Automated Levee Inspection System

Version 1.1

User Manual

US Army Corps
Of Engineers

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Introduction

The US Army Corps of Engineers Levee Inspection System is designed to enhance the process of levee inspection, project condition documentation, and reporting. This application was developed through several cycles of design and testing with input from Levee Inspectors, Emergency Managers, and Geographic Information Systems (GIS) developers. Anticipated benefits of the application include significant time-saving in the inspection process, increased accuracy of deficiency locations, more timely reporting, a valuable historic record, and improved logistics during flood response.

The Levee Inspection System represents a combination of technologies that provide a tailored solution for levee inspection. Using a combination of Global Positioning System (GPS), Geographic Information Systems (GIS), Open Database Connectivity (ODBC), and Microsoft Access database software, the system operates on a laptop computer running the Microsoft Windows 95, 98, NT, or 2000 operating systems. This application was developed as an extension to ArcView GIS and ArcView GIS Tracking Analyst available from Environmental Systems Research Institute, Inc. (ESRI). Data collected during an inspection can be analyzed and presented using the various tools available in ArcView GIS or other GIS software. All of the source code for the application is written in ArcView GIS Avenue programming language and can be modified to suit individual requirements. The following features illustrate some of the application's functionality:

Data Collection and Automated Alerts

The Levee Inspection System allows a user to collect real-time data in the field using common commercial GPS receivers that output a National Marine Electronics Association NMEA 0183 string. By using the GPS, the accuracy of data collection is enhanced and allows the inspector to more easily find and verify the locations of deficiencies during subsequent inspections through an automated alerting feature. Additional ease is incorporated into the data collection process by providing the inspector with data-entry tools to record the attributes of the deficiencies, enter remarks and recommended actions, and provide a rating and status.

Data Organization and Management

Data management is conducted using a Microsoft Access database, and all of the information recorded in the Data Collection phase is stored in a database table. Microsoft Access software is not required for data collection, but this software is essential for database editing, queries, and report generation. The Levee Inspection System also provides tools for managing digital photos, which reduces the amount of time spent renaming, copying, and updating database records.

Data Visualization & Analysis

Using inspection data in ArcView GIS allows the user to present and analyze inspection data spatially and see how the data relates to other phenomena. Real-time tracking of the inspection with detailed reference data, along with existing and historic deficiency data, enables the inspector to be more aware of current levee conditions. Visual presentation of data is accomplished with maps created in ArcView GIS, and these maps can be included in final inspection reports. All of the functionality found in this GIS software can now be used with inspection data.

The Levee Inspection System is designed to guide the user though the setup, data collection, and reporting processes using an intuitive program interface. Following is a brief outline of the workflow using this application.

- Administration
  - Software installation and configuration
  - Database customization
  - Inspection Project creation and organization of project data

- Field Data Collection
  - Project loading
  - GPS control
  - Point and Line feature collection and attribute entry and update

- Post Inspection Organization
  - Digital Image management using the Photo Link Utility
  - Viewing inspection data in ArcView GIS

- Reporting
  - Automated report table generation

Installation
And
Configuration

Hardware and Software Requirements

The minimum hardware and software requirements for using the Levee Inspection System are similar to those of **ArcView GIS**, however, using a real-time GPS feed and writing geographic and attribute data to the **Microsoft Access** database will affect computer performance. To ensure optimum performance, the following hardware recommendations should be considered.

Recommended Hardware Specifications

CPU:	Pentium II 233Mhz
Memory:	128 MB
Hard Drive:	Requires at least 100MB of free space.

Additional computer resources (CPU speed, memory, and hard drive space) will provide improved performance.

Required Software Specifications

Operating System:	**Microsoft Windows 95/98/NT/2000**
Open Database Connectivity (ODBC) Drivers:	**Microsoft Access Drivers**
Pre-installed Software:	**ArcView GIS v.3.2a or Later**
	ArcView GIS Tracking Analyst v.1.0 and Patch
	Microsoft Access 2000 *

* **Microsoft Access 2000** is not required for the data collection process, however, this software is necessary for database setup, editing, and automated report generation.

Note: ArcView GIS and ArcView Tracking Analyst must be installed prior to the Levee Inspection Application installation and configuration described in the following pages. The following discussion assumes the software was installed according to the vendor's instructions.

Installation

Installation of the Levee Inspection System requires three steps: Extracting files, copying files, and editing files.

Extracting Files

Load the Levee Inspection Application CD into the CD-ROM drive, or, if you downloaded the installation file (levee_inspection.exe) from the **Innovative Technologies** web site, save this file to a temporary directory.

Run the Levee_Inspection.exe file from **Windows Explorer** or from the **Windows Start** button. Click **Start** → **Run** → **Browse** to the installation file, and Click **OK**.

Extract the files to the desired hard drive. Once the file extraction process completes, the levee_inspection directory structure will appear exactly as it does in **Figure 2-1** (dependent upon drive to which the application is installed).

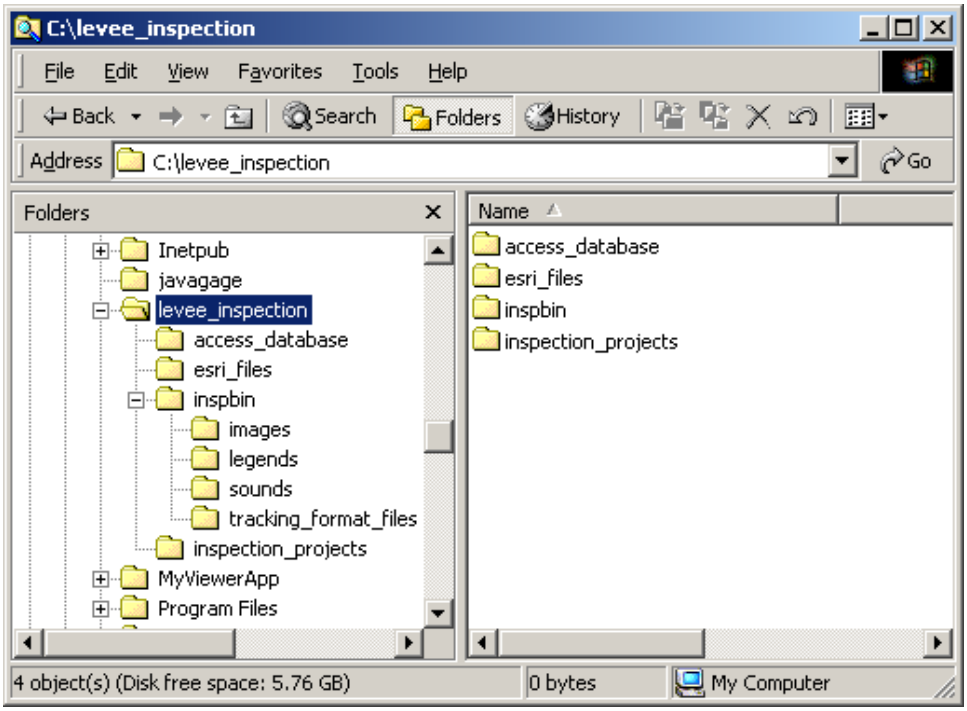


Figure 2-1 Installation Directory Structure.

Copying the Levee Inspection Extension File

Once the files have been extracted to the designated hard drive, the Levee Inspection extension must be copied to the **ArcView GIS** extension directory. Typically, **ArcView GIS** is installed in **c:\esri\av_gis30\arcview** or otherwise referred to as **$AVHOME**. Locate the **$AVHOME** directory, and copy the extension file (located in the [drive_letter:]\levee_inspection\esri_files directory) to the specified **ArcView GIS** sub-directory listed below.

Program File	Specified Folder Location
li.avx	**$AVHOME\ext32**

Configuration

Editing the ArcView GIS Startup file:

ArcView GIS users often edit the software's **Startup** file for particular applications. If the **ArcView GIS Startup** file has been customized for other applications, then follow the steps for editing the existing **Startup** file.

If the **ArcView GIS Startup** file **has not** been customized, then copy the provided **Startup** file (located in the [dirve_letter:]levee_inspection\esri_files directory) to the **ArcView GIS** directory specified below and answer "yes" to overwriting the existing startup file.

Program File	Specified Folder Location
Startup	**$AVHOME\etc**

Following are the instructions for editing the existing **ArcView GIS Startup** file. Make a backup copy of the existing **Startup** file (e.g. startup.bak) and edit the existing **Startup** file using **Microsoft Notepad** or **Microsoft Wordpad**. Add the code highlighted in yellow in **Figure 2-2**. The code must be placed in the exact same location as in this example.

```
' Check for a valid TMPDIR under UNIX.
if (system.GetOS = #SYSTEM_OS_UNIX) then
  home = System.GetEnvVar("HOME")
  if (Not (File.Iswritable(home.AsFileName))) then
    path = System.GetEnvVar("TMPDIR")
    if (path <> NIL) then
      if (Not (File.Exists(path.AsFileName) and File.IsWritable(path.AsFileName))) then
        MsgBox.Warning("TMPDIR directory " + path.AsString + " is not writable . " +
          "Please set environment variable TMPDIR to a writable directory.", "")
      end
    else
      System.SetEnvVar("TMPDIR","/tmp")
    end
  end
end



'***FOR LEVEE INSPECTION V 1.0
'****************************

system.SetEnvVar("LEVINSP","c:\levee_inspection")

'****************************
'****************************



MsgBox.Banner("$AVHOME/etc/banner".AsFileName, 1, "")
av.SetName("ArcView GIS 3.2a ")

avExt = FN.Make("$AVHOME")
avExt.MergePath("ext")
System.SetEnvVar("AVEXT", avExt.GetFullName)
```

Figure 2-2 ArcView GIS Startup file edit for Environment Variable.

Configuring the ODBC Data Source

This process establishes the connection of the **Microsoft Access** database (levee_inspection.mdb) with **ODBC**. Open the **ODBC Data Source Administrator** according to following Operating System specific instructions.

If you are using **Microsoft Windows 95/98/NT**, Click on **Start → Settings → Control Panel → ODBC Administrator**

If you are using **Microsoft Windows 2000**, Click on **Start → Settings → Control Panel → Administrative Tools → Data Sources (ODBC)**

The remaining steps are the same for **Microsoft Windows 95/98/2000/NT**.

Select the **System DSN tab**.

Click on the **Add…** button to create a new data source (**See Figure 2-3**).

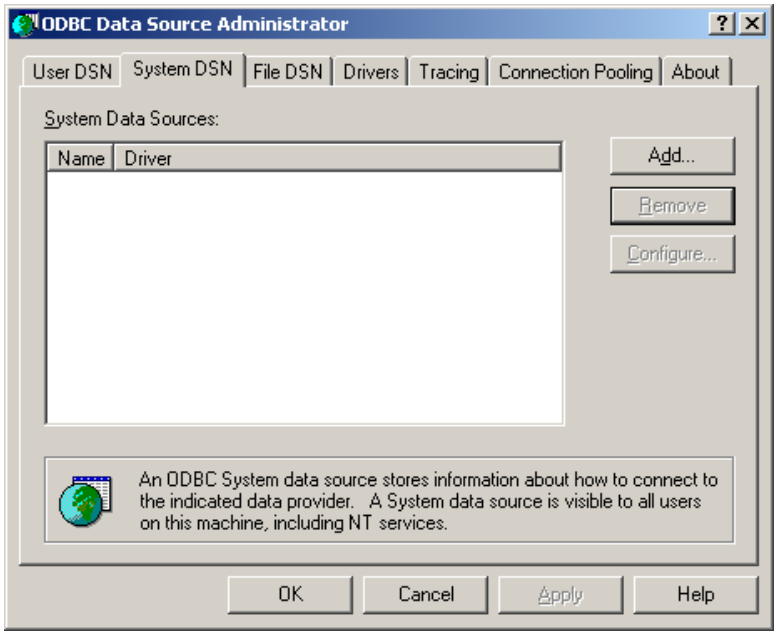


Figure 2-3 ODBC Data Source Administrator Dialog.

