1 SECTION 1 – INTRODUCTION AND BACKGROUND

1.1 Purpose

The U.S. Army Corps of Engineers has developed a corporate approach to the implementation of Computer Aided Design and Drafting (CADD). However, there are still issues that need to be addressed to assist field offices in implementing the CADD/GIS Technology Center's A/E/C CADD Standard (henceforth referred to as the Standard) and other ancillary work items that allow the Corps, its customers and A/E partners to fully realize the benefits of standardization. The purpose of this document is to provide guidance and a model implementation plan outline for the Districts and Divisions to use in facilitating a timely implementation of the Standard. The Corps of Engineers needs a coordinated effort to promote the Standard and encourage Districts to move to them. The information provided through this effort will assist Districts in that objective. As part of this process, each Division is responsible for consolidating issues and concerns identified by each District and reporting these items to Headquarters. Each Division should appoint a CADD POC for this purpose.

1.2 Corps and DoD CADD Support History

The large-scale deployment of CADD technology within the Corps of Engineers began in 1987. Since that time, both the technology and the mechanisms the Corps established to enhance the development of field office CADD capabilities have undergone considerable change. The USACE CADD Center, founded by the Corps at the Waterways Experiment Station in 1987 to act as a focal point for the sharing of ideas and successes across the organization, helped propel the Corps into a leadership role in the exploitation of CADD technology. Since the USACE CADD Center's evolution into the CADD/GIS Technology Center (Center) in the 1990's and the formation of the Corps' Field Action CADD Groups in 1995, the DoD has invested considerable resources in the development of CADD and GIS standards to assist in a corporate approach to the implementation of these technologies. These investments have yet to be realized by large portions of the Corps of Engineers.

1.3 CADD Standard and Workspace

The Corps developed its first CADD standard, "Standards Manual for U.S. Army Corps of Engineers Computer-Aided Design and Drafting (CADD) Systems" in July 1990, EM 1110 –1-1807. This standard was widely distributed, but not universally implemented throughout the Corps. Other service branches were also developing CADD standards with varying degrees of success of implementation. The Standard has been developed by the Center to reduce redundant CADD standardization efforts within the DoD and other agencies. The Standard is part of an initiative to consolidate existing CADD drafting standards into a format generic enough to operate under various CADD software packages (such as MicroStation® and

AutoCAD®) and to incorporate existing industry and national standards. It includes presentation graphics, level/layer assignments, electronic file naming, and standard symbology. In 1999, a MicroStation workspace was created to facilitate the usage of the Standard. The Workspace consists of four (4) major parts: menus, resource files, cell libraries and the checker. Each of these parts plays a vital roll in the overall functionality of the workspace. The menus are used to interface with the user and pull their intelligence from resource files and cell libraries to aid the user in creating standard-compliant drawings. The Checker is the last step in ensuring overall compliance to the Standard by informing the user of non-compliant elements.

1.4 Headquarters Directive to Implement the A/E/C CADD Standard

In July 1998, HQUSACE issued a policy that directed the Corps field offices to adopt the new A/E/C CADD Standard and rescinded EM 1110-1-1807. In the fall of 1999, the Corps of Engineers developed training material and hosted training sessions for the A/E/C Workspace and the Standard. In June 2000, the CADD/GIS Technology Center distributed Release 1.8 of the Standard, and version 1.4 of the A/E/C workspace for MicroStation. Progress is being made on a similar workspace for AutoCAD by the CADD/GIS Technology Center. This guidance is being issued to assist the Districts in a more effective use of the Standard to comply with HQ USACE guidance.

1.5 Implementation Plan

It is recommended that each District prepare an Implementation Plan as described in this document to reflect the unique mission(s) (Civil Works, Military, HTRW, and Support for Others) of the District. The following steps are recommended in developing an Implementation Plan and reporting the findings of this Plans:

Implementation Plans are prepared by Districts

Compliance issues are forwarded to Division

Division consolidates compliance issues and forwards to HQ

Compliance issues are forwarded by HQ to the Senior Action CADD (SAC) Group for resolution

1.5.1 Components of an Implementation Plan

Each office will have unique considerations and resolutions for the implementation of the Standard based upon their historic business practices, workflows and projects. Although the Corps is working towards a regional business model, it is obvious that each District's unique issues and structure prohibit the "one size fits all" plan. The final composition of each office's plan will most likely be unique, however there are some key components that each plan should contain. It is important to note that not all Districts will be addressing the same issues or resolving them in the same

manner. However, it is recommended that each office take this opportunity to re-evaluate their current business process toward CADD in light of the new Standard.

1.6 Benefits.

The immediate benefits of a CADD standard are many: consistent CADD products for customers; uniform requirements for A/E deliverables; sharing of products and expertise; and collection manipulation and exchange of database information. The strategic vision of the Corps to "leverage the total Corps organization through teamwork to provide seamless support to customers" is directly served by compliance with a standard.

