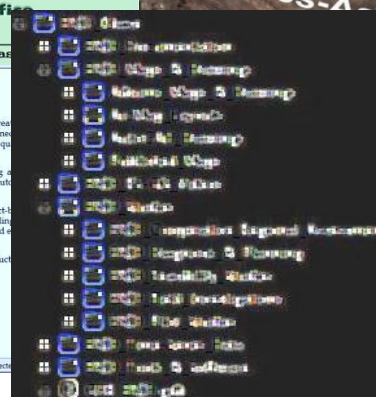
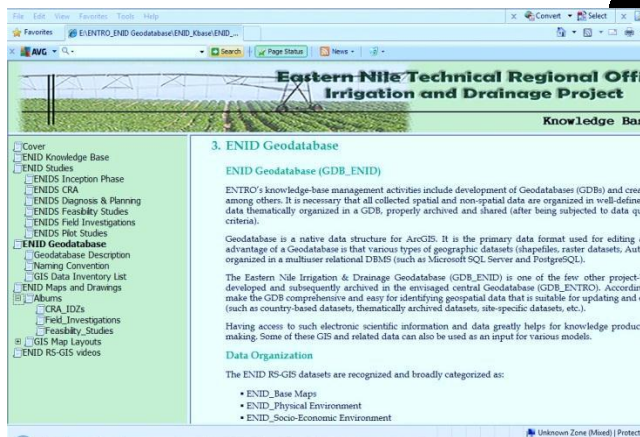
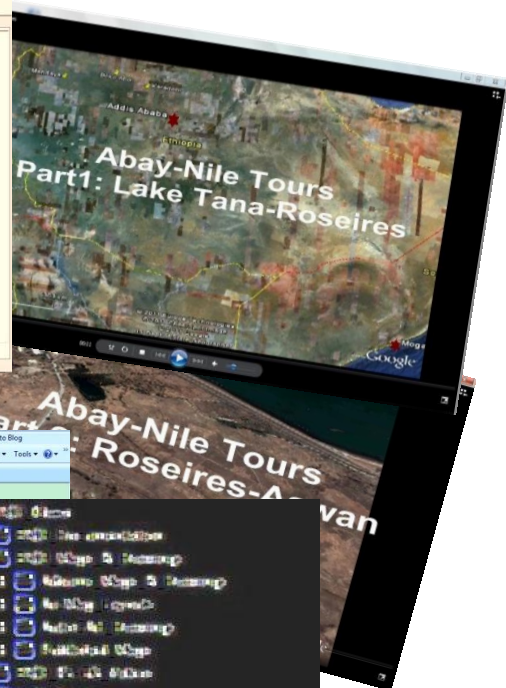
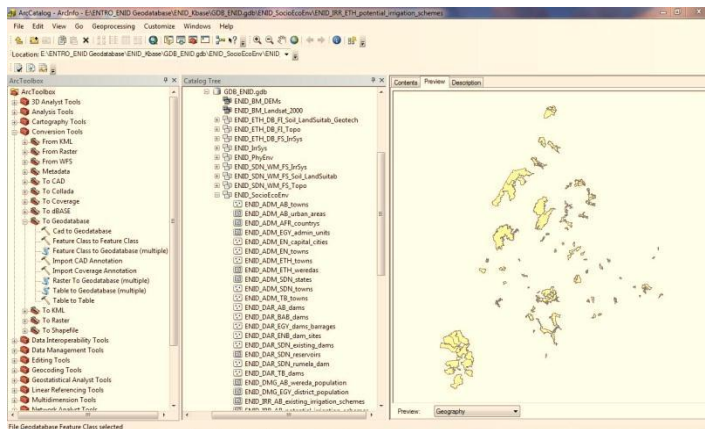


# Eastern Nile Technical Regional Office (ENTRO)

## Eastern Nile Irrigation & Drainage (ENID) Knowledge Base Development Final Report



**giz**

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**October 2011**

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# **Table of Contents**

## **1. Introduction**

- 1.1. General Overview
- 1.2. The Consultancy Service
- 1.3. The Structure of ENID Knowledge Base

## **2. ENID Studies**

- 2.1. ENID Project Objectives
- 2.2. ENID Study Components
- 2.3. Inception Phase
- 2.4. Diagnosis & Planning
- 2.5. CRA Analysis
- 2.6. CRA Finalization and conclusion
- 2.7. CRA Guideline
- 2.8. Field Investigations
- 2.9. Feasibility Studies
- 2.10. Pilot Studies
- 2.11. Meta-Document

## **3. ENID Geodatabase**

- 3.1. Development of ENID Geodatabase: Overview
- 3.2. Description of RS-GIS Datasets
  - 3.2.1. ENID Base Maps
  - 3.2.2. ENID Physical Environment
  - 3.2.3. ENID Socio-Economic
  - 3.2.4. ENID Irrigation System
  - 3.2.5. ENID Field Investigations
  - 3.2.6. ENID Feasibility Studies
  - 3.2.7. ENID Time-Series Data
- 3.3. GDB\_ENID: Naming Convention
  - 3.3.1. Physical Environment, Socio-Economic & Irrigation System
  - 3.3.2. Country-based Field Investigations and Feasibility Studies
- 3.4. Metadata

## **4. ENID Maps & Drawings**

## **5. ENID RS-GIS Videos**

- 5.1. Google Earth Pro
- 5.2. Touring Mainstream Abay-Nile
- 5.3. Other Short RS-GIS Presentation Videos

## **6. ENID Tools & Software**

- 6.1. Software Tools
  - 6.1.1. ESRI Products: ArcGIS
  - 6.1.2. Microsoft SQL Server
  - 6.1.3. Google Earth Pro
  - 6.1.4. ERDAS Imagine
  - 6.1.5. Global Mapper

- 6.1.6. Adobe Creative Suite
- 6.1.7. PostGreSQL
- 6.1.8. CropWat & Climwat
- 6.1.9. Other software
- 6.2. Irrigation Tool Kit

## **7. Recommendations**

## **8. Annotated Bibliography**

### **List of Annexes**

- Annex 1: Terms of Reference for the Development of GIS Database for the Eastern Nile Irrigation and Drainage Project
- Annex 2: ENTRO & NBI Information Resources
- Annex 3: ENID RS-GIS Data: Inventory List and Description
- Annex 4: Metadata for Selected ENID Feature Datasets
- Annex 5: List of ENID Study Documents (graphical display)
- Annex 6: ENID Map Catalogue
- Annex 7: List of ENID ArcMap Layouts (mxd)
- Annex 8: List of ENID AutoCAD Drawings (dwg)

### **List of Figures**

- Figure 1: ENID KBase Documentation: Web Interface
- Figure 2: ENID\_PhyEnv Feature Dataset
- Figure 3: ENID\_SocioEco Feature Dataset
- Figure 4: ENID\_IrrSys Feature Dataset
- Figure 5: ENID\_ETH\_DB\_FI\_Soils\_LansSuitab\_Geotech Feature Dataset
- Figure 6: ENID\_SDN\_WM\_FS\_Topo Feature Dataset

### **List of Tables**

- Table 4.1: ENID Albums: Maps & Drawings
- Table 5.1: Lake Tana to Roseires (Key Features)
- Table 5.2: Roseires - Aswan (Key Features)
- Table 5.3: Aswan - Mediterranean Sea (Key Features)
- Table 5.4: Existing Irrigation Schemes (large-to medium-scale)
- Table 5.5: Potential Irrigation Schemes (large-to medium-scale)
- Table 5.6: Dams and Reservoirs (on mainstream Abay-Nile)

## Acronyms/Abbreviations

AB	Abay sub-Basin
ABNB	Abay Blue Nile sub-Basin
ADM	Administration
AFR	Africa
aka	Also known as
AVI	Audio Video Interleave
BAB	Baro-Akobo sub-Basin
BASB	Baro-Akobo Sobat sub-Basin
BM	Base Maps
CAD/AutoCAD	Computer Aided Drafting
CRA	Cooperative Regional Assessment
CS/Adobe CS	Creative Suite
DAR	Dams & Reservoirs
DB	Dinger Bereha
DEM(s)	Digital Elevation Model(s)
DMG	Demographics
D&P	Diagnosis and Planning
d/s	Downstream
DSS	Decision Support System
DST	Decision Support Tool
EAF	East Africa
EGY	Egypt
EN	Eastern Nile
ENB	Eastern Nile Basin
ENFPEW	Eastern Nile Flood Preparedness and Early Warning
ENID	Eastern Nile Irrigation and Drainage
ENIDS	Eastern Nile Irrigation and Drainage Studies
ENPT	Eastern Nile Power Trade
ENPM	Eastern Nile Planning Model
ENSAP	Eastern Nile Subsidiary Action Program
ENWM	Eastern Nile Watershed Management
ENTRO	Eastern Nile Technical Regional Office
ESRI	Environmental Systems Research Institute
ETH	Ethiopia
ETM +	Enhanced Thematic Mapper Plus
EWUAP	Efficient Water Use in Agricultural Production
FAO	Food and Agriculture Organization of United Nations
FGDC	Federal Geographic Data Committee (of US)
FI	Field Investigations
FS	Feasibility Study
GDAS	Global Data Assimilation System
GDB	Geodatabase