Select **Microsoft Access Driver** and Click **Finish** (**See Figure 2-4**).

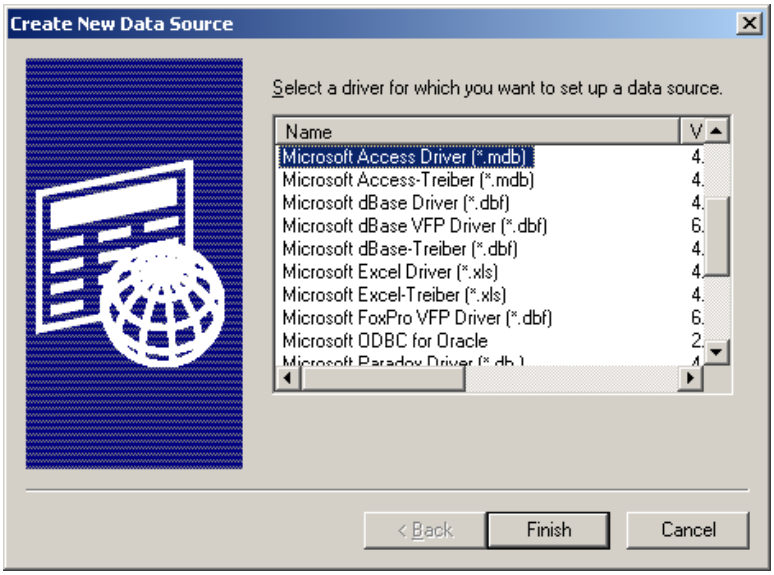


Figure 2-4 Create New Data Source Dialog.

Set **Data Source Name** to **Levee_Inspection** and Click on the **Select…** button. Navigate to the levee_inspection.mdb found in the [drive_letter:]\levee_inspection\access_database directory and Click **OK** (**See Figure 2-5**).

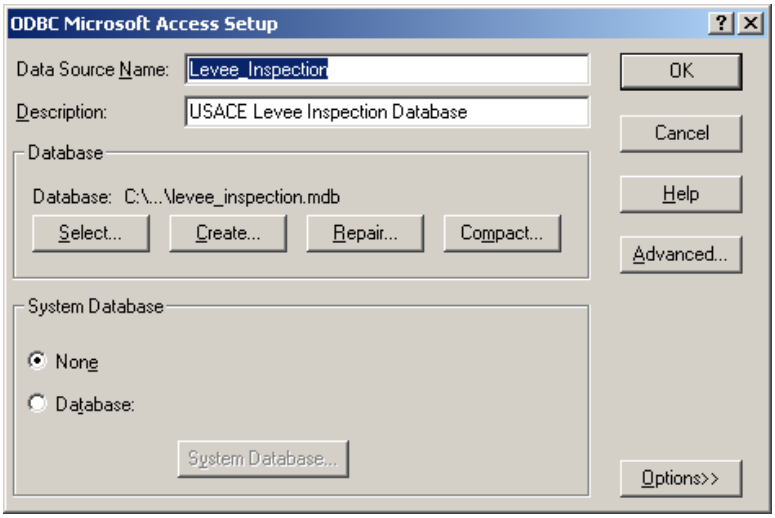


Figure 2-5 ODBC Microsoft Access Setup Dialog.

Setting the System Clock

The Levee Inspection Application relies on accurate computer system time to display the inspector's position from the GPS receiver. This position is based on the last known position reaching the **ArcView GIS Tracking Analyst** feed and requires that the computer's system clock is correctly set. In some cases, it may be necessary to set the computer system clock slightly ahead (1 to 2 minutes) of the actual time.

Set the system clock according to the Windows documentation or help file. In addition to the time, make sure the time zone is correctly set. Several web sites provide accurate time information, such as the **US Naval Observatory Master Clock** time at the following web site:

http://tycho.usno.navy.mil/cgi-bin/timer.pl

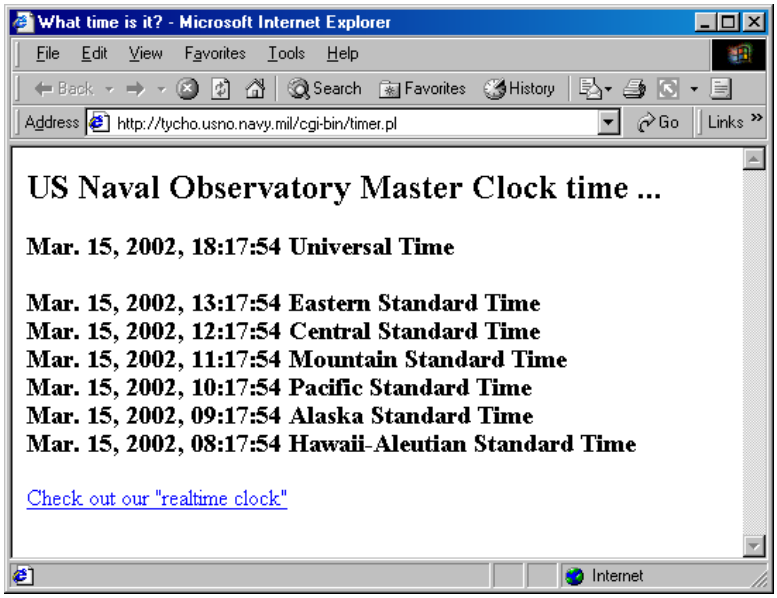


Figure 2-6 US Naval Observatory Master Clock time web page.

Levee Database Configuration

The Levee Inspection System uses a **Microsoft Access 2000** format database to store all inspection items and those items' associated attributes. Although it is not necessary to have **Microsoft Access 2000** loaded on the Inspection machine, certain tables must be populated for the software to work properly. Edit the database tables on a computer with **Microsoft Access 2000** installed. Once a copy of the database has been set up correctly, it can be copied to the machine(s) used for inspection.

The following discussion describes the items necessary for the Levee Inspection System to operate correctly for individual USACE Districts. A complete description of the Levee Database tables can be found in Appendix A – Database Table Specifications.

Table Summaries

Agency Table (Configuration **REQUIRED**) – This table provides a pick list of District Codes to generate a unique inspect_id. Users must enter the USACE District Code (5-character) for their district (e.g., CENWO, CEMVP).

Project Table (Configuration **REQUIRED**) – This table contains the levee district name and a unique 4 digit code. This code may not exceed four characters (alpha-numeric) and must be unique within a specific USACE District, as in the following examples:

Field Name	Value
Project	North River Drainage District
Code	NRDD
Project	Sny Island Levee and Drainage District (Cell 3)
Code	SNY3

Additionally the **Projection**, **Coord_sys**, **Datum**, and **Zone** fields should be populated for metadata purposes, but they are not required.

Feature Table (Configuration **Optional**) – This table contains a list of common features of a levee. Features specific to a particular project may be added if necessary.

Items Table (Configuration **Optiona**l) – This table contains common items (i.e, deficiencies) observed during an inspection, and the table may be customized for specific projects.

Note: These are the only tables that need to be configured for the Levee Inspection System to operate properly.

The Ratings Table and Status Table should NOT be edited. The Levee Inspection System relies on records in these tables to operate correctly.

Database Table Modification Instructions

Open the ***[drive_letter:]*\levee_inspection\access_database\levee_inspection.mdb** in **Microsoft Access 2000** or later.

Click on the **View Levee Inspection Database** button (**See Figure 2-7**). This will provide normal access to the database.

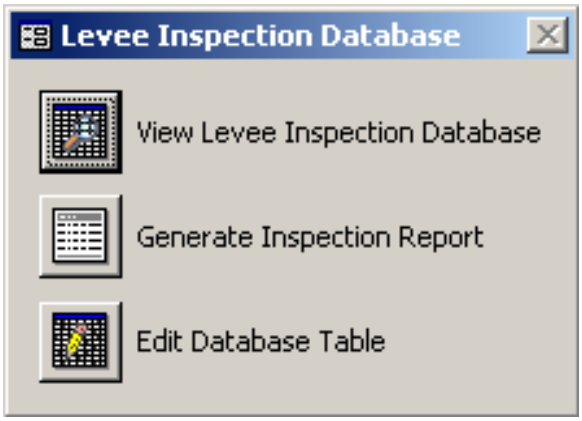


Figure 2-7 Custom Dialog to Database Functions

Agency Table

Open the **Agency Table** and enter your USACE District office symbol (**See Figure 2-8**).

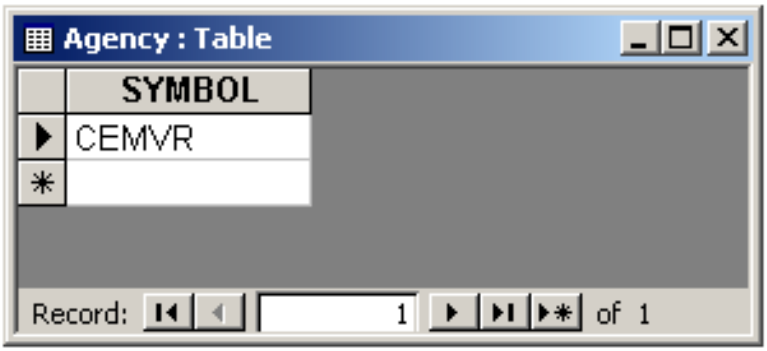


Figure 2-8 The Agency Table populated with a District office symbol.

NOTE: This table requires at least one entry. The symbol represents a value used to assemble a unique key code for each point and line collected during an inspection.

Project Table

Open the **Project Table** and enter a levee district project name and project code. The **PROJECT** and **CODE** fields are required fields (**See Figure 2-9**). It is important to maintain unique codes for each project.

Projects : Table

PROJECT	CODE	Projection	Coord_Sys	Datum	Zone
Bear Creek Reservoir	BCRR	Transverse M	UTM	NAD-83	15
Canton Missouri LFPP	CANT	Transverse M	UTM	NAD-83	15
Des Moines - Mississippi	DMMS	Transverse M	UTM	NAD-83	15
Fabius River Drainage District	FABS	Transverse M	UTM	NAD-83	15
Gregory Drainage District	GREG	Transverse M	UTM	NAD-83	15
Hannibal Missouri LFPP	HANL	Transverse M	UTM	NAD-83	15
Hunt Drainage District	HUNT	Transverse M	UTM	NAD-83	15

Record: 7 of 29

Figure 2-9 The Project Table populated with unique project codes.

Feature and Item Tables

The Feature and Item tables define where deficiencies are observed and the nature of the deficiency. It is recommended that you not remove records from these tables, but add to them per individual project requirements.

Features : Table

Feature
Berm
Closure Structure
Concrete Floodwall
Concrete Structure
Concrete Surface
Culvert
Drainage Channel
Drainage Structure
Embankment
Flood Wall
Floodway
Gate
Levee Crown Only
Levee Slope and Crown

Record: 1

Items : Table

Item
Animal Burrows
Breaks
Corrosion
Cracking
Debris
Depression
Deterioration
Encroachment
Erosion
Excavation
Grazing
Inoperable
Leaking
Obstruction

Record: 1

Figure 2-10 The Feature and Item Tables

Loading the Levee Inspection System Extension

Loading the Levee Inspection Extension

The following discussion assumes the application is installed and configured according to the instructions in the previous sections. The extension file is loaded in **ArcView GIS** using the **Extensions Dialog**.