1.7 Needs Assessment

To develop an Implementation Plan that moves a District from its present condition to full implementation of the Standard, it is necessary to assess the existing resources and procedures of the District. This information should be obtained primarily through workshops and interviews. The needs identified using these mechanisms should be used to develop the rest of the Implementation Plan.

1.8 Review of COE Documents Regarding CADD A/E/C Implementation

Each office should review the appendices referenced in this document and their own CADD implementation guidance prior to writing their plan. Examples of in-house guidance might be A/E contracting deliverable language, Customer's CADD or GIS standards, supplements to the Standard, drafting and system guidance.

1.9 Meeting/Workshop to Introduce the CADD Implementation Plan

Conduct a Meeting/Workshop to introduce the goals of the implementation plan and potential impacts on the District/Division, ensuring that all aspects of the CADD programs are represented. This meeting may include first line supervisors, CADD system managers, CADD users (engineers, architects and technicians), A/E contract managers, GIS users, EBS producers and other District elements that might be impacted by this conversion. The goals of the workshop should include but not be limited to:

Introduce the Implementation Plan concept to the District.

Develop enthusiasm for producing a strong, meaningful Plan.

Encourage ideas and discussion about key components and potential problems in such a Plan.

Gather information about existing and proposed CADD operations.

Address training needs for the Standard.

Familiarize A/E managers with the Standard and provide recommendations on incorporation into contracts.

1.10 Interviews

The purpose of interviews is to document the current business processes for developing CADD documents. Consider interviewing several people within each respective section/branch to determine how the Standard impacts their work. This is an opportunity to understand how (or if) they are using current standards. It may be useful at this point to ask both standard and free format questions.

2 SECTION 2 – IMPLEMENTATION PLAN

The intent of this plan is to formalize the steps needed to reach compliance with the standards while not adversely affecting A/E's and customers. Also, a time frame that is realistically attainable by the District and it's A/E's must be derived. This document identifies both A/E Management Processes and In-House Design processes. Portions of this document identify In-House Design changes, portions apply to A/E deliverables and portions apply to materials supplied to A/E's by In-House Sections, such as Survey and Geotechnical work.

2.1 Comprehensive Plan

A District wide plan should address how A/E and In-House contracts can be fulfilled with minimal detrimental affect on individual project costs and schedules.

To accomplish this both A/E's and In-House contracts must be notified of the requirements in a timely manner. Also, tools and utilities to facilitate implementation need to be provided.

2.1.1 Needs of Supporting Organizations

Documents and contracting language must be changed with sufficient time provided to A/E's to prepare for the new requirements. Supporting organizations whose business may be affected are:

Contracting

PPMD

Geotechnical

Quality Assurance Team

Real Estate

Others

2.1.2 Needs of A/E's and In-House Designers

The needs of each A/E will vary, as will the needs of In-house design offices. Therefore the plan should provide sufficient time for various A/E's and In-house design offices to get familiar with the Standards and be able to meet the specified requirements. While at the same time quality, costs and schedules should not be sacrificed.

2.2 General Issues

Certain issues are universal to any organizations implementing a new CADD Standard. These issues are:

plotting considerations (including color and pen tables),

file naming conventions and directory assignments,

translation tables,

custom scripts and applications,

review of established in-house CADD requirements, and;

addressing the relationship of the CADD Standard with GIS applications. Broader issues include multiple business types and project stages each A/E and In-House entity must address.

2.2.1 Special LRL Issues under Consideration

- Training of A/E's on the standards and their use
- Developing custom Workspaces for A/E customers with specific requirements that differ from the standards
- Determining which and how many files to check for QC and QA purposes.

2.2.2 Business Processes

LRL is in alignment with ISO 9000 requirements, therefore the implementation plan should address modifying the pertinent documents and procedures as applicable.

LRL administers a significant amount of A/E contracts and large portions of this document take this into consideration.

2.2.3 Business Types

For an overall plan, a review of the business types and the differences between them should be made. The business types could also be subdivided by customer type. A good place to start is with Military Construction because it is the largest mission and is part of the DoD directive. It is also assumed each of the types has a Request for Proposal or Design Build option and should be covered. The LRL business types are:

Military Construction (MC)

Army
Air Force
Reserves

Civil Works (CW)

Support for Others (SFO)

NASA
COE Districts
FEMA

2.2.4 Project Types

LRL has the following project types within their district.

- New Start
- Continuing Program/Project
- Revived Project
- A/E Design (one firm/one software format)
- A/E Design (multi firm/multi software format
- User Specific Requests
- Design Build
- Combination In-house and A/E
- Combination In-house and Other District
- Small Projects
- GIS Data Sources for CADD
- MDS
- Projects with significant prior CADD graphics available

Most of these project types fall into one or more of the following categories.

2.2.4.1 Existing Projects

The decision to migrate an in-progress project to the new Standard (or continuing with an old standard) is based on the progress of the project, and requirements of the customer.