GEO	Geology
GIS	Geographic Information System
GIZ	German Development Cooperation
GCS	Geographic Coordinate System
HYD	Hydrography & Hydrology
I&D	Irrigation and Drainage
IDZ(s)	Irrigation Development Zone(s)
IWUEP	Improving Water Use Efficiency and Productivity
IRR	Irrigation Schemes
IS/Nile-IS	Information System
IS	Irrigation System
ISO	International Organization for Standardization
IT	Information Technology
IWMI	International Water Management Institute
JMP	Joint Multipurpose Project
KBase/K-Base	Knowledge Base
KM	Knowledge Management
LAN	Local Area Network
LCO	Land Cover
MCE	Metaferia Consulting Engineers
MIS	Management Information System
MNB	Main Nile sub-Basin
MODIS	Moderate-Resolution Imaging Spectro-radiometer
NB	Nile Basin
NBI	Nile Basin Initiative
NDVI	Normalized Difference Vegetation Index
Nile-Sec	Nile Secretariat
NOAA	National Oceanic and Atmospheric Administration
OSI	One System Inventory
RDBMS	Relational Database Management System
RLF	Relief
RS	Remote Sensing
PET	Potential Evapo-transpiration
PS	Pilot Studies
SDE/ ArcSDE	Spatial Database Engine
SDN	Sudan
SMEC	Snowy Mountains Engineering Corporation
SOL	Soils
SQL	Structured Query Language
SRTM	Shuttle Radar Terrain Mission
SSEA	Strategic Social and Environmental Assessment
TB	Tekeze sub-Basin
TAB	Tekeze-Atbara sub-Basin
ToR	Terms of Reference
TRC	Transport & Communication

UN	United Nations
UNDP	United Nations Development Program
u/s	Upstream
USBR	United States Bureau of Reclamation
UTM	Universal Transverse Mercator
WGS	World Geodetic System
WM	Wad Meskin
WMV	Windows Media Video
WRL	World
WRPM	Water Resources Planning & Management

## 1. Introduction

### 1.1. General Overview

The Nile Basin Initiative (NBI) is a partnership of Nile Basin (NB) countries with a shared vision to “achieve sustainable socio-economic development through equitable utilization of, and benefit from, the common Nile Basin water resources”.

Eastern Nile Subsidiary Action Program (ENSAP) is an active program that strives for the realization of the NBI’s shared vision for the Eastern Nile (EN) region. Eastern Nile Irrigation & Drainage Studies (ENIDS) is one of several essential projects of ENSAP. Eastern Nile Technical Regional Office (ENTRO) is an organization established to plan and implement ENSAP in the three Eastern Nile Basin countries of Ethiopia, Sudan and Egypt.

It is generally recognized that there is a need to build efficient spatially-enabled institutions in Africa. ENTRO is one of these regional institutions in Africa with huge spatial datasets; which include data generated during project studies (sub-contracted by ENTRO) as well as other datasets created or collected from various sources by ENTRO staff. What is primarily required here is to organize these data and thematically archive Remote Sensing-Geographic Information System (RS-GIS) data in a central Geodatabase. Additional data/info can be generated, collected or captured from available resources to create knowledge products. Depending on current ENTRO plans, requirements and policy, some products can be made available or sharable for relevant stake-holders.

The German Development Cooperation (GIZ) is currently supporting the knowledge management (KM) activities in ENTRO. One of the notable supports is funding consultancy services of Geo-database development and spatial knowledge product creation that include the present assignment – ENID GIS database management project. The technical aspect of the KM activities is however coordinated by the Water Resources Planning Unit of ENTRO.

### 1.2. The Consultancy Service

#### Scope

The current consultancy service encompasses two study components:

- Development of ENID Geodatabase using software tools recently procured by ENTRO (ArcGIS Server, SQL Server and other available hardware resources).
- Production of spatial knowledge products; and designing a web-interface for documenting, accessing and presenting the spatial data pertaining to irrigation in the EN region

## **Deliverables**

The main deliverables of the consultancy service are reports, spatial knowledge products and well-organized ENID spatial and non-spatial database together with its documentation. This ENID knowledge base development final report is prepared as per the requirements stipulated in the Terms of Reference (ToR) of the contract (see Annex 1 of this report).

Three other documents precede this report. The first one, the inception report, provided the general scope of the current consultancy service, approach and methodology, data/information resources, data requirement and availability, procured software tools, tasks undertaken since work commencement, anticipated RS-GIS works to be carried out, main deliverables of the current project and other key issues. A presentation was made in July 2011.

The second one, the interim report, presented the progress made in July 2011 with the deliverables of this period as specified in the ToR and the inception report. The main accomplishments in this period have been mainly on data organization, data quality control, preparation of spatial knowledge products (particularly RS-GIS videos), and some GIS analyses and map production. A presentation was made in August 2011.

The third one, the progress report, presented parts of the tasks undertaken with regard to the ENID GIS Database Management Project from August to September 2011. Notable accomplishments include development of the ENID Geodatabase, preparation of the ENID Knowledge Base Documentation, and production of spatial knowledge products such as ENID Map Catalogue and Metadata for feature datasets and raster catalogs. A presentation was made in October 2011.

This final report, mostly compiled from the above-mentioned three reports, is prepared to provide basic information about the main ENID database (ENID\_KBase), ENID Study documents, archived RS-GIS datasets, ENID maps & drawings, tools & software, and spatial knowledge products in a single document.

The final deliverable of the project is provided as a package comprising the complete ENID\_KBase with the web-interface for the documentation (see the following section). In addition to providing essential information, the electronic version of the KBase documentation provided with navigation pane and links to required documents/maps/data, help users to easily access available resources (see Figure 1). All these have been made available on ENTROKBASE server.

### **1.3. The Structure of ENID Knowledge Base**

The ENID Knowledge Base Database is called ENID\_KBASE which comprises study reports, maps, drawings, ENID Geodatabase (GDB\_ENID), RS-GIS videos, tools, software, documentation resources and scripts, etc.



The directory structure of ENID\_KBase (in alphabetical order):

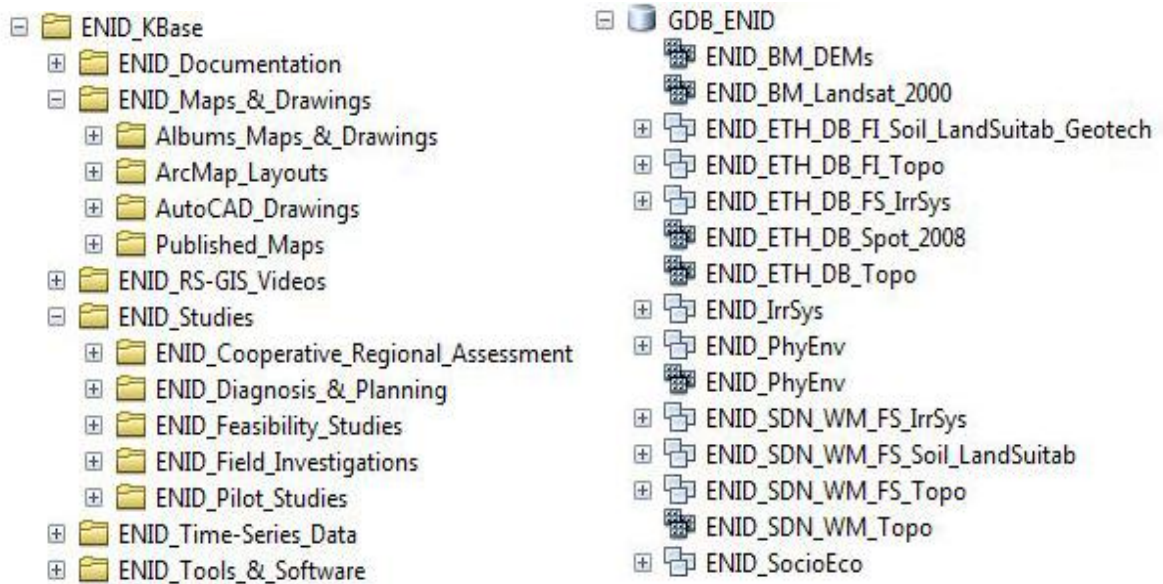
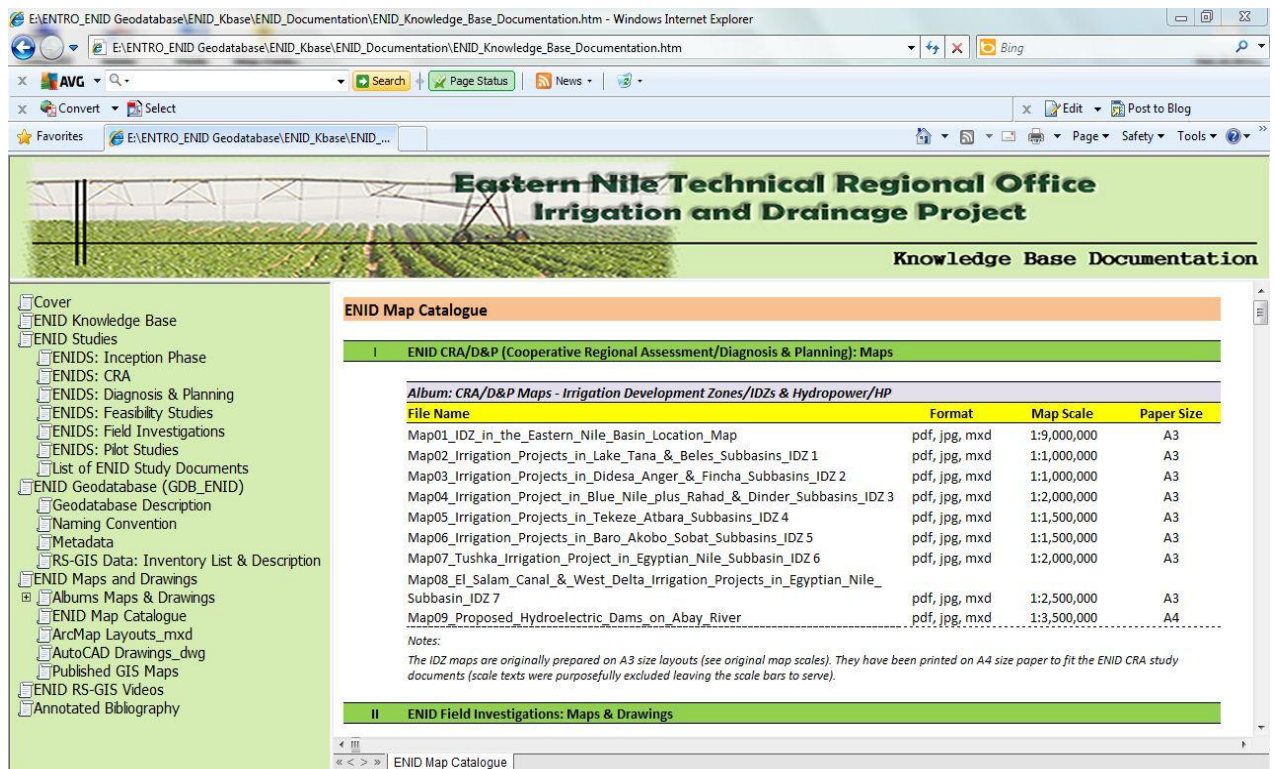


Figure 1. ENID KBase Documentation: Web Interface



## 2. ENID Studies

The Eastern Nile Irrigation and Drainage (ENID) project is one of the several projects of the Eastern Nile Subsidiary Action Program (ENSAP). The ENID project objectives and the various ENID Studies conducted as part of this project are briefly presented in the following sub-sections.