- **Start ArcView GIS**.
- From the **File** Menu Item, Select **Extensions**.
- Scroll down to **Levee Inspection System (USACE-EM) (See Figure 3-1)**
- Click on the name label **Levee Inspection System** to access the **About** information window. This window provides information on the extension version and the date the extension was created.
- Click on the **Check Box** to turn on the extension
- Click **OK** to close the **Extensions Dialog**.

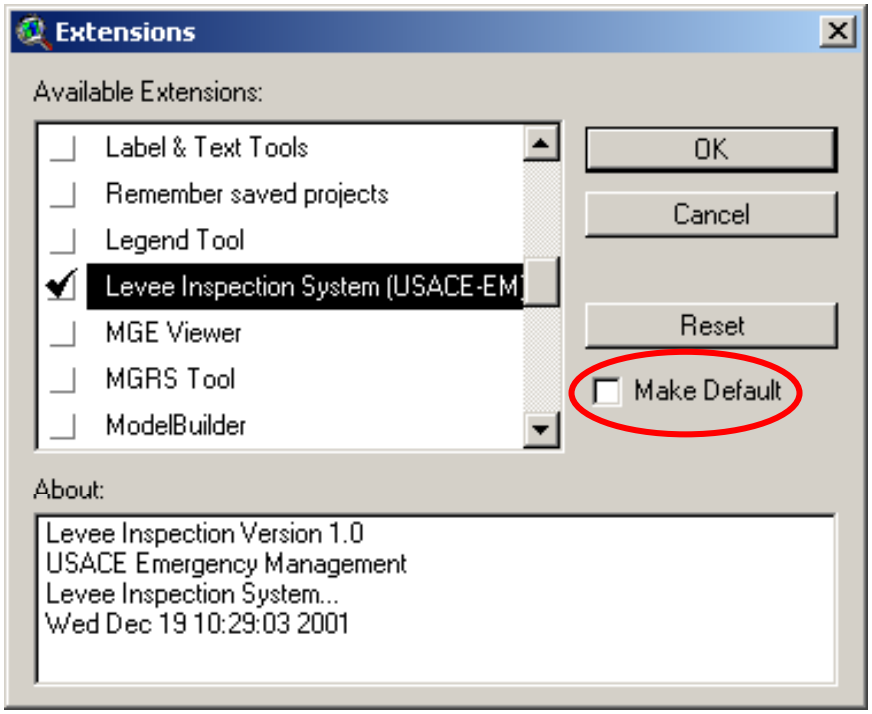


Figure 3-1 The ArcView GIS Extensions Dialog.

If you prefer that the Levee Inspection System extension loads automatically each time you start ArcView GIS, Click on Make Default (circled in red in Figure 3-1).

Note: It is not necessary to load the ArcView GIS Tracking Analyst (or any other) extension required for this application -- the Levee Inspection System extension will automatically load them.

After the **Extensions Dialog** is closed, the **ArcView GIS** application should appear as it does in **Figure 3-2**.

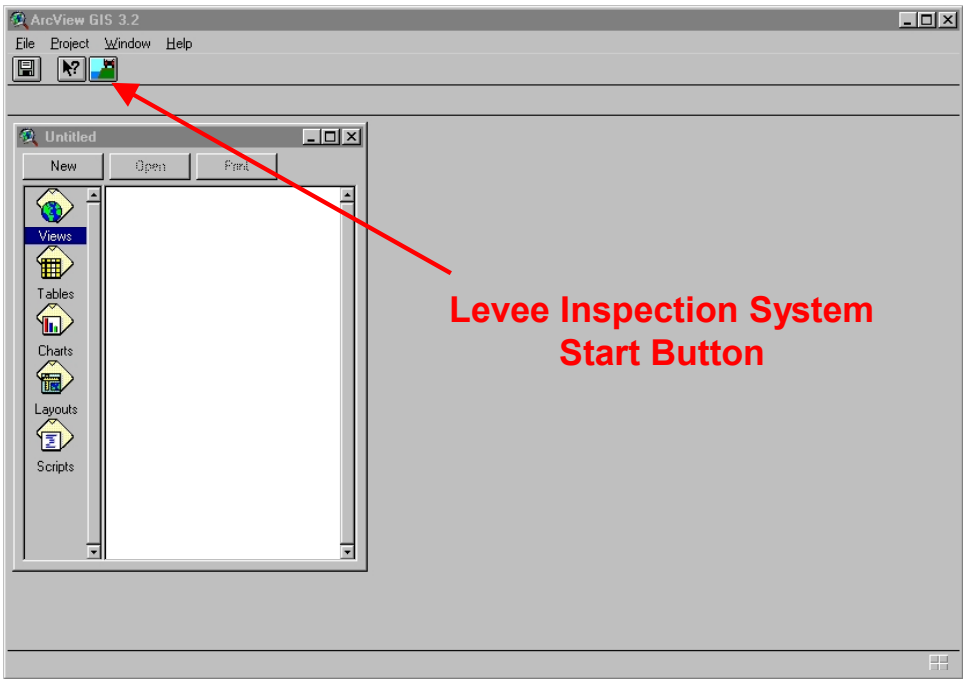


Figure 3-2 The ArcView GIS application with the Custom Start button.

Click the Levee Inspection System **Start** Button to open the **Toolbar** (**See Figure 3-3**).

Figure 3-3 The Levee Inspection System Custom Toolbar.

Virtually all functionality of the Levee Inspection System is controlled via this **Toolbar**. The following section provides an overview of the functions performed by each of the buttons on the toolbar. Detailed discussion of these functions is found in sections on **Setting up a Project**, **Data Collection**, and **Data Management Utilities**.

Toolbar Overview and Quick Reference

The Levee Inspection System Toolbar is organized left-to-right for the three main data collection and organization tasks: Pre-Inspection, Inspection, and Post-Inspection (**See Figure 3-4**).

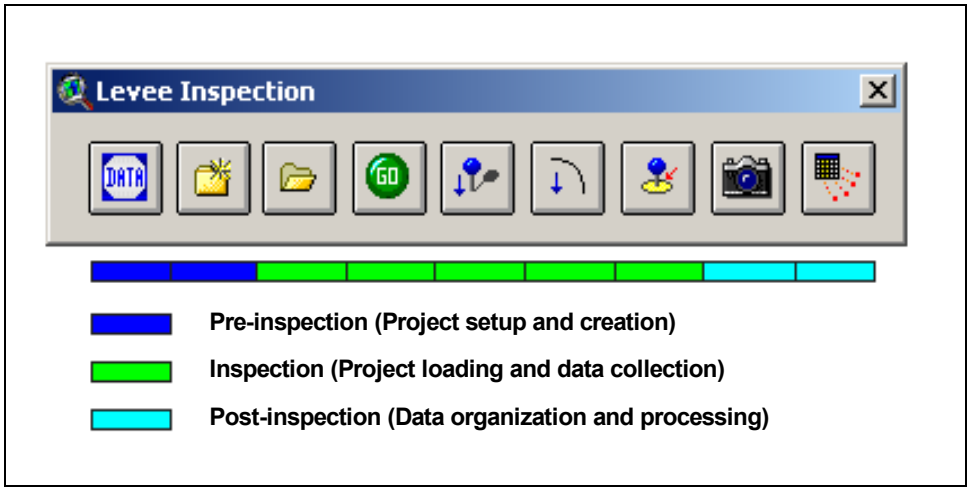


Figure 3-4 The Toolbar showing task organization.

Toolbar Button Descriptions

Add Project Data

Create a new project view and add reference data, or append additional data to an existing project.

Create/Edit Project

Sets projection information related to the reference data, allows a stationing file to be added, completes the creation of the directory structure, and copies the reference data to the appropriate project. This step is required for a project to correctly load.
This button also allow a stationing file to be added to an existing project.

Load a Project

Opens a dialog from which the user selects the inspection project, enters parameters specific to the project, defines buffer criteria, and activates the proper GPS feed.

Toggle Tracking

Determines tracking symbol visibility. Allow the user to turn the tracking symbol on/off.

Create Inspection Point

Places an inspection point on the display and opens the data entry dialog for attributing the inspection point.

Create Inspection Line

Starts a line where a linear deficiency begins, and opens the Inspection Line dialog. The Inspection Line dialog will monitor and control the line collection once it is open. Once a line has been ended, the data entry dialog is displayed. A maximum of 2 lines can be collected simultaneously.

Select Inspection Buffer

This tool allows the user to point and Click on an event buffer to display the attributes of the inspection point or line. Interactive selection provides a way to access the information of a given feature if the user is unable to “drive through” the buffer using the automated alert function.

Photo-Link Utility

The Photo-Link utility assists the user with associating selected digital photographs with specific inspection features in the database.

The Photo-Link utility assigns a digital photograph name to the database and places a copy of the file in the appropriate location inside the inspection projects directory.

Export Inspection Items

This utility allows the user to query and display inspection points and lines from a specific inspection year and cycle. The button opens a dialog where the user can enter the Project Name, Inspection Year, and Inspection Cycle to import the feature and all the database information about the item. Once displayed in ArcView GIS, the features can be saved as ESRI Shapefiles.

Setting Up A Project

Setting Up a Project

Setting up a project is the first step in conducting an inspection. Projects provide the container for all of the reference data used for the data collection process and also provide a way of organizing data for storage and retrieval. The process for setting up a project involves adding reference data and project creation.

Note: If you exit ArcView GIS at any time during this process, it is not necessary to save your work as an ArcView GIS project file. All control for setting up the Levee Inspection System is handled through the Toolbar.

Adding Project Data

Start **Arcview GIS**, load the Levee Inspection extension, and Click on the **Data** button on the **Toolbar**. The **Load Data** message box is displayed asking whether or not you want to create a new project View (**See Figure 4-1**). Click **Yes** to set up a new project View, or Click **No** to add data to an active project View.

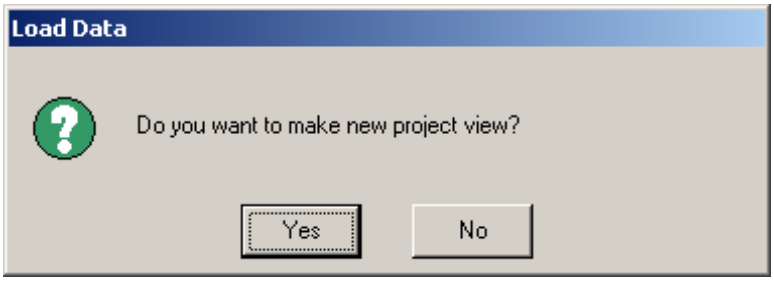


Figure 4-1 The Load Data Prompt Message Box.

If you are creating a new project View and Clicked **Yes**, the **Projects** dialog is displayed (**See Figure 4-2**). Select a project from the drop-down list, and Click **OK**. A new View is created and this View is named with the four-character abbreviation of the selected project.

If you are adding data to an existing project and the View for this project is active, press **No**.

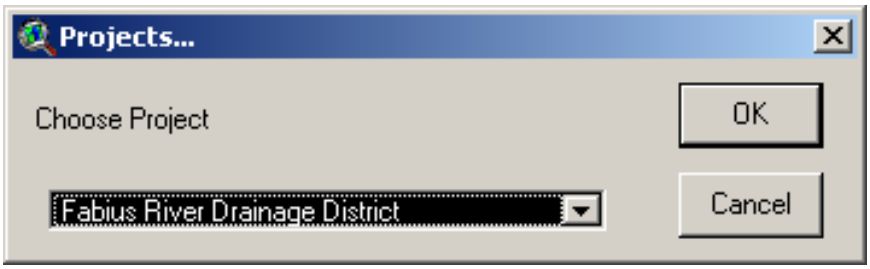


Figure 4-2 The Choose Project Dialog.

The Levee Inspection **Data Browser** window opens (**See Figure 4-3**), which provides a mechanism for easily loading multiple datasets from various directories to the project View.

