost (\$K) numeric
FY01		
FY02		
FY03		

Reference #816: Distribution Capacity Rating for Dedicated Substation(s) and Transmission Line(s)

JCSG: Army

Function(s): Environmental Elasticity

Question: What is the kW capacity rating for each dedicated substation servicing the installation? What is the kW capacity rating for each transmission line from a dedicated substation(s) to the installation?

Source / Reference: Local Utility

Amplification: A dedicated substation provides service solely to the installation. Dedicated Substations may be on or off the installation, regardless of ownership (Commercial or Installation). For substations with more than one transmission line, it is necessary to repeat the substation's name multiple times. This will provide a separate listing for each transmission line associated with that substation.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s), adding rows as necessary

Dedicated SubStation Name (Text) string75	Substation Capacity Rating (KiloWatts) numeric	Transmission Line Identification (Text) string50	Transmission Line Capacity Rating (KiloWatts) numeric

Reference #817: Distribution Capacity Rating and Peak Demand for Non-dedicated Substation(s)

JCSG: Army

Function(s): Environmental Elasticity

Question: If the installation is serviced by any substation(s) other than a dedicated substation, what is the kW capacity rating of each of the substation(s)? What is the greatest single peak demand from all users (all electric customers, including the installation, served by that substation) over the three year period FY01 – FY03?

Source / Reference: Local Utility

Amplification: A non-dedicated substation services other customers in addition to the installation.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s), adding rows as necessary

SubStation Name (Text) string75	Capacity Rating (KiloWatts) numeric	Greatest Peak Demand Day (KiloWatts) numeric

Reference #818: Natural Gas: Highest Monthly Usage and Total Annual Cost

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the highest monthly usage in Thousand Cubic Feet (MCF) for natural gas on the installation during each of the fiscal years: FY01, FY02, and FY03? How many days were in the reported month? What was the total annual natural gas cost in Thousands of Dollars for FY01, FY02, and FY03?

Source / Reference: Local records.

Amplification: ANSWER ONLY IF the installation purchases natural gas through a pipeline(s) from outside the installation. Mark N/A, if the installation DOES NOT purchase natural gas through a pipeline. Report Actual Dollars paid to the utilities supplier, do NOT adjust for inflation. DO NOT include any costs associated with the utility privatization process.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Highest Monthly Usage (MCF) numeric	Number of Days for Highest Usage Month (#) numeric	Total Annual Cost (\$K) numeric
FY01			
FY02			
FY03			

Reference #819: Natural Gas Pipeline Capacity

JCSG: Army

Function(s): Environmental Elasticity

Question: What is the capacity of EACH natural gas pipeline servicing the installation in terms of a Thousand Cubic Feet per Day (MCF/Day)?

Source / Reference: Local Utility

Amplification: If there are NO pipelines servicing the installation, check N/A.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s), adding rows as necessary

Servicing Pipeline Name (Text) string75	Capacity Rating (MCF/Day) numeric

Reference #820: Total Annual Cost of Solid Waste Collection and Disposal

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the total annual cost for solid waste collection and disposal for each of the fiscal years: FY01, FY02, and FY03?

Source / Reference: Local records.

Amplification: Solid Waste refers to municipal waste, NOT hazardous waste, NOT construction debris, NOT demolition debris, and NOT recyclable waste. Costs include any contract costs as well as "in-house" costs such as maintaining and operating on-post sanitary landfills and installation collection and disposal costs, whether disposal is on or off post or both. Report Actual Dollars, do NOT adjust for inflation.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Total Annual Cost (\$K) numeric
FY01	
FY02	
FY03	

Reference #821: Total Annual Cost of Training Range Maintenance and Repair

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the total annual cost of Training Range maintenance and repair for fiscal year FY03?

Source / Reference: Local records, LRAM and SRM

Amplification: Training ranges include all areas owned or controlled by the installation which are used to conduct training, research and development, and test and evaluation of military hardware, personnel, tactics, munitions, explosives, or electronic combat systems. Include LRAM (or "LRAM equivalent") and SRM maintenance and repair costs such as: Seeding, Grading, Clearing, Mowing, Berm Work, Vegetative Control, Erosion Control, Control Burning, and Pest Control. The costs DO NOT include maintenance for buildings or structures.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Total Annual Maintenance and Repair Cost (\$K) numeric
FY03	

Reference #822: Wastewater Treatment: Highest Monthly Usage and Total Annual Operational Cost

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the highest monthly usage in Million Gallons (MG) of domestic and industrial wastewater treatment on the installation during each of the fiscal years: FY01, FY02, and FY03? How many days were in the reported month? What was the total annual operational cost in Thousands of Dollars for FY01, FY02, and FY03?

Source / Reference: Local records. Data Call-1, DoD #282 (Industrial Wastewater Treatment System), #297 (Sanitary Sewage Treatment System/Plant)

Amplification: Report actual dollars, do NOT adjust for inflation. Costs include on or off-post treatment, by contract or in-house plant operations. DO NOT include any costs associated with the utility privatization process.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Highest Monthly Domestic Wastewater Usage (MG) numeric	Number of Days for Highest Usage Month Domestic Wastewater (#) numeric	Annual Domestic Wastewater Cost (\$K) numeric	Highest Monthly Industrial Wastewater Usage (MG) numeric	Number of Days for Highest Usage Month - Industrial Wastewater (#) numeric	Annual Industrial Wastewater Cost (\$K) numeric
FY01						
FY02						
FY03						

Reference #823: Potable Water: Highest Monthly Usage and Total Annual Cost

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the highest monthly usage in Million Gallons (MG) of POTABLE WATER on the installation during each of the fiscal years: FY01, FY02, and FY03? How many days were in the reported month? What was the total annual potable water cost in Thousands of Dollars for FY01, FY02, and FY03?

Source / Reference: Local Records. Data Call-1, DoD #291 (Potable Water Production), #292 (Potable Water Consumption Peak Month)

Amplification: Report actual dollars, DO NOT adjust for inflation. DO NOT include any costs associated with the utility privatization process. Potable water costs include the costs of potable water purchased from off-post potable water production and treatment.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Highest Monthly Usage (MG) numeric	Number of Days for Highest Usage Month (#) numeric	Total Annual Cost (\$K) numeric
FY01			
FY02			
FY03			

Reference #824: Non-Potable Water: Highest Monthly Usage and Total Annual Cost

JCSG: Army

Function(s): Environmental Elasticity

Question: What was the highest monthly usage in Million Gallons (MG) of NON-POTABLE WATER on the installation during each of the fiscal years: FY01, FY02, and FY03? How many days were in the reported month? What was the total annual non-potable water cost in Thousands of Dollars for FY01, FY02, and FY03?

Source / Reference: Local Records. Data Call-1, DoD #287 (Non-Potable Water Use), #288 (Peak Monthly Consumption of Non-Potable)

Amplification: Report actual dollars, DO NOT adjust for inflation.

Check here if this question is Not Applicable (N/A): ☐

Please fill in the following table(s)

Fiscal Years of Concern	Highest Monthly Usage (MG) numeric	Number of Days for Highest Usage Month (#) numeric	Annual Cost (\$K) numeric
FY01			
FY02			
FY03			

Appendix D – Data Condition by Installation

Installation Name	Model Output Condition
Aberdeen Proving Ground	Green
Adelphi Laboratory	Green
Anniston Army Depot	Green
Blue Grass Army Depot	Yellow
Carlisle Barracks	Green
Charles E Kelly Spt Fac	Green
Corpus Christi Arm	Green
Crane AAP	Yellow
Deseret Chemical Depot	Yellow
Detroit Arsenal	Green
Dugway Proving Ground	Green
Fort A P Hill	Green
Fort Belvoir	Yellow
Fort Benning	Green
Fort Bliss	Green
Fort Bragg	Green
Fort Buchanan	Green
Fort Campbell	Green
Fort Carson	Green
Fort Detrick	Green
Fort Dix	Green
Fort Drum	Green
Fort Eustis	Green
Fort Gillem	Green
Fort Gordon	Green
Fort Hamilton	Green
Fort Hood	Green
Fort Huachuca	Green
Fort Jackson	Green
Fort Knox	Green
Fort Leavenworth	Green
Fort Lee	Green
Fort Leonard Wood	Yellow
Fort Lewis	Green
Fort McCoy	Green
Fort McNair	Green
Fort McPherson	Green
Fort Meade	Green
Fort Monmouth	Green
Fort Monroe	Yellow
Fort Myer	Yellow
Fort Polk	Yellow

Installation Name	Model Output Condition
Fort Richardson	Green
Fort Riley	Yellow
Fort Rucker	Green
Fort Sam Houston	Green
Fort Shafter	Yellow
Fort Sill	Green
Fort Stewart	Green
Fort Wainwright	Yellow
Hawthorne Army Depot	Green
Holston AAP	Yellow
Iowa AAP	Yellow
Kansas AAP	Green
Lake City AAP	Green
Letterkenny Army Depot	Green
Lima Army Tank Plt	Green
Lone Star AAP	Green
Louisiana AAP	Yellow
McAlester AAP	Green
Milan AAP	Yellow
Military Ocean Tml	Green
Mississippi AAP	Green
Newport Chem Depot	Green
NTC and Fort Irwin	Yellow
Picatinny Arsenal	Green
Pine Bluff Arsenal	Green
Presidio of Monterey	Yellow
Pueblo Chem Depot	Green
Radford AAP	Yellow
Red River Army Dep	Green
Redstone Arsenal	Green
Riverbank AAP	Green
Rock Island Arsenal	Yellow
Schofield Barracks	Green
Scranton AAP	Green
Sierra Army Depot	Green
Soldier Systems Center	Green
Tobyhanna Army Depot	Green
Tooele Army Depot	Green
Tripler Army Medical Center	Green
Umatilla Chem Depoot	Yellow
US Army Garrison S	Green
Walter Reed AMC	Yellow
Watervliet Arsenal	Green
West Point Mil Res	Yellow
White Sands Missile Range	Green
Yuma Proving Ground	Green



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Characterizing Land Use Change Trends Around The Perimeter of Military Installations

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Robert C. Lozar, William D. Meyer, Robert H. Melton, Bruce A. MacAllister,
Joseph S. Rank, and Pat M. Kirby

*Construction Engineering Research Laboratory
PO Box 9005
Champaign, IL 61826-9005*

Joel Schlagel, Daniel P. MacDonald, and Paul Cedfeldt

*Cold Regions Research and Engineering Laboratory
72 Lyme Road
Hanover, NH 03755-1290*

Final Report

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ABSTRACT: The Total Army Basing Study (TABS) office, as one aspect of their stationing study, wished to determine the rate of development near the boundaries of nearly 100 military installations throughout the United States. The Engineer Research and Development Center proposed that this could be done by comparing the urbanization as derived from Ikonos images (taken around 2003 and acquired for all Services through the National Geospatial-Intelligence Agency) to a digital land use data set developed by the United States Geological Survey in about 1992. This decade difference could then be used to determine not only the amount of development, but also the trend. For the military, increasing development near installation boundaries can limit the ability to carry out their primary responsibilities of military training readiness and material testing activities. A team of 10 professionals was able to carry out the analysis for all the installations in about 4 months. This document describes the standard procedure used and the generalized results for the trends in increased development near the installation boundaries. It also summarizes the urbanization trends from the statistics generated to provide a snapshot of encroachment characteristics near a sample of nearly 100 military installations.

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Conversion Factors

Non-SI* units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	0.00001638706	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	$(5/9) \times (^\circ\text{F} - 32)$	degrees Celsius
degrees Fahrenheit	$(5/9) \times (^\circ\text{F} - 32) + 273.15$	kelvins
feet	0.3048	meters
gallons (U.S. liquid)	0.003785412	cubic meters
horsepower (550 ft-lb force per second)	745.6999	watts
inches	0.0254	meters
kips per square foot	47.88026	kilopascals
kips per square inch	6.894757	megapascals
miles (U.S. statute)	1.609347	kilometers
pounds (force)	4.448222	newtons
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
square feet	0.09290304	square meters
square miles	2,589,998	square meters
tons (force)	8,896.443	newtons
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

* *Système International d'Unités* ("International System of Measurement"), commonly known as the "metric system."

Preface

This study was conducted for the Deputy Assistant Secretary of the Army, DASA-IA (ATTN: Tarantino, William ASA-IA), 1400 Key Boulevard, Nash Building, Suite 200, Arlington, VA, 22209, under MIPR project number MIPR4CTABG4026, "To Characterize Land Use Encroachment Trends Around the Perimeter of Military Installations." The project was initially conceived and coordinated by William D. Goran, Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL).

The work was performed by the Ecological Processes Branch (CN-N) of the Installations Division (CN) at CERL and the Remote Sensing/GIS Center of the Cold Regions Research and Experiment Laboratory (CRREL). The CERL Principal Investigator was Robert C. Lozar. The technical editor was Gloria J. Wienke, Information Technology Laboratory - Champaign. Stephen Hodapp is Chief, CN-N, and Dr. John Bandy is Chief, CN. William D. Goran is the associated Technical Director. The Director of CERL is Dr. Alan W. Moore.

Both CERL and CRREL are elements of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan, and the Director of ERDC is Dr. James R. Houston.

1 Introduction

Background

Land use changes in the immediate vicinity of military installations can result in constraints being imposed on mission and resource management operations on these installations. The Department of Defense (DoD) labels these changes that result in constraints as “encroachment.” Encroachment can compromise sustained and future training and testing missions at an installation.

Recent advances in computer analysis techniques based on remotely sensed satellite images can be used with other geographic information systems (GIS) data to establish a scientifically derived baseline of land use change near military installations. New land uses, especially new urban and suburban uses, may in some way conflict with the ongoing activities at an installation. Military installations are increasingly asked to alter activities within their boundaries to alleviate land use conflicts. Examples include restrictions on flight routes and firing ranges.

The concept of following the trend of urbanization within a region and predicting how it might continue into the future has been developing for several decades (Steinitz 1967). The U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC/CERL) has engaged in several research projects investigating the assessment of risk to installation missions from increased development near installations (Deal 2001; Deal et al. 2002; Fournier et al. 2002; Lozar 2003a, b; Lozar et al. 2003; Timlin et al. 2002; Jenicek et al., 2004).

As a basis for studies that purport to predict the future, it is a good idea to have a clear sense of what has happened in the past. One approach developed at ERDC/CERL is an installation-specific historical urban growth series (Timlin et al. 2002). Several studies have advanced this historic approach to improve graphic presentation of changes over time and replicability of the approach from site to site (Lozar 2003a, b; Lozar et al. 2003).

Meanwhile, the DoD has implemented an effort, through the National Imagery and Mapping Agency (NIMA) [this organization is now called the National Geospatial-Intelligence Agency (NGA)], to acquire high-resolution (1- and 4-meter) commercial satellite imagery (Ikonos, composed of 1-meter Panchromatic integrated with 3 bands of 4-meter true color) for many major DoD installations. This data normally

includes a 1-mile buffer and often more than a 5-mile buffer around the installation perimeter, plus additional data within the image-bounding box.

The Ikonos data provides a consistent visual data source, for installations in all the services. Although the Ikonos imagery will be consistent, current, and have sufficient resolution for good visual inspection, this data by itself will not provide a good indication of “trends” in land use change.

There is a national data source, collected and analyzed by the U.S. Geological Survey (USGS) from LANDSAT TM (Thematic Mapper) images acquired in the early 1990s. The resulting National Land Cover Data (NLCD) can be compared to the Ikonos imagery to identify the “difference” in land use patterns around the perimeter of installations over the course of the past decade. For purposes of encroachment issues at installations, three “urban” categories used by the USGS are the most relevant to the issues discussed here. These categories are: 21 = Low Intensity Residential; 22 = High Intensity Residential; and 23 = Commercial/Industrial/Transportation.

To evaluate the degree of residential and urban growth near installation boundaries, a procedure or protocol was needed to use the available data sources (NLCD data and Ikonos imagery) in an objective manner that could be applied to military installations. This protocol needed to be clear, easily explained, and easily repeated by several different analysts.

Objectives

The objectives of this research project are to:

- Establish clearly the urban growth trends in areas surrounding a military installation.
- Provide intelligently based projections of future growth and change.

Approach

The approach to achieve these objectives is to:

1. Develop a Protocol for using the Ikonos images for an objective, comparable evaluation of land use change along the edges of military installations.
2. Apply the Protocol to selected military installations to evaluate the relative degree of near-boundary land use change. Analyses were completed for each installation using 1- and 5-mile buffers (if the available Ikonos imagery allowed analysis for the complete 5 miles). Land use changes were determined by comparing

the NLCD (<http://landcover.usgs.gov/natl/landcover.html>) to the land use categories derived from the Ikonos imagery.

3. Evaluate the statistics generated from the land use change study to characterize both the state of “urbanization” encroachment near military installations and the character of the statistics themselves.
4. Project the rate of change out to the year 2020.

Scope

This study deals only with land use changes, with specific emphasis on urbanization trends. After completing a historical trend analysis, the next logical step is to provide projections of future change.

The intent of this study was to obtain results that are highly consistent internally due to the application of a single standardized approach: the Protocol. Because of the time restriction and the need for internal consistency, the research team selected a simple and straightforward method.

Actual restrictions at a given installation will depend on the type of training and testing activities present and their spatial location in relation to the land use change taking place beyond the installation boundaries. It was beyond the scope of this work to determine or compare the training and testing activities present at specific installations and the extent of current or potential future mission impacts.

Due to the nature of the Total Army Basing Study (TABS), the list of installations evaluated will not be made available in this document. Further, any graphics used will be of the most general nature. The identity of any installation will be obscured and example data presented for a specific installation will be modified so that it cannot be recognized.

It is acknowledged that the installations selected for this study do not represent a random sample. The TABS Office (sponsor of this research) supplied the list of installations. On the other hand, this is the only large sample of military installations in existence to have undergone such a detailed and comparable evaluation.

Mode of Technology Transfer

This report will be provided only to the office of the Deputy Assistant Secretary of the Army, DASA-IA, Arlington, VA.

2 The Protocol

The research team developed a Protocol using initial installations that were intended to represent the different sizes, environments, and mission types. The team compared the situation at two time horizons: 1992 when the NLCD were generated, and about 2003 when many of the Ikonos images were taken. Two buffers corresponding to the Ikonos imagery coverage outside the installation were to be targeted and evaluated:

- 0 to 1 mile and
- 2 to 5 miles.

The Ikonos imagery has several drawbacks for this tasking:

- The original imagery has 1-meter resolution for the panchromatic image and 4-meter for the spectral red, green, and blue layers. The team received a 5-meter red, green, and blue file with the panchromatic layer integrated. Thus the original imagery was corrupted by:
 - Multiple resampling
 - Integration of data (the panchromatic layer) that was inseparable into its components.
- The 5-meter data, being a mosaic of several files, did not necessarily have a single date of acquisition. In fact, most of the time no date was available for imagery acquisition. This made trend analysis difficult.
- The near infrared (NIR) band that Ikonos also senses was not available for this project. The NIR is important in separating vegetation from non-living objects. This made image analysis more difficult.
- Meta data was inadequate (even as to the year of acquisition of the imagery).

For these reasons, other imagery sources (Landsat, ASTER, SPOT) may have been better alternatives for purchase by the government.

Rarely, the buffer extent had to be limited by the extent of the Ikonos images available. Using commercial spatial software packages (mostly ESRI's* ArcGIS and ERDAS Imagine), the developed Protocol used the Ikonos imagery to characterize

* ArcGIS is a product of ESRI GIS & Mapping Software, 380 New York Street, Redlands, CA 92372-8100. ERDAS Imagine is a product of Leica Geosystems GIS & Mapping, LLC, 2801 Buford Highway, N.E., Atlanta, GA 30329-2137. This does not constitute endorsement by the Army Corps of Engineers or the Department of Defense.

the more recent land uses within the buffer. Since the imagery had only three spectral bands, an unsupervised classification provided the input for the initial characterization. Additional protocols were developed to further refine and interpret this raw data. Thus, the Protocol resulted not only in an indication of the current land uses, but also data about the land use changes near installations that have the potential to restrict or impact the military training and testing activities occurring within the installation. The intent was to apply this simple protocol quickly to many additional locations. The basic products were:

- Protocol Procedure for identifying Land Uses and Land Use Changes within the immediate vicinity of installation boundaries.
- Maps and tables showing the trends within the buffer. One item will be the change in the land near installations (e.g., Table 1).

Table 1. Final product of historic and projected growth.

<i>Legend</i>	<i>Total Urban %</i>	<i>% increase/year</i>	<i>Trend to 2020 %Urban</i>
1992 - 1 mile buffer	1.9%		
2003 -1 mile buffer	15.9%	1.6%	45%
1992 - 2-5 miles buffer	1.4%		
2003 - 2-5 miles buffer	18.0%	1.9%	53%

Conceptually the Protocol was divided in seven major steps (Figure 1). These allowed sensibility related tasks to be completed. These seven were further divided into a series of substeps. Both levels of organization allowed project tracking as well as the ability to intelligently provide hand-off points among team members with responsibilities for the accomplishing different tasks.

These steps are visually presented as they actually might look at a fictitious installation in Figure 2.

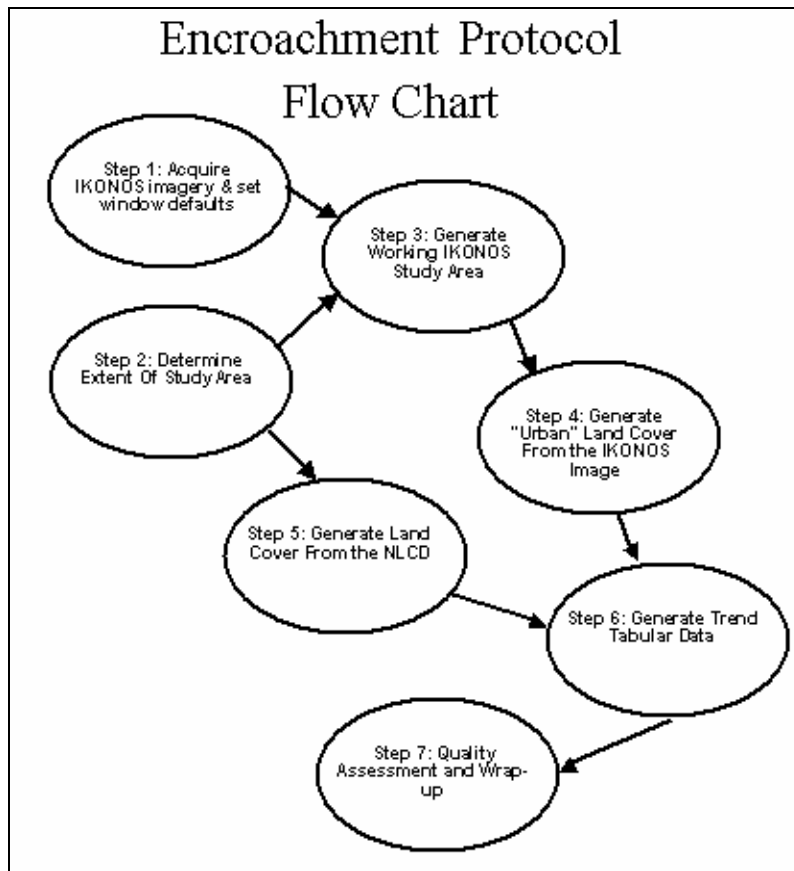


Figure 1. Seven major steps of the Protocol.

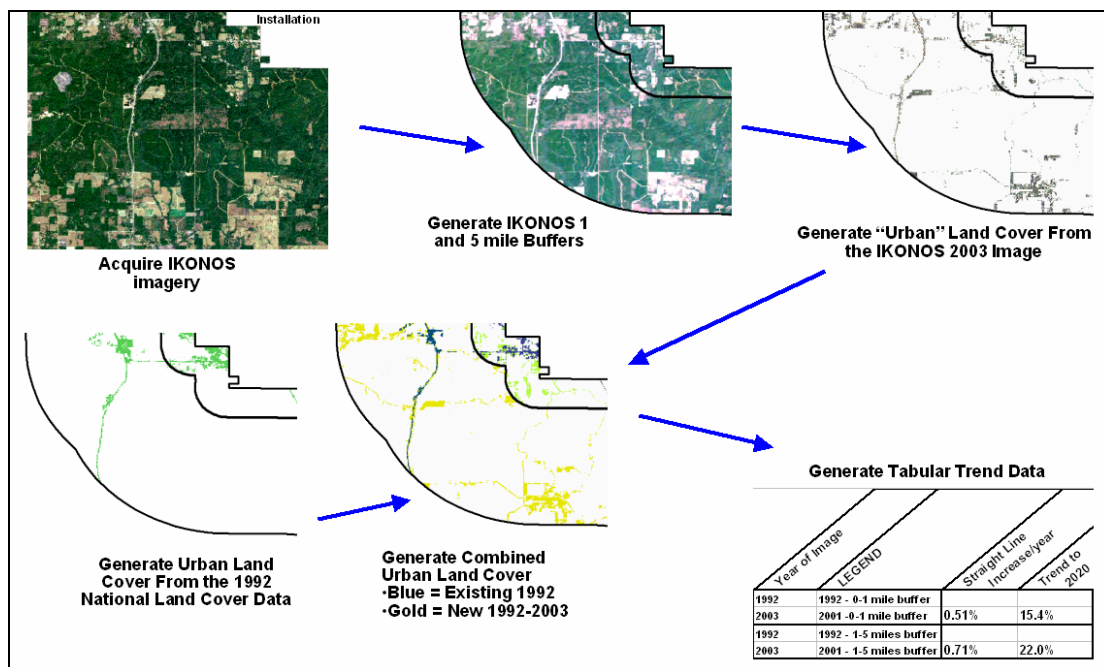


Figure 2. Visual interpretation of the protocol steps.