### 2.1. ENID Project Objectives

The long-term objective of the Eastern Nile Irrigation and Drainage Development project is to increase agricultural productivity through irrigation development, create rural employment opportunities, and improve rural livelihoods and incomes. The project is expected to contribute to food security, reduce rural poverty and reduce population pressures in the region, with associated beneficial effects on the environment.

The immediate objective of the project is to support the development and expansion of irrigated agriculture as well as to improve the productivity of small- and large-scale agriculture through improved agricultural water use.

The project, on a regional level, addresses institutional, infrastructure, and technological issues that are the causes of low agricultural productivity levels. It will contribute to the creation of national design, contracting and supervision capacity for project implementation, as well as to the promotion of local farmer responsibility for operation and maintenance.

### 2.2. ENID Study Components

The ENIDS comprises two main study components:

- I. Engineering Study Component
  - *Inception*
  - *Phase 1: Diagnosis and Planning*
  - *Phase 2: Feasibility Studies*
  
- II. Cooperative Regional Assessment (CRA)
  - *Phase 1: Inception*
  - *Phase 2: Analysis*
  - *Phase 3: Finalization and Conclusion*

In addition to the above two main study components, detailed *Field Investigations* (topographic and soil surveys, and geotechnical investigations) to support the Feasibility Studies, and *Pilot Studies* on improving water use efficiency and productivity (IWUEP) of the existing irrigation schemes in Ethiopia and Sudan, have also been conducted.

The ENID Studies, except the Pilot Studies, were all carried out by a consortium of consultants: BRLi (France), Shouraconsult (Sudan) and Metaferia Consulting Engineers (Ethiopia). The Pilot Studies on improving water use efficiency and productivity were carried out by SMEC (Snowy Mountains Engineering Corporation).

The following sub-sections provide brief descriptions (abstracts) for the above-mentioned ENID Studies. List of all the Study documents is given in Annex 5.

### **2.3. Inception Phase**

The report presents the results of the Inception Phase - covering the period September - October 2007. During this phase the Consultants had collected, in close collaboration with ENTRO and the National Coordinators (NCs), studies, maps, drawings, and other relevant information and had reviewed data, available on the relevant GIS databases in Ethiopia and Sudan.

This inception report is considered as a common document for the CRA and Engineering Study components.

### **2.4. Diagnosis & Planning**

The study conducted preliminary investigation on 23 potential irrigable areas with a total area of 630,000 ha in Ethiopia and 4 potential irrigable areas with a total area of 750,000 ha in Sudan. All aspects of technical (i.e. hydrological, pedological, topographical, geotechnical etc.), economic, social and environmental nature have been investigated on the potential areas. Following this, a multi criteria analysis based on social, financial and environmental criteria was conducted to rank the potential areas.

### **2.5. CRA Analysis**

This CRA Phase II study, covering all the three EN countries (Ethiopia, Egypt and Sudan), undertook trans-boundary, distributive and institutional analyses, and identified the existing challenges and opportunities associated with irrigation development in the EN sub-basin. Trans-boundary irrigation development scenarios were identified and the costs and benefits that will accrue across countries determined. The various levels and modes of cooperation have also been examined and the process that could be adopted for cooperation in Irrigation & Drainage sector proposed.

### **2.6. CRA Finalization and conclusion**

This CRA Phase III study, using inputs from Phase II and through review of consistency of respective Government policies towards rural development, has proposed institutional cooperative mechanism (software nature) and actual projects on the ground (hardware nature) that will give win-win benefit to the countries. Capacity building needs have also been identified and future projects that will give win-win benefit and enhance the cooperation proposed.

The Eastern Nile countries have a number of complex challenges ahead of them – challenges associated with water scarcity, technology, institutions and socio-economy – in their effort to satisfy the increasing food requirement of the growing population. Population growth has exceeded crop production and with limited available arable land, there is increasing competition for jobs and high unemployment in rural areas. Therefore, carefully planned and sustainable irrigation development and intensification of the existing irrigated agriculture is crucial in order to increase food security, enhance agricultural productivity and improve livelihoods in the sub-region. In this regard, the Cooperative Regional Assessment (CRA) study is a key document to streamline regional efforts in the field of irrigation and drainage and enhance the cooperation.

### **2.7. CRA Guideline**

In addition to the above, the CRA study has prepared a generic guideline for identification and study of national and regional irrigation and drainage development projects which maximize benefits at national and regional levels.

### **2.8. Field Investigations**

In order to complement and provide an indispensable input to the Feasibility Studies, detailed topographic and soil surveys, land evaluation, and geo-technical investigations were conducted on the two selected sites in Ethiopia (Dinger Bereha) and Sudan (Wad Meskin). Topographic maps at vertical contour interval of 1 meter were prepared and geo-technical survey including core drilling on barrage, diversion, pump and major hydraulic structure sites were conducted. Soils, land classification and land suitability maps at suitable scales were produced.

### **2.9. Feasibility Studies**

Following the completion of the Diagnosis and Planning, 15,000 ha equally divided between Ethiopia and Sudan were identified and studied up to feasibility level. The Feasibility studies involved advanced investigations including determination of basic engineering design for barrages, diversions, pumping stations, irrigation and drainage infrastructure, land use and cropping pattern and systems, agricultural inputs, credit and crop production, storage, transport and marketing, and economic and financial viability, environmental impact assessment and social desirability of the projects. Detail terms of reference for the next stage (detail design) of the projects have also been prepared.

### **2.10. Pilot Studies**

One of the opportunities identified by the CRA Study for addressing the existing crucial water scarcity in the EN sub-basin is improving the water use efficiency and productivity on the existing irrigation schemes. In line with this, pilot studies on selected existing irrigation projects in Ethiopia and Sudan were conducted. Covered by these studies are three small-scale irrigation schemes in three regions of Ethiopia and

the Rahad irrigation scheme in Sudan. Such type of studies can greatly help in alleviating the existing crucial water shortage in the EN sub-basin and to adopt the adverse effects of climate change.

### **2.11. Meta-Document**

Meta-documents have been prepared for all the above studies to provide the abstracts and other necessary descriptions (title, date, originator, consultants, file location/link, etc.) followed by list of all available documents. These are fully provided in the complete electronic version of ENID KBase documentation. The developed web interface for the documentation has been designed to easily access the study documents and meta-documents from the navigation pane as well as from links provided in the web-pages.

### 3. ENID Geodatabase

#### 3.1. Development of ENID Geodatabase: Overview

ENTRO's knowledge-base management activities include development of Geodatabases (GDBs) and creation of knowledge products, among others. It is necessary that all collected non-spatial data are organized in well-defined directories and the spatial RS-GIS data thematically organized in a GDB, properly archived and shared (after being subjected to data quality checking and selection criteria).

Geodatabase is a native data structure for ArcGIS. It is the primary data format used for editing and data management. The advantage of a Geodatabase is that various types of geographic datasets (shapefiles, raster datasets, AutoCAD files and tools) can be organized in a multiuser relational DBMS (such as Microsoft SQL Server and PostgreSQL).

The Eastern Nile Irrigation & Drainage Geodatabase (GDB\_ENID) is one of the few project-based GDBs intended to be developed and subsequently archived in the envisaged central Geodatabase (GDB\_ENTRO). Accordingly, it has been designed to make the GDB comprehensive and easy for identifying geospatial data that is suitable for updating and exporting geospatial datasets (such as country-based datasets, thematically-archived datasets, site-specific datasets, etc.).

This section only presents the broad classification used to thematically organize the RS-GIS datasets in the GDB. In organizing the ENID RS-GIS datasets, due attention was given to the ENIDS project components that are appropriately addressed in Chapter 2 of this report.

The ENID RS-GIS datasets are broadly recognized and categorized as:

- ENID\_Base Maps
- ENID\_Physical Environment
- ENID\_Socio-Economic
- ENID\_Irrigation System
- ENID\_Field Investigations
- ENID\_Feasibility Studies
- ENID\_Time Series Data

Description for the archived RS-GIS datasets in the GDB\_ENID and the adopted conventional naming given are provided in the following sections. Inventory list and description of each RS-GIS data is provided in Annex 3, while the electronic version has been made available for uploading on the intranet.

The maps and drawings are however separately archived in ENID\_Maps & Drawings directory which is part of ENID\_Kbase together with the Geodatabase (see Chapter 4).

Incorporated data include GIS map & AutoCAD drawing layouts as well as maps in pdf and jpeg formats.

Having access to such electronic, scientific and thematically-archived information and geospatial data greatly helps for knowledge production and informed decision-making. Some of these GIS and related data can also be used as an input for various models.

## **3.2. Description of RS-GIS Datasets**

### **3.2.1. ENID Base Maps**

The Base Maps (BM) include DEMs (digital elevation models), satellite imageries and other RS-GIS datasets.