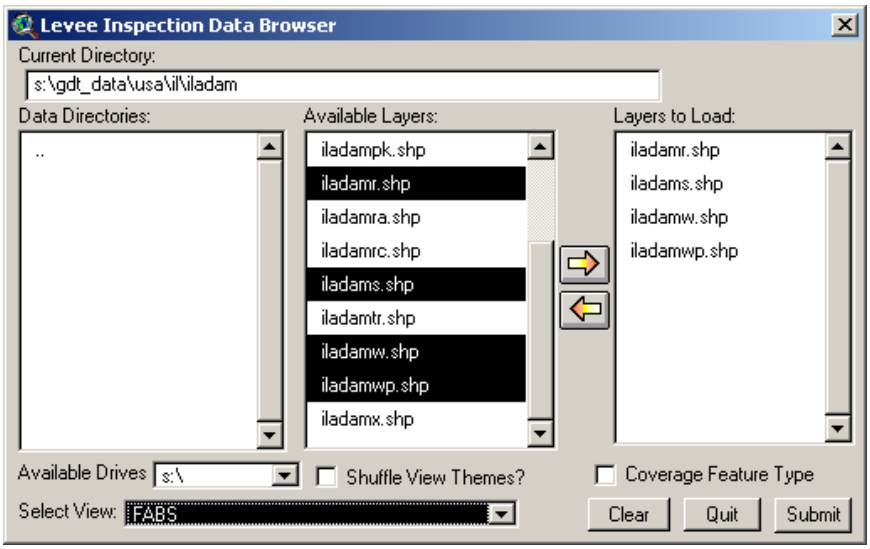


Figure 4-3 The Data Browser Dialog.

In the **Data Browser** window, the **Current Directory** indicates the absolute path of directory navigation. To navigate to desired reference data, select the drive letter on which the data can be found from the **Available Drives** selection box. Directories on that drive will be listed in the **Data Directories** panel.

Double-Clicking any directory opens it and displays the available data files it contains in the **Available Layers** panel. Data formats include all standard **ArcView GIS** supported formats (Arc/Info Coverages, Shapefiles, and image files), as well as MrSID and JPEG image files. Double-Clicking the double-dot (**..**) in the **Data Directories** panel moves up one level in the directory structure.

To load data, select from the files displayed in the **Available Layers** panel, and use a Shift-Click to select multiple files. Click the right-pointing arrow to move the selected files to the **Layers to Load** panel. Avoid loading unwanted files by selecting those files, and then Clicking the left-pointing arrow. Once all of the files for the project appear in the **Layers to Load** window, Click the **Submit** button, and the files will be loaded into the project view.

Note: At this point, if you change any legend symbols and colors, save the legend files.

Creating a Project

Click the **Create/Edit Project** button. Project creation is the final process in preparing the reference data and View for the inspection. The interface will prompt the user to choose whether or not to add a stationing file to the project. If the choice is **NO**, the interface continues with the project creation. If the choice is **YES**. the **Select Stationing Shapefile** window opens prompting the user to select a stationing shapefile.

Note: Select the Stationing Shapefile assumes the file you are selecting is in the same projection as all of the other reference data.

Note: The interface will validate the stationing file. If the stationing field (LEV_STA) does not exactly match that specified in Appendix B, the stationing file will not be used.

Click on the stationing shapefile (e.g. irgl_sta-sds_utm15-nad83.shp - **See Figure 4-4**), and Click **OK**. After selecting a stationing shapefile the interface will validate the file. If the stationing file is valid, it will be copied to the correct project folder. If the stationing file is not valid the interface will return an error message.

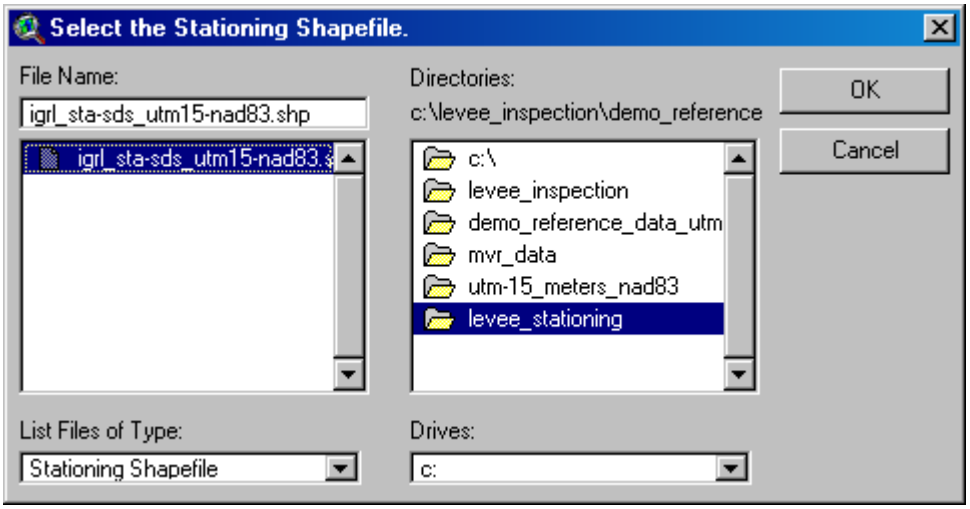


Figure 4-4 The Select the Stationing Shapefile window.

Once the stationing file operation completes, the **Select Projection** window opens prompting the user to select the projection of the reference data.

Note: Select Projection assumes all reference data are in the same projection.

Click on the projection (e.g. decimal_degrees.pcf - **See Figure 4-5**), and Click **OK**. After selecting a projection from the list all necessary files will be copied to the correct project folder.

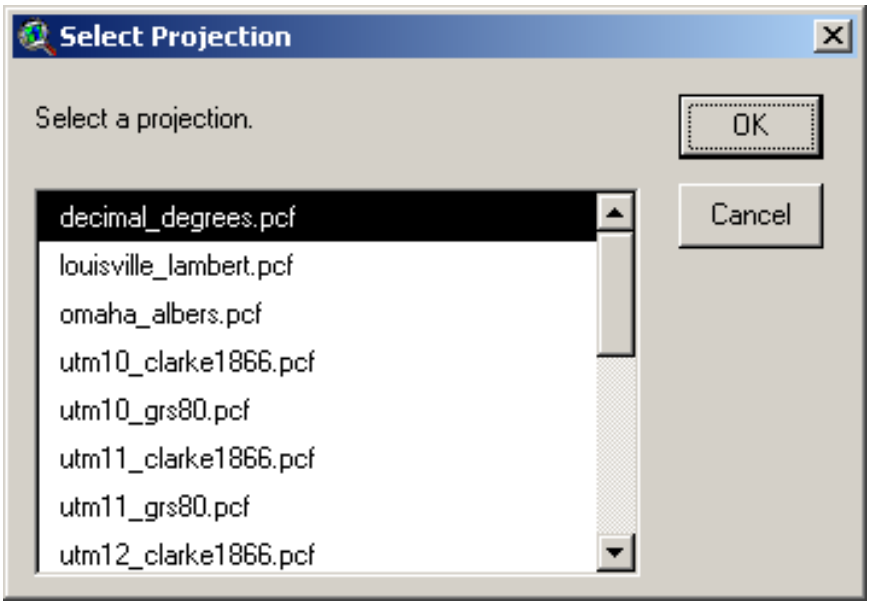


Figure 4-5 The Select Projection window.

Note: The Levee Inspection System contains projection files for Geographic Coordinates (decimal degrees) and UTM zones 1 through 19 in both NAD27 and NAD83. If you are experienced with the ArcView GIS Avenue programming language and are knowledgeable in projection parameters, you may edit a projection file specific to your needs. Projection (pcf) files are located in the levee_inspection/inspbin/ folder and are named according to the projection they represent (i.e. utm10_clarke1866.pcf). Each of these files contains parameters for projecting GPS information to the users chosen data projection. If you require assistance with a specific projection file, please request this file through one of the Technical Support Points of Contact located in Appendix C.

Data Collection

Loading a Project

Click the **Load Project** button to begin a new data collection project or continue with an existing data collection project. The **Load Project** Dialog window is displayed for setting and entering the project parameters (**See Figure 5-1**). This dialog contains 3 distinct functions. Two of these functions -- **Project Info** and **GPS Tracking Feed** -- are mandatory for the application to operate properly. If collecting data for the first time on a particular flood control project, set the parameters for **Project Info** and **GPS Tracking Feed.** (See the function sections outlined in red in **Figure 5-1**) If performing an inspection subsequent to the initial inspection using the Levee Inspection System, then also set the parameters for the **Buffers** function (**See Figure 5-2**).

Note: These functions must be completed <u>In Sequence</u> for proper execution.

- **Project Info (Mandatory)**
- **Buffers (Optional)**
- **GPS Tracking Feed (Mandatory)**

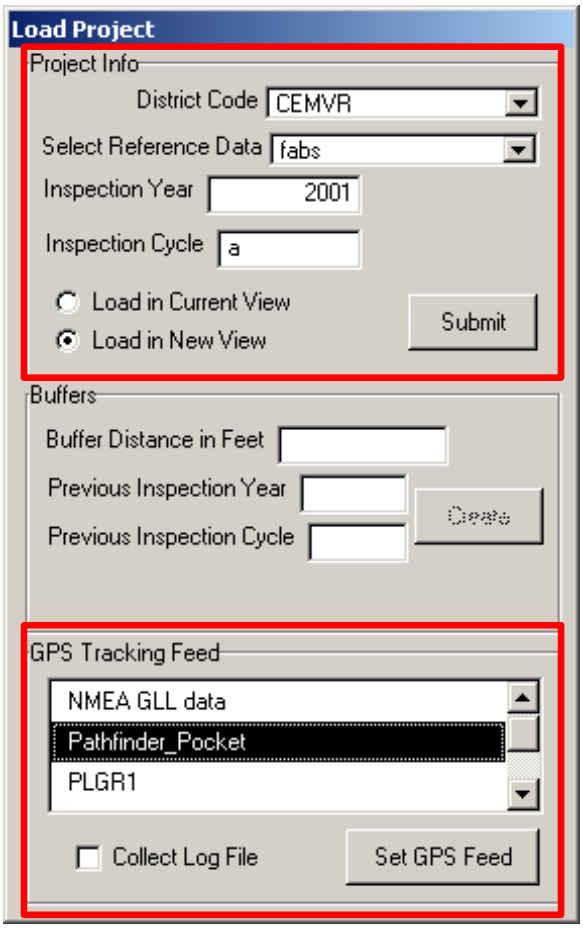


Figure 5-1 The Load Project Dialog with the mandatory sections outlined.

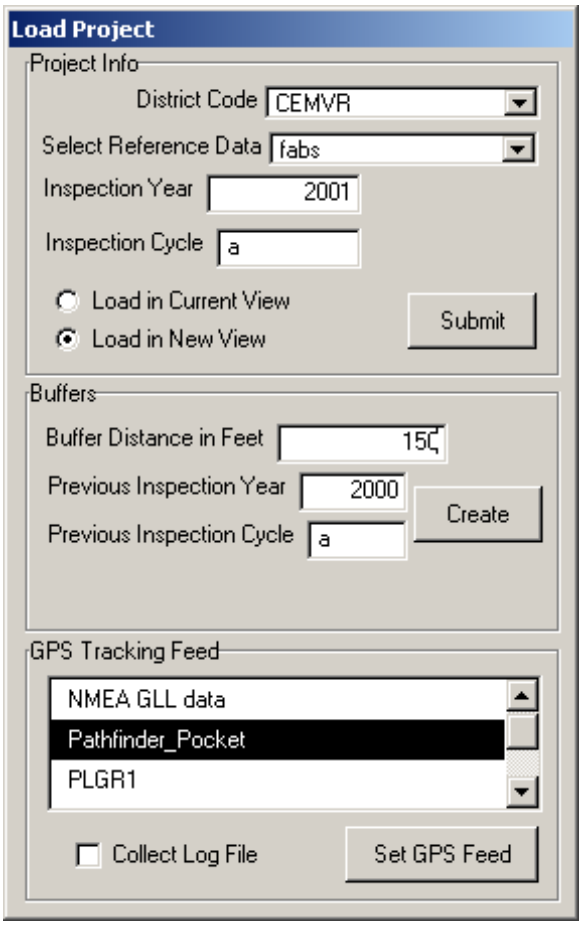


Figure 5-2 The Load Project Window showing information entered in all sections.