For projects in progress, the amount of data, drawing set size, projected design time, and funding are factors to be considered. As a general guideline, larger projects that are more than 35% complete are most likely beyond a point where conversions can be done efficiently. Once a project is completed to an existing in-house standard, it is time-consuming and costly to convert the files into a Standard-compliant project. Historical information (i.e., Contract/Record Drawings) does not need to be migrated to the new standard but should be “referenced” by any new drawings versus continuing to use an old standard.

When the decision is made to migrate an existing project,it is likely that the greatest effort in this migration is the extraction of graphic elements into the respective discipline file types and then the separation of the graphics into the appropriate levels with resymbolization.

2.2.4.2 New Projects

The selection of a project and the team assigned to execute it is critical to a District's success in implementation. The beginning of a new project is the ideal time to implement the Standard because all new information can be generated in a compliant format. Because of the learning curve involved in a first time implementation, each office is well advised to begin implementation of the Standard using a smaller project.

2.2.4.3 Special Projects and Customers

Consideration should be given to exclude certain project types from migration to the new standard. These project types include:

- MDS projects
- Specific Customer Request
- Additional Phases of Design
- Site Adapted Design

2.2.5 Method of Execution

The A/E/C CADD Standard is an evolving document and is not an all-inclusive document. Some discipline data (level/symbology tables and cells) are more developed than others. It is possible that offices may require supplemental or additional information. Districts can (and should) add items deemed necessary to the standards These proposed additions and changes to the Standard should be forwarded to the CADD/GIS Technology Center for consideration in future releases.

2.2.5.1 Decision to Implement A/E/C CADD Standard

Once the decision is made to implement the Standard a plan shall be formed such that these things in general can be accomplished.

All documents and Contracting language must be changed with sufficient time provided to A/E's to prepare for compliance.

Distribute information stating the goal of LRL is for all A/E work to be in compliance by the end of FY02 and provide milestones for meeting this goal.

A sample deliverable compliance time frame can be found in paragraph 2,.8

Following that the district must define which projects will not be required to satisfy the requirements.

2.2.5.2 General Process

1) Determine customer requirements for CADD standards
2) Incorporate into internal agreement with project management to address the standards requirement
3) Educate/market the customers on the benefits of the standard
4) Determine whether an A/E or In-House project will be done first

2.2.5.2.1 A/E

The A/E/C Standard facilitates the sharing of information and work between Districts by providing a common CADD data drawing production standard.. The A/E/C Standard should be a critical part of the District's contracting language for A/E deliverables. In this section each office should consider looking at their A/E contracting language and quality assurance documents for outsourcing work. When developing this language, consider how it might apply to other Districts supporting LRL efforts.

A sample Scope of Work and Electronic Deliverable Specification for A/E's that clearly establishes implementation and compliance requirements is provided in Appendix D. Each District should review the sample provided and make additions or adjustments necessary to obtain a quality product from the A/E. In addition, many A/E's work for more than one District and implementation of the Standard across the COE will provide a more effective method for the sharing of work. Districts should diligently pursue the enforcement of the Standard-compliant deliverables received from the A/E.

Items identified at LRL for review and modification include the following:

1) Appropriate A/E Appendix A Clauses
2) A/E QC Standards for CADD Work
    - Reporting
    - Provide software as needed
3) District QA Program for CADD
    - People, Process and Software

2.2.5.2.1.1 A/E Appendix A Clauses

1) Develop A/E Appendix A to fully address the required CADD Standard to be used
2) Identify Requirements for Standard Checking As Part of QC Plan
    - Level Symbology
    - File Names and Directory Structure
    - Identify compliance levels for all types of model files.
3) Identify Submittal Requirements
    - Dates or project phase (35%, 60%, etc) of submittals
    - File Types to be submitted

2.2.5.2.1.2 A/E QC Plan

1) Government will Make Available Most Recent Version of A/E/C Workspace With Checker
    - The A/E may elect to use a Commercial CADD Standards Checker
2) A/E will identify all CADD software used in the design process
3) A/E will amend QC process to provide a written report to include (but not limited to):
    - File Name of checked file
    - No of Elements Checked in the file
    - % of Compliant elements in the file

2.2.5.2.1.3 District QA Program for CADD

1) Establish procedures for Spot Checking designs for Compliance
2) Recommend AEC Checker or other Commercial Software
3) Establish how to handle failed QC for A/E's
    - Short-Tem
    - Long-Term

2.2.5.2.2 In-House

The migration to the new Standard is most effective at the onset of a new project. For those Districts with robust design programs, there may be a period of time where both the old In-House and the A/E/C CADD Standard will need to be concurrently operable. At the onset of a new project, the lead discipline or project manager should make clear the intention for implementation and all other disciplines should be prepared to implement.