- DEM  
Includes freely available SRTM (Shuttle Radar Terrain Mission) DEM (spatial resolution 90m) for the EN countries (available as enid\_en\_dem in ENID\_BM\_DEMs raster catalog). Also incorporated are watershed-based digital elevation models. The archived Abay basin DEM, for example, has been clipped from the Eastern Nile DEM and subsequently resampled to 50m resolution using GIS techniques. Hillshades and slopes derived from DEMs are however archived as relief data-theme (see Physical Environment).
- Satellite Imagery  
Includes the freely available Landsat 7 ETM+ imageries (year 2000, bands 7,4,2 composite, pan-sharpened, spatial resolution 14.25m, file format Mr. Sid/.sid) for EN countries. The coordinate system of the Landsat mosaics: UTM (Zones 34N, 35N, 36N, 37N, 38N), datum WGS 84. These imageries are archived as ENID\_BM\_Landsat\_2000 raster catalog.
- Other basemaps

Base maps other than satellite imagery or DEM are grouped here. These include vector GIS data showing political boundaries of nations (African and World countries), have been incorporated. Also included are shaded relief tiff images (with RGB color pixel values), and geo-referenced topographic and tourist maps. Base maps used for country-based ENID FI & FS are however archived separately (see the Geodatabase structure in section 1.3)

### **3.2.2. ENID Physical Environment**

The physical environment comprises the following main data themes:

- Geology (GEO)  
Includes country-based geological vector data extracted from national and publicly available datasets.

- **Relief (RLF)**  
Datasets of landscape, processed slope data, shaded/colored relief raster datasets and other related data are grouped here (see Annex 3 for sources of each RS-GIS data).
- **Hydrography & Hydrology (HYD)**  
The hydrography and hydrology datasets are the surface water bodies (rivers, lakes, reservoirs, swamps, marshy areas, etc.), watershed boundaries, and climatic and hydrometric station layers (see Annex 3 for sources of data).
- **Soils (SOL)**  
Includes sub-regional country- and watershed-based soil data extracted mainly from publicly available datasets and from basin studies. Soil data generated during ENIDS for FI, FS and PS are organized separately.
- **Land Cover (LCO)**  
Includes country-based land-cover and eco-region datasets extracted from publicly available land cover datasets (FAO Africover, Globalcover 2009 & Terrestrial Ecoregion). Also included are watershed-based datasets from Abay and Tekeze Master Plan studies.

### **3.2.3. ENID Socio-Economic**

The socio-economic environment comprises the following main data themes:

- **Administration (ADM)**  
Admin datasets include cities, towns, settlements, weredas/zones/states/provinces/governorates of EN countries and other related data.
- **Dams & Reservoirs (DAR)**  
Include watershed-based and country-based existing and potential/identified proposed dam sites. The barrages on the Nile in Egypt are also incorporated.
- **Demographics (DMG)**  
Country- & watershed-based demographic data are archived here: intended to provide counts/estimates of the population for administrative units of a country or a sub-basin (using fields like total, gender, age, etc.). Archived data include several years' population data for Egypt (in the attribute table), Abay basin population data by wereda (Central Statistical Agency/CSA 2000 & 2008 data) and others.
- **Transport & Communication (TRC)**  
The transport and communication datasets include roads, railways, airports/airfields (available for the whole Nile basin) and navigation canals (e.g. Suez canal); presented as country- and watershed-based (availability of data depends on studied project-scopes).



- **Irrigation System (IRR)**  
Existing irrigation schemes and potential/identified irrigation areas of EN countries are archived here. Available irrigation-related data such as irrigation infrastructure, irrigation water requirement, costs, etc. can however be looked at under Irrigation System category.

#### **3.2.4. ENID Irrigation System**

This category comprises the irrigation system as the main data-theme:

- **Irrigation System (IS)**  
Includes existing irrigation schemes and potential/identified irrigation areas of EN countries, and other available irrigation-related data such as irrigation infrastructure (canals, intake structures, pumping stations, etc.), costs, cropping pattern, crop water requirements, irrigation water requirements, etc. Data sources include national studies listed below and the ENID CRA-D&P studies (see Chapter 2). Also incorporated are those generated as part of this consultancy service (for example: digitized irrigation infrastructure features from high resolution satellite imageries and maps). The country-based project-specific ENID Field Investigations and Feasibility Studies are however archived separately.

*Note:* Effort has been made to include as much information as possible (within the time-frame allocated for this consultancy) on dams, reservoirs and irrigation schemes, by referring to several studies such as (in alphabetical order) Abay Master Plan (BCEOM et al., 1998; Ethiopia), Baro-Akobo Master Plan (TAMS and ULG, 1997; Ethiopia), Blue Nile Waters Study (Coyne et Bellier et al., 1978; Sudan), Land and Water Resources of the Blue Nile Basin (USBR, 1964; Ethiopia), Master Plan for Water Resources Development and Use (World Bank, 1977-81; Egypt) and Tekeze Master Plan (NEDECO and DHV, 1998; Ethiopia) and others.

#### **3.2.5. ENID Field Investigations**

The Field Investigations carried out as a prerequisite to the Feasibility Studies are country-based data incorporated in the GDB classified based on survey types. The field investigations data are those generated for Dinger Bereha (Ehtiopia) and Wad Meskin (Sudan) from different sub-contracted surveys: topographic survey, soil survey & land evaluation (land suitability), and geotechnical investigations (See section 3.3 for data organization in feature datasets; see next sub-section for Wad Meskin data). Also archived is Spot imagery procured for Dinger Bereha project (see sub-section 3.3.2 raster catalog).

#### **3.2.6. ENID Feasibility Studies**

Include RS-GIS data for the two country-based ENID Feasibility Studies – Dinger Bereha (Ethiopia) and Wad Meskin (Sudan). All necessary layers used for

the Dinger Bereha irrigation system maps are archived as FS data together with limited synthesized composite soil and land-suitability data. On the other hand, the Wad Meskin FS maps are all those presented for the Field Investigations except the overall project map (a sub-regional map showing the study area and its environs). Therefore, all the Wad Meksin GIS map layers are archived as FS data (see section 3.3 for naming: ENID\_SDN\_WM\_FS followed by data theme type). As for the ArcMap layers, the FI & FS map layouts are separately archived in the ENID\_Maps & Drawings directory as their title block details necessarily vary.

### **3.2.7. ENID Time-Series Data**

Included in this category are the hydro- and agro-meteorological tabular and raster time-series datasets. Some climatic and river-flow data (such as rainfall, river flow, etc.) are available in tabular form as well as a Postgres backup file. Downloaded publicly available raster data such as rainfall (RFE\_NOAA Climate Prediction Center), NDVI (MODIS, 250m resolution) and PET (using Global Data Assimilation System/GDAS analysis fields to produce daily global PET data) and others have also been archived as compressed files or short/long stack img files.

Links have been made available on ENTRO intranet for some known sites that provide downloadable global and regional datasets in public domain.

### **3.2.8. ENID Map & Drawings**

The map gallery includes the ArcMap document (.mxd) and AutoCAD drawing (.dwg) files as well as those exported pdf/jpg files. The mxds are also known as the GIS map layouts. Archived data include the CRA\_D&P (Cooperative Regional Assessment; Diagnosis & Planning), Feasibility Study and Field Investigation maps and drawings well-organized in albums. The published GIS maps on the intranet using ArcGIS Server are separately archived.

In addition, selected maps (in jpeg format) have been uploaded on ENTRO intranet by first adjusting the maps to manageable resolutions and sizes. Slide shows on the ENTRO intranet have been made possible as part of the map catalogue display.

## **3.3. GDB\_ENID: Naming Convention**

### **3.3.1. Physical Environment, Socio-Economic & Irrigation System**

#### **Data Themes**

The ENID physical environment, socio-economic and irrigation system are the main categories organized thematically as follows:

- **ENID Physical Environment**

<i>Theme</i>	<i>Prefix</i>
Geology	GEO
Hydrography & Hydrology	HYD
Land Cover	LCO
Relief	RLF
Soils	SOL

- **ENID Socio-Economic**

<i>Theme</i>	<i>Prefix</i>
Administration	ADM
Dams & Reservoirs	DAR
Demography	DMG
Transport & Communication	TRC
Irrigation Schemes	IRR

- **ENID Irrigation System**

<i>Theme</i>	<i>Prefix</i>
Irrigation System	IS

### Feature Dataset / Raster Catalog Naming

Category	Feature Dataset / Raster Catalog
ENID Physical Environment	<i>ENID_PhyEnv</i>
ENID Socio-Economic	<i>ENID_SocioEco</i>
ENID Irrigation System	<i>ENID_IrrSys</i>

### Naming of RS-GIS Layers

Archived in the Geodatabase in this category are RS-GIS data organized as country/region- and watershed/catchment/basin-based RS-GIS datasets are mostly those used to prepare the EN Irrigation Development Zones (IDZs) maps. Additional data included are those acquired from ENTRO OSI (One System Inventory), Nile-DSS and recognized institutions as well as those generated in house by ENTRO. Public domain regional and global data that are deemed useful for ENID Geodatabase and knowledge production are also archived here.