Project Info

Select **District Code** and **Reference Data** from their respective drop down boxes. Reference data are data that have been assembled during the **Data Loading** process. Enter the **Inspection Year** and **Inspection Cycle** into their respective text boxes. These four entries are used to create entries into the **Microsoft Access** database. Click **Submit** to load the reference data associated with the **Project Info** entries.

Buffers

Buffers provide a way for the inspector to be automatically alerted to existing levee deficiencies recorded during previous inspections. The **Buffers** function allows a user to define the **Buffer Size in Feet**, the **Previous Inspection Year**, and the **Previous Inspection Cycle**. Buffer size determines the amount of advance notification to existing deficiencies (e.g., a buffer size of 150 feet alerts when the vehicle/tracking device are within 150 feet of the deficiency). Click on **Create** once all three choices have been made.

GPS Tracking Feed

This function selects the GPS unit to be used for the inspection. Any GPS receiver that has been configured for **ESRI's ArcView GIS Tracking Analyst** Extension will be displayed in the list box. If the GPS unit you are using does not appear as a selection, ensure that it has been properly configured in **ArcView GIS Tracking Analyst**.

To choose a GPS receiver, highlight the device name and Click **Set GPS Feed**. Optionally, a **Tracking Log File** may be collected by Clicking on the **Collect Log File** check box.

Note: Collecting log files can significantly impact computer performance. Refer to the Using ArcView GIS Tracking Analyst manual for complete information regarding collecting log files.

Note: Some GPS devices that do not activate automatically, such as the Trimble Pathfinder Pocket, may require an updated Communications Port handler application. This file and instructions for installing the file may be downloaded from the Innovative Technologies web site at:

http://www.mvr.usace.army.mil/leveeinspection

or from ESRIs web site at:

http://support.esri.com/search/KbDocument.asp?dbid=22195

Toggle Tracking

The **Toggle Tracking** function determines whether the tracking symbol (red dot symbol) is visible in the inspection project View. When you are ready to begin the inspection, simply Click the **Toggle Tracking**, or **GO** button on the **Toolbar**. The tracking symbol should appear in the view within a few seconds. When the Levee Inspection System is tracking, the **Toggle Tracking** button displays a **STOP** icon. When data collection has been completed, Click the **Toggle Tracking**, or **STOP** button again to disengage location tracking. The **GO** icon will return.

Create Inspection Point

When an inspection issue is observed that can be best represented by a point in the database, Click on the **Create Inspection Point** button. The **New Point** dialog is displayed (**See Figure 5-3**). Complete the appropriate information in this dialog (**See Table 5-1**), and Click the **Submit** button to commit this feature to the inspection database. If you do not wish to commit this feature, Click the **Cancel** button.

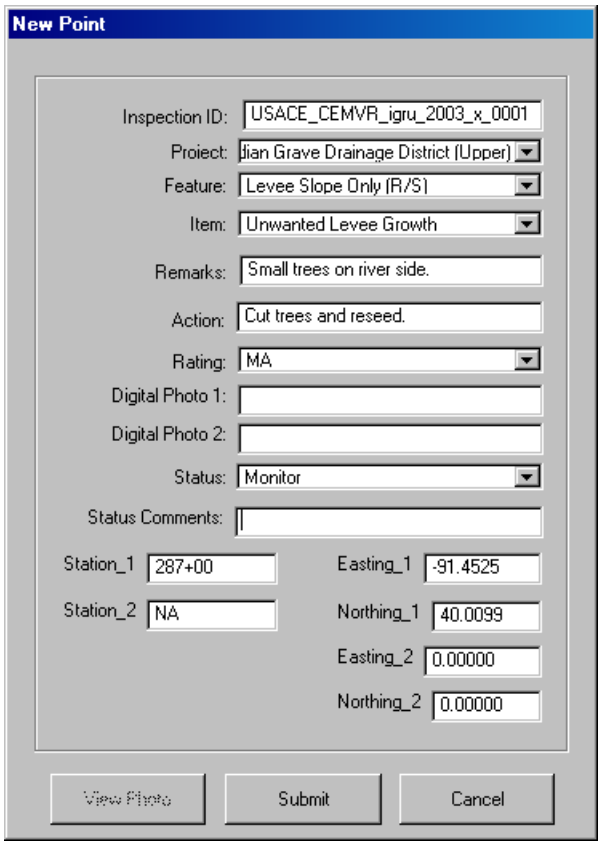


Figure 5-3 The New Point attribute entry dialog.

Field	User Entry	Update Process
Inspection ID	No	Application automatically updates and increments ID number
Project	No	Defaults to Current Project
Feature	Yes	User Picks from List
Item	Yes	User Picks from List
Remarks	Yes	User Enters Information (Maximum 255 Characters)
Action	Yes	User Enters Information (Maximum 255 Characters)
Rating	Yes	Pick from List (See Table 5-2)
Digital Photo 1	No	Application updates through Photo-Link Utility
Digital Photo 2	No	Application updates through Photo-Link Utility
Status	Yes	Pick from List
Status Comments	Yes	User Enters Information (Maximum 255 Characters)
Station_1	No	Application automatically updates
Station_2	No	Application automatically updates
Easting_1	No	Application automatically updates
Northing_1	No	Application automatically updates
Easting_2	No	Application automatically updates
Northing_2	No	Application automatically updates

Table 5-1 Data Entry Reference for New Point or New Line.

Rating	Rating_Description
A	Acceptable Performance Level
MA	Minimally Acceptable Performance Level
U	Unacceptable Performance Level
NR	Not Rated (Explain in Remarks)

Table 5-2 Ratings Abbreviations and Descriptions.

Create Inspection Line

When an inspection issue is observed that can be best represented by a line in the database, Click on the **Create Inspection Line** button. The **Line Collection** dialog is displayed (**See Figure 5-4**). This dialog provides the inspector with a means of monitoring the status of line data collection, ending a selected line, and entering point data.

Note: Up to two linear features can be simultaneously traced using the Levee Inspection System. Points may also be recorded while one or two lines are being recorded from the Create Inspection Point button on the Toolbar or from the Create Inspection Point button on the Line Collection dialog. There is no limit to the number of point features that may be collected while linear tracing is in progress.

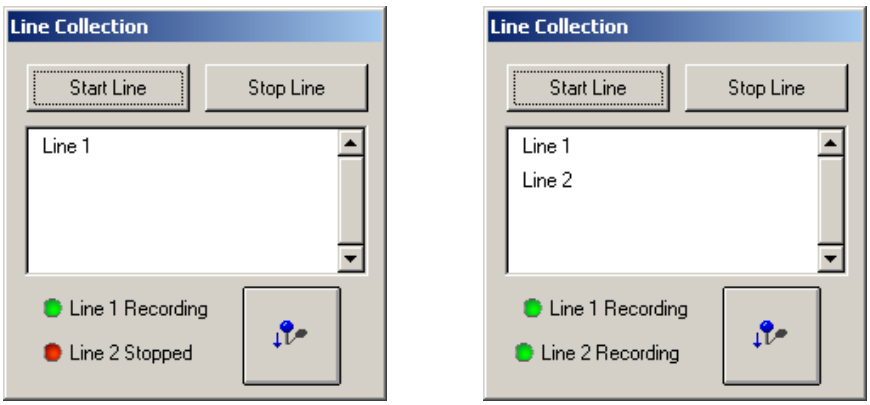


Figure 5-4 Line Collection Dialog with example status for one line and two lines.

When the linear feature ends, select the appropriate line from the list (**Figure 5-4**) and Click the **Stop Line** button. The **New Line** dialog (**See Figure 5-3 – New Point** entry dialog) is displayed for entering information about that deficiency.

As with the New Point dialog, fill in the appropriate information in this dialog and Click the Submit button to commit this feature to the inspection database. If you do not wish to commit this feature, Click the “Cancel” button.

Note: The line feature will not be displayed on the inspection View until the line is stopped.

Identifying and Maintaining Existing Inspection Data

Buffers created for automated alerts to previous inspection issues may be updated using the Levee Inspection System. When the system detects that it has moved inside a buffer for an existing point or line feature, it will automatically display either the **Existing Point** or **Existing Line** dialog, based upon the type of feature encountered. These dialogs allow the same information contained in the new feature dialogs to be updated for existing features (**See Figure 5-3 – New Point** entry dialog). After the information for the feature has been updated, Click the **Submit** button to continue.

Note: The Status field is used to control the availability of specific records in the database.

If you determine a deficiency has been corrected, select Resolved from the Status drop-down. The corresponding record will be updated. This record remains in the database, but will not be included in the records selected for the next inspection.

If you determine a deficiency has not been corrected, select Unresolved from the Status drop-down. The corresponding record will be updated. This record remains in the database, and will be included in the records selected for the next inspection.

If you determine a deficiency requires further monitoring, select Monitor from the Status drop-down. The corresponding record will be updated. This record remains in the database, and will be included in the records selected for the next inspection.

Automated Alert Feature

The Levee Inspection System's automated alert feature default is displaying the record of a particular point or line feature in the database with the option to view related digital photos.

Audible alerts may also be used. To enable the audible alert feature, see **Audible Alert** in **Appendix C**.

Select Inspection Buffer

In addition to updating the information for existing inspection features through the auto-detect facility described above, the buffer for an existing feature can be directly selected using the **Select Inspection Buffer** tool. This function is useful in situations where you are unable to gain access to a particular site (e.g., muddy road or obstruction). To update information for an existing feature, Click the **Select Inspection Buffer** tool, and then Click on the buffer around the feature in the View you want to revise. The **Existing Point** or **Existing Line** (**See Figure 5-3** – **New Point** entry dialog) will appear, allowing the feature attributes to be modified.

Data Management Utilities

Managing Digital Photos and Inspection Issues Spatial Data

This section introduces the two Data Management Utilities -- **Photo-Link** and **Export Inspection Items**. These utilities are designed to organize and retrieve data that is not native to **ArcView GIS**.

Digital photos of inspection locations provide valuable information for inspectors from year to year. Proper photo documentation allows for precise identification and documentation of levee issues. Numerous digital photos present management challenges, and the **Photo-Link** Utility is designed for the efficient management of digital photos.

The **Export Inspection Items** Utility provides a method for retrieving spatial data stored in the **Microsoft Access** database. This utility retrieves data for tasks such as map production, data distribution and data sharing, and GIS Analysis.

Photo-Link Utility

Download the digital photos from the camera or photo disk to a temporary folder(s). It is helpful to organize these photos according to date or inspection project. After processing these photos in the Photo Link utility, the photos will be copied to the appropriate inspection project directory and named according to the associated database ID.

Click the **Photo Link** utility button on the Levee Inspection **Toolbar**. The **Photo-Link** dialog should appear similar to the example in **Figure 6-1**.