Items identified at LRL for review and modification include the following:

1) Develop QC Plan for project
2) Install software as needed
3) Train individuals as needed on
    - Standards
    - Software/Workspace
    - QC Plan
    - Particular Project
4) Evaluate existing data (CADD files) and update as required
5) Establish QA Plan for CADD
6)

2.2.5.2.2.1 Develop QC Plan for Project

1) Identify additional team members and provide funding for them
2) Modify Work Instructions for Standards compliance
3) Update Work Instructions for A/E/C file names and file management
4) Team will identify all CADD software used in the design process
5) Require detailed reports with each submittal to include:
    - File Name of checked file
    - No of Elements checked in each CADD Drawing file
    - % of Compliant elements in each CADD Drawing file

2.2.5.2.2.2 Install Software As Needed

1) Workspace (determine network or local)
    - Set up configuration variables
2) Install Access ODBC,DAC,SQL Client for Oracle
3) Determine AECCK and AECMGR database requirements

2.2.5.2.2.3 Train Individuals As Appropriate

1) Assure personnel are aware of the standards for the project and are trained appropriately

2) Assure team members are trained on the Workspace and the appropriate standards checker

3) Assure personnel are aware of QC Plan for the project

4) Assume team members are aware and trained on any project particular requirements

2.2.5.2.2.4 Evaluate Existing Data and Update As Required

1) Update existing In-House data, as appropriate
2) Look through existing data archive
3) Evaluate need to make existing data compliant

2.2.5.2.2.5 Establish QA Plan for CADD

1) Establish procedures for spot checking designs for compliance
2) Decide between AEC checker or other commercial software
3) Establish non-conformance procedures
    - Short-Tem
    - Long-Term

2.3 System Considerations

2.3.1 File Storage

Use of the AEC File Manager Utility may impose some changes to file storage structure and should be reviewed.

2.3.2 Custom Scripts and Applications

Although many Districts have developed custom symbol libraries to facilitate their work, the default libraries delivered with the Standard should be used exclusively where possible. Custom symbols (updated to comply with the symbology requirements of the Standard) may be used where the Standard does not provide an equivalent. Custom symbols that are developed should be submitted to the Center for consideration in a future release. This is also a good time to inventory custom libraries and remove older or unwanted symbols.

2.3.3 Plotting

Plotting workflows, existing pen tables, and color tables should also be examined. If a District is using custom scripts or utilities to assist them in creating pen tables, these items also need to be addressed.

The use of pen table(s) to handle shading is being considered.

2.4 Implementation Tools

Software tools to improve the implementation of the Standard are available to the Corps and the public on the CADD/GIS Technology Center's web page (http://tsc.wes.army.mil) under A/E/C Workspace. (Note: It is not necessary to use the implementation tools in order to comply with the Standard. They are provided as a mechanism for more efficient, compliant design work.)

2.4.1 Workspace for MicroStation Users

To assist users in applying the Standard, a MicroStation Workspace tool is available to aid in the implementation of the Standard. The Workspace presents a series of discipline-specific menus that set Standard-compliant settings (e.g., level, color, line weight, line style) for various features. It includes a Checker utility for a basic compliance check and allows for setting the anticipated Plot Scale in the model file for sizing text, dimensions, linestyles and most cells.

The use of TSWS is recommended.

2.4.2 File Manager for MicroStation Users

A File Manager tool is available to assist in:

Creation of base Model and Sheet design files with Standard-compliant filenames and working units, creation of EBS .svd files, and reconciliation of filenames.

The use of AEC File Manager is recommended.

2.4.3 Workspace for AutoCAD Users

An equivalent Workspace tool for AutoCAD users completed and posted on the CADD/GIS Technology Center's web page.

2.5 Omissions and errors found in the Standard

The Standard is not a static document and is continuously being updated to make the documentation as thorough as possible. Input of the Districts/Divisions is critical to ensure that the Standard evolves into a valuable resource for CADD users.

2.5.1 Changes to the Standard

Should a CADD file require a particular item (symbol, line type, drawing type, etc.) that is not addressed in the Standard, it is recommended to first contact the Center for guidance. Should the Center confirm the omission, it is acceptable to create a symbology definition for that item. The District should document the item's usage as a deviation from the Standard, but under consideration for a future release. Submit the item to the Center for inclusion in the next release of the Standard.

To help prioritize the importance of changes to the Center, procedures to resolve any issues locally and consolidate comments should be distributed. An electronic form may be a suitable medium.

2.5.2 Changes to the Workspace

The CADD/GIS Technology Center is responsible for revisions, additions, or deletions to the Standard. Changes to the Standard will directly result in corresponding changes to the Workspace; however, changes to the Workspace may not necessitate changes in the Standard. Identified errors or requested changes in the Workspace must be submitted to the Center or through the Center's website at http://tsc.wes.army.mil.

Procedures similar to those in paragraph Changes to the Standard will be used.