Software Used

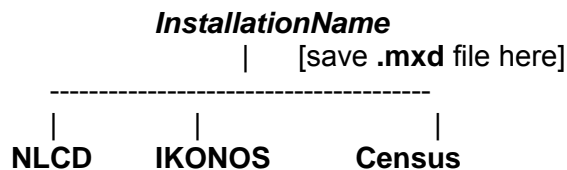
- ESRI ArcGIS 8.1 with extensions Spatial and Image Analyst
- ERDAS Imagine 8.6
- Microsoft Excel 2000
- WinZip Version 8.1

Required Data

- National Land Cover Data for each installation
(Six installations were in areas for which no NLCD were available. The comparable protocol for these is given in Appendix A)
- Installation Visualization Technology (IVT) Ikonos Image
- Installation Boundaries
- Roads from Census data
- Contextual Information

Required Standard Directory Structure and File Naming Conventions

The analysts were required to follow a standard directory format and place files in a central location, so that everyone knew where to look for data they needed to access and so that anyone looking at this report would be able to find the resulting data layers on the disk if they have access to the data files. The instructions were to make a directory titled with the installation name. All general data was to be saved within this level, including the .mxd file for that installation. Researchers then made three subdirectories; one for all NLCD related data, one for all Ikonos imagery and derived data, and one for the roads data (derived from Census data). Layers that are combinations of the Ikonos, NLCD, and Census data were stored in the general installation level directory.



This directory structure was used not only so all installations would be standard, but most importantly so that when completed, all the data associated with an installation could be archived in a single command. It was also the standard procedure to allow no spaces in file names because occasionally ESRI GRID file names would not be recognized if they contained spaces.

Within this document, the following conventions are established:

“Save in installation directory” means save in Drive:/InstallationName

“Save in Ikonos directory” means save in Drive:/InstallationName/Ikonos

“Save in NLCD directory” means save in Drive:/InstallationName/NLCD

“Save in Census directory” means save in Drive:/InstallationName/Census

The narrative for the Protocol’s 7 Steps is written as directions in present tense to the analyst carrying out the steps. All the steps need not be done in order. For example, while waiting for the Ikonos images, the research team began to format the NLCD data layers (Step 5) and to define the Study Area (Step 2).

Protocol Outline

Step 1: Acquire Ikonos imagery and set window defaults

Step 1.1 Set up Required Directory Structure

Step 1.2 Make boundary file for your installation

Step 1.3 Identify which imagery tiles cover your installation

Step 1.4 Determine if imagery coverage is adequate

Step 2: Determine Extent of Study Area

Step 2.1 Generate Installation buffers

Step 2.2 Optional: Define Rectangular Study Area

Step 2.3 Make a rectangular grid that coordinates with the location and resolution of the Ikonos images

Step 2.4 Convert the buffer shape file into a grid file at the final resolution.

Step 2.5 Make the roads buffer mask

Step 3: Generate Working Ikonos Study Area

Step 3.1 Subset the portion of the images to be used or define AOI (Area of Interest)

Step 3.1a Option 1: ESRI Image Analysis

Step 3.1b Option 2: ERDAS Imagine8.6

Step 3.2 Mosaic the subset images into one

ESRI Step 3.2a Mosaic the subset images into one

ERDAS Step 3.2b Mosaic the subset images into one

Step 3.3 Subset the portion of the mosaic to the 5-mile buffer

ESRI Step 3.3a Subset the portion of the mosaic to the 5-mile buffer

ERDAS Step 3.3b Subset the portion of the mosaic to the 5 mile buffer

Step 4: Generate “Urban” Land Cover from the Ikonos Image

Step 4.1 Use unsupervised classification with 16 categories to generate a classified image of land cover from Ikonos image for the study area.

Step 4.2 Reclass the categories to Urban

Step 4.3 Clip the preliminary urban category file by the roads buffer

Step 4.4 Let the unsupervised classifier reclassify only those areas in the preliminary-urban mask.

Step 4.5 Urban into a grid

Step 4.6 Preliminary Quality Evaluation

Step 5: Generate Land Cover From the NLCD

Step 5.1 Obtain the NLCD for the state

Step 5.2 Import to TIFF Format

Step 5.3 Reproject Images

Step 5.4 Clip NLCD Grid to the Study Area

Step 5.5 Reclass the NLCD data into an urban category layer

Step 5.6 Generate an exclude mask from the NLCD for areas that will never be developed land

Step 6: Generate Trend Tabular Data

Step 6.1 Make a combined grid file of 1992 and 2001 urban

Step 6.2 Calculate unique values for different urban growth degrees at different times depending on the buffer

Step 6.3 Export the data to an Excel file, populate the table and generate the trend data in Microsoft Excel

Step 6.5 Save Table to Trend directory

Step 7: Quality Control and Wrap up

Step 7.1 Complete Quality Evaluation

Step 7.2 Wrap Up

Protocol Steps

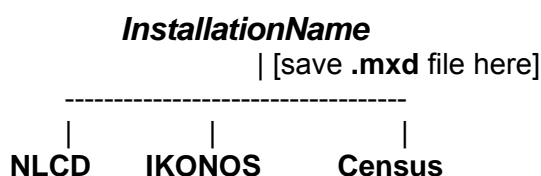
Step 1: Acquire Ikonos imagery and set window defaults

Step 1 General description: Acquiring the imagery required a time lag of between a day and a week, so it is best to begin with acquiring the imagery. For this research project, the research team contacted the IVT office where the imagery was being collected, and waited to receive it by mail written onto DVD (digital video disk) or to have team members download it by FTP (File Transfer Protocol). The team set up a working ArcMap Window. Once an analyst was assigned to do the tasks for an installation, but before the imagery arrived, Step 5 was often completed.

Step 1.1 Set up Required Directory Structure

Where to store installation data - To support the project, the team purchased three 300-gigabyte hard disks. Installations east of about 104 degrees west longitude were stored on the disk called TABS1. Installations west of about 104 degrees west longitude were stored on TABS2. To make this clear, the USA_portable.mxd file was distributed with a graphic showing the split. Installations assigned to the ERDC CRREL staff were mostly smaller eastern installations so their data all fit on the third hard disk.

Set up installation working directory per standard structure:



Set up context - To be compatible between different installations, set up an accessible version of the USA_portable directory on a disk at the same level as the Installation_Name level. To create a map document (.mxd file) for each installation, click on the USA_portable directory, double click on the file usa_instals.mxd. This will bring up an ArcMap window with contextual data. ***IMMEDIATELY*** go to the File menu item and choose Save as.... Navigate to your InstallationName directory and save it as InstallationName.mxd. Whenever you work on this installation, this will be your working document. If someone else needs to work on this installation, this is the document they will call up. It is also what will be used to present your work and in the end, to document your procedure.

ArcMap: When you click on the InstallationName.mxd, ArcMap will come up. To set the default tool bars within ArcMap:

From View select Toolbars. Choose the following toolbars (optional toolbars are in parentheses):

- Main Menu

- Standard

- Tools

- (Draw)

- (Effects)

- (Layout)

- Spatial Analyst

- Editor

- Image Analyst (Experience suggests that you should not save while this toolbar is open. It is recommended that you have this toolbar open only when you are using it and that you remove it before you save your .mxd file.)

If the Layer: input box in either the Spatial Analyst or the Image Analysis toolbars is grayed out, this means you must tell ArcMap that you want it:

- Go to the Tools menu

- Choose Extensions

- Click to place a checkmark next to both the Spatial Analyst and the Image Analysis boxes. Close.

Once the ArcMap window from the InstallationName.mxd is ready, you may want to change the way the layers are presented. For example, the default display mode for the installation boundaries will have the installation area filled in with an opaque color. To make modifications on how layers are presented, change the Symbology. The following is an example for the boundary, but the method is similar for other layers.

In the TOC (Table of Contents) double click on the layer name (e.g., Boundary). The Layer Properties menu will appear. Click on the tab for Symbology.

- Within the Symbol box, Click on the rectangle showing the color and outline. The Symbol Selector box will appear. Under Options, click on the Fill Color color sample square. To remove the current fill color click on the No Fill selection. Similarly you can modify the other properties from this window to suit your purpose. For example, the outline color can be changed to black and widened to an Outline width of 2. When done, click on OK, then OK again.

Click on the tab for Display.

- From here you can set the Transparency to be 60% so that you can look through the installation and see the Ikonos image behind it.

Step 1.2 Make boundary file for your installation

The usa_instals.mxd file includes the official TABS boundaries of all the installations. It is called Installation_Boundary.shp. You need to pull out your specific installation. To do this:

Right click on the Installation_Boundary.shp. On the pop-up menu, click on the Attribute Table option. At the bottom of the Attributes of Installation_boundary window, click on the Options down arrow and choose Find and Replace. In the Find and Replace window on the Find what box, enter only the “core” portion of your installation’s name. Make sure that Text Match: is set to Any Part, Search is set to All, and the Match Case and Search Only Selected Field(s) are NOT checked. Press Find Next. The entry for your installation should come up. Press Find Next again. If you find another line with your installation listed, you will have to select and save both/all sections according to the following procedure. On the Attributes of Installation_boundary window, click on the furthest left gray button to Select the entire row. For each additional line that includes your installation, you will need to hold down the shift key and click on the furthest left gray button to Select that entire row in addition to the first row. Select all rows that make up the extent of your installation. Back in the main ArcMap menu, click on Selection menu and then chose Zoom to Selected Features. Your installation should be centered in the window with the boundaries highlighted in blue.

Now you need to save the selected polygons as an individual .shp file for your installation. Right click on the Installation_Boundary.shp in the TOC. On the pop-up menu chose Data. (**Beware!!** The option “Save as layer file” is the wrong choice.) Now choose Export Data. In the Export Data window, Export: should be Selected features, choose the option Use the same Coordinate System as the data frame (i.e., Geographic WGS84; WGS is World Grid System) and for the Output Shapefile or feature class, navigate to your installation directory and save as boundary.shp. ArcMap will process for a minute then ask if you want to display it on your current map document. Reply “yes,” of course.

Step 1.3 Identify which imagery tiles cover your installation

Access Ikonos Imagery from central disk site.

Images are not named by installation, but by their latitude/longitude locations. For example: FB_5M_MOSAIC1_110w30na.tif refers to an image that is located roughly 110 degrees west longitude by 30 degrees north latitude. It is the “a” tile of a group of tiles (in this case, including “b,” “c,” and “d”). In ArcMap, use the Identify Button to left click on your installation. The data window that pops up will include a line with the image name on it (similar to FB_5M_MOSAIC1_110w30na.tif). This is the tile that covers your installation. It is likely that several tiles will be needed

to cover your study area. Find those that seem to cover your installation. You do not need to copy them to your work area. However, when you start saving Ikonos-derived images and grids, save them in the Ikonos directory for your installation.

Determine projection of the Ikonos imagery (see example metadata .txt file in box on next page). The official geographic projection for all work on this project is Geographic WGS84. The projection of all data frames should be in this projection. All databases generated should also be in this projection because when using Spatial Analyst, unexpected results can be derived when generating new maps. (Arc GIS 8.3 does projections FOR DISPLAY on the fly. FOR ANALYSIS it is best to generate information in the native projection of both the originating data and the frame.)

Use ArcCatalog to find the .txt file for your images. Click on the file name. On the Contents tab, you should see Band_1, Band_2, and Band_3. The Preview tab should show the image (usually in a GeoTiff format). On the Metadata tab you should see that the Coordinate System: is Geographic. Under the Spatial Reference Information, you should see a line that says: Geographic coordinate system name: GCS_WGS_1984. All databases generated should also be in this projection.

Sample Metadata file for Space Imaging

product

Image
 File : FB_5M_MOSAIC1_096w48na.tif
 Projection : Geographic
 Datum : WGS84
 Ellipsoid : WGS84
 GSD : 0.000040003200000 Degrees
 Upper Left : -96.000000, 48.000000
 Lower Right : -95.500000, 47.500000
 Coordinates refer to the center of the pixel
 Geographic coordinates for corners
 Upper Left : -96.000000 deg lon, 48.000000 deg lat
 Upper Right : -95.500000 deg lon, 48.000000 deg lat
 Lower Right : -95.500000 deg lon, 47.500000 deg lat
 Lower Left : -96.000000 deg lon, 47.500000 deg lat
 Image Size : 12500 samples, 12500 lines, 3 bands
 Produced by : Space Imaging

Step 1.4 Determine if imagery coverage is adequate

In some cases the 5-mile buffer and study area will extend beyond the imagery available. Make an estimate of a 5-mile buffer around the installation. If you do not have sufficient Ikonos imagery to allow you to create a rectangular grid, then you must request the missing imagery immediately – lack of the imagery will impede the rest of the processing until the data is in hand. In this case,

IMMEDIATELY re-request from the IVT office per Appendix B to see if the additional areas that are needed are available.

Step 2: Determine extent of study area

Step 2 General description: You need to define the extent of the work area. This step should be based on a combination of the installation boundaries and the extent of the available imagery.

Step 2.1 Generate Installation buffers

From the installation boundaries file generate two buffers:

Buffer1 – 0 to 1 mile

Buffer2 – 1 to 5 miles

Make sure the analysis is being done in the Ikonos projection. Finally, generate a rectangular area to be the Study Area extent.

From Tools select Buffer Wizard:

You want to Buffer: Features of a layer -> choose Boundary.shp (the shape file you just created)

Create Buffers as multiple buffer rings (Number of Rings = 5, Distance Between rings = 1). The Buffer distance, Distance units are: Miles. Then click Next.

Buffer output type: Dissolve barrier between: no.

Create buffers so they are: only outside the polygons

Save the buffer -> In a new layer -> Bond_Buf_5.shp

Remove the extra boundaries.

From the Editor toolbar select Start Editing.

For Which folder, chose the one that contains the Bond_Buf_5.shp file.

On the Editor toolbar, the Target is the Bond_Buf_5.shp file, the Task is Modify Feature.

On the Table of Contents (TOC) frame, right click on Bond_Buf_5.shp and chose Open Attribute Table.

Each buffer distance has its own Feature ID. Determine which relates to the 1-mile buffer by selecting different records until the 1-mile buffer is highlighted (FromBufDst field has a value of 0). Once identified, place a value of 1 in the ID field. Place a value of 2 in all the other ID fields. Click in another data location beside the last you entered. Under Options, Clear Selection.

On the Editor toolbar, click Stop Editing, then answer Yes to Do you want to save your edits?

On the Main Menu, click Tools, then Geoprocessing Wizard.

Chose Dissolve features based on an attribute.

1. Select the input layer to dissolve: Bond_Buf_5
2. Select an attribute on which to dissolve: ID

3. Specify the output shapefile: Bond_Buf15

For Choose one or more additional fields..., click on the FromBufDst and check Minimum and Maximum, then Finish.

The new Bond_Buf15 file will appear on the TOC.

Remove the intermediate file Bond_Buf_5 by right clicking on its name in the TOC and selecting Remove.

The new Bond_Buf15 file will be used throughout this analysis and the results depend on it being an accurate delineation of the extent of the imagery being used. Too often the imagery available is less than the extent of the 5-mile buffer. This means that the team modified Bond_Buf15 into a new file Bond_Buf15_trunc that was used where appropriate in place of Bond_Buf15 throughout the rest of this report.

You need to modify Bond_Buf15 to reflect only area for which imagery data is available. Known examples include:

1. Imagery only goes out to 2 miles. Digitize an outline that includes the entire imagery available and union, clip, or intersect it with Bond_Buf15. You can think of this as bond_buf12, but for consistency it is named Bond_Buf15_trunc.
2. One panel of imagery is missing.
3. A “spike” of imagery is missing between the satellite paths.
4. Imagery is unreadable or a portion is from a different season.

Digitize an outline that includes the entire imagery available and union, clip, or intersect it with Bond_Buf15. Follow a procedure similar to the variation given in Appendix C. The bottom line is that you end up with an edited outline that includes all the imagery available (by editing, unioning, clipping, or intersecting it to get Bond_Buf15_trunc) that represents the coverage of the imagery if it is less than Bond_Buf15. It is important that in the attribute table, there is a Field, possibly called Id, that shows a feature value=1 for the polygon that is the 0- to 1-mile buffer and a value=2 for the feature for the 1- to 5-mile buffer.

Changes in the Bond_buf15.shp to Bond_buf15_trunc.shp will have important direct effects on these steps:

Step 2.4 Convert the buffer shape file into a grid file at the final resolution – in generating Buf15_G

Step 2.5 Make the roads buffer mask – in generating rds_clip_5mile_buf

Step 3.3 Subset the portion of the mosaic to the 5-mile buffer – in generating Ikonos_Buf15.img

Step 4.1 Use an Unsupervised classification with 16 categories to generate a classified image of land cover from Ikonos image for the study area – in generating Ikonos_class16.img

Step 6.4 Populate the table and generate the trend data in MS Excel in generating:

Count of Undevelopable Land

% Undevelopable land is the Count of Undevelopable Land

1992 Urban Land Use Counts

Length of Roads within 1 mile

Towns within 1 & 5 miles & Town Population within 5 miles.

It may also have secondary effects on areas not generated directly from Bond_buf15.shp but from secondary products. If you have a non-standard Bond_buf15.shp, you must redo it as Bond_buf15_trunc.shp and check those steps listed above to ensure a correct result. Also review those secondary products to make sure they are correctly derived. This is not optional as the cell counts derived in Step 6 are based on Bond_buf15.shp.

Step 2.2 Optional: Define Rectangular Study Area:

Variation: In some cases the initial study area will extend beyond the imagery available. In this case, re-request from the IVT office to see if there exists additional images of areas that are needed. If not, you will need to modify the Study area to reflect only the area for which imagery data is available. Follow the procedure in Appendix C.

Make a shape file that is a rectangle slightly larger than the largest portion of the 5-mile buffer.

In ArcCatalog click on the directory name in which you are working.

On the main menu, click File, then New, then Shapefile.

To Create New Shapefile,

The Name will be StudyArea

The Feature Type will be Polygon

In the Spatial Reference box, click Edit

In the Coordinate System click the Import Button

Select the installation boundary shape (check to make sure this is the same as the standard frame projection). Click Apply.

Check to make sure you have the right projection, then click OK.

Click OK at the bottom of the Create New Shapefile box.

Click and drag the new StudyArea file into the ArcMap window.

In ArcMap, click on the Edit toolbar and choose Start Editing

Choose the directory to edit in which the StudyArea file resides.

On the Editor toolbar, the Target is the StudyArea.shp file, the Task is Create New Feature.

Click the Editor Down Arrow and choose More Editing Options and then choose the Advanced Editing option to display an additional toolbar.

On the Advanced Editing toolbar, click on the Rectangle Tool icon and in the ArcMap window; make a rectangle about 1 or 2 miles beyond the 5-mile buffer.

Optional: On the Editor toolbar, change the Task to Modify Features. Make sure the Edit Tool arrow is selected, move it over one of the edge lines (not in the interior) and right click. Select Properties to bring up the Edit Sketch Properties window.

In the Edit Sketch Properties window you can directly change the values of the X,Y corner points to make them more closely coordinate with even values in the projection you are using.

Click Finish Sketch and dismiss the Edit Sketch Properties window.

On the Editor toolbar, click the Editor down arrow, then Stop Editing, then answer Yes to Do you want to save your edits?

Step 2.3 Make a rectangular grid that coordinates with the location and resolution of the Ikonos images.

Under the Spatial Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to StudyArea

NOTE: because the frame is in the desired projection, you should never need to change the default setting of Analysis Coordinate System:. Always leave as Analysis output will be saved in the same coordinate system as the input (...)

On the Extent tab, set Analysis Extent to StudyArea and Snap Extent to: <None>

On the Cell Size tab, set Analysis cell size to Same as Layer “the Ikonos image you will be using”

Click OK to submit these to the system.

Under the Spatial Analysis toolbar, click the down arrow and choose Raster Calculator

In the Raster Calculator evaluation box, enter the value 1.

Click the Evaluate button.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option. In this window navigate to the installation directory and save the file as StudAreaG and for Save as type: choose ESRI GRID. Click the Save button.

In the TOC slowly double click on the name Calculation and rename it StudAreaG. Double left click on the name and on the Symbology tab, within the Show box, highlight Classified. In the Classification box, make the Classes equal 1. Click OK.

NOTE: For unknown reasons, saving a calculation using this procedure will sometimes cause ArcMap to crash. If this happens, there is a work-around:

First, create a temporary folder within the installation directory. This folder will be used in all subsequent calculations. To do this, go to the installation directory in ArcCatalog. In the Contents window, right click and choose New > Folder. Rename this new folder Temp_calc.

Under the Spatial Analysis toolbar, click the down arrow and choose Options.

Under the General tab, set the working directory to this new folder Temp_calc.

Click OK.

Go back to repeat the calculation using the Raster Calculator.

When the resulting calculation appears in the TOC, this time, double click the calculation, and select the Source tab in the Layer Properties dialog box.

In the Data Source field, there will be information about the raster file you just created. Take note of the name of the Raster your calculation represents. Because this calculation has not been made permanent yet, this name will be CALCsome_number. Leave the Layer Properties dialog box open.

Then in ArcCatalog, navigate to the temporary folder you created.

Click View > Refresh at the top of the ArcCatalog window. You should now see the temporary CALC file you generated. Copy this file and paste it into the Ikonos folder. Rename the file StudAreaG.

Back in ArcMap, click on the Set Data Source button in the Layer Properties dialog box. Navigate to the Ikonos folder of your installation, highlight the StudAreaG file, and click Add, to set it as the new source data for this layer. Click OK in the Layer Properties dialog box.

You may now rename the calculation in the TOC: Slowly double click on the Calculation and rename it StudAreaG. Experience has shown that this work-around may be necessary for all subsequent raster calculations for a given installation.

End of NOTE.

Step 2.4 Convert the buffer shape file into a grid file at the final resolution.

Under the Spatial Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to Bond_Buf15

On the Extent tab, set Analysis Extent to Bond_Buf15 and Snap Extent to:
<None>

On the Cell Size tab, set Analysis cell size to 0.00010 (the final resolution)

Click OK to submit these to the system.

Under the Spatial Analysis toolbar, click the down arrow and choose Convert and choose Features to Raster

On the Features to Raster window

For Input features enter the Bond_Buf15 file name.

For the Field, use the field (possibly called Id) that shows whether the polygon is in the 1-mile buffer (value=1) or the 2- to 5-mile buffer (value=2).

Output cell size: should be the same as the final target value of 0.0001 (it should default to the value you set in Options above).

For Output raster: navigate to the installation directory and name the new file Buf15_G and Save as type: ESRI GRID.

Press the Save button.

Click the OK button.

The result should appear on the map and in the TOC as Buf15_G. Right click on Calculation and choose the Open Attribute Table option. In this window, check to make sure that the buffer identities are correctly generated by alternately selecting either 1 or 2. When satisfied, click on Options and then choose Clear Selection.

Dismiss the table.

Double left click on the name Buf15_G and when the Layer Properties box appears, on the Symbology tab. Within the Show box, highlight Unique Values. Under the Label column, label 1 as the 0- to 1-mile category and label 2 as the 1- to 5-mile category. Click OK.

Step 2.5 Make the roads buffer mask:

Acquire the commercial GDT (Geographic Data Technology) Dynamap/2000 Street Network data (July 2003).

Generate needed roads file:

From the several roads files, the one that includes all the roads has a name like: STATEABBREVIATIONcountynames. Use ArcCatalog to load it to your ArcMap window.

Note: the registration is not perfect. Although the Datum's are different than our standard, reprojecting makes no difference at all. Therefore, use file as is.

If you need more than one county, merge them here. If not skip to the following Clip the count roads to the 5-mile buffer section.

On the Main Menu, click Tools, then Geoprocessing Wizard.