The following prefixes are used for naming the RS-GIS datasets:

▪ <b>General</b>	<b>Prefix</b>
Eastern Nile	EN
Eastern Nile Irrigation & Drainage	ENID
▪ <b>Sub-Basins</b>	<b>Prefix</b>
Nile Basin	NB
Eastern Nile Sub-Basin	ENB
Abay Sub-Basin	AB

Abay-Blue Nile Sub-basin	ABNB
Baro-Akobo-Sobat Sub-basin	BASB
Baro-Akobo Sub-basin	BAB
Main Nile Sub-basin	MNB
Tekeze-Atbara Sub-Basin	TAB
Tekeze Sub-Basin	TB

▪ <b>Country</b>	<b>Prefix</b>
Africa	AFR
East Africa	EAF
Egypt	EGY
Ethiopia	ETH
Sudan	SDN
World	WRL

### *Examples:*

File Name	Feature Dataset /Raster Catalog Name
ENID_HYD_ENB_rivers_1	ENID_PhyEnv
ENID_ADM_SDN_towns	ENID_SocioEco
ENID_RLF_AB_slope	ENID_PhyEnv *
ENID_IS_ETH_potential_irrigation_schemes	ENID_IrrSys
ENID_TRC_EGY_suez_canal	ENID_SocioEco
ENID_TRC_NB_airports	ENID_SocioEco

Notes: the number included in the first example indicates availability of other map layer/s with the same data name - important as it provides choice for users; \* refers to raster catalog

### 3.3.2. Country-based Field Investigations and Feasibility Studies

Field Investigations and Feasibility Studies carried out as part of the ENIDS are on two selected project areas in Ethiopia and Sudan.

#### Feature Dataset / Raster Catalog Naming

Currently incorporated in the Geodatabase are the two ENID Feasibility Studies (as part of ENIDS) conducted for Ethiopia and Sudan - Dinger Bereha and Wad Meskin study-projects respectively. The Field Investigations carried out as a prerequisite to the Feasibility Studies are also included based on survey types.

The main categories are organized thematically as follows:

▪ <b>Study Type</b>	<b>Prefix</b>
Field Investigations	FI
Feasibility Studies	FS
▪ <b>Country Name</b>	<b>Prefix</b>
Egypt	EGY
Ethiopia	ETH
Sudan	SDN
▪ <b>Project Sites</b>	<b>Prefix</b>
Dinger Bereha	DB
Wad Meskin	WM

<b>Dataset Classifiers</b>	<b>Prefix</b>
Ethiopia, Dinger Bereha, Field Investigation	ENID_ETH_DB_FI
Ethiopia, Dinger Bereha, Feasibility Study	ENID_ETH_DB_FS
Ethiopia, Wad Meskin, Field Investigation	ENID_SDN_WM_FI
Ethiopia, Wad Meskin, Feasibility Study	ENID_SDN_WM_FS

The Wad Meskin Feasibility Study maps are all those presented for the Field Investigations except the overall project map (a sub-regional map showing the study area and its environs). Therefore, all the Wad Meksin map layers are archived as ENID\_SDN\_WM\_FS. As for the ArcMap layers, the FI & FS map layouts are separately archived in the ENID\_Maps & Drawings directory as their block title details necessarily vary.

The field investigations data are those generated from the different sub-contracted surveys: topographic survey, soil survey & land evaluation, and geotechnical investigations.

<b>Theme/ Survey Type</b>	<b>Name</b>
Topographic	Topo
Soils & Land Evaluation (Land-suitability)	Soil_LandSuitab
Geotechnical	Geotech
Irrigation System	IrrSys

### Feature Datasets & Raster Catalogs

The following lists the FI & FS feature datasets and raster catalogs in the GDB\_ENID:

<b>Ethiopia, Dinger Bereha</b>	<b>Sudan, Wad Meskin</b>
<i>ENID_ETH_DB_FI_Topo</i>	<i>ENID_SDN_WM_FS_Topo</i>
<i>ENID_ETH_DB_FI_Soil_LandSuitab_Geotech</i>	<i>ENID_SDN_WM_FS_Soil_LandSuitab</i>
<i>ENID_ETH_DB_FS_IrrSys</i>	<i>ENID_SDN_WM_FS_IrrSys</i>
<i>ENID_ETH_DB_Topo *</i>	<i>ENID_SDN_WM_Topo *</i>
<i>ENID_ETH_DB_Spot_2008 *</i>	

**Note:** \* refers to raster catalogs (ENID\_ETH\_DB\_Topo contains scanned and geo-referenced 1:50,000 EMA topo-maps of Didessa area; ETH\_SDN\_WM\_Topo contains processed topographic surfaces for specific sites mentioned below; ENID\_ETH\_DB\_Spot\_2008 is Spot imagery of Dinger Bereha, imaging date 2008, spatial resolution 5m).

### Naming of RS-GIS Layers

The GIS layers in the above feature datasets are named with double prefixes that denote the project site (DB or WM) and the study type (FI or FS), followed by the specific name of the data. Exceptional case is the topographic surveys conducted for Wad Meskin which have been acquired as site-based. The following presents the prefixes that are included after study type:

▪ <b>Topo Survey Sites</b>	<b>Prefix</b>
Dinder Barrage	DNR
Khor Atshan	KAT
Rahad Barrage	RHD
Overall Project	OP

**Examples:**

<b>File Name</b>	<b>Feature Dataset Name</b>
DB_FS_main_canal	ENID_ETH_DB_FS_IrrSys
DB_FI_contour_lines_1m	ENID_ETH_DB_FI_Topo
WM_FS_irrigable_area	ENID_SDN_WM_FS_IrrSys
WM_FS_soil_units	ENID_SDN_WM_FS_Soil_LandSuitab
WM_FS_DNR_spot_height	ENID_SDN_WM_FS_Topo

**3.4. Metadata**

Metadata (data about data) have been prepared for RS-GIS datasets, related tabular data and tools using ISO 19139 metadata standard (the version of the standard and contents are shown below). Selected entries of the ISO metadata form, common to most datasets, were first filled-out and then exported to xml format to serve as a template. Subsequent tasks involved importing this template and completing forms for feature datasets, raster catalogs, feature class and others datasets. The metadata can be viewed on ArcCatalog using known metadata protocols such as ISO, FGDC, INSPIRE metadata directive, ESRI and others. The htm versions of the datasets' metadata are included in the electronic version of ENID K-Base documentation. The navigation pane provided therein help access the metadata prepared for feature datasets and raster catalogs of the ENID Geodatabase (GDB\_ENID). As an example, metadata prepared for three selected main feature datasets are provided in Annex 4.

NAME OF THE METADATA STANDARD USED ISO 19139  
 Geographic Information - Metadata - Implementation Specification  
 VERSION OF THE METADATA STANDARD 2007

**ISO 19139 metadata content**

- Resource Identification Information
- Spatial Representation Information
- Reference System Information
- Distribution Information
- Metadata Information

In addition, the inventory list and description prepared in MS-Excel thematically provide essential information for each RS-GIS data (Annex 3). This list has also been provided in the electronic version of the ENID documentation after having the entire document converted to htm web page format keeping the excel tabs.