2.6 Deviation from Standard

Items that pertain only to a certain District or a District's customer should be maintained as a list of deviations from the Standard. A plan on how this will be tracked and maintained should be outlined in your implementation plan.

All deviations from the standard should be documented for quick identification. Further documentation is required if deviations are complex.

2.6.1 Collaboration between Districts

Ideally all the Districts will implement the A/E/C CADD Standard to facilitate collaboration between Districts. For collaborative designs, the hosting District has sole discretion on the standard to be used by any supporting District or A/E.

LRL's deviations from the A/E/C Standard shall be well documented.

2.6.2 Collaboration with Customers and Third party Vendors

The Standard should be proposed to customers who do not have standards in those circumstances where it is determined by LRL that adopting the Standard would be in the best interest of the customer. Deviations from the Standard that better support the customer should be considered. Those requirements must be addressed and incorporated until they can be revised to match the Standard.

Third party vendors are encouraged to design standard-compliant software or allow user customization. Some third party software programs utilize parameter or configuration files that must be updated to implement the new Standard. Existing data sets might also have to be re-processed to work with the new standard. Plotting pen and color tables may have to be updated on user, server and plotting computers. It is a good idea to inventory the software in each office and determine whether it needs to have modifications to its settings to accommodate the Standard.

2.7 At LRL the following third party software was identified: TriForma, IrasB/C, Geosystems, Modeler, InRoads, SmartSketch, MathCAD, HecRas, Geo-Ras, Deed Plotter, and Frameworks. Data Exchange

Inter- and intra- district drawing exchange is part of our current business process. Drawings are exchanged between the Corps, its customers and A/E's. The utilities and preference files used to translate design and drawing files may need to be updated to accommodate the new Standard. Consideration should also be given to translating GIS coverage's into CADD files.

2.8 Time Frame

Due to accelerated design schedules, limited resources or other issues, it may be unrealistic to comprehensively implement the use of the Standard across all projects. A more reasonable approach is to determine the feasibility of implementation on a project-by-project basis. Once the projects have been selected, team members should be trained and have the appropriate tools loaded on their systems.

The time frame will be based on a project by project-by-project basis. The scope and compliance will be detailed while scooping the project and documented within the project.

Generally it is anticipated one level of implementation will be done at any given time. This is to minimize training and confusion. Therefore major changes (to be defined on a case-by-case basis) are done as much as practicable after previous projects are completed.

An assumed time frame follows, based on a fictitious start. Depending upon the number of business types, a review of the previous delivery and problems should be made before starting the next business group.

Typical In-House Time Frame						
Phase	Time	Description	Compliant	Compliant with Exceptions	Non-Compliant	

1	2nd Qtr (Jan) 2002	Model File Symbology	X			
		Model File Names	X			
		Working Units (all files)	X			
		Drawing Set Follow UDS Ordering and numbering	X			
		Sheet File Symbology			X	
		Sheet File Names			X	
		Details			X	
		Plots			X	
2	3rd Qtr 2002	Sheet File Symbology	X			
3	4th Qtr 2002	Plots compliant	X			
4	1st Qtr 2003	Sheet File Names	X			
5	2nt Qtr 2003	Details	X			
6	3rd Qtr 2003	*Miscellaneous				
7	4th Qtr 2003	1st Business Unit Complete				

*See Appendix C Compliance Checklist

The time interval from the start of the initial business unit (from the notice to A/E's) to the time it actually comes into general compliance for any phase should be tracked. A second business unit should probably not be started until the first unit is complete. Failure to do this may lead to wasted effort, and review and resubmitals would take precedence over design and solicitation.

2.8.1 A/E Deliverables Phase In

Time Frame Based on General Process in paragraph 2.2.5.2.1.

- New Starts Could/Should Be required to be Compliant

- Incorporate New A/E Requirements for Compliance By (Jan 2002)
- With Exceptions A/E Contracts Should Be 100% Compliant End (FY 02)

2.8.2 In-House Deliverables Phase In

Time Frame Based on General Processes in paragraph 2.2.5.2.2.

- Demonstration Project With New In-House Requirements By (Jan 2002)
- Add Selected Projects Through FY02
- With Exceptions In-House Contracts Should Be 100% Compliant End (FY 03)

2.8.3 Develop Potential In-House Migration Plan

2.8.3.1 First Group

1) Survey Section
   - Update Existing MDL Utilities
2) Civil
   - Begin Using Compliant InRoads Preference Files (CADD Center)
   - Determine local or network distribution
3) Real Estate
4) Geotechnical exploration logs Exception to Standard
5) Hydraulics and Hydrology Exception to Standard

2.8.3.2 Second Group

1) Structural Section
2) Electrical/Mechanical

2.8.3.3 Third Group – Dependent on Tri-Forma

1) Architecture

2.9 Training

2.9.1 AEC Standards and Workspace

User training can be accomplished in a one-day class where the fundamentals of the Standard are reviewed in a morning session and a hands-on training of the Workspace is conducted in the afternoon. This reimbursable course is available

through the CADD/GIS Technology Center. Tools available to assist in using the standard include the A/E/C Workspace and File Manager. The Instructor's and User's Workspace Guide, and class files are available on the latest A/E/C CADD Standard CD or can be downloaded from the Center's web site. A "Workspace Training for Administrators" guide is also available from the CADD/GIS Technology Center for those needing to know how to customize the Workspace. The File Manager User documentation is available on the CKB web site. Migrating to the Standard is not entirely transparent to the users or customers. Internal customers, design engineers, technicians, architects and construction personnel who regularly view, edit or create electronic CADD documents will need training to understand how they are to produce using the new Standard.