Chose Merge layers together, then Next>.

1. In the Select at least two layers to merge window put a check next to all the polyline layers that cover your study area.
2. For Use fields from: Select one of the polylines.

Specify the output shapefile: Navigate to your installation's Census directory and name the file: STATEABBREVIATIONcountynames
Then click the Finish button.

The new STATEABBREVIATIONcountynames file will appear on the TOC.

Note: For locations that are largely desert or barren, using all roads may include too much area. If this seems to be the case, consider using only those road files that are major or named roads (i.e., in the attribute table for STATEABBREVIATION-countynames, sort by Road Name. Then delete all roads without a name). This will eliminate dirt trails in many locations that are unsuitable for development. Basically, use logic to reflect reality as closely as possible.

Variation: Sometimes it is also wise to prune out even named roads. If many roads have no development, there is no sense in keeping them. Once again, use logic to reflect reality as closely as possible.

Clip the county roads to the 5-mile buffer:

On the Main Menu, click Tools, then Geoprocessing Wizard.

Chose Clip one layer based on another, then Next>.

Select the input layer to clip: STATEABBREVIATIONcountynames

Select a polygon clip layer: The Bond_Buf15 file

Specify the output shapefile: rds_clip_5mile_buf in the Census directory.

Then click the Finish button.

The new rds_clip_5mile_buf file will appear on the TOC.

Buffer the roads:

From Tools select Buffer Wizard

You want to Buffer Features of a layer -> rds_clip_5mile_buf. Click Next>

Create Buffers as At a specified distance. The distance will be 150 meters. The

Buffer distance, Distance units are meters. Then click Next.

Buffer output type: Dissolve barrier between: Yes.

(Create buffers so they are: is grayed out as not available for this specification.)

Save the buffer -> In a new layer -> navigate to the Census Directory and save as: rds_clip_5mile_buf_150mbuf.shp.

The roads buffer will be used in Step 4.

Step 3: Generate working Ikonos study area

Step 3 General description: Several Ikonos images are usually required to cover an installation. In addition, you may want to use only that portion needed to carry out the tasking, so sew together the images you need and extract only the area that will be required for the analysis. This will also save computational time in the following steps.

1. Subset the portion of the images to be used or define AOI
 ESRI ArcGIS Version- Step 3.1a Option 1: ESRI Image Analysis
 ERDAS Imagine Version - Step 3.1b Option 2: ERDAS Imagine8.6:
2. Mosaic the subset images into one.
 ESRI ArcGIS Version - Step 3.2a Mosaic the subset images into one
 ERDAS Imagine Version - Step 3.2b Mosaic the subset images into one
3. Subset the portion of the mosaic to the 5 mile buffer
 ESRI ArcGIS Version - Step 3.3a Subset the portion of the mosaic to the 5-mile buffer
 ERDAS Imagine Version - Step 3.3b Subset the portion of the mosaic to the 5 mile buffer.

Subset the portion of the images to be used

End using the Spatial Analysis, Start using the Image Analysis.

Step 3.1a Option 1: ESRI Image Analysis:

Under the Image Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to Stud_area_G. This way only those areas within the study area will be considered.

On the Extent tab, set Analysis Extent to Stud_area_G

On the Cell Size tab, set Analysis cell size to Same as Layer Oneo theIkonosImages.img

On the Preferences tab, set the Resample Using: to Nearest Neighbor.

Click OK to submit these to the system.

Under the ESRI Image Analysis toolbar, click the down arrow and choose Data Preparation, then the Subset Image option.

In the Subset Image window

For the Input Image: click the down arrow and choose the image you wish to cut to the study area size

For Select desired band numbers: Click in the number area and 1:3 will pop up. If not, enter 1:3

For the Output Image, navigate to the Ikonos directory and name the new image: Ikonos_studtile#. (The # refers to which of the different Ikonos images you are subsetting. For large installations, the tile number can be large. If one image covers the entire study area, then you can skip the next step (mosaicing) and directly name the file Ikonos_stud_area.). Save as type will be ERDAS IMAGINE. Press the Save button.

Press the OK button.

Repeat this process for each image that will make up the study area.

Step 3.2a Mosaic the subset images into one.

If more than one image is required to make up the study area, you must mosaic the subset images into one.

Under the Image Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to StudyArea (or to the Tuncated StudyArea file)

On the Extent tab, set Analysis Extent to StudyArea and Snap Extent to: <None>

On the Cell Size tab, set Analysis cell size to Same as Layer “the Ikonos image you will be using”

On the Preferences tab, set the Resample Using: to Nearest Neighbor. Click OK to submit these to the system.

Sometimes the computer internal settings need to be reset at this point. To do this, remove the Image Analysis toolbar, Save the map document and exit ArcMap. Then put up the ArcMap document, replace the Image Analysis toolbar and continue.

Mosaic the subset images into one

In the TOC select (highlight) all those subset images that need to be mosaiced. In the Image Analysis toolbar, for Model Types: choose the Ikonos option.

Under the Data Prep toolbar button, click the Mosaic Images option.

In the Mosaic Tool window

Under the Edit menu select Add Images...

Method is Individual File. Press the Open File icon and in the Image File-name box, navigate to the installation Ikonos directory. Change the Files of type: to TIFF and choose the files that make up the study area. You can chose more than one by holding down the SHIFT key while clicking on the correct file names. Click OK, then Add and Close if you have them all.

For the Output Image, navigate to the Ikonos directory and name the new image called: Ikonos_stud_area. Save as type will be ERDAS IMAGINE. Press the Save button.

Press the OK button.

Check to make sure the resulting image is exactly the same as the component images by:

One after the other, double click on the names of both the input images and the resultant images and under the Symbology tab, set the Stretch to None. Press OK. Zoom into the edge area between the input images and resultant and make sure that the colors and spatial locations are correct. You might want to compare the road location to the image to make sure they are in the right place.

Step 3.3a Subset the portion of the mosaic to the 5-mile buffer.

Under the ESRI Image Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to Bond_Buf15. This way only those areas within the boundary will be analyzed.

On the Extent tab, set Analysis Extent to Bond_Buf15

On the Cell Size tab, set Analysis cell size to Same as Layer Ikonos_stud_area.img

On the Preferences tab, set the Resample Using: to Nearest Neighbor.

Click OK to submit these to the system.

Under the Image Analysis toolbar, click the down arrow and choose Data Preparation, then the Subset Image option.

In the Subset Image window:

For the Input Image: click the down arrow and choose the image you wish to cut to the 5 mile buffer size

For Select desired band numbers: Click in the number area and 1:3 will pop up. If not, enter 1:3

For the Output Image, navigate to the Ikonos directory and name the new image: Ikonos_Buf15. Save as type will be ERDAS IMAGINE. Press the Save button.

Press the OK button.

End Option 1

Step 3.1b Option 2: ERDAS Imagine8.6:

First define subset of the study area as an AOI

1. Open two Viewers. In Viewer #1 you will need to display the Ikonos images for the installation. In the Select Layers to add dialog box, change the Files of type: to TIFF and choose the files that make up the study area. (You might be able to

- choose more than one by holding down the SHIFT key while clicking on the correct file names.) Click OK.
2. In Viewer #2, first display one of the Ikonos tiles (this ensures that the projections in both viewers are the same), then display the vector layer, StudyArea, from which you want to create the AOI. Images in Viewer #1 must be in the same map projection as the StudyArea vector file in Viewer #1.
 3. In Viewer #2, select (click on) the StudyArea file. The StudyArea turns the selection color (probably yellow).
 4. In the menu bar of Viewer #1, select AOI | Copy Selection to AOI...
 5. In the menu bar of Viewer #1, select View | Arrange Layers. In the Arrange Layers Viewer #1, right click on the Aoi layer and choose Save layer. In the Save AOI as: window, navigate to the installation directory and save it as StudyArea.aoi. Click OK, then OK again to dismiss the Save AOI as: window.

Step 3.2b Mosaic the subset images into one:

In Viewer #1, under the Raster menu item, click the Mosaic Images option.

In the Mosaic Tool window, all the files will be displayed.

Under the Edit menu select Set Overlap Function. No Outline Exits. For the Select Function select Average. Click the Apply, then the Close buttons.

Under the Edit menu select Output Image Options. For Define Output Map Areas(s) choose User-defined AOI.

For Output Multiple AOI Object to: A Single File. Press the Set Output AOI bar. Choose AOI from AOI File. Navigate to your installation directory and select studyarea.aoi. Press OK.

Select the default (do NOT Change output Map Projection) and for Output Cell Size: (dd) select 0.000040 while Output Data Type: is Unsigned 8 bit. Click OK.

On the menu for the Mosaic Tool, click on Process, then Run Mosaic.

In the Run Mosaic box, for the Output File Name, navigate to the Ikonos directory, save as Files of type: Image, and name the new image Ikonos_Stud_Area. Click OK.

Check the Output a Common Look up Table, Ignore Input Values of 0, make sure Output background Value is 0 and do NOT Compress. Then press OK.

Press the OK button. Processing will take a while.

Step 3.3b Subset the portion of the mosaic to the 5 mile buffer:

Define subset of the five mile buffer as an AOI.

1. Open two Viewers. In Viewer #1 display the Ikonos_stud_area.img for the installation.
2. In Viewer #2, first display the Ikonos_stud_area.img (this ensures that the projections in both viewers are the same), then display the vector layer, Bond_Buf15, from which you want to create the AOI. Images in Viewer #1 must be in the same map projection as the StudyArea vector file in Viewer #2.
3. In Viewer #2, select (click on, then shift & click) all of the rings of the Bond_Buf15 file. The Bond_Buf15 turns the selection color (probably yellow).
4. In the menu bar of Viewer #1, select AOI | Copy Selection to AOI..
5. In the menu bar of Viewer #1, select View | Arrange Layers. In the Arrange Layers Viewer #1, right click on the AOI layer and choose Save layer. In the Save AOI as: window, navigate to the installation directory and save it as Bond_buf15.aoi. Click OK, then OK again to dismiss the Save AOI as: window.

Subset the portion of the mosaic to the 5-mile buffer:

Under the Data Preparation menu item, click the Subset Image option.

In the Subset Image Tool window:

For the Input File Name navigate to the Ikonos directory, choose the image Ikonos_stud_area.

For the Output File Name, navigate to the Ikonos directory, save as Files of type: Image, and name the new image Ikonos_buf15.

For the Data Type set:

Input: Unsigned 8 bit

Output: Unsigned 8 bit

Output: Continuous

For Output Options set

Select Layers: 1:3

Click on the AOI button on the bottom.

In the Choose AOI window, for the Select an AOI Source: click on AOI File option.

In the Select the AOI File box, navigate to the installation directory, and choose the Bond_buf15.aoi file. Click OK.

Press the OK button to start the sub setting.

End Option 1

Step 4: Generate “urban” land cover from the Ikonos image

Step 4 General description: Determine from the imagery which are the locations that are most likely urban. To do this, run the image through an unsupervised classification routine. From this image, choose those categories that best fit urban. Using this urban definition as a mask, do another unsupervised classification but only on those areas that are most likely to be urban.

Use an Unsupervised classification with 16 to 100 categories to generate a classified image of land cover from Ikonos image for the study area.

Option 1: ESRI Image Analysis (very slow):

Step 4.1a Start using the Image Analysis

On the Image Analysis toolbar, in the Layers: window, click the down arrow and choose Ikonos_Buf15.img, then for the Model Types: window, click the down arrow and choose the Ikonos option.

Under the Image Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to Bond_Buf15. This way only those areas within the boundary will be analyzed.

On the Extent tab, set Analysis Extent to Ikonos_stud_area.img

On the Cell Size tab, set Analysis cell size to Same as
Layer Ikonos_stud_area.img

On the Preferences tab, set the Resample Using: to Nearest Neighbor.

Click OK to submit these to the system.

In the *Image Analysis* window, click the down arrow and choose Classification, then the Unsupervised Classification option.

In the Unsupervised Classification window

For the Input Image: click the down arrow and choose the Ikonos_Buf15.img layer.

For Desired Number of Classes: fill in the value 16 (initially).

For the Output Image, navigate to the Ikonos directory and name the new image: Ikonos_class16.img*. Save as type will be ERDAS IMAGE.

Press the Save button.

Press the **OK** button.

* The appropriate number of classes was found to be highly variable. The more classes, the more work is required. Experience suggests that areas of desert, barren areas or agricultural fields would require more classes. Most analysts tended toward 32 classes. To facilitate communication among team members, the name Ikonos_Class16 was used independent of the actual number of classes generated.

End Option 1: ESRI Image Analysis:**Begin Option 2: ERDAS Imagine 8.6:****Step 4.1b Start using the *ERDAS Imagine*.**

On the main tool bar click the Classifier (or Data Prep) button. On the Classification menu, choose Unsupervised Classification.

In the Unsupervised Classification (Isodata) window for the Input Raster File navigate to your installation Ikonos directory and choose Ikonos_Buf15.img.

For the Output Files of Type, choose GRID Stack (*.stk). For File Name: input I_Class16_g. Press OK twice. Uncheck Output Signature Set.

For Number of Classes: enter 16.

Take the defaults for the rest:

Initialize from Statistics

Maximum Iterations: 6

Convergence Threshold: 0.950

Skip Factors: x=1, y=1

Press OK

Warning boxes may appear. Just click OK so the processing can continue.

You will be informed when the processing is finished.

End Option 2: ERDAS Imagine 8.6:

Examine this classified image closely to determine which two or three categories coordinate closely with residential and commercial development types.

Guidance: In this first classification, there can be a good deal of confusion between developed uses and barren land/soil. In a more humid environment, it is assumed here that land is barren because of human activity; therefore this is a part of the encroachment on which you are focusing. On the other hand, in an arid environment, barren land is not necessarily a sign of human activity.

If it looks like 16 classes are inadequate to cleanly distinguish urban vs. non-urban, redo Step 4.1 with 32 to 100 classes so that the categories are distinctive.

The next step generates an “urban” mask. There are several reasons for generating a mask of urban land uses for the time of the Ikonos image, roughly 2003. First, it will provide a conservative evaluation of the encroachment that is occurring. You may miss counting areas that were “urban” in 1992. However, by this restrictive technique, you end up counting as urban only those areas that are included in the 2003 “urban” mask. That is, for the 1992 urban value, count only those areas that were urban in both 1992 and 2003. Second, this procedure ensures a single direction for development (i.e., greater development as time goes on). Third, the procedure has the desired advantage of mitigating the great difference in resolution be-

tween the Ikonos imagery (5 meters-on-a-edge/pixel) and the NLCD (30 meters-on-a-edge/pixel).

To implement these concepts, fine-tune the identification of the 2003 urban areas. In general the procedure is to develop a mask from the most urban categories from the previous step, then let the unsupervised classifier reclassify only those areas in the preliminary-urban mask. By testing each of the resulting categories, you can determine the best dividing line between categories that are urban (yellow in Figure 3) and non-urban (usually barren) which are represented as light pink in Figure 3.

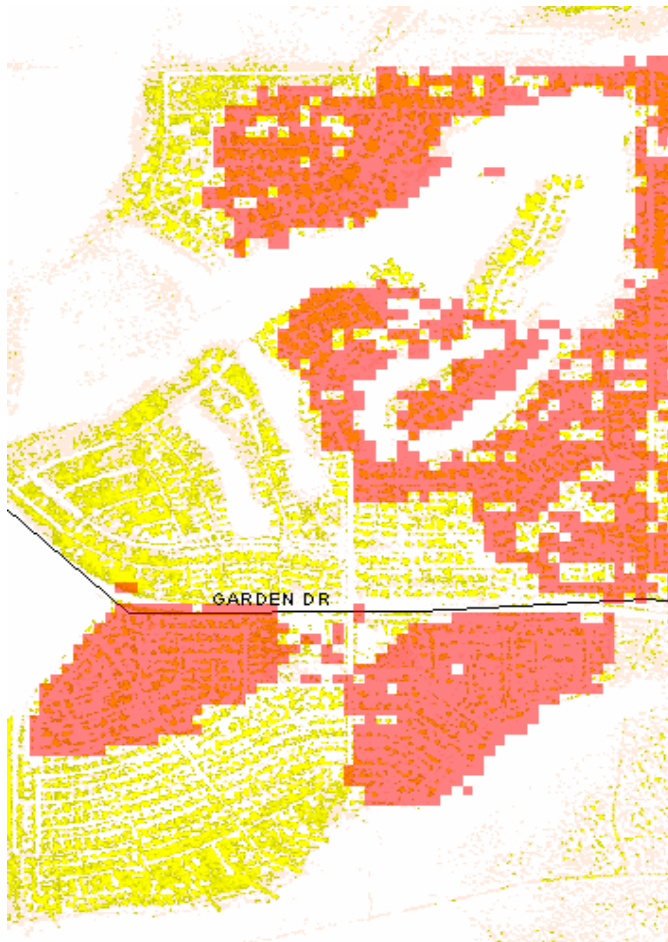


Figure 3. 1992 development data in semi-transparent red; 2001 development in yellows; only the “yellow” area of the red will be counted; Light pink is rejected urban (usually barren areas).

Make a grid mask for most urban categories:**Begin Option 1: ESRI Image Analysis:**

First, change the format of the file to a Grid:

On the Image Analysis toolbar, in the Layers: window, click the down arrow and choose Ikonos_class16.img, then for the Model Types: window, click the down arrow and choose the Ikonos option.

In the Image Analysis window, click the down arrow and choose Save As....

In the Save Ikonos_class16.img window, for the Look in: option, navigate to the Ikonos directory

For Save as type: choose the ESRI GRID and for the Name: enter I_Class16_g

Press the Save button.

Use ArcCatalog to place I_Class16_g in ArcMap.

End Option 1: ESRI Image Analysis:**End using the ESRI Image Analysis Start using the ESRI Spatial Analysis****Step 4.2 Next, reclass the categories to Urban and [NoData or Zero]**

Under the Spatial Analysis toolbar, in the Layers: window, click the down arrow and choose I_Class16_g.

Under the Spatial Analysis toolbar, click the down arrow and choose Reclassify.

On the Reclassify window

For Input raster enter the I_Class16_g (or if the grid was generated by ERDAS Imagine i_2class16_c1) file name.

For the Reclass Field, use the Class_names field.

Depending on the software you will use, in the next step set all the values to reclassify to one of the following:

1. If you will submit the result to ERDAS set:
non-urban categories to 0
OR
urban to 1
2. If you will submit the result to ArcGIS set:
non-urban categories to NoData
urban to 1

For Output raster: navigate to the installation Ikonos directory and name the new file I_Class_urb_g.

Save as Type: ESRI GRID, press Save

Press the OK button. When complete the I_Class_urb_g file will appear on the ArcMap TOC. You may wish to change the Symbology to show that it is Classified with a Classification of only 1 Class of value 1.

Often, particularly in arid areas, the classification for barren soils and urban will be the same. You need to distinguish between the two. Experiment has shown that the imagery does not do this well. So make the following assumption about development and then carry out its implementation for the analysis: All building development will occur within about 150 meters of a road because of a need for transportation and utility access. To accomplish this, adopt the “roads” file from the GDT Dynamap/2000 Street Network data from July 2003 (hereafter referred to as the Census data) as standard. Though the date of the Street Network file from Dynamap will not exactly be the same date as the imagery, it will be within a few years of that date. Assume few major new roads are built between the imagery date and the Census roads date.

Step 4.3 Clip the preliminary urban category file by the roads buffer.

Now use the roads buffer completed at the end of Step 2. As mentioned there, if the locations are largely desert or barren, using all roads may include too much area. Consider using only those road files that area major or named roads. (i.e., in the attribute table for STATEABBREVIATIONcountynames, sort by Road Name. Then delete all roads without a name). This will eliminate dirt trails in many locations that are unsuitable for development. Basically, use logic to reflect reality as closely as possible.

Make the preliminary urban category file, I_Class_urb_g

- Under the Spatial Analyst toolbar, click the down arrow and choose Options

- On the General tab, set Analysis mask to rds_clip_5mile_buf_150mbuf

- On the Extent tab, set Snap Extent to: I_Class_urb_g

- On the Cell Size tab, set Analysis cell size to Same as Layer “I_Class_urb_g”.

- Click OK.

Under the Spatial Analyst toolbar, click the down arrow and choose Raster Calculator

- In the Raster Calculator window, double click on I_Class_urb_g so that it appears in the Calculator window. Press the Evaluate button.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option. In this window navi-

gate to the Ikonos directory and save the file as i_clas_urbufg and for Save as type: choose ESRI GRID. Click the Save button*. In the TOC slowly double click on the name Calculation and rename it i_clas_urbufg.

Let the unsupervised classifier reclassify only those areas in the preliminary-urban mask.

End using the ESRI Spatial Analysis, Start using the ESRI Image Analysis.

Step 4.4a On the Image Analysis toolbar, in the Layers: window, click the down arrow and again choose Ikonos_stud_area.img, then for the Model Types: window, click the down arrow and choose the IKONOS option.

Under the Image Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to i_clas_urbufg

On the Extent tab, set Analysis Extent to Ikonos_stud_area.img

On the Cell Size tab, set Analysis cell size to Same as Layer

Ikonos_stud_area.img

On the Preferences tab, set the Resample Using: to Nearest Neighbor.

Click OK to submit these to the system.

In the Image Analysis window, click the down arrow and choose Classification, then the Unsupervised Classification option.

In the Unsupervised Classification window

For the Input Image: click the down arrow and choose the

Ikonos_Buf15.img layer.

For Desired Number of Classes: fill in the value 16 (initially).

For the Output Image, navigate to the Ikonos directory and name the new image: i_2class16_g. Save as type will be ESRI GRID. Press the Save button.

Press the OK button.

End Option 1: ESRI Image Analyst:

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

Begin Option 2: ERDAS Imagine8.6:

Step 4.4b

Import the urban road buffer into an .Img format.

On the ERDAS Imagine8.6 main tool bar click on the Import button. In the Import/Export window change Type: to Grid and Media: to File. Navigate to the Ikonos directory and select i_clas_urbufg. For the Output File enter i_clas_urbuf_img. Click OK. In the Import GRID window, click OK.

Mask the 5 mile buffer image by the preliminary urban road buffer file.

On the ERDAS Imagine8.6 main tool bar click on Image Interpreter:, then select Utilities then Mask. In the Mask window:

For the Input File: navigate to the installation Ikonos directory and select Ikonos_Buf15_img.

For the Input Mask File: navigate to the installation Ikonos directory and select i_clas_urbuf_img.img. Check the attributes are set correctly by clicking on the Setup Recode... button.

In the Thematic Recode window, there should be two lines where the Value 0 represents areas to be dropped out of consideration and the Value 1 represents those to be retained. If this looks ok, click the OK button.

For the Output File: navigate to the installation Ikonos directory and enter I_class_urbuf_masked.img (Figure 4). Put a checkmark in the Ignore Zero in Output Stats box. Press OK to launch the process.



Figure 4. Ikonos Image masked (black) beyond 150-meter road buffer, ready for second unsupervised classification.

Run the second Unsupervised classification on only the likely urban areas.

On the main tool bar click the Classifier button. On the Classification menu, choose Unsupervised Classification.

In the Unsupervised Classification (Isodata) window for the Input Raster File navigate to your installation Ikonos directory and choose I_class_urbuf_masked.img. For the Output Cluster Layer, navigate to the installation Ikonos directory and for Files of type: enter GRID Stack (*.stk) then for File name: enter i_2class16_g. Uncheck the Output Signature Set box. For Number of Classes: enter 16.

Take the defaults for the rest of the options:

Initialize from Statistics

Maximum Iterations: 6

Convergence Threshold: 0.950

Skip Factors: x=1, y=1

Press OK to run the classification.

Warning boxes may appear. Just click OK so the processing can continue.

You will be informed when the processing is finished.

End Option 2: ERDAS Imagine 8.6:

Examine **i_2class16_g** (or **i_2class16_c1** if generated by ERDAS Imagine) closely. You should see output for only those areas that were previously designated as roughly urban. In the **i_2class16_g** (or **i_2class16_c1** if generated by ERDAS Imagine) determine which classifications best coordinate with real urban areas and still pick up as little barren land as possible. Normally the “lighter” or higher number categories are the most truly urban, while the “darker” areas in this classified image tend to be the barren areas. As a rule of thumb the lighter few categories will best represent true urban. It is recognized that some barren areas will still be included in this delineation of urban, but the technique should divide the two categories well.

As a point of interest, it was found empirically that better delineation of urban areas was accomplished by using a two-step unsupervised classification (with 16 categories) rather than a single step unsupervised classification with more categories (e.g., 32).

Step 4.5 Turn the classes determined to be urban into a grid that will also act as a mask:

End using the *Image Analysis*, Start using the *Spatial Analysis*

Reclass the categories to Urban and NoData:

Under the Spatial Analysis toolbar, in the Layers: window, click the down arrow and choose i_2class16_g (or i_2class16_c1 if generated by ERDAS Imagine).