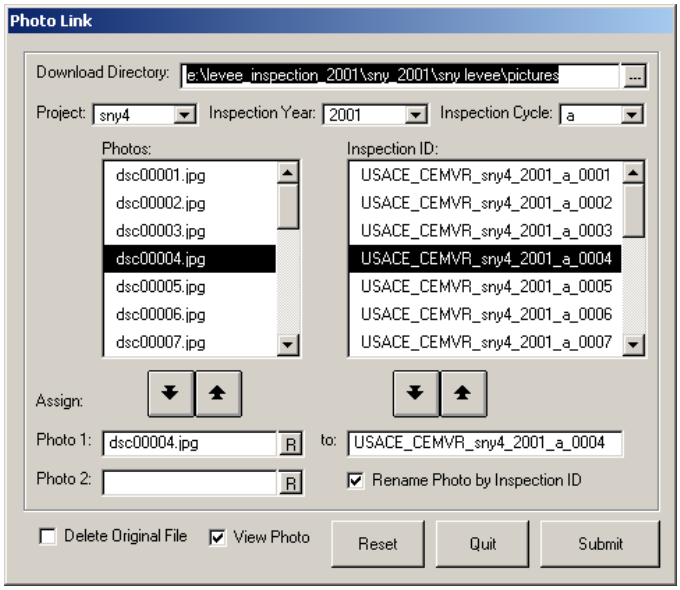


Figure 6-1 The Photo-Link Utility dialog.

Specifying the Photo(s)

Begin using the **Photo-Link** dialog by selecting the **Download Directory** where the digital photos currently reside. You can specify the directory by typing it in the text line, or by using the browse function. To initiate the browse function, Click on the **Browse** button to right of the **Download Directory** text line. The **Select Download Directory** dialog will be displayed (**See Figure 6-2**).

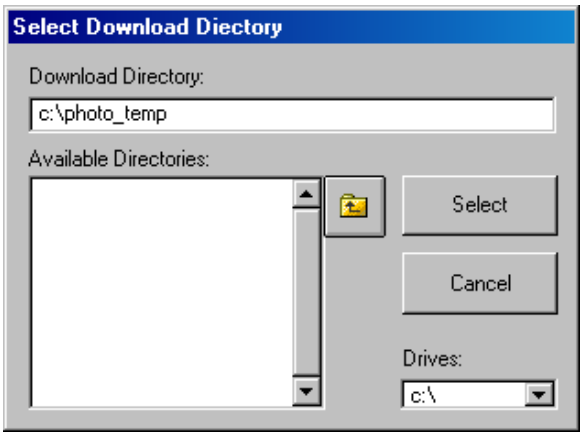


Figure 6-2 The Select Download Directory dialog.

The directory shown in the **Download Directory** text line of this dialog is the location where the **Photo-Link** utility will search for **JPEG** images (digital photo files with a .JPG extension). When the directory containing the digital photos is shown in the text line, Click the **Select** button to return to the **Photo-Link** dialog (**See Figure 6-1**). The selected directory should be displayed in the **Photo-Link** dialog's **Download Directory** text line.

When a directory containing **JPEG** images is entered in the **Download Directory** text line of the **Photo-Link** dialog, the **Photos** list box, on the left-hand side of the dialog, will show available digital photographs. If the **View Photos** option is on, a selected photo in the list box will be displayed in an image window (**See Figure 6-3**).

One or two photos, but not more than two, may be selected for assignment to an inspection feature. To select two files, hold down the **SHIFT** key while selecting. When you have selected a photo, or two, Click the **Assign Photo(s)** button (It has a down arrow on it). The photo name(s) will be moved to the **Photo 1** (and, optionally, the **Photo 2**) text line(s). To deselect photo(s) for assignment, Click the **Clear Photo Assignment(s)** button (It has an up arrow on it).

If you choose, you may rename these photos from this dialog. Once the photos have been placed in the **Photo 1** (and, optionally, the **Photo 2**) text line(s), Click the rename (**R**) button. You will be prompted to enter a new name for the file.

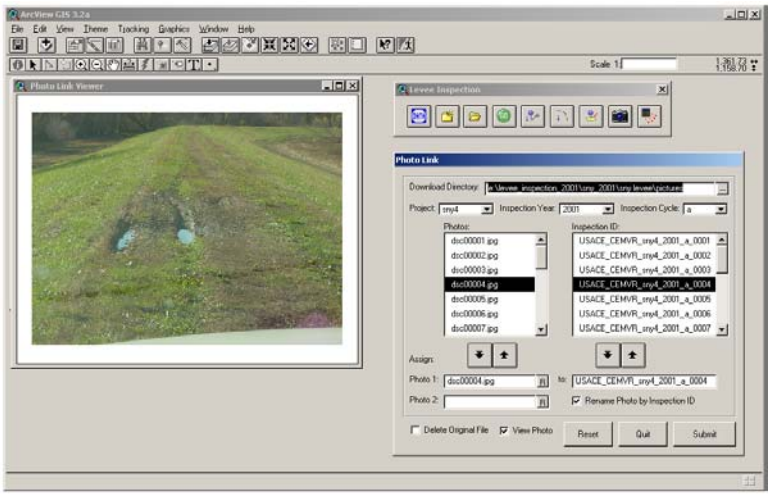


Figure 6-3 The Photo-Link Utility with selected image displayed.

Specifying the Inspection ID

First select the **Project** from the appropriate combo box. Then, select the **Inspection Year**. Finally, select the **Inspection Cycle**. The **Inspection ID** list box, on the right-hand side of the dialog, will show Inspection IDs available for the selected **Inspection Cycle**. When you have selected the desired ID from the **Inspection ID** list box, Click the **Assign Inspection ID** button (It has a down arrow on it). To deselect an Inspection ID for assignment, Click the **Clear ID Assignment***(s)* button (It has an up arrow on it).

Assigning the Photo(s) to the Database

When assigning photos to the database, be aware of two options. First, if the **Delete Original File** option is on, the file will be moved from its current location to the inspection projects directory. If this option is not selected, the file will simply be copied from the current location to the inspection projects directory.

If the **Rename Photo by Inspection ID** option is on, the file will be renamed to reflect the Inspection ID when it is placed in the inspection project photos directory. For example, two photos assigned to Inspection ID **USACE_cenwo_hanl_1987_b_026** will be renamed **USACE_cenwo_hanl_1987_b_026a** and **USACE_cenwo_hanl_1987_b_026b**. If only one photo is assigned, it would be renamed **USACE_cenwo_hanl_1987_b_026a**.

After specifying which photo(s) to assign to an Inspection ID, execute the assignment by Clicking on the **Submit** button at the bottom of the dialog. The database will be updated and the digital photo files will be moved (or copied) appropriately. To assign additional photos to their respective projects, repeat the process as necessary. To start over from scratch, Click the **Reset** button. To exit, Click the **Quit** button.

Note: If you are documenting deficiencies with digital photos while collecting data in the field, it is helpful to keep a written log of the photo number as it appears on the camera and the related ID in the inspection database.

Export Inspection Data

Click the **Export Inspection Data** button on the **Toolbar**, and the **Display points …** (and lines) form is displayed (**See Figure 6-4**). Enter the **Project Code**, **Inspection Year**, and **Inspection Cycle**. Click **OK**.

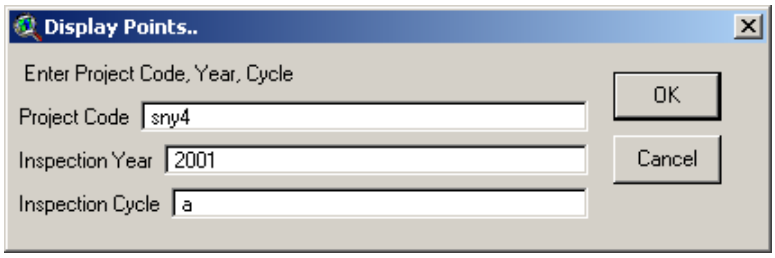


Figure 6-4 The Display Inspection Data dialog.

Features from any inspection contained in the database may be selected for display. These features will be displayed in the active View (**See Figure 6-5**).

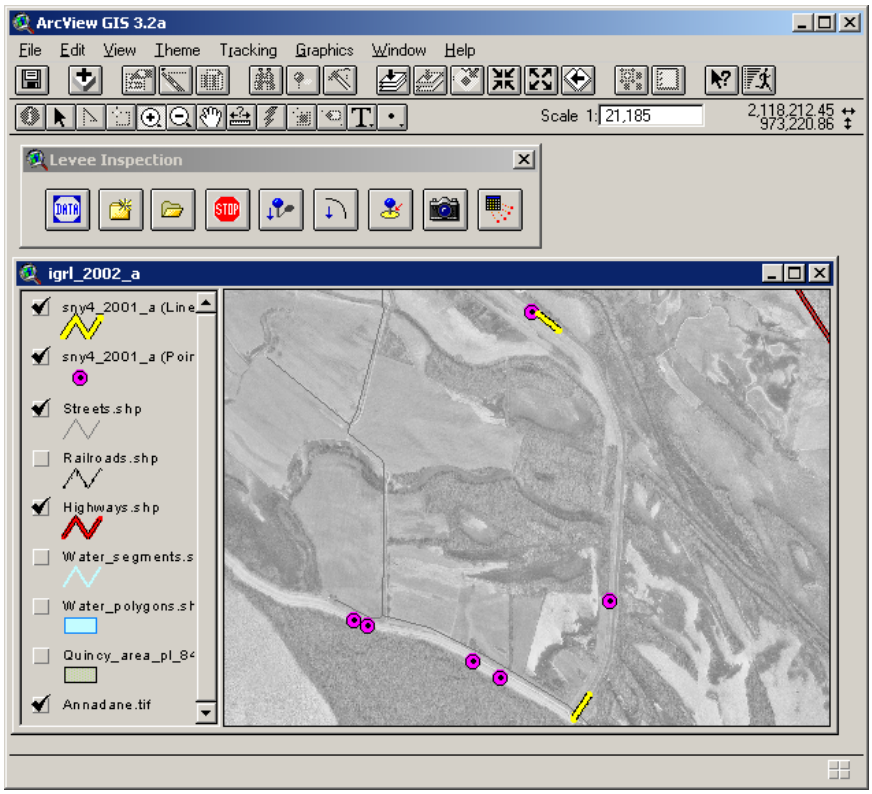


Figure 6-5 Inspection features displayed in the active View.

To save these features permanently to **ArcView GIS Shapefile** format, Click **Theme** (menu) → **Convert to Shapefile…** (**See Figure 6-6**), and the **ArcView GIS Shapefile Save** dialog is displayed. This process must be completed once for point features and once for line features.

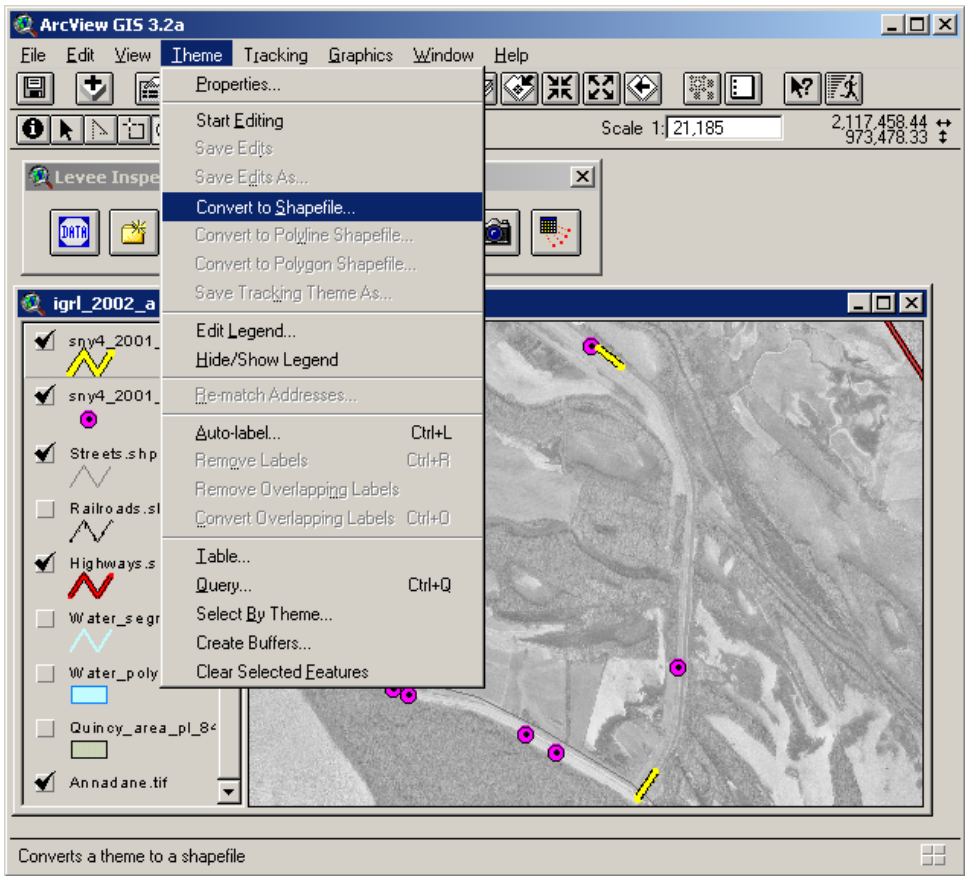


Figure 6-6 The ArcView GIS Convert to Shapefile menu item.