A 4-hour quick introduction to the TSWS has been done.

Generally speaking, the TSWS should be made available for more detailed usage to gain familiarity and identify problems before utilizing on a project. These users should be consulted as part of determining if the first few projects are good potential candidates for the TSWS.

2.9.2 A/E/C Compliance

Some training may be required for both A/E and In-House QA compliance, and PM training. Training needs would be based on Paragraph 2.11, Document Quality Assurance Considerations.

2.10 Costs

There will be costs associated with migrating from current standards to the new Standard. These costs are included in all the categories of items previously discussed. It is important to understand these costs and how to best distribute them within each organization. This topic should be addressed as a critical part of any implementation plan.

- Identify workflows that impact the TSWS or vice versa.
- Discuss and arrive at potential solutions and their documentation into this and other documents.
- Identify and implement the best solutions.
- Additional training and learning curve for implementation.
- QA/QC for new Standard.

2.11 Document Quality Assurance Considerations

2.11.1 District Policy

Districts should develop a policy on the compliance of projects. The implementation plan should acknowledge higher authority guidance covering CADD Standards and

related work, if applicable. Each report should discuss how guidance is implemented at the District level. Additional issues to be covered that may includes quality assurance guidance prepared at both the District and Division level. In this portion of the report it may be appropriate to develop a higher authority compliance checklist to demonstrate/track each offices' compliance.

At each implementation phase the compliance policy for that phase will be reviewed. The general compliance workflow at this time is as follows:

3rd party applications will complicate the compliance and schedule but those will be treated on a case-by-case basis. For example the configuration of InRoads for dual projects will become a system/training issue.

2.11.1.1 In-House Compliance and Quality Assurance

The District will establish a Quality Control or Quality Assurance method in the District to ensure that products meet the Standard.

2.11.1.2 A/E Compliance and Quality Assurance

The A/E should be held to the same QA/QC review as in-house work. Include the detail of compliance in the A/E Deliverables document that is also being composed.

2.11.2 Compliance and Quality Assurance Procedures

2.11.2.1 In-House Compliance

Although more frequent compliance checks will ensure a better success rate of compliance, it is recommended that at a minimum the A/E compliance requirements that follow be applied in house.

1) Identify additional team members and funding
2) Modify Work Instructions for Standard compliance
3) Update Work Instructions for A/E/C file names
4) Identify procedures and all CADD software used
5) Detailed reports with each submittal
    - File Names
    - No. of elements checked in each file
    - **%** of elements compliant in each file

2.11.2.2 A/E compliance

Compliance requirements and guidelines for Design/Contract Drawings are specified in the sample Scope of Work provided under "Other Items of Concern", as well as a

structure for validating the compliance of the work submitted by A/E's. The Scope of Work requires the submittal of CADD files at 30, 60 and 90% design stages for review by the District. Reviews at these stages allow for;

- An initial review for compliance and the correction of procedures at an early stage in the project
- A middle stage review to confirm that procedures have been corrected and the Standard is being followed
- A final review that permits adequate time for the A/E to make corrections.
- The SOW also requires a successful compliance review as part of the checklist for project acceptance.

The A/E QC Plan includes:

1) The Government will make available the most recent version of the A/E/C Workspace with Checker
    - Options For Commercial or Other Checker
2) The A/E will identify procedures and all CADD software used
3) The A/E will provide detailed reports with each submittal
    - File Names
    - No. of elements checked in each file
    - % of elements compliant in each file

2.11.2.3 Record Drawings (As-Builts)

Regardless of whether the Record Drawings are completed by the A/E, the Construction Contractor, or an in-house team, the same compliance requirements and validation checks should apply.

2.11.3 Compliance Validation

2.11.3.1 In-House.

A procedure for checking a file for compliance with the standard can be as simple as running the built-in checker provided in the MicroStation Workspace. The simple checker does not perform a thorough check, but is restricted to checking element symbology and fonts only. It does not produce a report to document the compliance effort with details of non-compliant elements. The checker is a good tool for a designer to use for a quick basic check, but is not adequate for a thorough compliance check. A thorough checklist is provided in Paragraph 2.11.3.5 (Compliance Checklist).