Under the Spatial Analysis toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to <None>. On the Extent tab, set Analysis Extent to StudyArea and Snap Extent to: <None>.

On the Cell Size tab, set Analysis cell size to Same as Layer “i_2class16_g” (or “i_2class16_c1” if generated by ERDAS Imagine)

Click OK to submit these to the system

Under the Spatial Analysis toolbar, click the down arrow and choose Reclassify

On the Reclassify window

For Input raster choose i_2class16_g (or i_2class16_c1 if generated by ERDAS Imagine) for the file name.

For the Reclass Field, use the Class_names field.

For the Set values to reclassify section, set all the New values that are:

urban to 2

on each non-urban category, right click and chose the Remove Entries option.

Check Mark the statement Change missing values to NoData

For Output raster: navigate to the installation Ikonos directory and name the new file I_2_urb_g.

Save as Type: ESRI GRID, press Save

Press the OK button.

When complete, the I_2_urb_g file will appear on the ArcMap TOC. You may wish to change the Symbology to show that it is classified with a Classification of only one Class of value 2.

You need to take steps to begin to mitigate the difference in resolutions. The Ikonos imagery 5-meter resolution is 0.000040003 degrees. You have now identified urban at 5-meter resolution, but to compare it with the 30-meter NLCD, you need to “spread” the identification out to be more comparable, particularly since there are likely to be registration issues between some of the layers you are using. Further, you need to ensure that the urban determination is correctly preserved later when you deal with the NLCD at 30 meters. Therefore, buffer the individual sites to 20

meters. This process therefore includes the yards around a building, which, of course, anyone would consider part of the urban landscape.

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set Analysis mask to None

On the Extent tab, set Analysis Extent to i_2_urb_g

On the Cell Size tab, set Analysis cell size to Same as Layer “Ikonos_stud_area.img” (The Ikonos imagery 5-meter resolution is 0.000040003 degrees.)

Under the Spatial Analysis toolbar, click the down arrow and choose Distance... then Straight Line

In the Straight Line evaluation box, enter

For Distance to: enter: i_2_urb_g

For Maximum Distance: enter: 0.00016 (degrees - that's 4 times 5 meters or 20 meters).

For Output cell size: enter: 0.00004

Do not Create direction or Create allocation

For Output raster navigate to the Ikonos directory and enter i_2urbbuf_g

Press OK

This will generate a file with more area extent to it than that obtained from the original image (Figure 5).

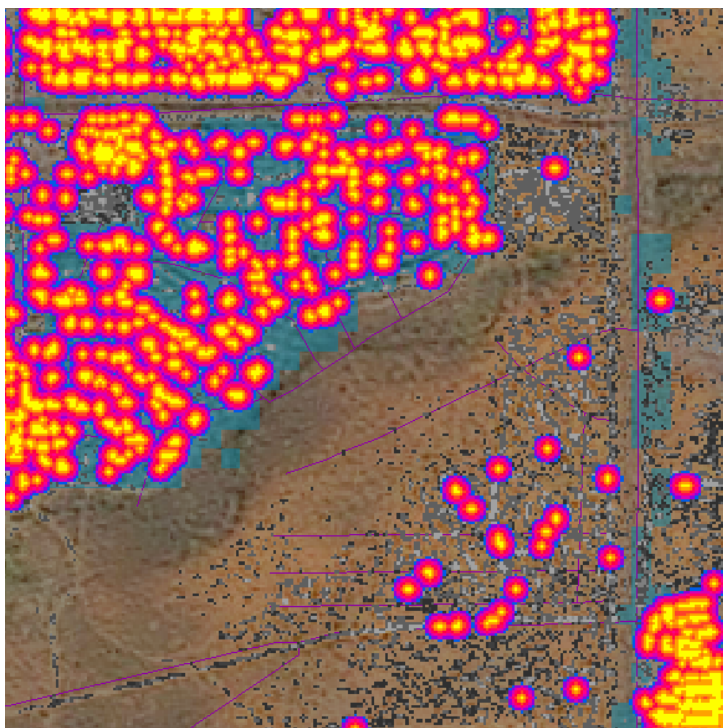


Figure 5. Expanding the urban locations (yellow) to a parcel size extent (orange balls). Noise removed is spectroled grays. Transparent blue squares along the road show incorrectly identified urban in the 1992 USGS NLCD.

Now you need to simplify the i_2urbbuf_g layer to a single value.

Under the Spatial Analysis toolbar, click the down arrow and choose Raster Calculator.

On the Raster Calculator window enter a statement of the form (if values in this layer are greater than or equal to zero, assign value 2, otherwise assign a zero): Con ([i_2urbbuf_g] >= 0, 2, 0).

Click the Evaluate button.

When complete, Calculation file will appear on the ArcMap TOC with a single value of 2. Right click on Calculation and choose the Make Permanent option.

In this window navigate to the Ikonos directory and save the file as i_2_urb4_g and for Save as type: choose ESRI GRID. Click the Save button.*

Still Too Much Noise Remains?

Occasionally by this point some i_2_urb4_g files will still have too much land mistakenly identified as urban. The most common incorrect situations are barren areas and mountains in arid areas, agricultural fields in the South, or snow on the ground in the North. This is particularly irritating in areas that are sparsely developed. If the procedure has resulted for these reasons in an unacceptable rating in the next step, define obvious urban/develop areas using polygons and cut away most of the noise outside of these polygons. To accomplish this, a brief outline follows. You will have to modify it based on your particular situation.

Define Polygon Shape: In ArcCatalog, click on the installation directory name, go to file on the menu bar, and choose New then Shapefile... In the Create New Shapefile window Name the file Masker. The Feature Type: is Polygon. For the Spatial Reference, press the Edit... button and Import. Pick one of the existing files in the standard Geographic WGS84 projections and Add it to the Masker file. Put this empty file in the ArcMap window.

Make MASKER Polygon Shape: In the ArcMap window, click on the Editor Toolbar, then click Start Editing. On the Start Editing window, choose the directory that lists MASKER. Make sure that the Target window lists Masker. The Task window should read Create New Feature. Click on the Sketch Tool icon. Use this tool to define those areas that you want to SAVE after you use Masker

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

to eliminate the noisy areas. Save your edits once in a while, then press Stop Editing when you are finished.

Guidance: You will make Masker as a definition of areas you want to save. To see the general areas, in the ArcMap window display both the Urban areas file and the cities_dtl file. You will certainly want to define these as polygons as well as other obvious areas. Remember, the polygons are those areas you wish to KEEP.

Make Mask: When you are done with Masker, you need to change it to a GRID format. Under Spatial Analyst click on Convert, then on Features to Raster... Fill in the requested items in the window, name the output grid MaskerG. It will appear in the TOC when done.

Clip out unwanted areas: Under the Spatial Analyst toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to MaskerG.

On the Extent tab, set Analysis Extent to StudyArea.

On the Cell Size tab, set Analysis cell size to Same as Layer “i_2_urb4_g”.

Under the Spatial Analyst toolbar, click the down arrow and choose Raster Calculator.

In the Raster Calculator window, double click on Layer i_2_urb4_g so that it appears in the Calculator window. Press the Evaluate button.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option. In this window navigate to the Ikonos directory and save the file as i_2_urb4_g_m and for Save as type: choose ESRI GRID. In the TOC rename it to i_2_urb4_g_m.*

Step 4.6 Do a Quality Control evaluation on the urban-class layer per criteria per Preliminary Quality Evaluation

Although you have not completed all tasks, at this point you are probably pretty familiar with the issues for the installation. Copy out and then fill out the Prelimi-

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

nary Quality Evaluation form below for this Step 4. Save it as a Word .doc in the installation directory.

Preliminary Quality Evaluation For *Installation Name*

Do an inspection of the result Ikonos image urban identification and in terms of that resultant image, and answer the following questions:

1. How well does the Ikonos classification of urban correspond to what one would think of as urban from comparison with the original study area image?

1 2 3 4 5 Best

2. Roughly by how many percent would you think, the urban areas are:

Overestimated 1 3 5 10 20 percent

Underestimated 1 3 5 10 20 percent

3. Identify the location within the study area that is the least accurate. What appears to be the cause? What would eliminate the problem? (Example pictures of the points you make are desired).

4. Is the result of this analysis

Good OK Fair Poor Unacceptable

If unacceptable, what needs to be done to make it acceptable?

If in point 2, the over or under estimate was more than 20 percent, redo Steps 4.1 and 4.4 using 24-100 classes rather than 16.

Step 5: Generate land cover from the NLCD

Step 5 General description: Land use changes will be determined by comparing the National Land Cover Data – NLCD. Download the NLCD; import it to your format by reprojecting it and clipping it to the study area extent and at the resolution of the NLCD. Then make a mask that excludes areas that cannot be developed.

A few installations are in locations not covered by the NLCD. For these few, an alternative approach was generated such that similar final encroachment indices (as described in Step 6) could be generated. This alternative procedure is described in Appendix A.

Step 5.1 Obtain the NLCD for the state you are working in.

This can be had from the web for all states. If you need more than one state to cover the study area and buffer, do each state separately to Clip NLCD Grid to the Study Area. In this step you will sew the states together.

To retrieve the data from its web home, go to the following web location:

<http://edcftp.cr.usgs.gov/pub/data/landcover/states>

Right click on the GeoTiff formatted state file you want (it has the .tif.gz extension) and then save target as..... You might wish to save this in a directory dedicated to manipulating NLCD data. Be sure the .gz extension is part of the downloaded file name (*.bin.gz). Lastly, be sure to save the associated txt files into the same directory, particularly the state_readme.txt and the state_FGDC.txt files. [FGDC is the United States Federal Geographic Data Committee. It has the lead role in defining spatial metadata standards.]

Go to the directory where you have saved the compressed NLCD file and double click on the name. If you have associated the .gz extension with WinZip, this action should bring up the WinZip utility. Extract to your NLCD directory. Close WinZip.

In ArcCatalog look at the file. ArcCatalog probably recognizes the file and recognizes that the projection is probably the wrong projection (see example projection information box). Therefore you must do a reprojection.


```

Projection: Albers Conical Equal Area
Datum: NAD83
Spheroid: GRS80
Standard Parallels: 29.5 degrees North Latitude
                   45.5 degrees North Latitude
Central Meridian: 96 degrees West Longitude
Origin of the Projection: 23 degrees North Latitude
False Easting: 0 meters
False Northing: 0 meters
Number of Lines (rows/height): 23328
Number of Samples (columns/width): 20036
Number of Bands: 1 Pixel size: 30 X 30 meters
Projection Coordinates (center of pixel, projection meters)
Upper Left Corner: -1747230 meters(X),
                  1701780 meters(Y)
Lower Right Corner: -1146180 meters(X),
                  1001970 meters(Y)

```

Step 5.2 Import to TIFF Format

Do the following steps in ERDAS Imagine

Start using the ERDAS Imagine Version 8.6

Open Imagine

Click on the Import button

In the Import/Export window Type is GeoTIFF, Media is File. Browse to find the Input File for your state in the NLCD directory.

Name the Output File (make sure you are putting it in the desired NLCD directory) StateName_projection (e.g., Virginia_albers). Note: the projection is stated in the .txt file that came in the .zip package. For the Files of type: box select Img (the default). Press the OK button.

The Import TIFF box should appear with the correct data. Check that the rows and columns are correct. Press the OK button several times to get it started.

Step 5.3 Reproject Images

When the data is available, to reproject, click on the Data Prep button on the main menu bar. In the Data Preparation box, click on the Reproject Images button. In the Reproject Images box, chose the state_projection.img file name. For the output file:

Name it State_ll and put it in the NLCD directory (remember the name must be less than 13 characters).

For the Files of type: select GRID Stack (*.stk). Press OK.

In the Output Projection Section change the characteristics of the projection you are using to Geographic and Lat/Lon (WGS 84). Take the defaults for other options. (Note: sometimes an error message appears. Just click OK to the message and let the processing finish.)

End using the *ERDAS Imagine*, start using the *ESRI ArcGIS*

When the reprojection is finished, two GRIDS will be listed. Either can be used. We will use the layer that ends in “c1”. Use ArcCatalog Metadata to make sure the projection is correct. Then submit it to ArcMap. Check to make sure that there is a sense that features between layers are consistent.

Step 5.4 Clip NLCD Grid to the Study Area

Use the grid of the study area to clip out the NLCD portion you are interested in. Start using the Spatial Analysis.

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set Analysis mask to StudyArea.

On the Extent tab, set Analysis Extent to StudyArea and Snap Extent to: state_nlcc1.

On the Cell Size tab, set Analysis cell size to Same as Layer “state_nlcc1”.

Under the Spatial Analyst toolbar, click the down arrow and choose Raster Calculator.

In the Raster Calculator window, double click on Layer state_nlcc1 so that it appears in the Calculator window. Press the Evaluate button.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option. In this window navigate to the NLCD directory and save the file as NLCD_StudArea and for Save as type: choose ESRI GRID.* In the TOC slowly double click on the name Calculation and rename it NLCD_StudArea. Right click on the state_nlcc1 and click the Remove button.

If your study area includes more than one state:

In this step you will sew the states together. Since each state includes a small buffer of land use of the adjacent state, you need to put these together without double counting the overlaps.

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set Analysis mask to StudyArea.

On the Extent tab, set Analysis Extent to StudyArea.

On the Cell Size tab, set Analysis cell size to Same as Layer “state_nlcc1”.

Under the Spatial Analyst toolbar, click the down arrow and choose Raster Calculator.

In the Raster Calculator window set up a conditional statement similar to:

Con ([nlcd_studarState1] > 0, [nlcd_studarState1], [nlcd_studaraStat2])

Press the Evaluate button.

The result should appear on the map and in the TOC as Calculation.

Right click on Calculation and choose the Make Permanent option. In this window navigate to the NLCD directory and save the file as NLCD_StudArea and for Save as type: choose ESRI GRID. In the TOC slowly double click on the name Calculation and rename it NLCD_StudArea.* Right click on the state_nlcc1 and click the Remove button.

Step 5.5 Reclass the NLCD data into an urban category layer

From the NLCD data reclass the data from categories 21, 22 and 23 into an urban category layer.

Under the Spatial Analyst toolbar, click the down arrow and choose Reclassify. In the Reclassify window:

Choose NLCD_StudArea as the Input Raster, Value as the Reclass Field and at the bottom of the box, name the Output raster NLCD_urban of Type: ESRI GRID inside the NLCD directory.

In the Set values to reclassify section, for:

Categories 21, 22, 23 set New values to 1

All other categories, set New values to 0.

Click OK. NLCD_urban grid file will appear in the ArcMap window. This is the extent of urban land in about 1992.

Step 5.6 Generate an exclude mask from the NLCD for areas that will never be developed land.

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

From the NLCD you can determine that there are areas that will never be developed land. Now generate a mask to exclude these areas in the later analyses:

- 11 Open Water
- 12 Perennial Ice/Snow
- 31 Bare Rock/Sand/Clay
- 32 Quarries/Strip Mines/Gravel Pits

Under the Spatial Analyst toolbar, click the down arrow and choose Reclassify. In the Reclassify window:

Choose NLCD_StudArea as the Input Raster, Value as the Reclass Field and at the bottom of the box, name the Output raster NLCD_exclude of Type: ESRI GRID inside the NLCD directory.

In the Set values to reclassify section, for:

Categories 11, 12, 31, and 32 set New values to 1

All other categories, set New values to 0.

Click OK. NLCD_exclude grid file will appear in the ArcMap window.

Step 6: Generate trend tabular data

Step 6 General description: At this point you have two data sets that can be overlaid visually (such as in Figure 3) to illustrate changes in urbanization over time. Now you need to compare these quantitatively. Do this by spatially linking the Ikonos urban data layer table with the NLCD urban areas. Then delineate which buffer the urban areas are in. Finally, generate a table showing the growth during the period and use this to do trend predictions to the year 2020. In this manner, you will have a simple summary evaluation of the state of encroachment current and in the future.

Step 6.1 Make a combined grid file of 1992 and 2001 urban:

Start using the *ArcToolbox*

Export from Raster; use the Grid to Polygon Coverage tool. Input grid is nlcd_exclude, create output coverage called Exclude. Leave Weed Tolerance alone.

Start using *ArcMap*

Add Exclude coverage to your map. Change Symbology to show the categories unique values. Change the value field to GRID_CODE. Press the Add All Values button and uncheck the box All other values. Click Apply and OK.

Right click Exclude coverage layer and then Open Attributes Table. Sort GRID_CODE Ascending and select all of the Zero value records. Export those records to a new coverage file and call it Exclude_Mask. Add it to the map. You can now delete the Exclude coverage if you want.

Start using the *Spatial Analysis*

Exclude never to be developed land:

- Under the Spatial Analyst toolbar, click the down arrow and choose Options

- On the General tab, set Analysis mask to Exclude_Mask

- On the Extent tab, set Analysis Extent to Exclude_Mask

- On the Cell Size tab, set Analysis cell size to 0.00004 (the Ikonos imagery 5-meter resolution)

- Under the Spatial Analysis toolbar, click the down arrow and choose Raster Calculator

- In the Raster Calculator evaluation box, click on the last urban data file so the window reads:

- [i_2_urb4_g]

- or

- [i_2_urb4_g_m] if you had to use a mask made from polygons.

- Click the Evaluate button.

- This will result in the same file but with non-buildable areas excluded.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option. In this window navigate to the Ikonos directory. For Save as type: choose ESRI GRID and save the file as i_2_urb4xg. Click the Save button.*

Under the Spatial Analyst toolbar, click the down arrow and choose Options

On the General tab, set Analysis mask to i_2_urb4xg

On the Extent tab, set Analysis Extent to i_2_urb4xg

On the Cell Size tab, set Analysis cell size to 0.00010 (this is one of the steps in which you begin to mitigate the difference in resolutions. The Ikonos imagery 5-meter resolution is 0.00004 degrees. Decrease this by 2.5 times to about 12.5 meters. This will also allow for faster calculation time in the next several steps).

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator.

In the Raster Calculator evaluation box, enter a statement similar to:

Con ([NLCD_urban] == 1, 1, 2)

This will assign values of 1 to cells that were urban in 1992 and 2001 and values of 2 to cell that were urban only in 2001.

Click the Evaluate button.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option. In this window navigate to the installation directory. For Save as type: choose ESRI GRID and name the file urb92_01g. Click the Save button.†

In the TOC slowly double click on the name Calculation and rename it urb92_01g.

Step 6.2 Calculate unique values for different urban growth degrees at different times depending on the buffer.

Now you need to apply an equation that integrates the characteristics of the buffers and the different urban growth degrees at different times. The resulting values are unique, depending on the buffer in which they occur.

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set Analysis mask to <None>

On the Extent tab, set Analysis Extent to Same as Layer "BUF15_G"

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

† You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

On the Cell Size tab, set Analysis cell size to 0.00010 (our standard from now on).

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator.

In the Raster Calculator evaluation box, enter the a statement similar to:

Con ([Buf15_G] == 1, [urb92_01g], [urb92_01g] + 5)

This will assign values of:

- 1 to cells that were urban in 1992 and 2001 and are within a 1-mile buffer of the installation.
- 2 to cells that were urban only in 2001 (i.e. newly developed) and are within a 1-mile buffer of the installation.
- 6 to cells that were urban in 1992 and 2001 and are within a 1 to 5 mile buffer of the installation.
- 7 to cells that were urban only in 2001 (i.e. newly developed) and are within a 1 to 5 mile buffer of the installation.

Click the Evaluate button.

The result should appear on the map and in the TOC as Calculation. Right click on Calculation and choose the Make Permanent option*. In this window, navigate to the installation directory and save the file as urbbuf_92_01g and for Save as type: choose ESRI GRID. Click the Save button.

In the TOC slowly double click on the name Calculation and rename it urbbuf_92_01g. urbbuf_92_01g is the product of this effort and will be sent to the TABS office. From it, you will generate the growth rates and trend data.

Step 6.3 Export the data to an Excel file

You now have the data needed to make the comparisons among the installations.

Right click on the urbbuf_92_01g file in the TOC and click on Open Attribute Table. Accompanying this Protocol, you will find a prepared MS Excel table, Example_Installationname_urbbuf_92_01.xls. This file has all the calculation routines already integrated into it, so your job is finding and plugging in values from your installation. Copy Example_Installationname_urbbuf_92_01.xls to your installation directory. Rename it to your installation name. Open the file. Copy the values from the urbbuf_92_01g file Attribute Table to the similar locations in the .xls file. You will need only to enter values in those colored boxes (colored Red below and YELLOW in the Excel spread sheet).

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

Step 6.4 Populate the table and generate the trend data in MS Excel.

Start using *MS Excel*

Generate Trend data in MS Excel.

You will see that the Attribute Table only has a “Count” column, rather than acres. Count is adequate because we will deal only with percentages, not absolute areas. This makes comparisons between installations more reasonable.

Under the Legend column enter the correct label for each value:

Legend	Value
1992 - 1 mile buffer	1
2001 -1 mile buffer	2
1992 - 2-5 miles buffer	6
2001 - 2-5 miles buffer	7

Now, you need to know the amount of area within each buffer. Go to ArcMap and right click on the BUF15_G file in the TOC. Move down the menu and choose Open Attribute Table.

In the attribute table there are only **Count** values for the 0-1 mile and the 1-5 mile buffers (MAKE SURE that the resolution used in both BUF15_G and urbbuf_92_01g are the same, otherwise the cell counts will not be comparable). From the Attributes of BUF15_G for the inner buffer (value 1) copy the Count to the new Column **BufferCount** in the Excel file for Values 1 and 2 (the 0- to 1-mile buffer values) and from the Attributes of BUF15_G for the outer buffer (value 2) copy the Count to the Column (**BufferCount**) in the Excel file for Values 6 and 7 (the 1- to 5-mile buffer values).

From this table generate the rate of growth in percentage between NLCD (1992) and Ikonos image (for short hand, use 2001). Use these values to generate a projection to the year 2020. Additional inputs required are:

Year of Image

The NLCDs are all assumed to be 1992. The year of the Ikonos image is not available for files that had a 5-meter resolution. They are all assumed to be 2003. For any received 1-meter data that was translated to 5-meter, the .txt files that came with the 1-meter data will have the image date. Find it and enter it in the “2003” rows.

Quality Evaluation

In the Quality Evaluation you gave a numerical rating (1-5 with 5 as best) in answer to the first question. Enter this value once in this column.

OverUnder%

When you completed your Preliminary Quality Evaluation you made an estimate of how well the imagery evaluation worked. Take the Overestimated%, subtract the Underestimated%, and enter this value in the table. For example enter .1 for 10%. Negative values indicate a net underestimate. Most values are expected to be positive.

Count of Undevelopable land 1992. If land is undevelopable, it will help protect the installation against encroachment. This value is available from the attribute file of the NLCD_Exclude. Do the evaluation for the different buffers to see how well protected the installation is.

Generate the basic excluded data for the 0-1-mile buffer:

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set the Working directory to the installation NLCD directory and set Analysis mask to Bond_Buf15 (or Bond_Buf15_trunc if this is what you used).

On the Extent tab, set Analysis Extent to Same as Layer “NLCD_StudArea”

On the Cell Size tab, set Analysis cell size to Same as Layer “NLCD_StudArea”

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator

In the Raster Calculator evaluation box, enter the a statement similar to the following two line expression:

```
con([nlcd_exclude] == 1 & [buf15_g] == 1,1,~
con([buf15_g] == 1,0))
```

This statement will pull out only those cells within the 1-mile buffer. Remember that if the study area was truncated, you must substitute the buf15_g_trunc or equivalent file.

The new Calculation file will appear on the TOC.

Right click on Calculation and choose the Make Permanent option. In this window navigate to the NLCD directory and save the file as xCount1. For Save as type: choose ESRI GRID. Click the Save button*. In the TOC slowly double click on the name Calculation and rename it xCount1.

Right click on xCount1, click on Open Attribute Table. Fill in the following information in the excel table.

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

Count of Undevelopable Land

% Undevelopable land is the Count of Undevelopable Land cells divided by the total count of cells in the xCount1 attribute table. To get the Total Count, right click on the Count column, select “statistics” and enter the value for Sum: into the spreadsheet under the Total Cells in buffer column.

After closing the statistics dialog box, copy the number in the Count column that corresponds to objectID 1 in the xCount1 attribute table. This is the number of cells that cannot be developed within the 1-mile buffer. Paste this figure into the Excel spreadsheet under the “Count of undevelopable land cells” column for the 1-mile buffer.