Note: Line files may require editing to remove unwanted vertices prior to using them for cartographic presentation or for permanent storage. These edits will only affect the shapefiles, and will not be written back to the spatial information in the Microsoft Access Database. The spatial data in the Access database is required for buffering, and unedited data should not adversely affect the performance of the buffer function.

Report Table Generation
And
Database Maintenance

Report Table Generation and Database Maintenance

When the inspection database is opened in **Microsoft Access**, a dialog is displayed prompting the user to **View Levee Inspection Database**, **Generate Inspection Report** (table), or **Edit Database Table** (**See Figure 7-1**).

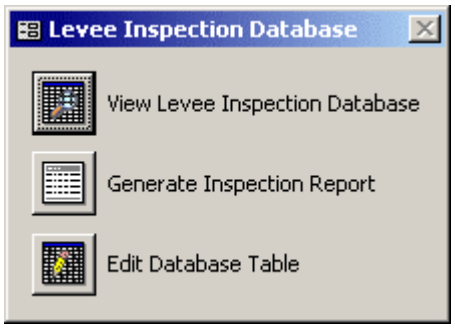


Figure 7-1 Levee Inspection Database dialog.

View Levee Inspection Database

If the option to **View Levee Inspection Database** is selected, all standard Microsoft functionality is available to the user. Users may use Microsoft Access as they normally would.

Report Generation

If the option to **Generate Inspection Report** is selected, the user is prompted with the **Report Criteria** dialog (**See Figure 7-2**). To generate a report for an inspection, enter the four-character **Project Code**, the **Inspection Year**, the **Inspection Cycle**, and Click the **Set Criteria** button.

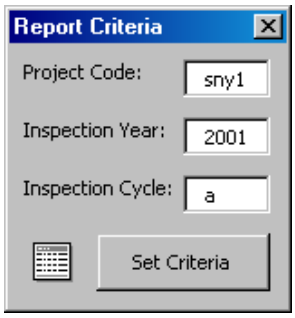
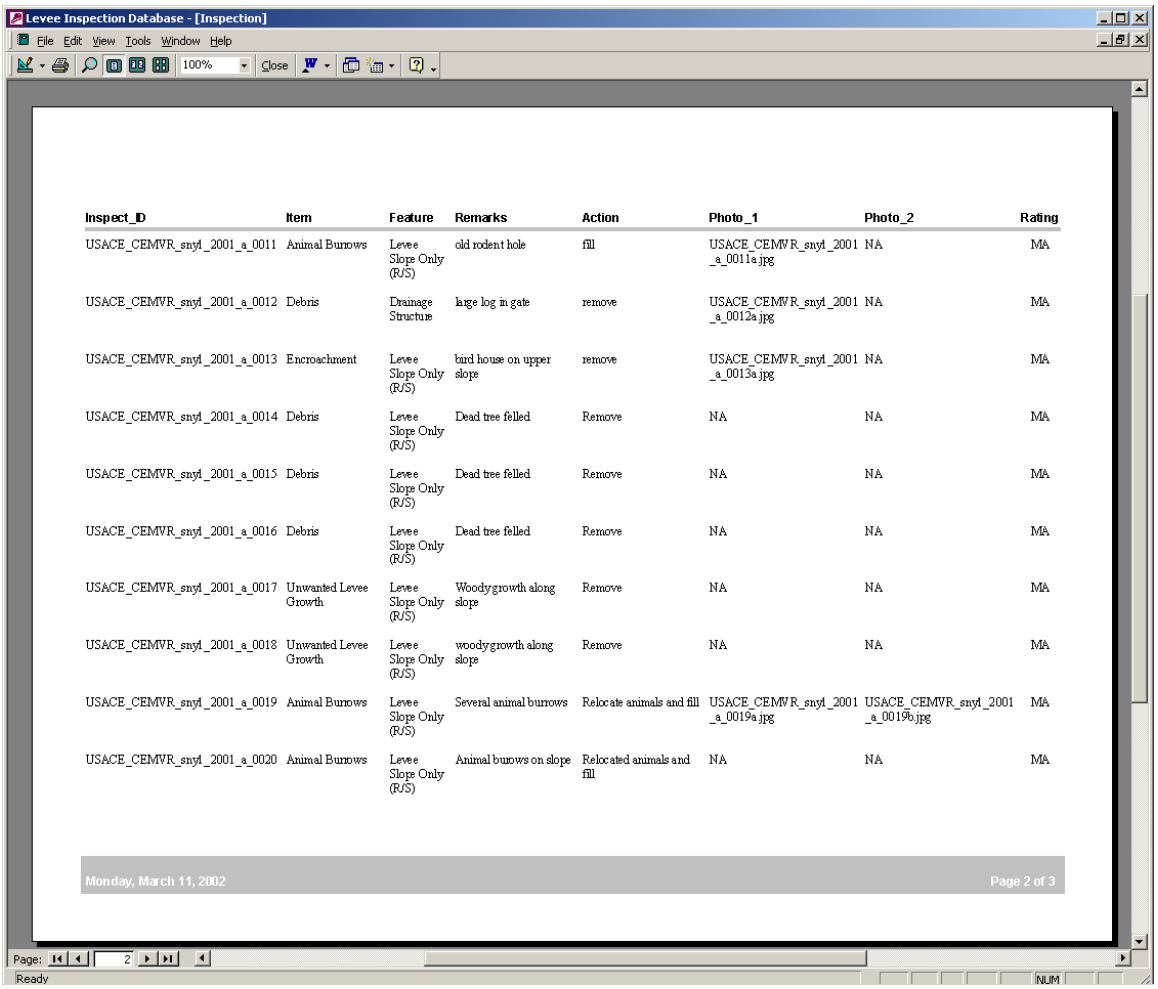


Figure 7-2 The Set Criteria dialog for automated report tables.

The automated report is generated and displayed (**See Figure 7-3**).



Inspect_ID	Item	Feature	Remarks	Action	Photo_1	Photo_2	Rating
USACE_CEMVR_snyl_2001_a_0011	Animal Burrows	Levee Slope Only (R/S)	old rodent hole	fill	USACE_CEMVR_snyl_2001_a_0011a.jpg	NA	MA
USACE_CEMVR_snyl_2001_a_0012	Debris	Drainage Structure	large log in gate	remove	USACE_CEMVR_snyl_2001_a_0012a.jpg	NA	MA
USACE_CEMVR_snyl_2001_a_0013	Encroachment	Levee Slope Only (R/S)	bird house on upper slope	remove	USACE_CEMVR_snyl_2001_a_0013a.jpg	NA	MA
USACE_CEMVR_snyl_2001_a_0014	Debris	Levee Slope Only (R/S)	Dead tree felled	Remove	NA	NA	MA
USACE_CEMVR_snyl_2001_a_0015	Debris	Levee Slope Only (R/S)	Dead tree felled	Remove	NA	NA	MA
USACE_CEMVR_snyl_2001_a_0016	Debris	Levee Slope Only (R/S)	Dead tree felled	Remove	NA	NA	MA
USACE_CEMVR_snyl_2001_a_0017	Unwanted Levee Growth	Levee Slope Only (R/S)	Woodygrowth along slope	Remove	NA	NA	MA
USACE_CEMVR_snyl_2001_a_0018	Unwanted Levee Growth	Levee Slope Only (R/S)	woodygrowth along slope	Remove	NA	NA	MA
USACE_CEMVR_snyl_2001_a_0019	Animal Burrows	Levee Slope Only (R/S)	Several animal burrows	Relocate animals and fill	USACE_CEMVR_snyl_2001_a_0019a.jpg	USACE_CEMVR_snyl_2001_a_0019b.jpg	MA
USACE_CEMVR_snyl_2001_a_0020	Animal Burrows	Levee Slope Only (R/S)	Animal burrows on slope	Relocated animals and fill	NA	NA	MA

Figure 7-3 An example automated report table.

This report may be printed, exported, or saved using standard **Microsoft Access** tools.

Edit Database Table

If the **Edit Database Table** option is selected, the user will be prompted to select a table to edit (**See Figure 7-4**). The user may then modify the selected table through a dialog.

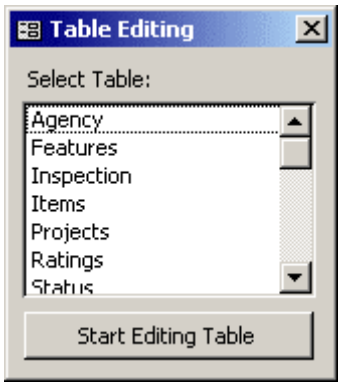


Figure 7-4 Table Editing selection dialog.

Example **Table Editing** dialog windows are shown in **Figures 7-5 through 7-11**.

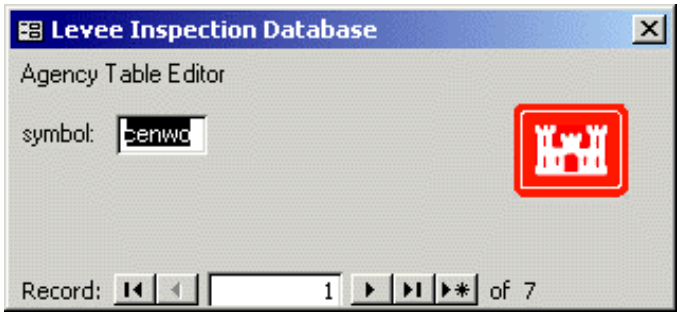


Figure 7-5 Agency Table Editor.

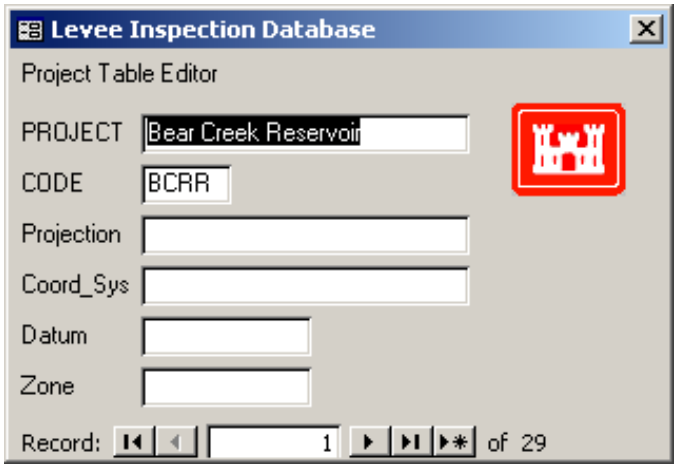


Figure 7-6 Project Table Editor.