The District QA Program for CADD includes:

1) Establish procedures to Spot Check Compliance
2) Recommend AEC Checker or Commercial Software
3) Establish Non-Conformance Procedures
    - Short-Tem
    - Long-Term

2.11.3.2 Third –Party Software

CADD files can be checked with various third-party vendor software. Contact the CADD/GIS Technology Center for applicable software and available scripts for various products. The inspection should also include a report with specifics as to why an element was non-compliant and the quantity of errors.

2.11.3.3 A/E.

It is the A/E's responsibility to determine how they want to perform the verification of compliant CADD files. However, it is recommended that A/E's contact the reviewing District for specifics as to which validation method or tools will be used during the review stages. Reviews and coordination on project-specific issues will tend to have better results when all participants are using the same tools and procedures.

2.11.3.4 Record Drawings

In addition to a review verifying that hardcopy redlined As-Built changes are included in the delivered CADD files, Record Drawings are subject to the same compliance validation procedure requirements as Contract Drawings.

2.11.3.5 General Compliance Checklist

A more complete checklist can be found in Appendix C.

- Symbology (color, linestyle, lineweight)

- Fonts and text sizes

- Specific elements types on designated levels/layers (i.e., only pattern elements may be on pattern levels and may not be on any non-pattern levels)

- Elements on levels/layers for which the Standard has not specified a use

- Use of specific symbols (cells or blocks) when an equivalent Standard symbol is available

- Are pattern components used vs. basic linework

- Proper usage of the Status Levels

- Correct border sheet sizes

- Proper sheet sequencing

- Model and Sheet Filenaming convention

- Review the method used for screening (half-toning)

- MicroStation cells should not be decomplexed

- Appropriate MicroStation Working Units

Appendixes

These appendixes provide copies and samples of the actual standards, other documents and files. Because these will be out dated, the current copy should be obtained from the sources below as part of any implementation.

Appendix A

Glossary

A/E/C CADD Standard (Standard) Formerly known as the Tri-Service A/E/C CADD Standard

Archive A set of files stored such that it can be retrieved complete and fully functional.

As-Built A set of documents representing the design in its "As-built" condition with all construction changes illustrated.

Software (SW) Computer programs (e.g., AutoCad, MicroStation, Microsoft Word, Microsoft Excel, etc.)

Hardware (HW) Computer related components (e.g., computer, plotter, printer, disk drives, etc.)

Pen Table Application specific set of instructions which defines how to interpret CADD elements for plotting.

Spatial Data Standards (SDS) The Spatial Data Standards for Facilities, Infrastructure, and Environment. The SDS have focused on the development of graphic and nongraphic standards for GIS implementations at Air Force, Army, Navy, and Marine Corps installations, and U.S. Army Corps of Engineers Civil Works activities.

Tri-Service Work Space (TSWS) Menu application which uses the A/E/C CADD Standard, available in AutoCAD and MicroStation versions.

Tri-Service File Manager (TS File Manager) Corps of Engineers sponsored MicroStation interface to name and manage file names in accordance with the A/E/C CADD Standard name convention.

Appendix B

Sample Implementation Plan in Outline Format http://ckb.wes.army.mil/

A sample implementation plan outline using the processes from the main body of this document also available on this CD at:
.\ImplementationPlan\appendix\sample_plan\sample_plan_outline.doc.

Appendix C

Sample Compliance Requirementshttp://ckb.wes.army.mil/

This is a Corps of Engineers authored document also available on this CD on \Implementation\Plan\appendix\compliance_requirements\aec_compliance_checklist.doc

Appendix D

Sample Electronic Deliverable Specification http://ckb.wes.army.mil/

This is a Corps of Engineers sample document with a combination of items obtained from various Districts available on this CD on \ImplementationPlan\appendix\elec_deliverable\AE_Deliverables.doc.

Appendix E

Sample Record Drawings Considerations

Similar checks and balances should be anticipated for Record Drawings or As-Built files as those recommended in the Electronic Deliverables document sample. When Standard compliant files are being As-Built the Standards used should continue to be followed, consideration should also be given for compliance checking in addition to the normal As-Built acceptance criteria. It is not reasonable for non-compliant files to be made compliant by another party. Of note there are potential conflicting requirements from Headquarters, which require changes to be made on the "sheet" files and not the "model" files. It is not known if this is being followed by any. This is an issue that needs further discussion.

Appendix F

A/E/C Standard http://tsc.wes.army.mil/

Versions 1.8 and 2.0 are available on this CD at \ImplementationPlan\appendix\aec_standard\. This also includes sheet file plotting matrices updated for version 1.8.

Appendix G

Spatial Data Standards http://tsc.wes.army.mil/

Version 1.95 is available on this CD on \ImplementationPlan\appendix\sd_standards\ running setup195.exe will install it on your computer. Note the SDS contains a Civil set which corresponds to the A/E/C CADD Standard.