Figure 2. ENID\_PhyEnv Feature Dataset

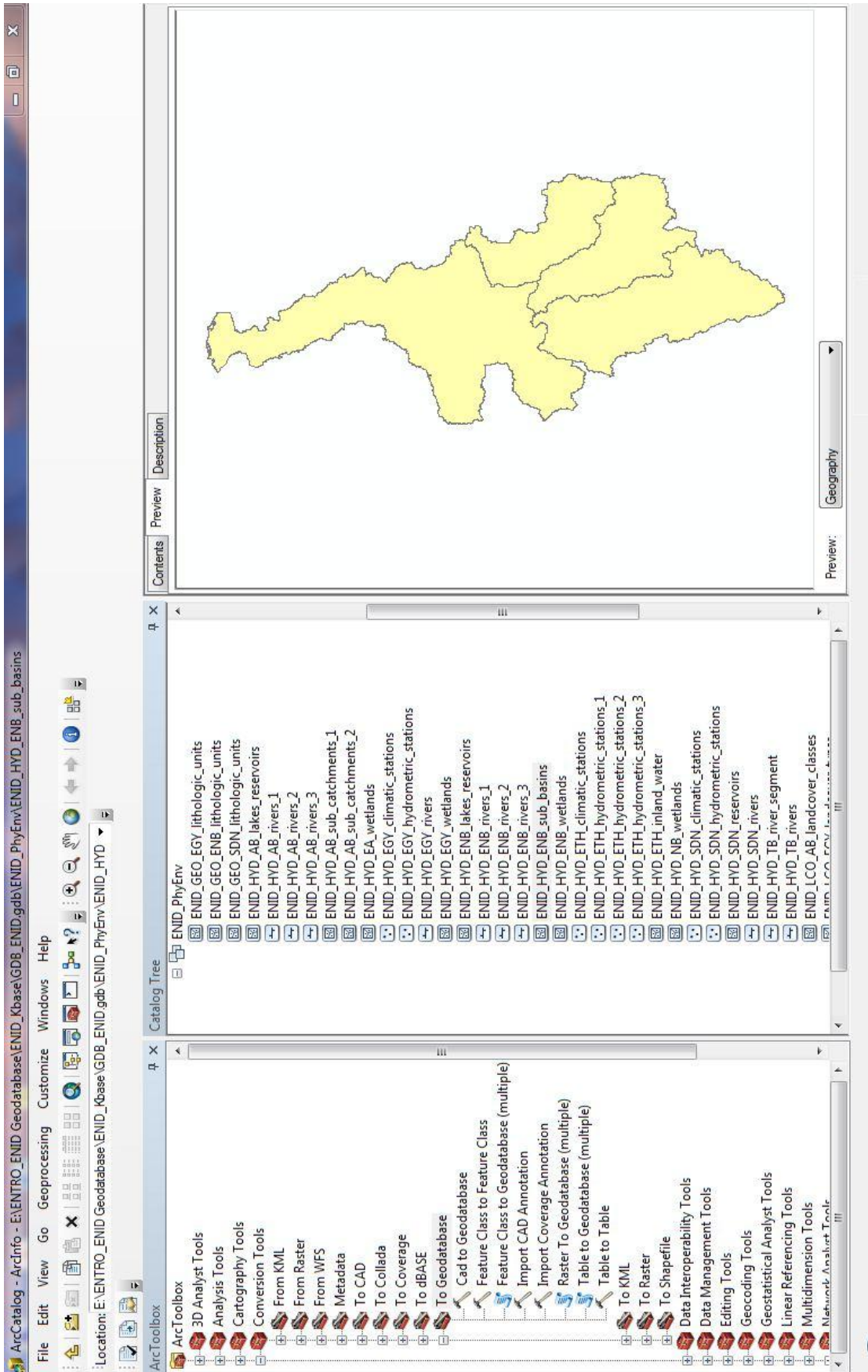


Figure 3. ENID\_SocioEco Feature Dataset

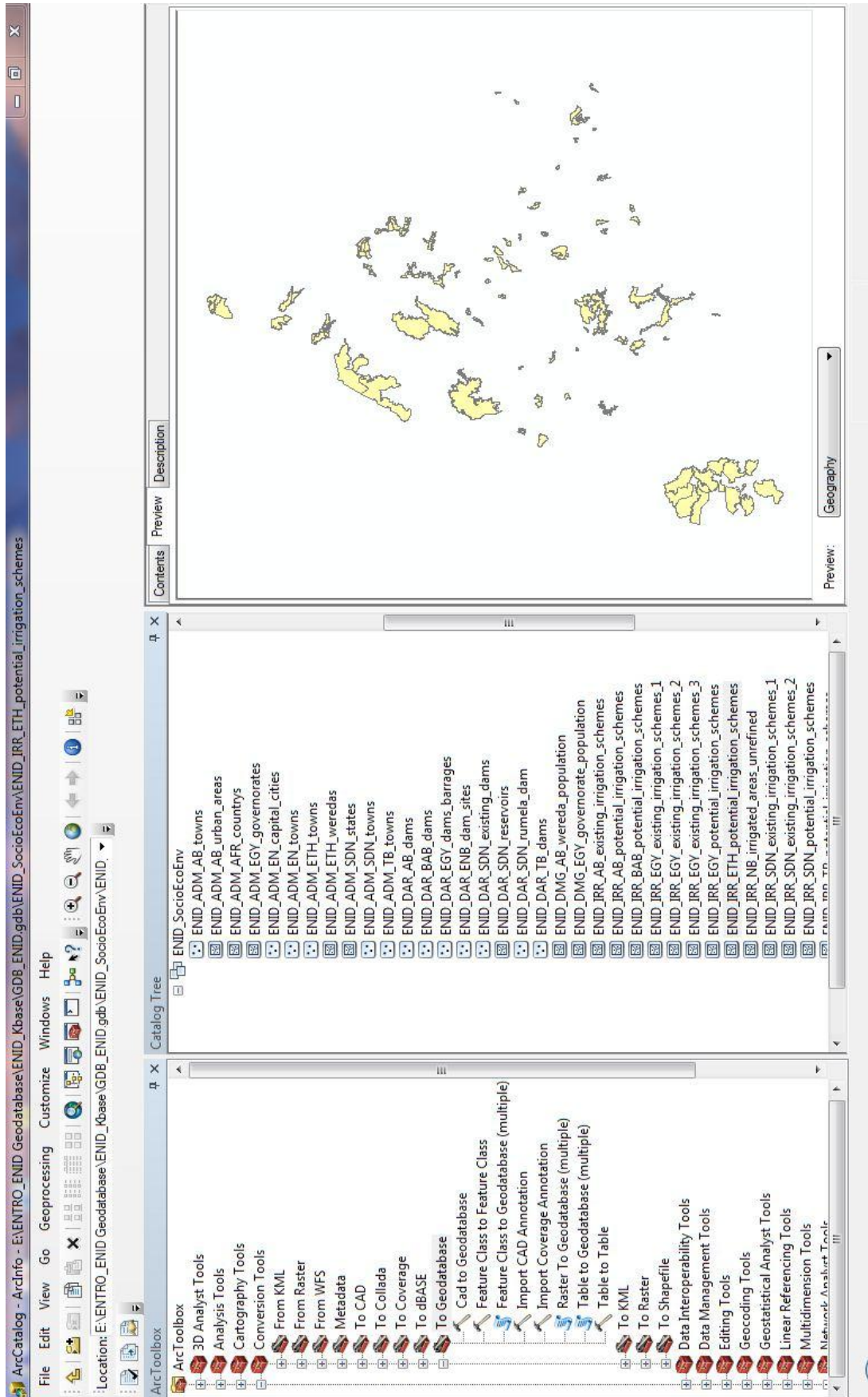




Figure 4. ENID\_IrrSys Feature Dataset

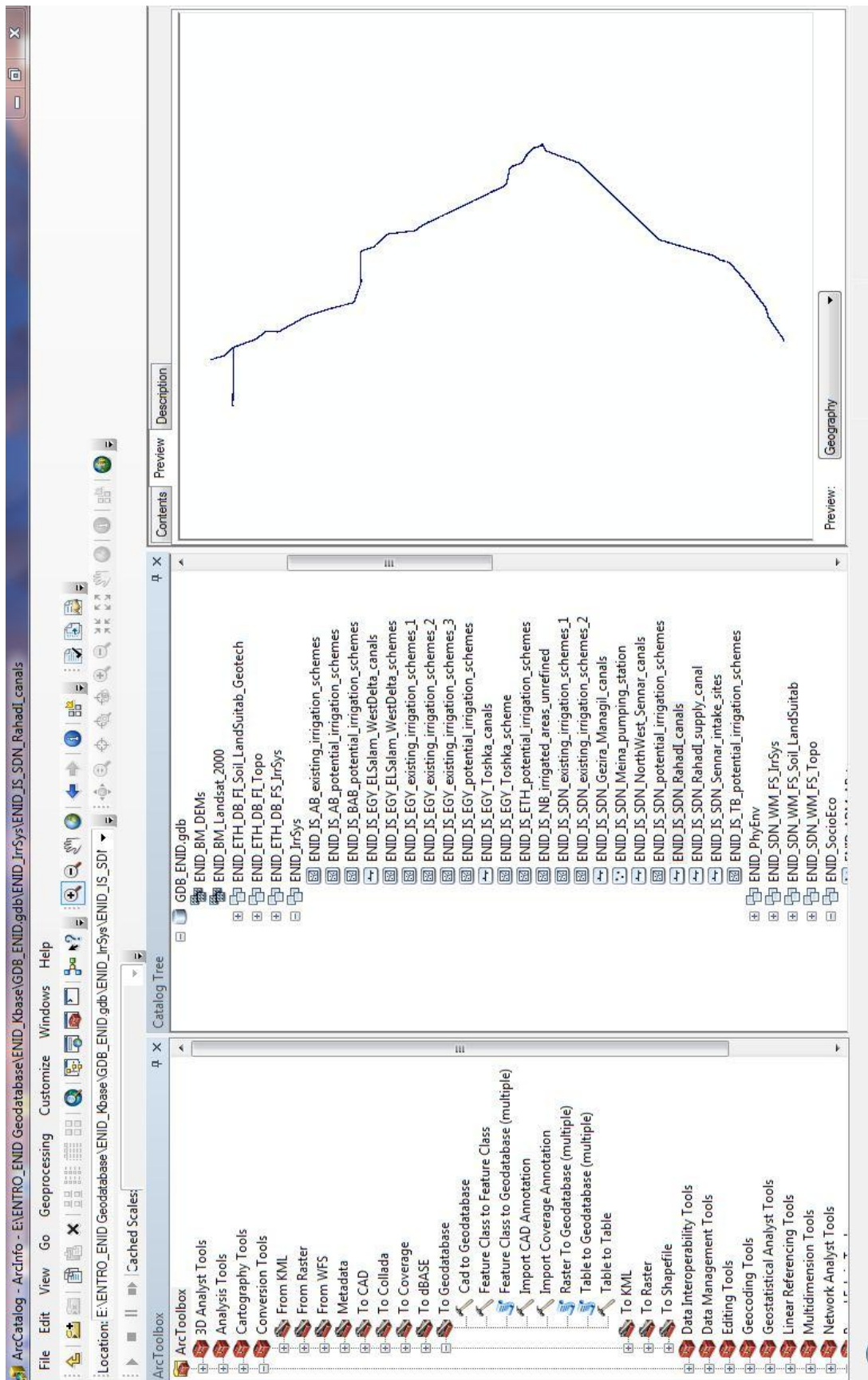


Figure 5. ENID\_ETH\_DB\_FI\_Soil\_LandSuitab\_Geotech Feature Dataset

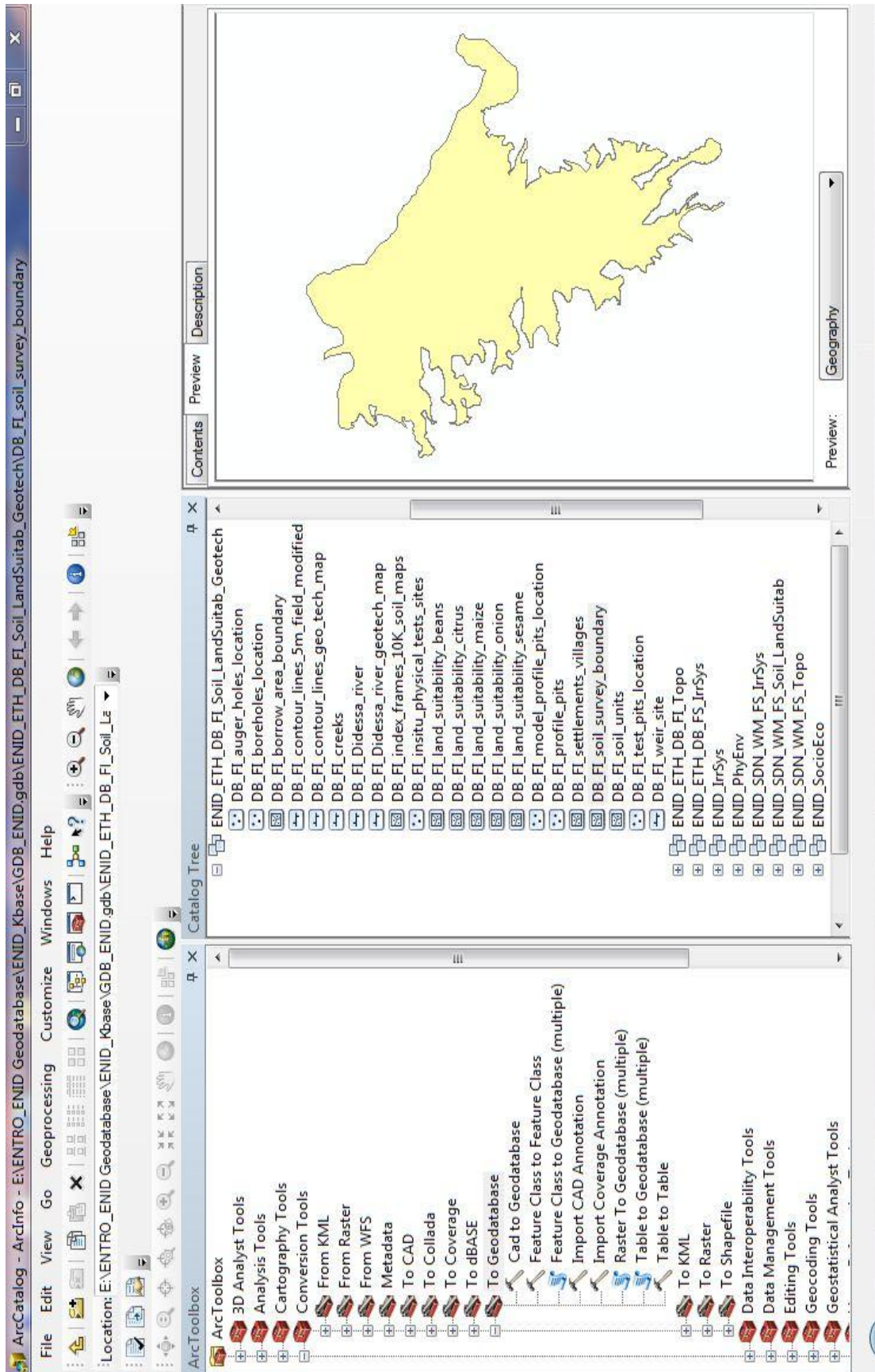
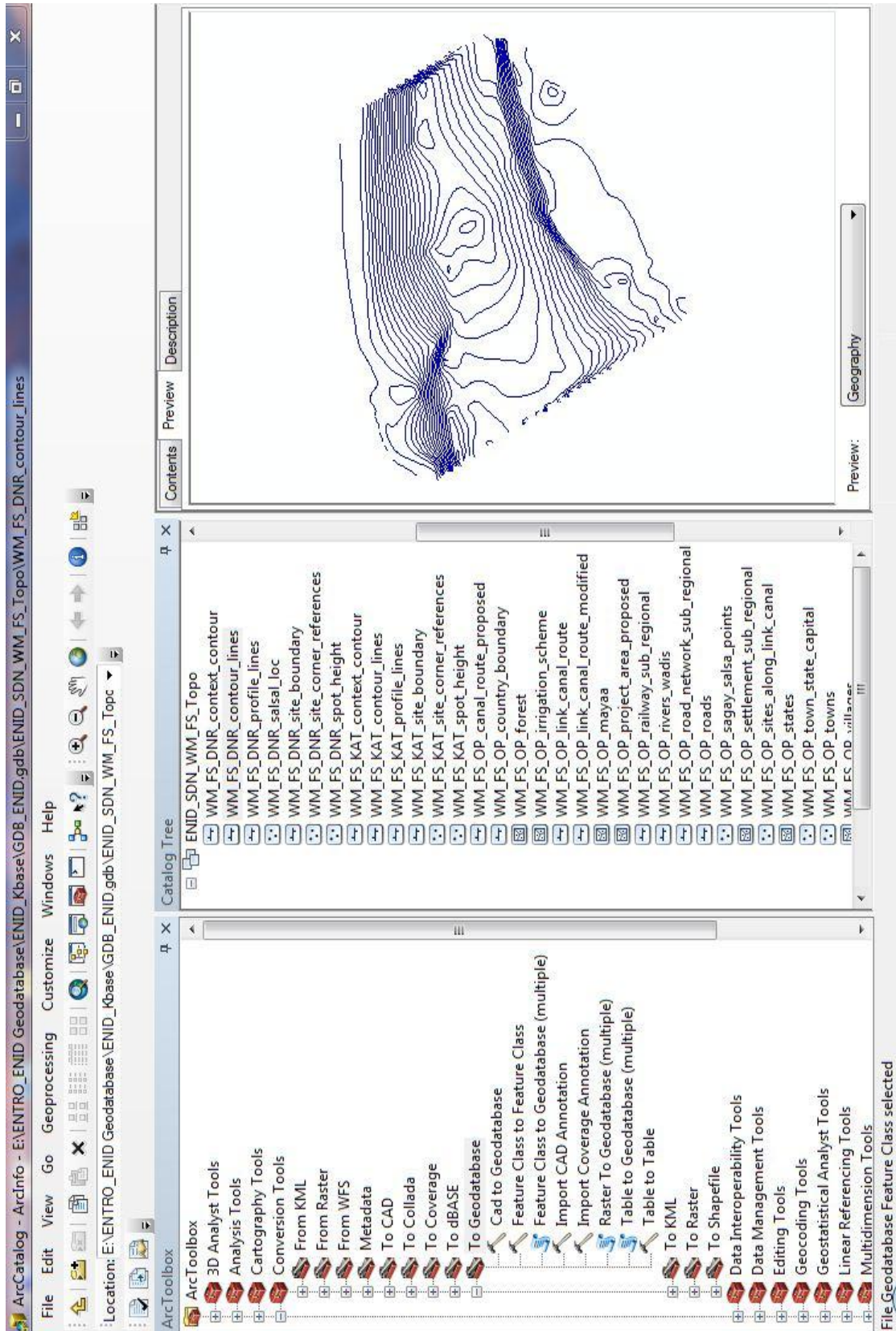


Figure 6. ENID\_ETH\_DB\_FI\_Soil\_LandSuitab\_Geotech Feature Dataset



## 4. ENID Maps & Drawings

More than 250 maps and drawings have been prepared during the ENID Studies. Included in the database are ArcMap layouts (mxd files) and AutoCAD drawings (dwg files) as well as the exported maps in pdf and jpeg formats.

One of the essential spatial knowledge products prepared as part of this consultancy service is the ENID Map Catalogue (see Annex 6). It provides list of all the ENIDS maps & drawings, organized by study component and data-theme, with necessary details like title, scale, format and paper-size. The lists of ENID ArcMap layout and AutoCAD drawing files are also provided in Annex 7 & 8 respectively.

Selected maps have been published using ArcGIS Server to ENTRO server (see the navigation pane of the web-interface for ENID K-Base documentation). Relative file paths of the map layers that make-up the GIS map layouts are also documented separately to help locate individual map layers easily. In addition, selected metadata (prepared for the ArcMap document files) have also been made available in the ENID K-Base documentation keeping the ArcCatalog metadata presentation.

Table 4.1: ENID Albums: Maps & Drawings

Albums: Maps & Drawings	Albums
ENID_CRA_D&P	<i>ENID_CRA_D&amp;P</i>
ENID_Feasibility_Studies	
▪ ETH_FS_Dinger_Bereha	<i>DB_FS_Maps_A1</i>
	<i>DB_FS_Drawings_A3</i>
▪ SDN_FS_Wad_Meskin	<i>WM_FS_Topo_IrrSys_Maps_A1-A0</i>
	<i>WM_FS_Soils_Land_Suitab_Maps_A1-A0</i>