Generate the basic excluded data for the 1- to 5-mile buffer:

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set the Working directory to the installation NLCD directory and set Analysis mask to Bond_Buf15
(or Bond_Buf15_trunc)

On the Extent tab, set Analysis Extent to Same as Layer
“NLCD_StudArea”

On the Cell Size tab, set Analysis cell size to Same as Layer
“NLCD_StudArea”

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator.

In the Raster Calculator evaluation box, enter the a statement similar to the following two-line expression:

```
con([nlcd_exclude] == 1 & [buf15_g] == 2,1,~
con([buf15_g] == 2,0))
```

This statement will pull out only those cells within the 1-5 mile buffer. Remember that if the study area was truncated you must substitute the buf15_g_trunc or equivalent file.

The new Calculation file will appear on the TOC.

Right click on Calculation and choose the Make Permanent option. In this window, navigate to the NLCD directory and save the file as xCount5. For Save as type: choose ESRI GRID. Click the Save button.* In the TOC slowly

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

double click on the name Calculation and rename it xCount5. Right click on xCount5, click on Open Attribute Table. Fill in the following information in the excel table.

Count of Undevelopable Land

% Undevelopable land is the Count of Undevelopable Land cells divided by the total count of cells in the xCount5 attribute table. To get the Total Cells in the 5-mile buffer, right click on the Count column, select “statistics” and enter the value for Sum: into the spreadsheet under the Total Cells in buffer column.

After closing the statistics dialog box, copy the number in the Count column that corresponds to objectID 1 in the xCount5 attribute table. This is the number of cells that cannot be developed within the 5-mile buffer. Paste this figure into the Excel spreadsheet under the “Count of undevelopable land cells” column for the 5-mile buffer.

The ratio of these two values, suggests how well the nearby areas are naturally protected from development. Ratios greater than 1 suggest that the installation is more protected.

New corrected value for Count of Undevelopable land cells

Because the excluded cells in the xCount files were generated from the NLCD data, the cell counts are not directly comparable to the cell counts in the Buf15_g files due to the differences in resolution. The Excel spreadsheet has a built-in conversion equation to compensate for this discrepancy and will correct for these differences in resolution. This correction is displayed in the “new corrected value for Count of undevelopable land cells” column of the spreadsheet.

Urban %

Count/BufferCount in each row is derived by the formula; it uses the OverUnder% to correct for evaluated inaccuracies.

Total Urban %

Sum of Urban within Buffer so there is a value only every other row.

Straight-line % Increase/Year

Urban % for the 1-mile buffer divided by the number of years between NLCD and Ikonos Image. Since the NLCD is made up of many TM images, it is assumed to be roughly 1992. The Ikonos images vary by a few years. Check the metadata file for the correct date.

Straight-line Trend to 2020 %Urban (Developable)

Beginning Total Urban % Developable plus the product of % increase/year times the number of years from the Ikonos image to 2020.

Monomolecular Trend to 2020 %Urban

Most development will start slowly and have a high rate in the mid portions of its development cycle. The rate will decrease as the best lands have already been used to a point where it will take a long time to use those last less choice parcels. The Monomolecular trend takes this into account. It will also avoid the situation where the Straight-line will easily go beyond 100%. The Monomolecular Trend uses the same information, but results in a prediction that probably reflects reality more closely. It is a hyperbolic curve tending to a 100% asymptote.

During the development of the data researchers came across or generated several pieces of data that are useful in evaluating encroachment risks. In this section you will gather these into the same .xls table. These will be used to generate comparison tables among the installations in the final group report to the TABS office. The purpose of each, data source location, and/or formula are discussed below:

UrbanizationRate/Cell 1mile. You need to normalize the rates in the buffers above to a cross-installations rate. This value is calculated as %Increase/Year divided by the 1 mile BufferCount.

UrbanizationRate/Cell 2_5miles. This value is calculated as %Increase/Year divided by the 5 mile BufferCount.

1mile vs. 5mile buffer Increase/Year ratio. Divide the UrbanizationRate/Cell 1mile by the UrbanizationRate/Cell 2_5miles. A ratio greater than 1 indicates urbanization is occurring at a greater rate near the installation – this is less desirable than a value less than 1, which indicates encroachment is tending to stay away from the installation.

Length of installation perimeter. The greater the length of the edge of an installation, the greater the potential of encroachment. Read this value from the attribute table of the vector file: Boundary as follows:

On the TOC right click on Boundary, click on Open Attribute Table. Find the column Perimeter. Enter the value of Perimeter as the Length of installation perimeter.

Perimeter/area index. The greater the boundary varies from a circle; the greater is the opportunity for the perimeter to be encroached upon. To generate this value divide Boundary by Area value.

On the TOC right click on Boundary, click on Open Attribute Table. Find the column Area. Divide the Perimeter by the Area to get the Perimeter/area index.

1992 Urban Land Use Counts: The issue here is what is the mix of land use types that can cause encroachment? It would be difficult and unreliable to pull this information from the Ikonos images, but it can be read directly from a layer you will create.

Generate the basic data for the entire 5-mile buffer:

Under the Spatial Analyst toolbar, click the down arrow and choose Options.

On the General tab, set the Working directory to the installation directory and set Analysis mask to Bond_Buf15

On the Extent tab, set Analysis Extent to Same as Layer “NLCD_StudArea”

On the Cell Size tab, set Analysis cell size to Same as Layer “NLCD_StudArea”

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator

In the Raster Calculator evaluation box, enter the a statement similar to:

`con([nlcd_urban] == 1,[NLCD_StudArea],0)`

This statement will pull out only those urban cells within the 5-mile buffer.

The new Calculation file will appear on the TOC.

Right click on Calculation and choose the Make Permanent option. In this window, navigate to the NLCD directory and save the file as UrbanCount5. For Save as type: choose ESRI GRID. Click the Save button*. In the TOC slowly double click on the name Calculation and rename it UrbanCount5. Right click on UrbanCount5, and then click on Open Attribute Table. Fill in the following information in the excel table.

5-mile 1992 Count. To find percentages you need to know the total area in the 5-mile buffer. From the UrbanCount5 file attribute table, right click on the Count column and choose Statistics. In the Statistics of urban-count5 window, the Sum: is the number to add to the Excel table.

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

5-mile 1992 Count of Low Density Housing. This can be read directly from the UrbanCount5 file attribute table in the Count column for value 21.

5-mile 1992 Count of High Density Housing. This can be read directly from the UrbanCount5 file attribute table in the Count column for value 22.

5-mile 1992 Low to High Density Ratio. To characterize the growth demographics, generate this index by dividing the 1992 Count of Low Density Housing by the 1992 Count of High Density Housing.

5-mile 1992 Count of Commercial Transportation. This can be read directly from the UrbanCount5 file attribute table in the Count column for value 23.

Generate the basic data for the 1-mile buffer:

Under the Spatial Analyst toolbar, click the down arrow and choose Options

On the General tab, set the Working directory to the installation directory and set Analysis mask to Bond_Buf15

On the Extent tab, set Analysis Extent to Same as Layer “BUF15_G”

On the Cell Size tab, set Analysis cell size to Same as Layer “BUF15_G”.

Remember that if the study area was truncated you must substitute the buf15_g_trunc or equivalent file.

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator

In the Raster Calculator evaluation box, enter a statement similar to:

```
con([BUF15_G] == 1,1)
```

This statement will create a 1-mile GRID buffer. Remember that if the study area was truncated you must substitute the buf15_g_trunc or equivalent file.

The new Calculation file will appear on the TOC.

Right click on Calculation and choose the Make Permanent option. In this window navigate to the NLCD directory and save the file as Buf1_G. For Save as type: choose ESRI GRID. Click the Save but-

ton.* In the TOC slowly double click on the name Calculation and rename it Buf1_G (or Buf1_G_trunc if appropriate).

On the General tab, set Analysis mask to Buf1_G or Buf1_G_trunc.

On the Extent tab, set Analysis Extent to Same as Layer “Buf1_G” or “Buf1_G_trunc”

On the Cell Size tab, set Analysis cell size to Same as Layer “NLCD_StudArea”

Under the *Spatial* Analysis toolbar, click the down arrow and choose Raster Calculator

In the Raster Calculator evaluation box, enter a statement similar to:
con([Buf1_G] == 1,[UrbanCount5],0).

This statement will pull out only those urban cells within the 1-mile buffer. Remember that if you truncated the study area, you must substitute the buf1_g_trunc or equivalent file.

The new Calculation file will appear on the TOC.

Right click on Calculation and choose the Make Permanent option. In this window, navigate to the NLCD directory and save the file as UrbanCount1. For Save as type: choose ESRI GRID. Click the Save button†. In the TOC slowly double click on the name Calculation and rename it UrbanCount1.

Right click on UrbanCount1, click on Open Attribute Table. Fill in the following information in the excel table.

1-mile 1992 Count. To find percentages you need to know the total area in the 1-mile buffer. From the UrbanCount1 file attribute table, right click on the Count column and choose Statistics. In the Statistics of urbancount1 window, the Sum: is the number to add to the Excel table.

1-mile 1992 Count of Low Density Housing. This can be read directly from the UrbanCount1 file attribute table in the Count column for value 21.

* You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes halt the ARCMAP session.

† You may wish to use the work-around for saving calculations, as using the Make Permanent option will sometimes kill the ARCMAP session.

1-mile 1992 Count of High Density Housing. This can be read directly from the UrbanCount1 file attribute table in the Count column for value 22.

1-mile 1992 Low to High Density Ratio. To characterize the growth demographics we generate this index by dividing the 1-mile 1992 Count of Low Density Housing by the 1-mile 1992 Count of High Density Housing.

1-mile 1992 Count of Commercial Transportation. This can be read directly from the UrbanCount1 file attribute table in the Count column for value 23.

Ratio of low to High density compared between 5- and 1-mile buffer. This ratio shows the character of the development near the installation. A value greater than 1 shows more low density near installation. The greater the value, the more predominant the low-density housing is near the installation.

Length of Roads within 5 miles. The presence of roads is a very important attractor for development. In fact, development rarely occurs unless road access already exists. To get this value, use rds_clip_5mile_buf as follows:
On the TOC right click on the file rds_clip_5mile_buf, click on Open Attribute Table. Right click on the column LENGTH. The Statistics of rds_clip_5mile_buf window will appear. Enter the value of SUM: as the Length of Roads within 5 miles.

Roads/unitarea within 5 miles. The formula already exists in the Excel sheet to divide the Length of Roads within 1-5 mile by the 1992 COUNT for the 5-mile buffer.

Length of Roads within 1 mile. To get this value, use rds_clip_5mile_buf as follows:

In the TOC, click on the Bond_Buf15 file (or Bond_Buf15_trunc file) to highlight it. Right click on the Bond_Buf15 file, click on Open Attribute Table. Select the row that corresponds to the 1-mile buffer. It will be highlighted on the map itself.

On the Main Menu, click Tools, then Geoprocessing Wizard.

Chose Clip one layer based on another, then Next>.

Select the input layer to clip: rds_clip_5mile_buf

Select a polygon clip layer: The Bond_Buf15 file (or Bond_Buf15_trunc file). MAKE SURE that the Use selected features only box has a checkmark in it.

Specify the output shapefile: roads1_clip in the installation directory.

Then click the Finish button.

The new roads1_clip file will appear on the TOC. Right click on roads1_clip, click on Open Attribute Table. Right click on the column LENGTH. Click on the Statistics option. The Statistics of roads1_clip box will appear. Enter the value of SUM: as the Length of Roads within 1 mile.

Roads/unitarea within 1 mile. In this step you determine the density of the road network. Simply divide the Length of Roads within 1 mile by the 1992 COUNT for the 1-mile buffer.

Ratio of Roads/unitarea within 1 mile divided by Roads/unitarea within 5 miles. A number less than 1 is good – it means that the intensity of road building near the installation is less than is characteristic of the nearby regions.

Towns within 5 miles & Town Population within 5 miles. The more towns that exist near the installation, the more attractiveness there exists for potential development to occur. To generate this value, clip the vector file cities_dtl with Bond_Buf15 (or Bond_Buf15_trunc file).

On the Main Menu, click Tools, then Geoprocessing Wizard.

Chose Clip one layer based on another, then Next>.

Select the input layer to clip: cities_dtl

Select a polygon clip layer: The Bond_Buf15 file (or Bond_Buf15_trunc file)

Specify the output shapefile: cities5_clip in the installation directory.

Then click the Finish button.

The new cities5_clip file will appear on the TOC. Right click on cities5_clip, click on Open Attribute Table and read the number of rows. This is the value of Towns within 5 miles. Right click on the column POP_98. Choose the Statistics option. The Statistics of cities5_clip will appear. Enter the value of SUM: as the Town Population within 5 miles.

Towns within 1 mile & Town Population within 1 mile. The more towns that exist near the installation, the more attractiveness there exists for potential development to occur. To generate this value, select the one-mile buffer and clip the vector files, Bond_Buf15 (or Bond_Buf15_trunc file) with cities_dtl.

In the TOC, click on the Bond_Buf15 file (or Bond_Buf15_trunc file) to highlight it. Right click on the Bond_Buf15 file, click on Open Attribute Table. Select the row that corresponds to the 1-mile buffer. It will be highlighted on the map itself.

On the Main Menu, click Tools, then Geoprocessing Wizard.

Chose Clip one layer based on another, then Next>.

Select the input layer to clip: cities_dtl

Select a polygon clip layer: The Bond_Buf15 file (or Bond_Buf15_trunc file). MAKE SURE that the Use selected features only box has a checkmark in it.

Specify the output shapefile: cities1_clip in the installation directory.

Then click the Finish button.

The new cities1_clip file will appear on the TOC. Right click on cities1_clip, click on Open Attribute Table and read the number of rows. This is the value of **Towns within 1 mile**. Right click on the column POP_98. Click on the Statistics option. The Statistics of cities1_clip box will appear. Enter the value of SUM: as the **Town Population within 1 mile**. Note: There must be at least 1 individual per town even if the POP_98 says less. This prevents division by zero and preserves a sense of reality.

Town density & ratios. The Excel sheet formulas divide the number of towns by the 1992 Count for each 1-5 and 0-1mile buffers. They then divide the 0-1 mile density by the 1-5 mile density. A ratio greater than 1 means the towns are more numerous near the installation boundary, an undesirable situation.

Population density & ratios. The Excel sheet formulas divide the Population by the 1992 Count for each 1-5 and 0-1 mile buffers. They then divide the 0-1 mile density by the 1-5 mile density. A ratio great than 1 means the Population is greater near the installation boundary, an undesirable situation.

Step 6.5 Save Table to Trend directory.

To make a final report to TABS office, save one copy of the table to the installation directory and another to the Trend directory. The Trend directory is located at the same level on the hard disks as the InstallationName directories. It is from this location you will generate the report.

Step 7: Quality Control and Wrap up

Step 7 General description: Although you may have gone through the procedure, you need to ensure that each product represents the situation correctly. To answer these questions objectively, fill out a form for each installation and save it as a MS Word .doc in the installation folder. Finally there is a procedure to save the InstallationName directory to DVDs for backup locally and for submission to the TABS Office.

Step 7.1 Complete Quality Evaluation

Although you may have gone through the procedure, you need to ensure that each product represents the situation correctly. Since the NLCD is a USGS/EPA (Environmental Protection Agency) product, you can assume it is correct. That leaves the question of the quality of the Ikonos classification and the resulting table. Since the table is a simple summary of the NLCD and Ikonos classification, if you get the Ikonos classification right, the table will present the results correctly. Therefore, issues of quality control uniquely revolve around the Ikonos classification. The following are the criteria by which the urban classification will be judged:

1. Does inspection show a good match between the Ikonos classification and what makes sense based on the Ikonos image?
2. Does inspection show that areas that are not urban are excluded based on the Ikonos image?
3. How much urban is excluded from the urban category?
4. How much non-urban is captured within the urban category?
5. What are the thresholds of acceptable?
6. Is there an acceptable percent for incorrect (non-urban included and urban excluded)?

To answer these questions in a more objective manner, revise the answers you made in Step 4.6 in the Preliminary Quality Evaluation and save your answers as a MS Word .doc in the installation folder. If there are any changes, make sure that those changes are reflected in the urbbuf_92-01 excel files.

Step 7.2 Wrap-Up

This is a good time to clean up the intermediate files. For each file you no longer need, right click on the name in the TOC and choose Remove. There should be only 4 layers left in the final .mxd document for the installation.

These are: installationName_boundary, urbbuf_92_01g, Buf15_G, and ikonos_study_area.img, descending in that order. Double click on the Buf15_G layer to open the Layer Properties dialog box. Click on the Display tab and set the

transparency of the layer to 80%. Close the Layer Properties dialog box by clicking the OK button. In ArcCatalog right click on the name of the intermediate files and choose Delete.

You have to save the data you have generated. With the directory structure suggested, it should be feasible to save the entire installation data to a couple DVDs. The concept is that all data used will be within the installation directory. In addition the .mxd ArcMap file will be there too. For anyone else to read the data and the .mxd file, all they would have to do is copy the entire installation directory to their local machine and open the .mxd.

To make the .mxd file portable:

- Open ArcMap .mxd file from the installation directory.

- Click on File, Map Properties click on Data Source Options.

- Make sure the Store Relative Path Names, box is checked. If it is not, do so.

- Click OK, OK.

- Save the .mxd.

Make two copies of the entire installation directory. Once you are sure the copies are readable, you can erase the installation directory from the hard disk. One copy will be sent to the IVT office, the other kept as backup.

3 Discussion of General Land Use Change Indicators

This project was designed to determine the land use change near military installations. There are many metrics to measure this change. This chapter discusses the characteristics of all the metrics and what they indicate. To satisfy the requirements of this project, this discussion does not name individual installations, nor are data or comments presented that would allow identification of individual installations. If the reader requires knowledge about individual installations, contact the TABS Office directly.*

First, let us deal with what is believed to be the primary measure of urbanization, then later with secondary measures. Percent of area near an installation that was urbanized was not adequate as the ultimate measure because it did not tell about the rate of change, which was developed by comparing the 1992 NLCD to the 2003 Ikonos images. On the other hand, the rate of change by itself could be misleading because a large rate could be caused by the addition of a few houses, for example in a desert, which overall would not make much difference. Further, since the installations are of vastly different sizes, researchers needed a way of comparing them fairly. For example, it is possible that a 200% increase in urbanization near an installation in the middle of a desert could represent one house being joined by two new houses. However, dividing the percent increase by the area (i.e., number of unit areas used — or “cells”) you normalize the increase for the size of the installation (e.g., correct for situations where a large percentage increase represents an insignificant change). The actual resulting numbers look strange (3.02E-7) because the process divides a percent (usually in the range of 2% to 4%) by a huge number. All installation buffers contain a large number of cells. The standard size used was 12.5 meters on edge/cell. In a square kilometer there would be 80,000 cells. Even the 1-mile buffers were almost always many square kilometers. The factor is called the *Urbanization Rate/Developable Cell*. It is a measure of urbanization because it takes into account both the rate of growth and size.

* Headquarters, Department of the Army, DASA-IA, (ATTN: William Tarantino, ASA-IA), 1400 Key Boulevard, Nash Building, Suite 200, Arlington VA 22209 or by telephone at 703-696-9529.

The team calculated the *Urbanization Rate/Developable Cell* in a series of steps that were integrated into the MS Excel® spreadsheet. The value is determined as follows:

$$\text{UrbanizationRate/Developable Cell} \\ = \text{Increase\%/Year (Developable)}/ \\ \text{Count_of_ \#_cells_that_are_Developable_in_that_Buffer}$$

$$\text{Increase\%/Year (Developable)} \\ = \text{Increase Urban \% (Developable)}/\text{number of years between 1992 and image date}$$

$$\text{Increase Urban \% (Developable)} \\ = \% \text{ Urban in image} - \% \text{ urban in 1992} \\ \{\text{this is how we integrate the date difference}\}$$

where:

Count_of_#_cells_that_are_Developable_in_the_Buffer
is read from one of the tables supporting that buffer

There are a few more preliminary steps preceding the above equations where we:

Corrected for those cells that cannot be developed (e.g., lakes).

Corrected for what we believed were systematic errors that the imagery analysis had introduced but which could be numerically characterized.

Corrected for cell sizes that vary between steps.

In fact there were two *Urbanization Rate/Developable Cell* values. One is the simple classical Straight-Line Trend analysis method; the other is called the Monomolecular Trend analysis method. While the straight-line projections could (and did) go over 100% near some installations, the more sophisticated monomolecular projection (an exponentially based geometric curve tending to a 100% asymptote) ensures that the rate will taper off so growth will never exceed 100% (i.e., a better representation of reality). In reality, in any area, the best land for development is usually used first. Poorer parcels are developed later. As the parcel suitability decreases, the development rate slows. This trend is the common sense situation that the monomolecular equation represents. At no installation did the monomolecular projection go over 99% developed, while the straight-line projection did. In the straight-line method, the rate is the slope of the line between the percent urbanized in 1992 and 2003. However, the monomolecular graph shows a curve — the rate of change varies continuously. The curve is fit to the origin; the 1992 value, and the 2003 value such that it tends to 100%. In the monomolecular method, the “rate” is the slope of the tangent to the curve at any point. For our projection equation, we used the “instantaneous” or “maximum” rate that is the slope of the tangent at the origin.

How different were the two techniques? For the TABS office we ranked all the installations (97 total) based on the *Urbanization Rate/Developable Cell* index by both techniques. In comparing the straight-line vs. monomolecular rankings, no difference or little difference (+1 or -1) was found in the ranking in 63% of the installations. A difference of 9 positions in the ranking occurred once (in the middle of the rankings). Otherwise, all rankings were within a difference of 6. Thus, it was concluded that the rankings are stable and largely independent of the trend method used.

What are the characteristics of encroachment as represented in this set of military installations? The following statements are findings from the data presented in Table 2. The following statements reflect the 0- to 1-mile buffer data (with the 1- to 5-mile buffer data in parentheses).

- The current percent-developed urban land (high and low density residential plus commercial and transportation land per the categories defined in the USGS NLCD) near military installations is 26% (24%) with a standard deviation of 26% (24%). This indicates that, in general, about a quarter of land is developed, but that a good deal of variation exists in the encroachment character among installations. One installation is 88% (93%) surrounded.
- The straight-line increase per year is on the average 1% (1%) but can be as much as 3% (4%) while the mean monomolecular yearly growth rate is 2% (2%) but can be up to a maximum of 13% (13%). The monomolecular “instantaneous” growth rate tends to be higher in earlier stages of encroachment; so by this indicator, most installations are still in the “youthful” stages of encroachment.
- The Straight-Line Trend to 2020 results in a predicted average 35% (38%) urban encroachment and as great as 144% (157%). The monomolecular predictions for 2020 are less at 30% (28%) with as much as 99% (98%) encroachment possible. Significantly, the predictions by these two methods are at odds. Straight-line trend suggests that the areas in the 1- to 5-mile buffer away from the installation will develop faster than those directly adjacent to the installation (i.e., the 0- to 1-mile buffer). The monomolecular predicts that areas adjacent to the installations will develop faster.

Table 2. Evaluation statistics for buffer zones.

	Summary Statistic									
	0-1 Mile Buffer	0-1 Mile Buffer	0-1 Mile Buffer	0-1 Mile Buffer	0-1 Mile Buffer	1-5 Miles Buffer	1-5 Miles Buffer	1-5 Miles Buffer	1-5 Miles Buffer	1-5 Miles Buffer
	Current Urban %	Straight Line Increase%/Year	Straight-Line Trend to 2020 %Urban	Monomolecular maximum yearly growth rate	Monomolecular Trend to 2020 % Urban	Current Urban %	Straight Line Increase%/Year	Straight-Line Trend to 2020 %Urban	Monomolecular maximum yearly growth rate	Monomolecular Trend to 2020 % Urban
Mean	26%	1%	42%	2%	37%	23%	1%	38%	1%	33%
Standard Deviation	26%	1%	35%	2%	30%	24%	1%	34%	2%	28%
Maximum	88%	3%	144%	13%	99%	93%	4%	157%	13%	98%

4 Statistical Evaluation

This chapter contains a statistical summary of encroachment indices for each of several variables for the Army installations (population of 89) and a comparison of these values to those of the other Services (population of 8 installations). It also includes a comparison of the statistic for the buffer zone from 0 to 1 mile to the 1- to 5-mile buffer zone. The purpose was to draw out anything significant about the characteristics of urbanization and how that varies within the immediate installation environment and the broader region (as characterized in the 1- to 5-mile buffer).

Methods

Table 3 contains a list of the variables used in the analyses. Of these variables, the one labeled “RelativeGrowthRate,” or RGR, was not included in the set of variables listed in the Protocol. This variable was calculated for each buffer of each installation as:

$$\text{RGR} = \{\log_e P_2 - \log_e P_1\} / \{\text{Year}_2 - \text{Year}_1\}$$

Where P stands for the proportion of developable pixels classed as “urban,” the subscripts 1 and 2 refer to the time order of the observations, with Year1 = 1992 and Year2 = 2001, with some variation in this year among installations.