Appendix H

Developers Guide for Producing and Publishing Engineering Electronic Documents http://tsc.wes.army.mil/products/

This illustrates concepts and formats of a drafting practices (for paper Engineering drawings) to its electronic Engineering (drawings) document counterpart and is available on this CD on \ImplementationPlanappendix\developers_guide\devguide for documents.pdf

Appendix I

-Software Resources Available

In general, these software products are capable of complying with all standards. Problems arise with the requirements to manually set the symbology as the graphics are placed. The following software is available which interfaces with these CADD engines to place graphics according to the Standard.

COE Supported Applications

CADD ENGINE	APPLICATION	STATUS	SOURCE
N/A (.pdf document)	A/E/C CADD Standard	Release 2.0	CADD Center http://tsc.wes.army.mil/products/standards/aec/toc-index.asp
AutoCAD	A/E/C CADD Standard Workspace	Release 4.0 available on this CD on \appendix\tsws_Acad	CADD Center http://tsc.wes.army.mil
MicroStation	A/E/C CADD Standard Workspace	Version 2.0 available on this CD on	*CADD Center* http://tsc.wes.army.m

		\appendix\tsws_mstn\.	il/Products/standards/workspace/default.asp
MicroStation	File Manager Included with TSWS Version 2.0	Version 1.2 available on this CD on \appendix\ts_fileman ager\.	COE Knowledge Base http://ckb.wes.army.mil/
Iplot Pen Tables			Some examples are provided for information only. This is available on this CD on \appendix\iplot\.

The following lists standard mdl applications maintained by the COE and are used by most Districts

CORPS MDL APPLICATION	GRAHPICS GENERATED	USER CONTROL ON SYMBOLOGY
3dls.ma		
Cellplot.ma		
Cellx.ma		
Cirfen.ma	NO	
Civtools.ma	YES	User settings in interface
Co2wt.ma		
Coord.ma		
Cvt2vd.ma		
Cvtdata.ma		Parameter text file
Cvtline.ma	YES	Parameter text file
Cvtxsect.ma/Cvtseclg.ma	YES	Parameter text file
3dtools.ma	YES	User settings in interface
Datstmp.ma	YES	Microstation active settings
Drftools.ma	YES	User settings in interface

Droptxt.ma	NO	
Emsshape.ma		
Extpnt.ma		
Extrude.ma		
Fenc2shp.ma		
Filepro.ma	NO	
Flu.ma	NO	
Grid.ma	YES	
Gscale.ma		
Histdel.ma		
Loctxt.ma		
Loctxt.ma		
Lvlshow.ma		
Ne.ma	YES	
Nekey.ma	YES	
Pfiles.ma	NO	
Pltpnt.ma		
Pltrange.ma		
Areatxt.ma	YES	
Pntdata.ma		
Scale.ma		
Sclcalc.ma		
Scrllbox.ma		
Scrntbl.ma/Bsiscrntbl.ma	NO	
Setvar.ma		
Setz.ma	NO	
Steel97.ma/Steelm.ma	YES	
Thin.ma	NO	
Tsws.ma	YES	
Txt2node.ma		

Upper.ma		
Us2si.ma		
Utils.ma		
Vacantlv.ma	NO	
Welddlg.ma	YES	
Xygraph.ma		
Xyplot.ma		
Backup.ma		
Barmenu.ma	NO	
Cellname.ma		

Vendor Software

Many applications are graphic-design oriented tools that generate graphics inside a CADD engine. These products typically come with default parameter files used for setting symbology for various graphics generated. These parameters can be changed by the user. Since some products are used throughout the COE, efforts have been taken to update these files for compliance with the Standard.

VENDOR	APPLICATION	STATUS
Intergraph	Inroads SelectCADD (includes all inroads products such as Inexpress)	CADD Center obtaining preference sets. Expected to be available for download from *http://www.ckb.wes.army.mil* . Expected availability October 2000. http://tsc.wes.army.mil/Products/in_roads/default.asp Version 2.0 available on this CD on \appendix\inroads\.
	Survey SelectCADD	Feature codes for data collectors will be available for download October 2000 from *http://ckb.wes.army.mil* .
	Storm and Sanitary SelectCADD	
	Frameworks	
	InSewer	

	InSitu	Requires user setting of symbology through parameter files
Bentley Systems	Triforma	CADD Center
	Triforma Structural	No current compliant settings have been developed. Settings will need to be done manually.
	Triforma HVAC	No current compliant settings have been developed. Settings will need to be done manually.
	Geopak	
GraphiSoft	ArchiCad	
?	Eagle Point	

Other vendor software

Many manufactures provide software used primarily for design analysis calculations but which also have sketching capabilities. Generally, any graphics would be saved in a .dxf format which could be imported into the cadd software.

VENDOR	APPLICATION	STATUS
	Mathcad	
	DAPPER	Will require user manipulation of graphics
	Strudl	
	Staad	
Elite Software	Elite Ductsize	