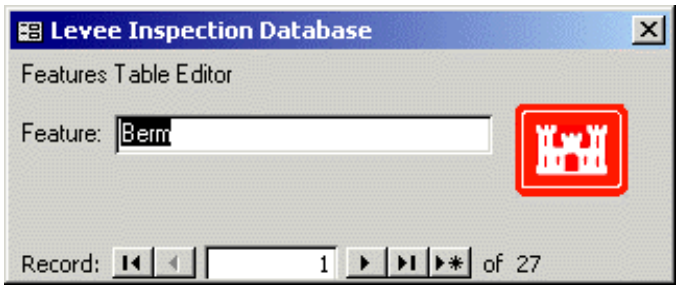


Figure 7-7 Features Table Editor.

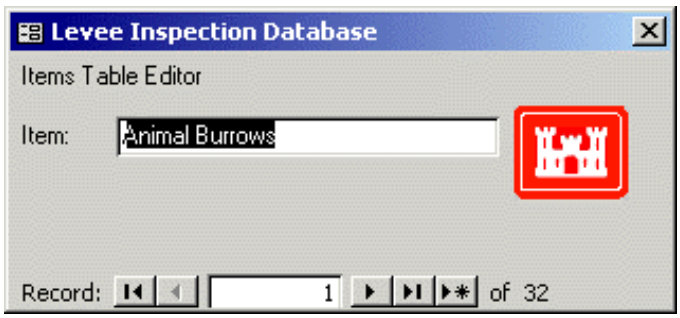


Figure 7-8 Items Table Editor.

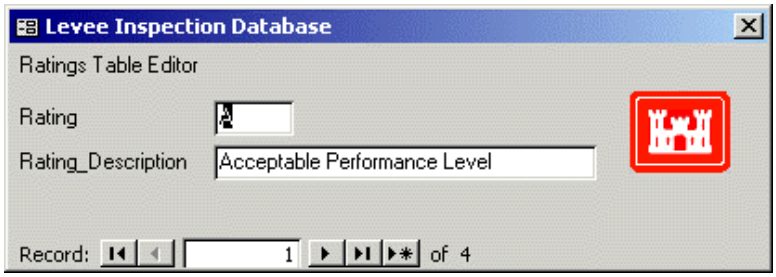


Figure 7-9 Ratings Table Editor.

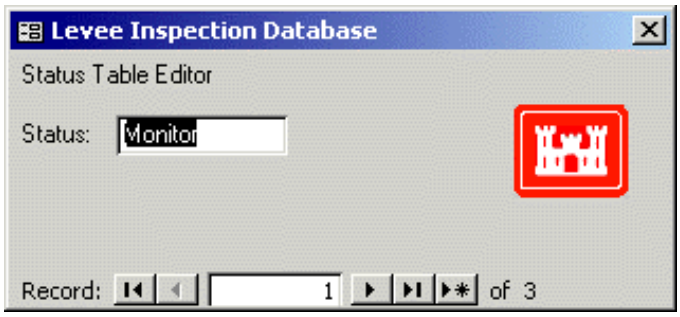


Figure 7-10 Status Table Editor.

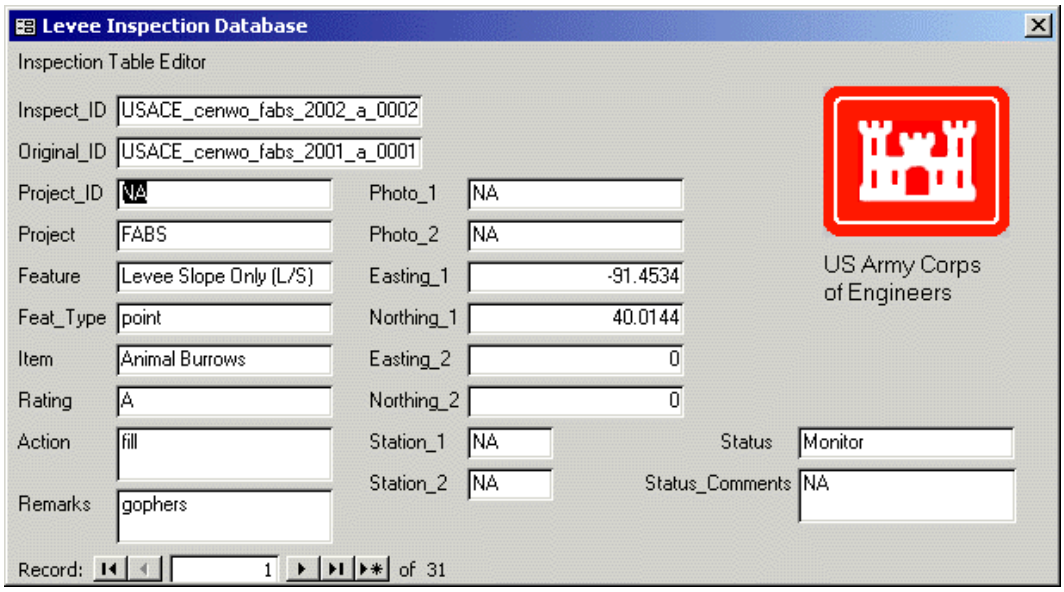


Figure 7-11 Inspection Table Editor.

Appendix A
Database Tables Specifications

Table Name: Inspection				
Description: Stores all of the Inspection deficiency geometry and attributes.				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Inspect_ID	Text	30	Unique ID for each inspection point	USACE_CEMVR_sny4_2001_a_0001
Project	Text	50	4 char code for inspection project. Derived from project table	SNY4
Feature	Text	35	Type of feature selected from Feature Table	Levee Crown Only
Feat_Type	Text	6	Indicates if feature is point or line	Point
Item	Text	35	Inspection feature	Debris
Rating	Text	5	Rating selected from Rating table	MA
Remarks	Text	255	Verbose description of the Item	Trees in Trash Rack
Action	Text	255	Corrective action	Remove
Photo_1	Text	50	Name of First Item Photo	USACE_CEMVR_sny4_2001_a_0001a.jpg
Photo_2	Text	50	Name of Second Item Photo	USACE_CEMVR_sny4_2001_a_0001b.jpg
Easting_1	Number	Double (6)	Point Coordinate or Line start point	-90.9877
Northing_1	Number	Double (6)	Point Coordinate or Line start point	39.42167
Easting_2	Number	Double (6)	Line End Point	-90.985
Northing_2	Number	Double (6)	Line End Point	39.42164
Station_1	Text	10	Coordinate of nearest station (Not Enabled)	
Station_2	Text	10	Coordinate of nearest station (Not Enabled)	
Status	Text	15	Status selected from Status table	Monitor
Status_Comments	Text	255	Notes on the status	Has never been corrected
Original_ID	Text	30	The first instance of violation	USACE_CEMVR_sny4_2001_a_0001
Project_ID	Text	50	Link to EM database (Not currently in use)	
Coordinates	Memo		Line Feature Geometry	-90.98777,39.64745,-90.84755,39.7474
Coordtemp	Text	255	Internal Usage field	
Note: Primary Key = Inspect_ID				

Table Name: Agency				
Description: Lists all the symbols for Corps Districts				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Symbol	Text	5	5 character code for corps district	CEMVR

Table Name: Features				
Description: Lists all the features in the Features menu				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Feature	Text	35	Levee feature where inspection deficiency if located	Berm

Table Name: Items				
Description: Lists all the Items in the Items menu				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Item	Text	35	Actual item causing deficiency on levee	Burrows

Table Name: Projects				
Description: Lists all the levee projects available to the program from the Projects table				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Project	Text	50	Full Name of the Levee project area	Bear Creek Reservoir
Code	Text	5	4 Character code for Project	BCRR
Projection	Text	50	Coordinate projection of the project	UTM
Coord_sys	Text	50	Coordinate system of the project	
Datum	Text	15	Project datum	NAD83
Zone	Text	15	Project Zone (if needed)	Zone 14

Table Name: Ratings				
Description: Rating of the inspection point or line feature performance level				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Rating	Text	5	Rating Code for inspection item	MA
Rating_Description	Text	40	Rating Code description for inspection item	Minimally Acceptable Performance Level

Table Name: Status				
Description: Current status of the inspection Item from Status table				
Field	**Datatype**	**Field Size**	**Description**	**Example**
Status	Text	15	Current status of the inspection item	Resolved
Note: The STATUS table is critical to the Levee Inspection System functionality and should only be changed with supervision from developer.				

Appendix B
Stationing File Specifications

The Automated Levee Inspection System allows the user to add a SDS formatted stationing file. The stationing file must be an ESRI shapefile and the attribute table must contain the lev_sta field as specified in the following table. The stationing file may contain fields other than those specified below.

Stationing File Attribute Table Description		
Field	**Datatype**	**Field Size (Decimal Places)**
Shape[1]	Point	NA
Levsta_id	String	20
Map_id	Number	11 (0)
Meta_id	String	20
Media_id	String	20
Coord_id	String	20
Grid_value	Number	16 (6)
Coord_z	Number	16 (6)
Sur_crs_id	String	20
River_mile	Number	16 (6)
Dsgn_grade	Number	16 (6)
Extg_grade	Number	16 (6)
Levee_name	String	30
Design_flo	Number	16 (6)
Lev_sta[2]	String	20
Ls_toe_ele	String	16 (6)
Lev_dist	String	20
Levee_item	String	30
Rec_draw	String	120
Project_id	String	50
File_no	String	15
Sheet_no	Number	11 (0)
Coord_x	Number	16 (6)
Coord_y	Number	16 (6)
Feat_name	String	30
Area_size	Number	16 (6)
Area_u_d	String	16
Perim	Number	16 (6)
Perim_u_d	String	16
Instln_id	String	20
Facil_id	String	20
User_flag	String	20

[1]This field is automatically generated when creating an ArcView shapefile of the type point.
[2]This is the field that the station number will be pulled from to populate the inspection database

Appendix C
Technical Information

Contents

1.0 Tracking Format Files

Tracking Format Files are **ArcView GIS Tracking Analyst**'s method of reading and using a real time **NMEA 0183** string for individual GPS receivers. **ArcView GIS Tracking Analyst** comes with several default Format Files, and other Format Files created by the developers and testers are included with the Levee Inspection System. The generation of a Format File for a specific GPS receiver is the responsibility of the user.

2.0 Compatible Commercial GPS Receivers

Below is a list of compatible (tested) commercial GPS receivers. Most commercial GPS receivers should operate properly with the Levee Inspection System.

- Trimble GeoExplorer I
- Precision Lightweight GPS Receiver (PLGR)
- Trimble Pathfinder Pocket GPS
- Garmin GPS III Plus

3.0 Audible Alert

An audible alert can be enabled for the Levee Inspection System to notify an inspector that they have entered the buffer area of an inspection point or line. To enable the audible alert, use **Microsoft Windows Explorer** to navigate to the <InstallDir>\levee_inspection\inspbin\sounds directory. Rename the **Alert_Inspection_Point_Off.wav** file to **Alert_Inspection_Point.wav**. This will enable the Audible Alert. Other sound files can replace this file by simply naming the file Alert_Inspeciton.wav and placing it in the sounds directory.

4.0 Status Table

The STATUS TABLE in the Levee_inspection.mdb cannot be altered without impairing the operation of the Levee Inspection System. If this table needs to be altered it is suggested that the operator/developer contact one of the persons in the contact list.

5.0 Links to Levee Inspection Procedural Manuals

http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep500-1-1/toc.htm

Publication Number: **EP 500-1-1**
Title: **Emergency Employment of Army and Other Resources - Civil Emergency Management Program - Procedures**
Proponent: **CECW-OE**
Publication Date: **30 September 2001**
Distribution Restriction Statement: **Approved for public release; distribution is unlimited.**

6.0 Contact and Technical Support Information

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Appendix D
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