	<i>WM_FS_Drawings_A3</i>
ENID_Field_Investigations	
▪ ETH_FI_Dinger_Bereha	<i>DB_FI_Soils_LandSuitab_Geotech_Maps</i>
	<i>DB_FI_Topo_Maps</i>
▪ SDN_FI_Wad_Meskin	<i>WM_FI_Soils_LandSuitab_Geotech_Maps</i>
	<i>WM_FI_Topo_IrrSys_Maps</i>
ENID_Pilot_Studies	
▪ ETH_PS_IWUEP_Drawings	<i>ETH_PS_IWUEP_Drawings</i>
▪ SDN_PS_IWUEP_Drawings	<i>SDN_PS_IWUEP_Drawings</i>

Some of the selected project maps, particularly from the CRA IDZs (Irrigation Development Zones), Feasibility Study and Field Investigation maps have been uploaded on ENTRO intranet. Content management has been made possible using the SharePoint installed on the intranet. The slide-shows display maps from well-organized albums archived in the gallery (also provided therein is the above-mentioned Map Catalogue).

## 5. ENID RS-GIS Videos

Creating RS-GIS (Remote Sensing – Geographic Information System) videos with animated features is necessary for visualization of the physical nature and irrigation-related developmental works of the Nile River Basin. Hence they assist in the better conceptualization of the Abay-Nile system.

### 5.1. Google Earth Pro

Google Earth Pro is one of the main navigation tools made available for RS-GIS works by ENTRO. Apart from providing recent imageries, Google Earth Pro also incorporates databases such as borders and labels, places, roads, etc. The tour recording capabilities, using mouse and keyboard interaction with the 3D viewer while traversing around selected areas of interest, makes Google Earth Pro suitable for the current project. Movies can also be created from recorded tours and saved in WMV (Windows Media Video), .mov (QuickTime) and AVI (Audio Video Interleave) formats. These movies can then be used for information synthesis, knowledge management and presentations. Upon approval, these movies can also be uploaded on ENTRO Intranet, ENSAP website or Nile IS.