Statistical calculations were performed using SAS®/BASE and SAS®/STAT software of SAS® Release 8.02, under Microsoft Windows® 5.0.2195. The analyses of covariance were calculated using a mixed-models approach, employing SAS® PROC MIXED using a protocol for statistical model selection essentially similar to that described in Littell et al. (1996, pp. 176, 201-211). The model was run separately for each independent variable listed in Table 3, and tested the effects of the class variables “Buffer” and “Military Department,” using the log10 transform of the Installation Area as a covariate. Where significant “covariate × class variable” interactions were found, these effects were taken to represent the data better than using a single covariate slope, and the results were interpreted accordingly. The class variable “Installation” was included in the model as a random effect nested within each military department. Statistical significance always refers to significance at the traditional $\alpha = .05$ level.

Table 3. Variables used in statistical analyses, their interpretations, and the data transformation performed.

Dependent Variable Name	Interpretation	Transformation
General		
Log10Area	Installation Area (sq. m)	log10
Log10Perimeter	Installation Perimeter (m)	log10
PrelimQuality	Preliminary quality assessment of imagery analyses (values 0-5)	None
QualityEval	Final quality evaluation of imagery analyses, expressed as approximate percent that the number of pixels classed as "Urban" was overestimated in the final imagery analysis.	None
Analyses of Covariance (using Log10Area as covariate)		
<i>Class Variables:</i>		
Installation	Name of installation	
MilDept	Military department (Army vs. Other) to which the installation belongs	
Buffer	Buffer zone surrounding the installation (1 = 0- to 1-mile buffer, 2 = 1- to 5-mile buffer)	
<i>Dependent Variables (for each buffer on each installation):</i>		
PctUndevel	Percentage of pixels in 1992 considered undevelopable (unsuitable for eventual development into urban pixels)	arcsin(square-root)
TownsWithin	Count of towns within buffer in 1992	square-root
DensTownPop	Density of town population (population per unit buffer pixel area) in 1992	sixth-root
Ratio_LDH_HDH	Ratio of Low-Density-Housing to High-Density-Housing pixels in 1992	log10
Pct92_CommTransp	Percentage of Commercial transportation pixels in 1992	arcsin(square-root)
DensRoadsWithin	Density of roads per unit pixel area in 1992	square-root
CorrPctUrbDev_Start	Percentage of developable pixels classed as urban in 1992 (corrected for over- or underestimation of urban pixel counts).	arcsin(square-root)
StraightLineSlp	Rate of increase in the percentage of total developable urban pixels per year (Linear Model)	square-root
RelativeGrowthRate	Growth rate of urban pixels per urban pixel (Exponential Model) (urban pixels per urban pixel per year, = year ⁻¹)	log10
MonoMaxGrowthRate	Maximum growth rate of the percentage of developable pixels classed as urban per year (Monomolecular Model)	square-root
MonoPctUrb2020	Projected percentage of developable pixels classed as urban in 2020 (Monomolecular Model)	arcsin(square-root)
LinearPctUrb2020	Projected percentage of developable pixels classed as urban in 2020 (Linear Model)	square-root
URDC	Urbanization rate per developable cell per year (Linear Model)	Log10(x) + 10

Results

Installation Area and its relation to Installation Perimeter. Length of installation perimeter. The greater the length of the edge of an installation, the greater the potential of encroachment.

The distribution of installation areas (in square meters) is shown in Figure 6. The mean \pm standard deviation of \log_{10} -transformed areas was 7.682 ± 1.137 , having an acceptably normal distribution (Shapiro-Wilk $W = 0.981518$, $p = .23$), with this average corresponding to about 48 square km, and with area values ranging from 0.073 to 20319 square km.

The \log_{10} -transformed installation perimeters were related to \log_{10} -transformed areas by a regression equation with a slope (\pm standard error) of 0.51984 ± 0.01194 and an intercept of 0.60320 ± 0.09153 . The regression line is plotted in Figure 7. The slope of this line is somewhat higher than the value of 0.5 that might be expected from the typical Euclidian relationship of perimeter to area, but not significantly so, with $\Pr(0.49607 < \text{slope} < 0.54362) = 95\%$. As Figure 7 shows, the perimeter-area relationship is not statistically different from what might be expected for circles or squares of comparable area. **This means that in general, the outlines of the installations do not lend themselves to encouraging encroachment.**

The residual data values of the perimeter-area regression relationship can be interpreted as an index of the relative length of the perimeter for a given installation area. Table 4 shows that these residuals were positively, but rather weakly, correlated with the three indices of encroachment used in this study.

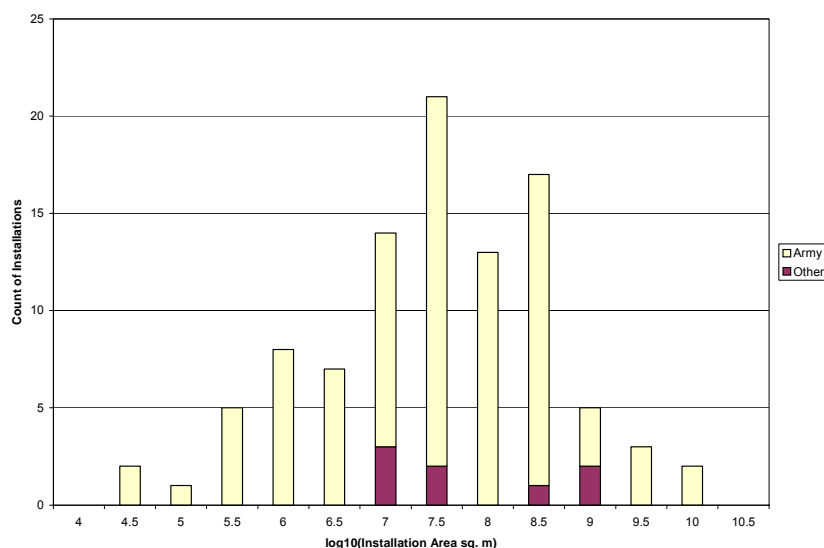


Figure 6. The distribution of values for $\log_{10}(\text{Installation Area})$, with stacked frequencies for levels of Military Department = “Army” vs. “Other Departments.”
 $\log_{10}(\text{Installation Area})$ values are truncated to the lowest multiple of 0.5.

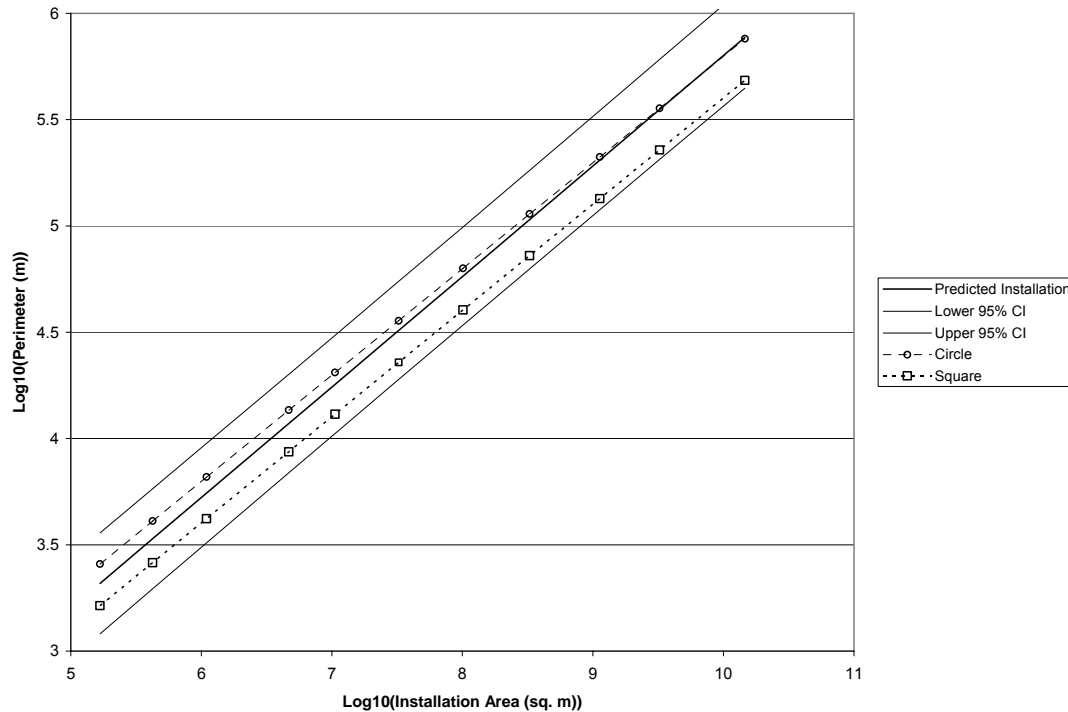


Figure 7. The scaling relationship of installation perimeter to installation area, as calculated by regression using log10-transformed values.

The heavier solid line represents the regression line (see text for parameter values), while the lighter solid lines represent upper and lower 95% confidence bands for the line. The dashed lines depict the hypothetical perimeter values calculated for circles and squares of comparable area.

Table 4. Correlations of the values of residuals from the regression relationship of installation perimeter vs. installation area with the values of variables that served as indices of urban “encroachment.”

Variable		Transform	Sample Size	Pearson's r	p-value	Kendall's tau-b	p-value
CorrPctUrbDev_Start	Buffer 1	arcsin(square-root)	81	0.2218	0.0466	0.2142	0.0046
CorrPctUrbDev_Start	Buffer 2	arcsin(square-root)	80	0.2159	0.0545	0.1747	0.0218
MonoPctUrb2020	Buffer 1	arcsin(square-root)	81	0.2433	0.0286	0.1617	0.0326
MonoPctUrb2020	Buffer 2	arcsin(square-root)	80	0.2359	0.0351	0.1601	0.0355
LinearPctUrb2020	Buffer 1	square-root	81	0.2623	0.0180	0.1667	0.0276
LinearPctUrb2020	Buffer 2	square-root	80	0.2506	0.0249	0.1646	0.0307

Quality estimations

In addition to conducting statistical analysis, the analysts were asked to describe their individual sense of the quality of the results. A preliminary quality evaluation was done for each installation. For each installation, a number between 0 and 5 (with 5 being the best) was assigned based on the analyst’s feeling of how well the

outcome reflected the actual situation. The most common assignment was 4. Forty installations were given a rating of 4, 15 were given a rating of 5, 24 were given a rating of 3. Only 11 installations were given a rating of 2 or 1.

The distribution of subjective preliminary quality evaluations for the data from each installation (with 0 being the worst and 5 being the best) is shown in Figure 8. The majority of the installations were deemed to have reasonably satisfactory data, with a mode at quality level 4, and the great majority with quality levels of 3 to 5. **Our sense is that this is better than expected.**

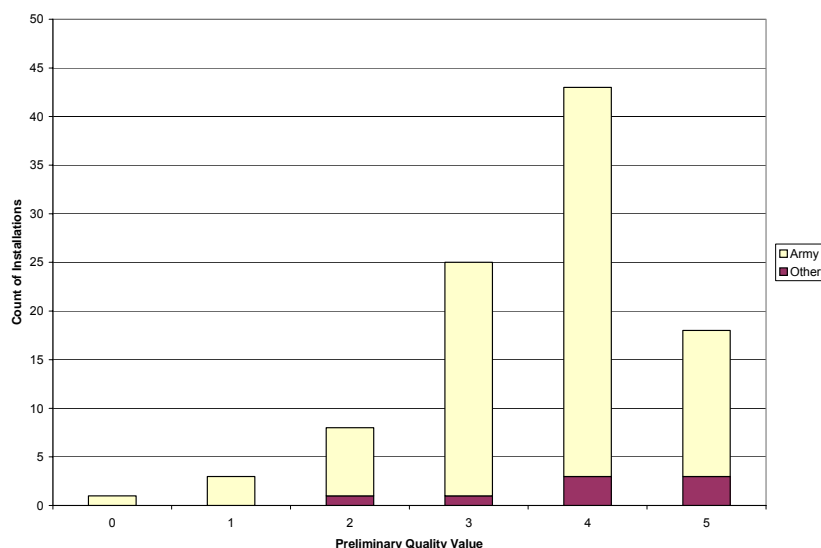


Figure 8. The distribution of values for the preliminary quality assessment, with stacked frequencies for levels of Military Department = “Army” vs. “Other Departments.”

0 represents the worst quality, while 5 represents the best.

In addition to assigning the preliminary quality rating, each analyst looked at their information and assigned two percentage values. The first was the percentage of land area that the analyst thought overestimated — urbanization that did not exist, (e.g., 10 percent). In addition, the analysts assigned another percentage for urbanization indicated in the analysis, but was known not to occur. The difference between these two numbers became the “over/under” estimate. The over/under estimate was used to correct the final percentage as reported to the TABS office. Looking at the statistics for all of these numbers indicates that the analysts judged that the process tended to overestimate more often than underestimate.

The distribution of the final quality evaluation, representing the percentage by which number of urban pixels was assessed to be overestimated (in the subjective appraisal of the analyst) is shown in Figure 9. The distribution had a mean \pm standard deviation of $4.45\% \pm 10.63\%$, significantly different than 0 (1-sample $t = 4.14$, $N = 98$, $p < .0001$), showing a small but significant tendency for overestimation of the

number of urban pixels. **This suggests that our protocol tended to overestimate urbanization.**

Neither the preliminary nor the final quality evaluations showed any correlation with $\log_{10}(\text{Installation Area})$ at the .05, or even the .1, level of significance, for either parametric (Pearson's r) or non-parametric (Kendall's tau-b) correlations. **So there was no relationship between the installation size and its quality evaluation.**

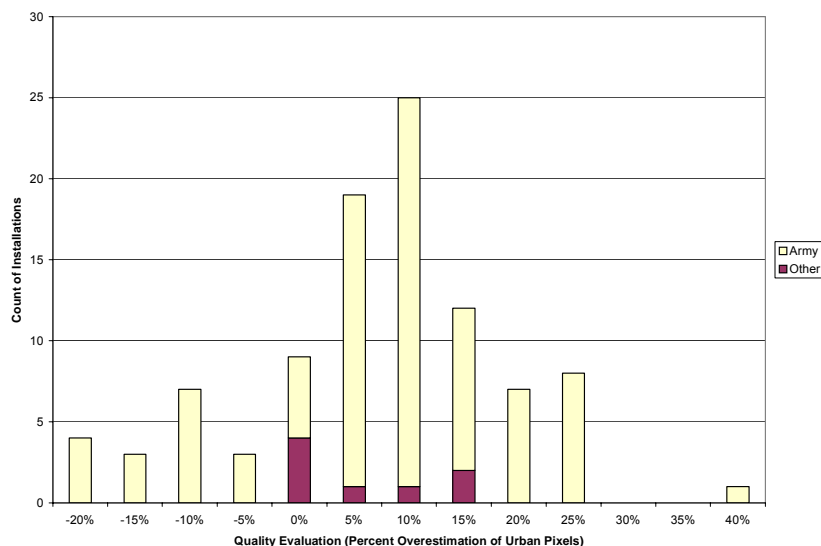


Figure 9. The distribution of values for the final quality assessment, with stacked frequencies for levels of Military Department = “Army” vs. “Other” Departments.

The quality assessment value represents the percentage by which number of urban pixels was subjectively assessed, by the analyst, to be overestimated in the final grid file product, with negative values indicating underestimation.

Analyses of covariance for 12 dependent variables

Variables Reflecting Conditions in 1992. The issue here is what is the mix of land use types that can cause encroachment? It would be difficult and unreliable to pull this information from the Ikonos images, but it can be read directly from a newly created layer.

Count of Undevelopable land 1992. If land is undevelopable, it will help protect the installation against encroachment. Although there are many considerations that would contribute to undevelopable land, in this study is limited to Open Water, Perennial Ice/Snow, Bare Rock/Sand/Clay and Quarries/Strip Mines/Gravel Pits as defined in the NLCD (see Step 5.6). The evaluation is conducted for the different buffers to see how well protected the installation is. There is a value for the 0- to 1-mile buffer and another for the 1- to 5-mile buffer. The ratio of these two values, sug-

gests how well the nearby areas are naturally protected from development. Ratios greater than 1 suggest that the installation is more protected.

Analysis of Covariance (ANCOVA) results pertaining to the percent of land that deemed unsuitable for urban development (PctUndevel) are shown in Table 5, row (a). No significant effects due to either military department or buffer were found.

Table 5. Final models used in analyses of covariance, and results expressed as p-values.

Cells containing “---” indicate that the effect was dropped from the final model for lack of significance. Some effect significance values greater than, but close to, the $\alpha = .05$ level are shown. “ns” represents not statistically significant at the 0.05 level. The two random effect columns contain variance component estimates, not p-values. The variables labeled (a)-(g) represent conditions in 1992. The variables labeled (h)-(j) represent growth rates, and the variables labeled (k)-(l) represent projected urbanization by the year 2020. See Table 3 for variable definitions.

ID	Dependent Variable	Class Effects p-values			Covariate Effects p-values				Random Effect Variance Components	
		MilDept	Buffer	MilDept × Buffer	Log10(Area)	Log10(Area) × MilDept	Log10(Area) × Buffer	Log10(Area) × MilDept × Buffer	Installation Nested Within MilDept	Residual
(a)	PctUndevel	ns	ns	ns	---	---	---	---	0.05438	0.006624
(b)	TownsWithin	ns	0.0025	ns	---	---	---	---	0.2853	0.8189
(c)	DensTownPop	ns	ns	ns	0.0033	---	---	---	0	0.1090
(d)	Ratio_LDH_HDH	ns	ns	ns	---	---	---	---	0.01353	0.002669
(e)	Pct92_CommTransp	ns	<.0001	ns	<.0001	---	<.0001	---	0.009867	0.003535
(f)	DensRoadsWithin	ns	ns	ns	<.0001	---	---	---	1.78E-06	2.25E-06
(g)	CorrPctUrbDev_Start	ns	0.0004	ns	<.0001	ns	0.0015	---	0.0487	0.0061
(h)	StraightLineSlp	ns	ns	0.0345	ns	ns	ns	0.0368	0.0016	0.000256
(i)	RelativeGrowthRate	ns	0.0132	ns	<.0001	---	0.0117	---	0.1468	0.02684
(j)	MonoMaxGrowthRate	ns	ns	ns	<.0001	---	---	---	0.003505	0.000463
(k)	MonoPctUrb2020	ns	.0636	ns	<.0001	---	---	---	0.08366	0.01151
(l)	LinearPctUrb2020	ns	0.0321	0.0683	0.0662	ns	0.0496	0.0755	0.05960	0.008368
(m)	URDC	ns	<.0001	0.0606	<.0001	---	---	---	0.5508	0.1821

Towns within 5 miles and Town Population within 5 miles. The more towns that exist near the installation, the more attractiveness there exists for potential development to occur. Note: There must be at least 1 individual per town even if the POP_98 says less. This prevents division by zero and preserves a sense of reality. This data generates the Town density and ratios. A ratio greater than 1 means the towns and populations are greater near the installation boundary, an undesirable situation. Of the Army installations in this study, the mean of this index was 3.8 (1.8 for Other Services). Since the ratio is greater than 1, this is the less desirable situation where the population is greater near the installation boundary.

Analysis of Covariance (ANCOVA) results pertaining to the number of towns present (TownsWithin) are shown in Table 5, row (b). There was a significant difference between buffers, illustrated in Figure 10. The 1- to 5-mile buffer tended to

have more towns that the 0- to 1-mile buffer. **This means that the installation boundary is not an attractor to establishment of towns.**

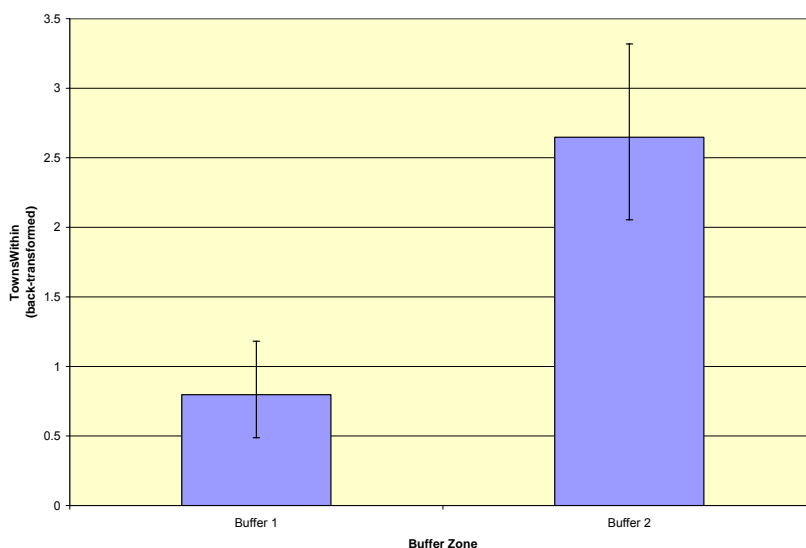


Figure 10. Least-squares means for the count of towns within each buffer (TownsWithin), from the analysis of variance presented in Table 5, row (b).

Error bars represent 1 standard error (back-transformed). Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

Town Population within 5 miles. The greater the population near the installation, the more attractiveness there exists for potential development to occur. Of the Army installations in this study, the mean of the town population index was 3.8 (1.8 for Other Services). Since the ratio is greater than 1, this is the more desirable situation where the population is greater away from the installation boundary. The variation in the standard deviations (Army 13.5, Other Services 2.1) is great enough that crossing over the 1.0 threshold would be easily accomplished.

Analysis of Covariance (ANCOVA) results pertaining to the density of the urban population per unit pixel of buffer (DensTownPop) are shown in Table 5, row (c) and Table 6, row (c). The only significant effect was the installation area covariate, with no significant effects of military department or buffer zone. These results are illustrated in Figure 11, with a line representing the relationship of urban population density with installation area. **This means as installation area increases, adjacent population density decreases quasi-exponentially.**

Table 6. Regression parameter estimates from the analyses of covariance presented in Table 5.

The labels in the ID column correspond to the analyses with the same ID labels in Table 5. Where a 2-factor or 3-factor "Covariate x Class Variable" effect was significant, the regression parameters were estimated separately for each level of that class variable combination.

ID	Dependent Variable	Transformation	MilDept	Buffer	Regression Relationship to Log10Area			
					Intercept	Standard Error	Slope	Standard Error
(a)	PctUndevel	arcsin(square-root)			---	---	---	---
(b)	TownsWithin	square-root			---	---	---	---
(c)	DensTownPop	sixth-root			0.9079	0.1844	-0.0684	0.0229
(d)	Ratio_LDH_HDH	log10			---	---	---	---
(e)	Pct92_CommTransp	arcsin(square-root)		1	0.9544	0.0863	-0.0984	0.0111
				2	0.6656	0.0865	-0.0643	0.0112
(f)	DensRoadsWithin	square-root			0.0145	0.0013	-0.0012	0.0002
(g)	CorrPctUrbDev_Start	arcsin(square-root)		1	1.6291	0.1621	-0.1687	0.0209
				2	1.3500	0.1621	-0.1368	0.0209
(h)	StraightLineSlp	square-root	Army	1	0.1531	0.0307	-0.0088	0.0040
			Army	2	0.1731	0.0307	-0.01177	0.0040
			Other	1	0.2425	0.1388	-0.01954	0.0172
			Other	2	0.1021	0.1388	-0.00284	0.0172
(i)	RelativeGrowthRate	log10		1	-2.9957	0.2910	0.2431	0.0375
				2	-2.5654	0.2912	0.1893	0.0375
(j)	MonoMaxGrowthrate	square-root			0.2797	0.0444	-0.0231	0.0055
(k)	MonoPctUrb2020	arcsin(square-root)		1	1.8864	0.2067	-0.1636	0.0266
				2	1.8421	0.2067	-0.1636	0.0266
(l)	LinearPctUrb2020	square-root	Army	1	1.6155	0.1856	-0.1349	0.0240
			Army	2	1.5448	0.1857	-0.1298	0.0240
			Other	1	1.3935	0.8401	-0.1102	0.1041
			Other	2	0.5352	0.8401	-0.0098	0.1041
(m)	URDC	log10(x)+10	Army	1	5.5297	0.5572	-0.4720	0.0719
			Army	2	4.8218	0.5571	same	same
			Other	1	5.3816	0.6510	same	same
			Other	2	5.0967	0.6510	same	same

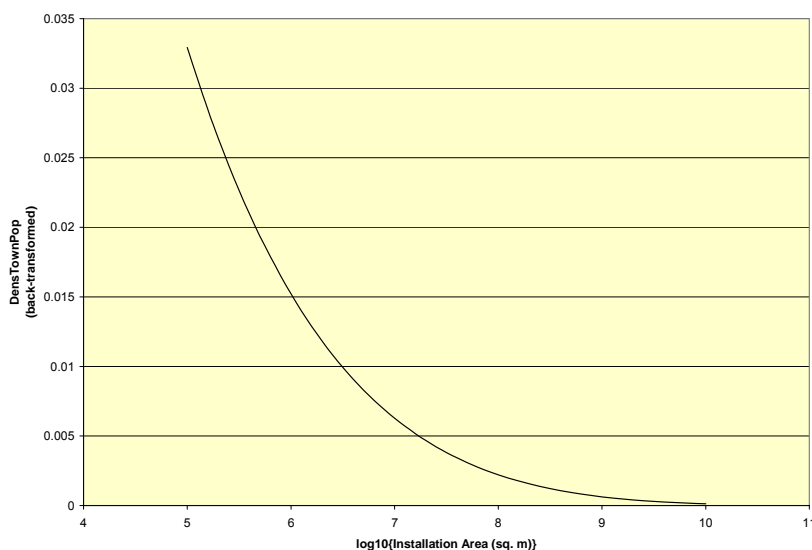


Figure 11. The relationship of town population density (DensTownPop) to installation area, from the analysis of covariance presented in Table 5, row (c).

The 1- and 5-mile 1992 Count of Low Density Housing and the 1- and 5-mile 1992 Count of High Density Housing are read directly from the data. The ratio, the 1- and 5-mile 1992 Low to High Density Ratio, is used to characterize the growth demographics between the Low Density Housing and High Density Housing. The Ratio of Low to High density compared between the 1- and 5-mile buffers shows the character of the development near the installation. A ratio greater than 1 shows more low-density housing near the installation. The greater the value, the more predominant the low-density housing is near the installation. Of the Army installations in this study, the mean of the Low to High-density housing index was 4.0 (0.8 for Other Services). Since the ratio is greater than 1, this is the more desirable situation where the low-density housing is greater near the installation boundary than further away. Interestingly, the situation is reversed for the Other Services. There is enough variation in the standard deviations (Army 16.2, Other Services 0.5) that in both, crossing over the 1.0 threshold would be easily accomplished.

Analysis of Covariance (ANCOVA) results pertaining to the ratio of low-density housing pixels to high-density housing pixels (Ratio_LDH_HDH) are shown in Table 5, row (d). No significant effects were found for military department, buffer zone, or installation area.

The 1- and 5-mile 1992 count of Commercial Transportation. This category represents more intense land use. The question is, “Does the installation tend to attract higher intensity types of land use?”

Analysis of Covariance (ANCOVA) results pertaining to the percentage of commercial transportation pixels (Pct92_CommTransp) are shown in Table 5, row (e) and

Table 6, row (e). The significant interaction effect “ $\text{Log}_{10}(\text{Area}) \times \text{Buffer}$ ” implies that the relationship of this dependent variable to installation area is different for the different buffer zones. This effect is illustrated in Figure 12. **So the answer to the question “Does the installation tend to attract higher intensity use types of land use?” is Yes for relatively small installations, and No for the large installations based on a comparison of the two buffers.**

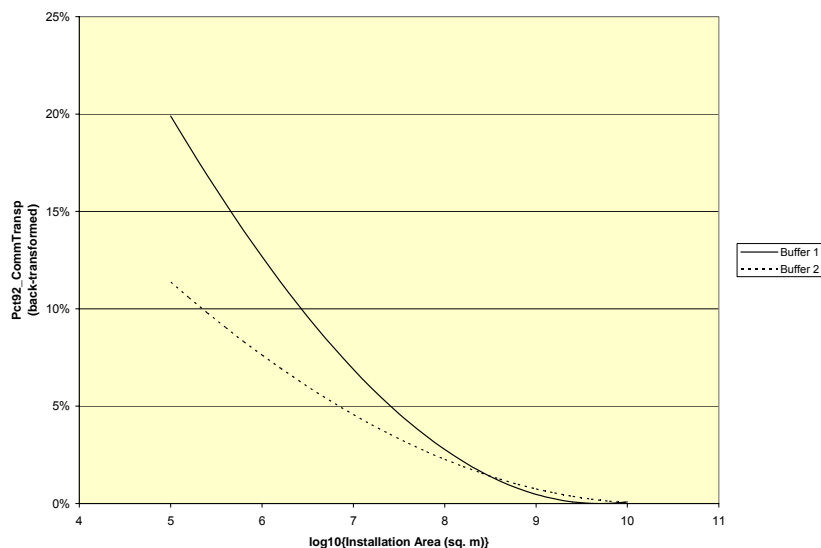


Figure 12. The relationship of the percentage of commercial transportation pixels (Pct92_CommTransp) to installation area, separately for each buffer, from the analysis of covariance presented in Table 5, row (e).

For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

Length of Roads Within 5 miles. The presence of roads is a very important attractor for development. In fact, development rarely occurs unless road access already exists. Although it is conceded that roads of different types will show different degrees of attraction for development, this research considered roads to all be of the same type, as developed and defined in Step 2.5 of the Protocol. The ratio of Roads/unitarea within 1 mile divided by Roads/unitarea within 5 miles generates an index. A number less than 1 is good – it means that the intensity of road building near the installation is less than is characteristic of the nearby regions.

Of the Army installations in this study, the mean of the Roads per unit area index was 1.9 (1.0 for Other Services). Since the ratio is greater than 1, this is the less desirable situation where the road density is greater near the installation boundary than further away. Interestingly, the index is exactly 1.0 for the Other Services; for them, there is no difference. There is enough variation in the standard deviations (Army 6.8, Other Services 0.4) that crossing over the 1.0 threshold would be easily accomplished.

Analysis of Covariance (ANCOVA) results pertaining to the length of roads within each buffer per unit pixel of buffer (DensRoadsWithin) are shown in Table 5, row (f) and Table 6, row (f). The only significant effect was the installation area covariate, with no significant effects of military department or buffer zone. These results are illustrated in Figure 8, with a line representing the relationship of road density with installation area. **The result is that there seems to be no difference in roadage adjacent to versus near the installation.**

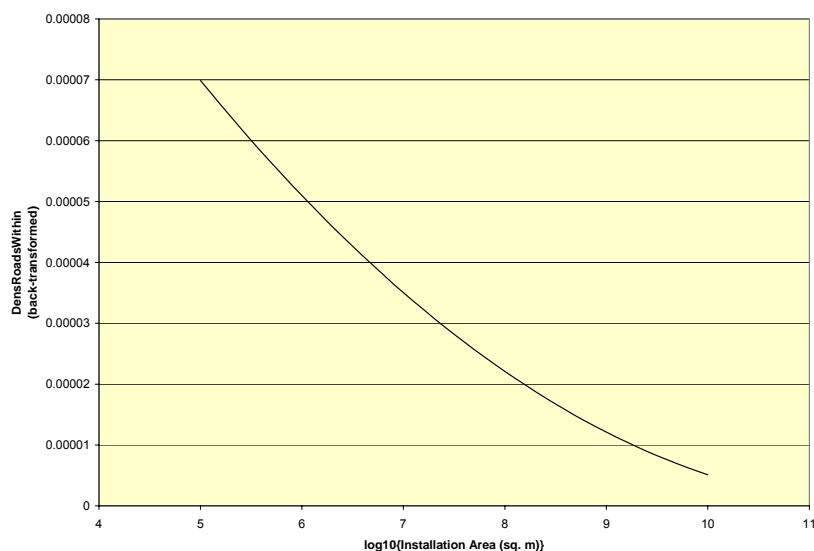


Figure 13. The relationship of road density (DensRoadsWithin) to installation area, from the analysis of covariance presented in Table 5, row (f).

Percentage Of Developable Pixels Classed As Urban. The greater this number, the more urban-developed is the area around an installation.

Analysis of Covariance (ANCOVA) results pertaining to the (corrected) percentage of developable pixels classed as urban in 1992 (CorrPctUrbDev_Start) are shown in Table 5, row (g) and Table 6, row (g). The significant interaction effect “Log10(Area) × Buffer” implies that the relationship of this dependent variable to installation area is different for the different buffer zones. This effect is illustrated in Figure 14. **This means that for small installations, areas closer to the installation boundaries tend to be more developed than areas further away, but as the installations increased in size, the difference became negligible.**

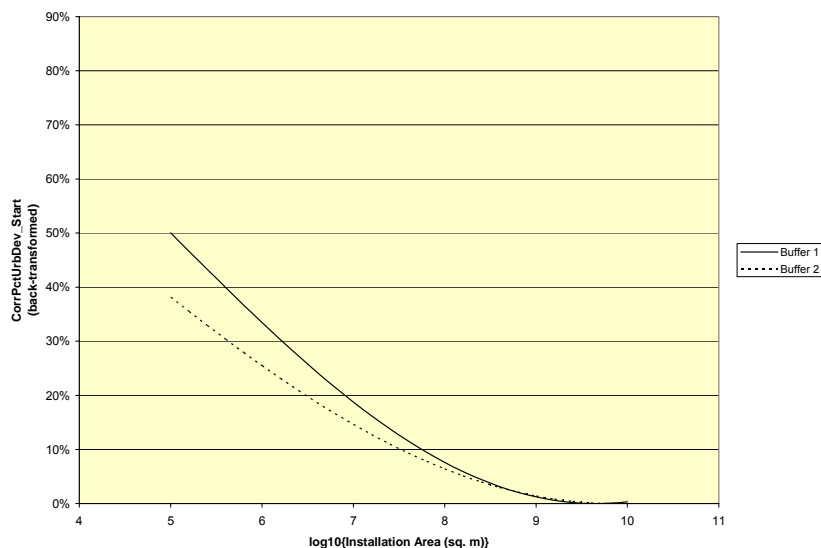


Figure 14. The relationship of the percentage of developable pixels classed as urban in 1992 (CorrPctUrbDev_Start) to installation area, separately for each buffer, from the analysis of covariance presented in Table 5, row (g).

For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

Variables reflecting urban growth between 1992 and 2003

Classical Straight-Line Trend Analysis Method is simply a line drawn on a graph between % urban in 1992 and the date of the Ikonos imagery (usually in the year 2003). The research team extended the graph to the year 2020 to find what percentage value that line would indicate in 2020. The slope of the line is the yearly rate of growth.

Analysis of Covariance (ANCOVA) results pertaining to the linear rate of increase in the percentage of total developable urban pixels per year (StraightLineSlp) are shown in Table 5, row (h) and Table 6, row (h). The significant interaction effect “Log10(Area) × MilDept × Buffer” implies that the relationship of this dependent variable to installation area was different for the different combinations of military department and buffer zone. This effect is illustrated in Figure 15. Figure 15 shows that:

1. As the size of an installation grows, the straight-line growth rate goes down.
2. The straight-line growth rate for Army installations is indistinguishable between buffers. For installations other than Army (a small sample), the growth rate situation is not clear enough to make a conclusion.

3. The straight-line growth rate varies between Military Services. The Army's growth tends to be more similar between the buffers compared to the other Services.*

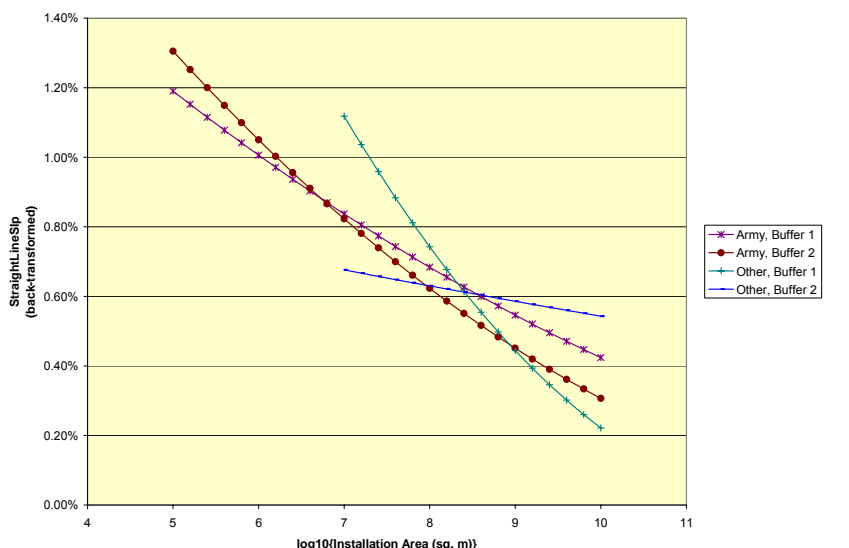


Figure 15. The relationship of the linear rate of increase in the percentage of total developable urban pixels per year (StraightLineSlp) to installation area, from the analysis of covariance presented in Table 5, row (h).

The relationships are drawn separately for each combination of military department and buffer. For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

The “RelativeGrowthRate,” or RGR, (not included in the set of variables listed in the protocols) was calculated for each buffer of each installation as explained in the Methods section (page 66).

Analysis of Covariance (ANCOVA) results pertaining to the annual growth rate of urban pixels per urban pixel assuming an exponential growth model (RelativeGrowthRate), are shown in Table 5, row (i) and Table 6, row (i). The significant interaction effect “Log10(Area) × Buffer” implies that the relationship of this dependent variable to installation area is different for the different buffer zones. This effect is illustrated in Figure 16. **It means that the relative growth rate is less for areas adjacent to the installations than for areas more distant at smaller installations but the trend reverses for the larger installations.**

* Keep in mind that the sample is not random and that the sample of 89 Army locations is much larger than the other Services (8). Though it is likely that the large number of Army installations probably is representative, the same cannot be said for the Other Services.

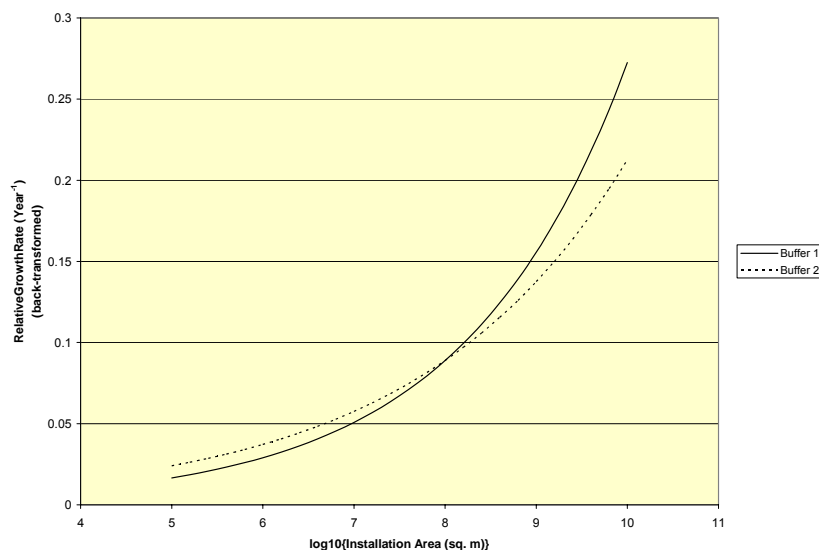


Figure 16. The relationship of the annual growth rate of urban pixels per urban pixel assuming an exponential growth model (RelativeGrowthRate) to installation area, separately for each buffer, from the analysis of covariance presented in Table 5, row (i).

For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

UrbanizationRate/Cell/buffer. A normalized value for the rates in the buffers across-installations was calculated as %Increase/Year divided by the BufferCount. There was a value for the 0- to 1-mile buffer and another for the 1- to 5-mile buffer.

1mile vs. 5mile buffer Increase/Year ratio. A ratio greater than 1 indicates urbanization occurred at a greater rate near the installation – this is less desirable than a value less than 1, which indicates urbanization is occurring at a lower rate near the installation.

Analysis of Covariance (ANCOVA) results pertaining to the urbanization rate per developable cell per year (URDC) are shown in Table 5, row (m) and Table 6, row (m). The covariate effect “Log10(Area)” was highly significant. There was also a strongly significant effect of buffer, and a marginally non-significant “MilDept × Buffer” interaction. This implies that the slopes of the relationship of URDC to area were essentially the same, with the significant differences due to MilDept and Buffer relating to differences in the y-intercepts for these relationships. This effect is illustrated in Figure 17. For Army installations, statistical comparison of least-squares means showed that the line depicting URDC for Buffer 1 was significantly higher than that for Buffer 2 ($p < .0001$). None of the other lines differed significantly from one another at the .05 level. Figure 17 shows that, of the installations in this study, **the rate of growth in the adjacent buffer was higher than the further distant areas. Otherwise there was little difference to be found among other factors.**

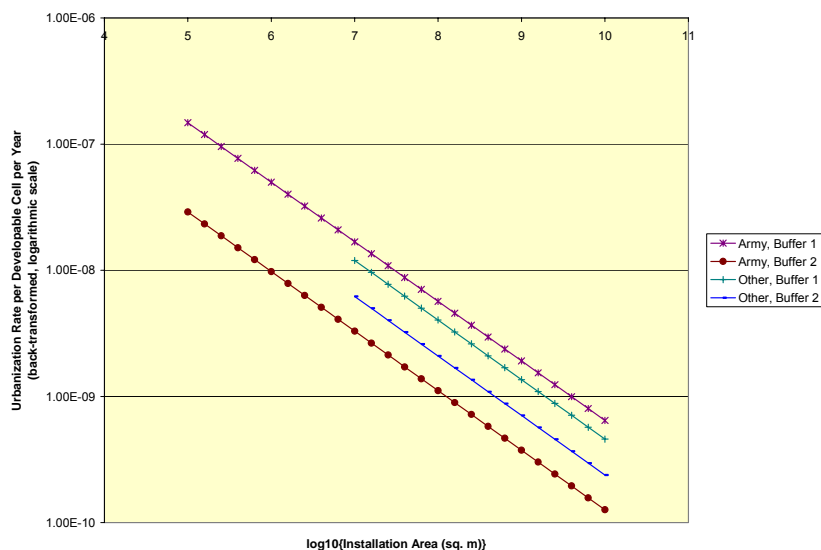


Figure 17. The relationship of the urbanization rate per developable cell per year (URDC) to installation area, from the analysis of covariance presented in Table 5, row (m).

The relationships are drawn separately for each combination of military department and buffer. Values on the vertical axis are presented on a logarithmic scale. For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

The **monomolecular projection** is a concave, non-linear growth curve, beginning at zero, fitted to the two year points (1992 and 2003 % urban) and tending to a 100% asymptote. It ensures that the rate will taper off so growth will never exceed 100%. In reality, in any area, the best land for development is usually used first. Poorer parcels are developed later. As the parcel suitability decreases, the development rate slows. This trend is the common sense situation that the monomolecular equation represents. The MonoMaxGrowthRate growth rate is that growth rate that would exist if there were almost no urbanization already. Since as development occurs, the value of the growth rate decreases, the MonoMaxGrowthRate is also near the initial growth rate value.

Analysis of Covariance (ANCOVA) results pertaining to the maximum growth rate of the percentage of developable pixels classed as urban per year, based on the monomolecular growth model (MonoMaxGrowthRate) are shown in Table 5, row (j) and Table 6, row (j). The only significant effect was the installation area covariate, with no significant effects of military department or buffer zone. These results are illustrated in Figure 18, with a line representing the relationship of maximum growth rate with installation area. **This data shows that when using the monomolecular equation, the growth rate can be expected to decrease with larger installations in a quasi-exponential fashion.**

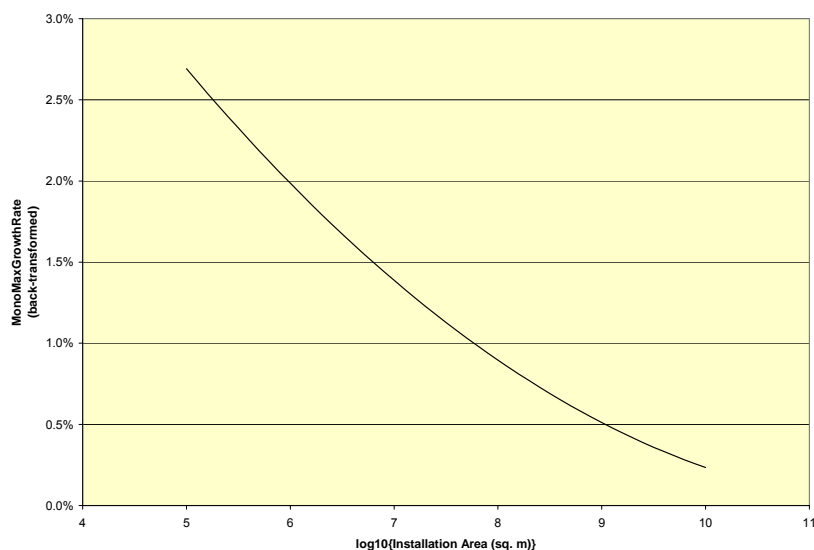


Figure 18. The relationship of the maximum growth rate of the percentage of developable pixels classed as urban per year, based on the monomolecular growth model (MonoMaxGrowthRate) to installation area, from the analysis of covariance presented in Table 5, row (j).

For details of variable descriptions, see Table 3.

Variables reflecting encroachment of urban lands by 2020

For the **monomolecular projection** pertaining to the projected proportion of developable pixels classed as urban in 2020 (MonoPctUrb2020), the results are shown in Table 5, row (k) and Table 6, row (k). The only significant effect was that the installation area was covariate, meaning that as the size of the installation increased, the monomolecular projection would tend to decrease. There was no significant effect relating to military department. However, the effect of buffer zone was very close to significant at the .05 level, suggesting that the functional relationships of MonoPctUrb2020 with installation area were slightly different, but parallel lines on a log scale. **The interpretation of this finding is that as the installation area increased, the monomolecular prediction decreased in a similar proportion for each buffer, but the nearer areas would have a slightly greater percentage of urbanization than the further areas.** These results are illustrated in Figure 19.

Analysis of Covariance (ANCOVA) results pertaining to the projected proportion of developable pixels classed as urban in 2020 using the Linear Model (LinearPctUrb2020) are shown in Table 5, row (l) and Table 6, row (l). The significant interaction effect “Log10(Area) × MilDept × Buffer” implies that the relationship of this dependent variable to installation area was different for the different combinations of military department and buffer zone. This effect is illustrated in Figure 20.

Figure 20 can be read to mean that as the area of an installation increased:

- There would be decrease in urbanization in all Army areas and in Other Services adjacent areas.
- As a whole, the Army installations were similar to Other Services installations except for less adjacent areas that, for other Services, didn't vary much with installation area.

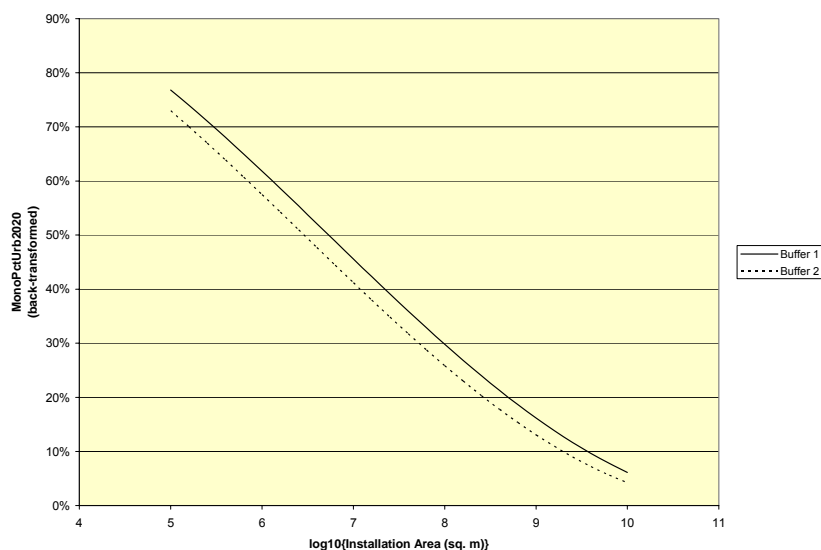


Figure 19. The relationship of the projected proportion of developable pixels classed as urban in 2020 using the Monomolecular Model (MonoPctUrb2020) to installation area, separately for each buffer, from the analysis of covariance presented in Table 5, row (k).

For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

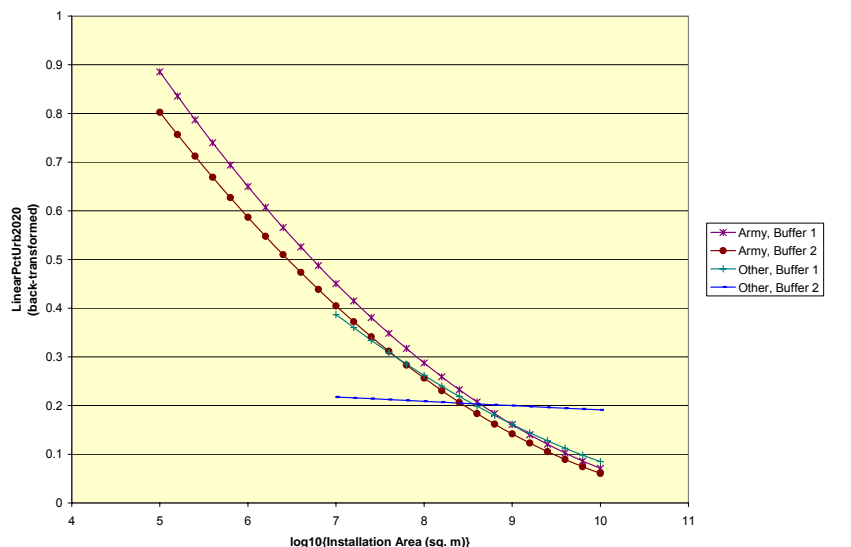


Figure 20. The relationship of the projected proportion of developable pixels classed as urban in 2020 using the Linear Model (LinearPctUrb2020) to installation area, from the analysis of covariance presented in Table 5, row (l).

The relationships are drawn separately for each combination of military department and buffer. For details of variable descriptions, see Table 3. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

Discussion of Statistical Issues

Scale

The first, and most striking, feature of the data was the range of installation areas represented in the data set; a range that spanned nearly 6 orders of magnitude. Because the issue of scale was thus an important consideration in the interpretation of the data, all variables analyzed were tested in some way for their potential relationships to installation area. This proved to be worthwhile, since some variables had complex functional relationships to installation area, such that omission of area from the analyses would have produced misleading results.

The relationship of installation perimeter to installation area was about what would be expected; perimeter scaling as approximately the square root of the area. **The positive correlation of the residuals of the perimeter-area regression with three measures of urban encroachment suggests that installations with large perimeters for their area (i.e., more convoluted perimeters) tended to be more vulnerable to encroachment.** The effect, however, was rather weak.

Quality assessment

There is little to interpret regarding the preliminary quality and final quality assessments, beyond the results presented. Preliminary quality was substantially skewed to the left, indicating a relatively high subjective assessment of quality overall. The final quality assessment showed a statistically significant average tendency for the subjective assessment of the number of pixels classed as urban to be an overestimate of what the assessor thought to be the actual value.

Aspects of urban encroachment in 1992

The analyses in Table 5, rows (a) through (g) dealt with variables relating to urbanization around installations in 1992. Some results were of relatively minor import. The percentage of land considered by the assessor to be undevelopable as urban land did not differ with respect to buffer zone, military department, or installation area, and so was not a confounding factor in any of the subsequent analyses. The ratio of low-density housing to high-density housing also showed no statistically significant relationships among these factors.

The number of towns within each buffer was higher overall for the 1- to 5-mile buffer than for the 0- to 1-mile buffer (Figure 10), which was not surprising, given that the former buffer tended to encompass more surrounding area than the latter. The density of the urban population within each buffer (Figure 11), and the density of roads within each buffer (Figure 13), declined dramatically as installation area

increased. This is perhaps unsurprising, since larger installations tend to be located in unpopulated regions, predominantly in the western portion of the United States, whereas the eastern United States contains a larger number of small installations in relatively populous locations. Neither of these variables, however, showed significant differences due to military department or buffer zone.

The percentage of commercial transportation pixels (Figure 12), and the percentage of developable pixels classed as urban in 1992 (Figure 14) exhibited significantly different relationships to installation area for the 0- to 1-mile buffer vs. the 1- to 5-mile buffer. For smaller installations, the 0- to 1-mile buffer showed significantly higher values for these variables than the 1- to 5-mile buffer, suggesting higher levels of urbanization and commercialization in the region closest to the installation boundary. However, this difference between the buffers decreased to essentially nothing for larger installations, and the overall averages decreased concomitantly to very low levels relative to the smaller installations.

Thus, in 1992, urbanization was higher overall for smaller installations compared to larger installations, and, at least for commercial transportation and percent of pixels classed as urban, urbanization was higher near the installations than further away, but this difference was not apparent for larger installations.

Growth in the percentage of land classed as urban, 1992-2001

The analysis of covariance results for the simplest estimate of urban growth, the linear (absolute) increase in percentage of urban pixels per year, showed a weakly significant ($p = .036$) 3-factor interaction among the military department and buffer zone class variables, and installation area covariate. This yielded complex results that were difficult to interpret (Figure 15). The general trend was for this absolute growth rate to decrease with increasing installation area, which is perhaps unsurprising since, as mentioned previously, larger installations tend to be built in unpopulated regions. It is unclear why these relationships would differ among combinations of military department and buffer zone.

The results for the relative growth rate (Figure 16), or growth rate of urban pixels per urban pixel per year, were also complex, but somewhat less difficult to interpret. The RGR in the 0- to 1-mile buffer was lower than the RGR in the 1- to 5-mile buffer for small installations, but this difference became 0 for installations near 10^8 square meters (i.e., 199 sq km), and reversed itself above this value. Comparison with the results shown in Figure 14 provides a possible interpretation for this pattern. In 1992, on smaller installations, urbanization was higher in the buffer near the installation than in the buffer farther from it. This could imply that, for small installations, the land closer to the installation was closer to its “carrying capacity” for urbanization than land further away. In that case, the potential for further growth

would have been higher in the buffer zone further from the installation. On the other hand, with increasing installation size, the difference in urbanization between the near and far buffers declines dramatically, allowing the trend to be reversed for large installations. The results for very large installations may be somewhat inflated, since they were based on very low counts, and percentages, of urban pixels per buffer.

The maximum growth rate, as calculated using the “monomolecular” urban growth model, declined with increasing installation area, but showed no statistically significant effects due to military department or buffer zone. Under the monomolecular model, this variable indicates what the absolute growth rate of the percentage of urban pixels “would be” when the percentage of urban pixels is far below its “carrying capacity” of 100%.

The urbanization rate per developable cell (URDC) declined exponentially with increasing installation area. For Army installations, this rate was higher in the buffer closest to the installation boundary. For non-Army installations, the difference between buffers was not clear, but the pattern of decline with increased installation area was consistent with that seen for the Army installations.

Urban encroachment projected for year 2020

The monomolecular model, in theory, provides a more reasonable estimate for the projected percentage of pixels classed as urban in 2020, since under this model the projected percentage cannot exceed 100%. The results using this model showed that the percentage of urban pixels would be expected to be quite high for smaller installations, but much lower for large installations, with only a small, non-significant difference between the 0- to 1-mile buffer and the 1- to 5-mile buffer at all installation sizes. This result is most usefully interpreted by contrast with the comparable percentages of urban pixels in 1992 (Figure 21), which probably represents the most informative result of the present study. The comparison of these figures suggests that, if the growth trends measured in this study continue:

- Urbanization of the land surrounding the installations will increase substantially for all installations,
- Urbanization will remain higher for small than for large installations, and
- For smaller installations, the urbanization of the 1- to 5-mile buffer will “catch up” to the levels of urbanization on the 0- to 1-mile buffer, resulting in a more homogeneously high level of urbanization throughout the entire 0- to 5-mile buffer range examined in this study.

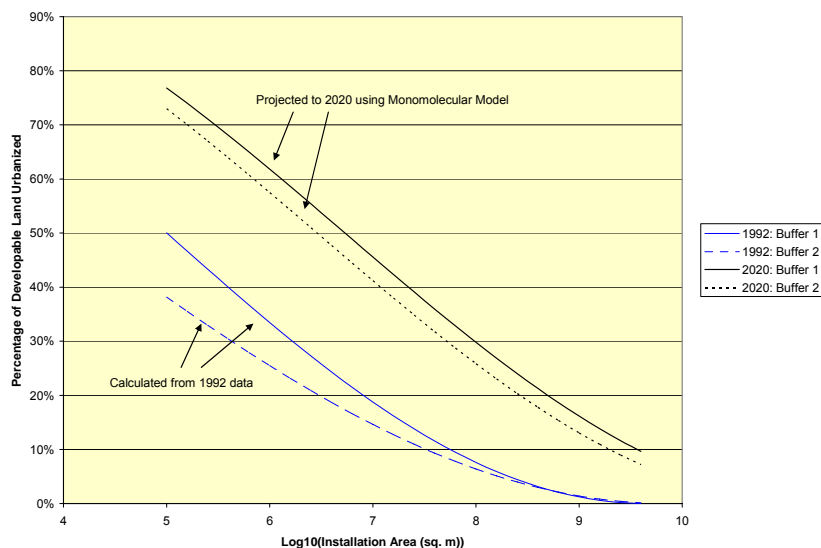


Figure 21. The percentage of developable land urbanized in 1992 vs. the projected values for 2020 under the monomolecular model.

This figure is comprised of Figures 14 and 19 superimposed. Buffer 1 = 0 to 1 mile. Buffer 2 = 1 to 5 miles.

The projected levels of percentage of urban pixels using the linear growth model were calculated for comparison (Figure 20). As with the case for the linear growth rate (Figure 15), the linear prediction is difficult to interpret, due to the effect of a somewhat mysterious 3-factor interaction among military department, buffer zone, and installation area. For all cases except the combination of Buffer = “1-5 mile buffer” and Military Department = “Other,” the predicted values are similar to the predictions using the monomolecular model, if perhaps somewhat higher than the latter for small installations. This may simply be due to the fact that predicted values of the linear model are not constrained to be less than or equal to 1. **Thus, in spite of the fact that the monomolecular equation tends to better represent reality than a straight-line technique, either method will result in similar conclusions. So for purposes of encroachment prediction, it does not matter which technique is used – the resulting story will be largely the same. This is particularly true for Army installations.**

5 Summary and Recommendations

Summary

Many DoD installations are experiencing increased pressure on their military mission activities due to the development and placement of land uses near the installation boundaries. The new land uses, often described as “urbanization,” may in some way conflict with the ongoing activities at an installation. To deal with this issue, it is useful to clearly establish the historical urban growth trend in areas surrounding an installation. Recent advances in computer analysis techniques based on remotely sensed satellite imagery have allowed the establishment of a scientifically derived baseline for development growth near an installation.

In this task, ERDC evaluated 97 military installations in terms of urban land use change and the characteristics of that encroachment on the installations. This report describes in detail the Protocol by which this was accomplished. Analyses were completed for each installation using a 1- and 5-mile buffer. Land use changes were determined by comparing the National Land Cover Data – NLCD (dated roughly 1992) to Ikonos satellite images (taken in 2001 to 2003). These data for each installation were reported to the TABS office for integration into their multi-consideration evaluation program.

This compilation of data is the only existing large data set of detailed, compatible information on the status of encroachment near military installations. To take advantage of this unique set of data, a series of statistical evaluations of both the procedure and results were carried out. This evaluation is here used to characterize the encroachment status of military installations as represented by the installations in the sample.

The results of the analyses provide a unique snap shot on the status of urban encroachment at military installations for the Army (and might suggest the status for the other Services). The following paragraphs represent a verbal summary of the significant characteristics of urbanization near military installations.

- With a good deal of variation, about a quarter of the land is developed near military installations. One installation is 88% surrounded. Several are 0% surrounded by urban land uses.
- The straight-line increase per year is on the average 1% while another technique, the monomolecular, results in a 2% rate. The monomolecular “instan-

taneous” growth rate suggests that most installations are still in the “youthful” stages of encroachment.

- The maximum “monomolecular” growth rate declines with increasing installation area.
- The urbanization trend predictions for the year 2020 suggest an average encroachment in the range of 30% to 35%. Straight-line suggests that the areas away from the installation will develop faster. The monomolecular predicts that areas adjacent to the installations will develop faster. In either case, the monomolecular predicts those areas will develop a good deal less. Since the monomolecular rate better represents reality and it is the lower of the two, this is good news for military installations.
- Installations with convoluted perimeters tended to be more vulnerable to encroachment.
- The density of the urban population within each buffer and the density of roads within each buffer declined dramatically as installation area increased. Larger installations tend to be located in unpopulated regions, predominantly in the western portion of the United States.
- For smaller installations in 1992, adjacent areas were more occupied by higher intensity uses and developable land. However, this difference decreased to essentially nothing for larger installations.
- Urban growth rate decreases with increasing installation area.
- The growth rates in areas adjacent to small installations were lower than in areas further away. This situation reversed itself for installations above 10² square kilometers - installations larger than 6 miles on an edge.
- Urbanization projected for the year 2020 will be high for smaller installations, but much lower for large installations. There will be no difference between areas adjacent to installations and those further away.
- If these growth trends continue:
 - Urbanization of the land surrounding the installations will increase substantially for all installations,
 - Urbanization will remain higher for small rather than large installations,
 - For smaller installations, the urbanization of more distant areas will “catch up” to the levels of urbanization the adjacent areas.
- Both the straight-line and monomolecular projection methods result in similar conclusions. For predicting encroachment, the method does not matter – the resulting story will be the same.

The following statements paint a concise picture of the urbanization around military installations. Although there is a great deal of variation, about 25% of the nearby land is urbanized and by 2020 this will increase by about a third (to about 33%). Smaller installations are much more vulnerable to urban encroachment than large installations, in part because larger installations are in less developed areas of the western United States). Any differences between areas adjacent to installations

and areas further away will disappear by 2020. Larger installations will continue to be less threatened by nearby urbanization. These predictions are largely independent of the method used to make them.

Recommendations

Based on the goal of finding ways to prevent urbanization from potentially impacting the military mission of installations, the following recommendations are made:

- Additional lands are needed, in some cases, to “buffer” installation activities from incompatible land uses.
- A comprehensive study is needed to examine the relative risk of change to perimeter lands and the relative risk to mission, to identify priority locations for land agreements and land acquisition actions across the Army and perhaps across all service installations and ranges.

This report avoids naming individual installations for reasons of confidentiality. The data exists to generate another more detailed evaluation of urbanization character and risks. It is recommended that this investigation be funded and carried out.

It is also recommended that when similar urbanization studies are carried out, the protocol developed and documented for this tasking be adopted so that the results will be comparable to those generated in this study. By this means, a larger database will be made available on which to carry out other studies. However, because the Ikonos imagery has many problems associated with it, it is recommended that another imagery source (Landsat, SPOT, or ASTER) would be a much better, less corrupted, original data source.

Appendix A: Protocol for Installations Without NLCD Data

For some installations, USGS NLCD data did not exist. For these, a different evaluation was carried out in order to generate the data needed for the TABS office.

Approach

The analysis of urban area growth using other than NLCD data uses U.S. Bureau of Census, Census 2000 Urban Areas shape files. These files were obtained from the U.S. Bureau of Census Web Site (Figure A1).

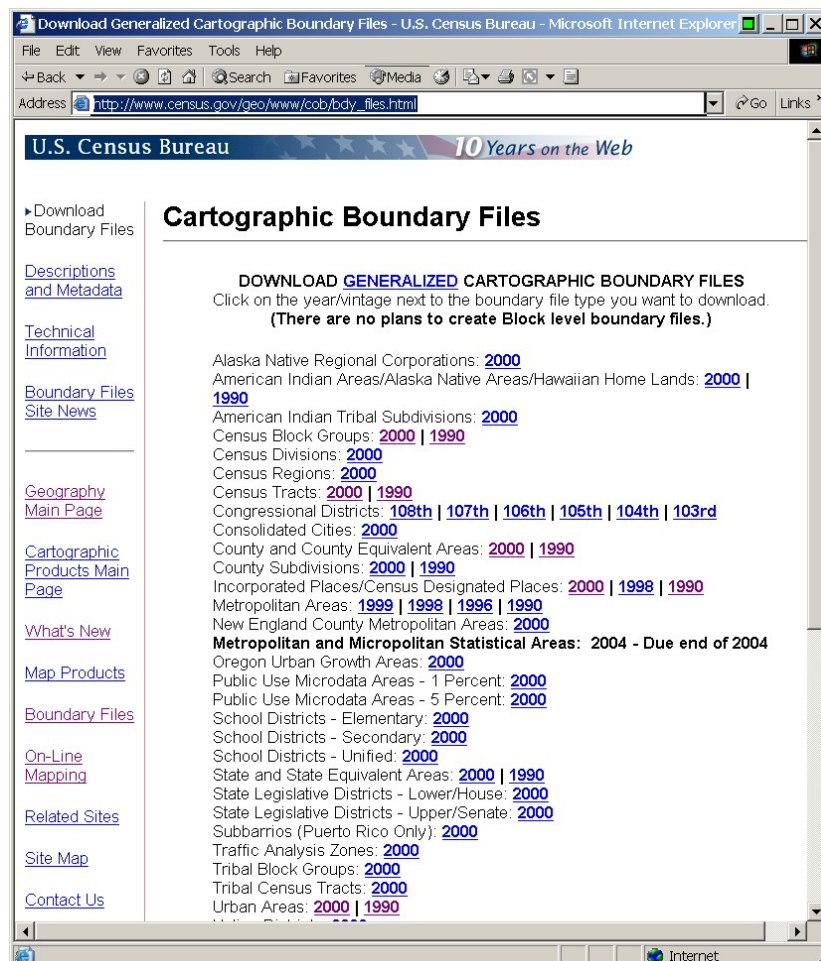


Figure A-1: U.S. Bureau of Census Web Site.

Once downloaded the files are re-projected to WGS84, which is the projection environment of the standard TABS protocol. A study area shape file and 1-and 5-mile buffer file were created using the Ikonos Imagery (provided by the IVT Office, era 2001 to 2003) and the installation boundary file. To accomplish this, the procedure in Step 2 of the TABS Encroachment protocol was followed. Next, an edit of the 2000 Census Urbanized Area shape file was conducted. Using the Ikonos imagery and a GIS roads layer (time period 2001) provided in the standard protocol, the boundaries of the urbanized area shape file were corrected to reflect the full extent of urban development. This newly edited urban area shape file becomes the basis for the extent of urban development in 2001. To provide a basis for the extent of urban development in 1992, a similar editing process was applied using a roads file that is as close to the 1992 time period as possible. The source of this earlier road layer information is the municipal GIS web sites, the United States Geological Survey, and NGA.

The two urban area maps created by this process serve as the source of information for change in urban area form 1992 to 2001. This information when entered into the TABS Protocol Trends Spreadsheet yields the percentage of yearly growth, the percentage of area developed, the straight-line 2020 growth expectation and monomolecular 2020 growth expectation. Additional information regarding length of installation perimeter, roads per unit area, and the number of cities within the 1- and 5-mile buffer can be acquired by completing the appropriate sections of Step 6.4 of the standard TABS protocol.

Source Material Used in the Analysis of these Installations included:

- 2000 Urbanized Areas Map, Department of Commerce, Census Bureau, Geography Division, January 1, 2000. An urbanized area (UA) consists of densely settled territory that contains 50,000 or more people. A UA may contain both place and nonplace territory. The U.S. Census Bureau delineates UAs to provide a better separation of urban and rural territory, population, and housing in the vicinity of large places. At least 35,000 people in a UA must live in an area that is not part of a military reservation.
- Military Installation Map 1:50,000, Defense Mapping Agency Hydrographic/Topographic Center, Washington D.C. 1986.
- Ikonos Imagery provided by the Office of the Assistant Chief of Staff for Installation Management (OACSIM).
- Road Map per regular TABS Encroachment Protocol.
- U.S. Geological Survey (USGS) 1:25,000-scale Digital Line Graphs; ROADS, 1992.
- Municipality Parcel Maps. Data layer containing platted, surveyed, and deeded parcel lines, right-of-way lines, as well as attribute information.

Appendix B: Getting Additional Data from the IVT office

If the study area or 5-mile buffer requires more Ikonos imagery coverage, immediately make a request for it. After requesting the imagery, you will be able to download it via ftp.

Contact IVT POC:

Office of the Assistant Chief Of Staff
for Installation Management (OACSIM)
Plans and Operations (DAIM-MD)

Download from FTP site:

You'll be notified when the data is available at the FTP site.

<ftp://gis.hqda.pentagon.mil>

This may require downloading several images.

Once you are at <ftp://gis.hqda.pentagon.mil/Lozar/>, select (highlight) the files you wish to Download, right click on the selected files. On the pop-up menu box, choose Copy to a folder, and when the Browse for Folder window appears, navigate to (or make a new folder) for the IkonosImagery. Click OK. Download time runs about 20 minutes per installation. It will be slowest during mid-day.

Uncompress the files. You will have to use WinZip to decompress the files. Double click on the file name. The .zip extension should cause WinZip to appear (if not, see your system administrator). Click I agree to the license agreement page, then on the menu click the Extract button. The Extract to: window will appear. Navigate to the Ikonos directory and then click the Extract button. Make sure your disk has enough room (extracted tiles are about 0.5 G each. Repeat for each tile sent to make up the installation.

Appendix C: Alternatives for Step 2: Define Rectangular Study Area and Bond_buf15_trunc.shp

In some cases the initial study area will extend beyond the imagery available. You need to modify the study area to reflect only the area for which imagery data is available. To do this, follow this procedure:

- On the ArcMap Toolbar, choose the “Identify” button.
- Click on the map at the locations where the study area box needs to be modified. Record the X, Y Location: values.
- In ArcMap, click on the Edit toolbar and choose Start Editing
- Choose the directory to edit in which the StudyArea file resides.
- On the Editor toolbar, the Target is the StudyArea.shp file, the Task is to Modify Feature
- Make sure the Edit Tool arrow is selected, move it over one of the edge lines (not in the interior) and right click. Select Properties to bring up the Edit Sketch Properties window.
- In the Edit Sketch Properties window you change the values of the X,Y corner points to make them reflect the truncated coordinates you wrote down.
- Click Finish Sketch and dismiss the Edit Sketch Properties window.
- On the Editor toolbar, click the Editor down arrow, then Stop Editing, then answer Yes to Do you want to save your edits?

For the same reason, you may also have to modify the buffer created to reflect the lack of complete Ikonos coverage. After you have done the above, follow this procedure for the buffer:

- On the Main Menu, click Tools, then Geoprocessing Wizard.
- Chose Clip one layer based on another, then Next>.
 - Select the input layer to clip: Bond_Buf15
 - Select a polygon clip layer: The truncated StudyArea
 - Specify the output shapefile: Bond_Buf15_trunc
- Then click the Finish button.

The new Bond_Buf15_trunc file will appear on the TOC.

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Acronyms and Abbreviations

Term	Spellout
AOI	Area of Interest
ArcGIS	GIS Software package from ESRI
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CERL	Construction Engineering Research Laboratory
CRREL	Cold Regions Research and Experiment Laboratory
DoD or DOD	Department of Defense
DVD	Digital video disk
EPA	U.S. Environmental Protection Agency
ERDAS	A company that makes software for Remote Sensing
ERDC	U.S. Army Engineer Research and Development Center
ESRI	A Company that makes GIS software
FTP	File Transfer Protocol
FGDC	United States Federal Geographic Data Committee. The FGDC has the lead role in defining spatial metadata standards.
GDT	Company Name
GIS	Geographic Information Systems
GRID	A format for saving GIS data in a cell form rather than line form
GRS	Grid Reference System
Ikonos	Name of a remote sensing satellite instrument
IMAGINE	An ERDAS software package
IVT	Installation Visualization Technology (office)
LANDSAT	Name of a remote sensing satellite
MS	MicroSoft®
NAD	North American Datum
NIMA	National Imagery and Mapping Agency
NGA	National Geospatial-Intelligence Agency (formerly NIMA)
NIR	Near Infrared (one of the bands of satellite imagery)
NLCD	National Land Cover Data
POC	Point of Contact
RGR	Relative Growth Rate
SAS	A company that makes statistical software
TABS	Total Army Basing Study (office)
TIFF	Tagged Image File Format, a graphic file format developed by Aldus and Microsoft.
TM	Thematic Mapper
TOC	Table of Contents
USGS	U.S. Geological Survey
WGS	World Grid System

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14. ABSTRACT The Total Army Basing Study (TABS) office, as one aspect of their stationing study, wished to determine the rate of development near the boundaries of nearly 100 military installations throughout the United States. The Engineer Research and Development Center proposed that this could be done by comparing the urbanization as derived from Ikonos images (taken around 2003 and acquired for all Services through the National Geospatial-Intelligence Agency) to a digital land use data set developed by the United States Geological Survey in about 1992. This decade difference could then be used to determine not only the amount of development, but also the trend. For the military, increasing development near installation boundaries can limit the ability to carry out their primary responsibilities of military training readiness and material testing activities. A team of 10 professionals was able to carry out the analysis for all the installations in about 4 months. This document describes the standard procedure used and the generalized results for the trends in increased development near the installation boundaries. It also summaries the urbanization trends from the statistics generated to provide a snapshot of encroachment characteristics near a sample of nearly 100 military installations.					
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