### 5.2. Touring Mainstream Abay-Nile

For the purpose of the present RS-GIS video preparation using Google Earth Pro, the mainstream Abay-Nile (from Lake Tana area up to the Nile Delta) has been divided into three reaches (segments):

- Lake Tana – Roseires
- Roseires – Aswan
- Aswan – Mediterranean Sea

The RS-GIS videos show the landscape along the mainstream Abay/Nile, the river morphology, dams and accompanying reservoirs, and irrigation schemes of the Eastern Nile Basin (ENB). To make these videos more informative and interesting, major cities like Bahir Dar, Khartoum and Cairo are covered with more detail, important roads and bridges have been included, and major towns are indicated on the landscape.

Data themes shown as layers on the navigation view include:

- Country boundaries (from Google Earth Pro database)
- Cities and towns (from Google Earth Pro database)
- Roads (from Google Earth Pro database)
- EN sub-basins boundaries (from ENID archive)
- Dams and reservoirs (from ENID & ENTRO archives and other sources)
- Irrigation schemes (from ENID archive)
- River gauging stations (from ENTRO archive)

The following tables present key features selected for reference in each of the above three RS-GIS video parts. Key features include selected cities/towns, lakes, dams, reservoirs, irrigation schemes, major diversion sites, key river level gauging stations, etc.

Table 5.1: Lake Tana to Roseires (Key Features)

✚ Lake Tana (Natural Reservoir)
✚ Bahir Dar (regional capital city)
✚ Chara Chara weir
✚ Bahir Dar gauging station
✚ Some irrigated agriculture along the Abay
✚ Tis Abay (diversion canal and hydropower sites)
✚ Kessie gauging station
✚ Karadobi (proposed dam site)
✚ Beko-Abo (proposed dam site)
✚ Mabil (proposed dam site)
✚ Mandaya (proposed dam site)
✚ Border (aka Grand Millennium/Renaissance dam site)
✚ El Diem hydrometric station
✚ Roseires reservoir

Table 5.2: Roseires – Aswan (Key Features)

✚ Roseires (dam & existing reservoir)
✚ Recession agriculture along the Nile
✚ Meina/Singa pump station and supply canal (for Rahad I)
✚ Sennar (dam & existing reservoir)
✚ Sennar intakes (Gezira-Managil canals)
✚ Gezira-Managil schemes
✚ North West Sennar scheme
✚ Rahad Scheme with main canal
✚ Khartoum gauging station
✚ Khartoum (nation capital)
✚ Tamaniat gauging station (d/s of Khartoum)
✚ Recession agriculture along the Nile
✚ Merowe (dam site)
✚ Dongla gauging station
✚ Nubia & Nasir reservoirs
✚ Toshka scheme & diversion site
✚ Aswan (high dam site)

Table 5.3: Aswan – Mediterranean Sea (Key Features)

✚	Aswan (high dam, existing Nasir reservoir and low dam)
✚	Irrigated schemes (along the main Nile b/n Aswan and Cairo)
✚	Barrages on the Nile b/n Aswan & Cairo and associated irrigation canals (Esna, Naga Hammadi & Asyut)
✚	Cairo (nation capital)
✚	The Pyramids area, near Cairo
✚	Barrages on the two Nile branches in the deltaic region (Delta, Zifta)
✚	Nile Delta Irrigation Schemes
✚	El Salam and Suez Canals
✚	Mediterranean Sea (two main channeled delta outlets)

### 5.3. Other Short RS-GIS Presentation Videos

The above Abay-Nile tour videos are the main RS-GIS videos which are intended to provide comprehensive information and knowledge on various essential science disciplines. The tour record durations of these videos are relatively longer and their file sizes larger. In addition to these, few other short RS-GIS videos - each displaying a single theme such as dams & reservoirs, existing & potential irrigation schemes, and key hydrometric stations, have been prepared.

Table 5.4: Existing Irrigation Schemes (large-to medium-scale)

✚	Abay - Blue Nile Sub-basin
▪	Abay: Lake Tana Sub-basin
–	Koga Scheme
▪	Abay: Fincha Sub-basin
–	Fincha Sugarcane Plantation
▪	Rahad- Dinder Sub-basins and Blue Nile Sub-basin in Sudan
–	Gezira-Managil (aka Al Jazira)
–	Rahad I
–	NW Sennar, Guneid, Kenana, Suki & others
–	Recession Agriculture along the Blue Nile in Sudan
✚	Tekeze-Atbara Sub-basin
–	New Halfa (aka Khashm Al Girbah)
–	Gash Spate Irrigation in Sudan
✚	Main Nile Sub-basin (d/s of Khartoum)
–	Recession Agriculture along Blue Nile in Sudan
–	Egypt Schemes along the Nile b/n Aswan and Cairo
–	Egypt Schemes in the Nile Delta

Table 5.5: Potential Irrigation Schemes  
(large-to medium-scale)

<b>■ Abay - Blue Nile Sub-basin</b>	
<ul style="list-style-type: none"> <li>▪ Abay: Lake Tana Sub-basin</li> </ul>	<ul style="list-style-type: none"> <li>- Megech, Ribb, Gumera, Gilgel Abay, NW Tana, NE Tana, SW Tana</li> </ul>
<ul style="list-style-type: none"> <li>▪ Abay: Beles Sub-basin</li> </ul>	<ul style="list-style-type: none"> <li>- Upper Beles &amp; Lower Beles</li> </ul>
<ul style="list-style-type: none"> <li>▪ Abay: Didessa Sub-basin</li> </ul>	<ul style="list-style-type: none"> <li>- Didessa Pump &amp; Didessa Dam</li> <li>- Anger &amp; Nekemte</li> <li>- Dabana (aka Dinger Bereha project as per the recent ENID Feasibility Study)</li> <li>- Negeso</li> </ul>
<ul style="list-style-type: none"> <li>▪ Rahad- Dinder Sub-basins and Blue Nile Sub-basin in Sudan</li> </ul>	<ul style="list-style-type: none"> <li>- Rahad &amp; Galegu in Ethiopia</li> <li>- Upper &amp; Lower Dinder in Ethiopia</li> <li>- Rahad II in Sudan</li> <li>- Great Kenana (I-IV)</li> </ul>
<b>■ Tekeze-Atbara Sub-basin</b>	
<ul style="list-style-type: none"> <li>▪ Tekeze sub-basin</li> </ul>	<ul style="list-style-type: none"> <li>- Humera, Angereb &amp; Metema</li> </ul>
<ul style="list-style-type: none"> <li>▪ Atbara Sub-basin in Sudan</li> </ul>	<ul style="list-style-type: none"> <li>- Upper Atbara</li> </ul>
<b>■ Baro-Akobo-Sobat Sub-basin</b>	
	<ul style="list-style-type: none"> <li>- Baro Right Bank (Itang Dam on Baro river)</li> <li>- Gilo Right Bank (Gilo 2 Dam on Gilo river)</li> <li>- Other schemes from Baro-Akobo Master-Plan Study</li> </ul>
<b>■ Main Nile Sub-basin and adjacent Toshka Depression (d/s of Khartoum)</b>	
	<ul style="list-style-type: none"> <li>- Toshka (from Nubia reservoir/lake); partly developed</li> <li>- El Salam Canal &amp; West Delta; partly developed</li> </ul>

Table 5.6: Dams and Reservoirs (on mainstream Abay-Nile)

<ul style="list-style-type: none"> <li>▪ Chara Chara Weir (Bahir Dar outlet) Abay River</li> </ul>	<ul style="list-style-type: none"> <li>- Lake Tana outlet/ (natural dam &amp; reservoir)</li> </ul>
<ul style="list-style-type: none"> <li>▪ Karadobi (proposed dam site)</li> </ul>	<ul style="list-style-type: none"> <li>- Abay River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Beko-Abo (proposed dam site)</li> </ul>	<ul style="list-style-type: none"> <li>- Abay River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Mabil (proposed dam site)</li> </ul>	<ul style="list-style-type: none"> <li>- Abay River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Mandaya (proposed dam site)</li> </ul>	<ul style="list-style-type: none"> <li>- Abay River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Border (proposed dam site) (aka Grand Millennium/Renaissance dam)</li> </ul>	<ul style="list-style-type: none"> <li>- Abay River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Roseires (existing dam &amp; reservoir)</li> </ul>	<ul style="list-style-type: none"> <li>- Blue Nile River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Sennar (existing dam &amp; reservoir)</li> </ul>	<ul style="list-style-type: none"> <li>- Blue Nile River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Merowe (existing dam &amp; reservoir)</li> </ul>	<ul style="list-style-type: none"> <li>- Main Nile River</li> </ul>
<ul style="list-style-type: none"> <li>▪ Aswan (existing dam &amp; reservoir)</li> </ul>	<ul style="list-style-type: none"> <li>- Main Nile River</li> </ul>



Table 5.7: Key Hydrometric Stations  
(on mainstream Abay-Nile)

■ Bahir Dar	Abay River
■ Kessie	Abay River (Abay bridge linking Goha Tsion and Dejen towns)
■ El Diem	Blue Nile River (near ETH-SDN border; u/s of Roseires)
■ Khartoum	Blue Nile River
■ Tamaniat	Main Nile (d/s of the Blue Nile and White Nile confluence)
■ Hassanab	Main Nile (u/s the confluence of Atbara with Nile)
■ Dongola	Main Nile (d/s of Merowe dam)
■ Aswan	Main Nile

## 6. ENID Tools & Software

Several software tools and licenses have been made available and installed on ENTRO server and client desktop computers. Brief descriptions for important software are provided below. Original software CDs/DVDs are available at ENTRO IT office. However, those software downloaded from the internet have been archived in the ENID KBase database. Also archived in the KBase is irrigation tool kit recently developed by ENTRO KM team.

### 6.1. ESRI Products: ArcGIS

ArcGIS refers to a suite of GIS software products of ESRI (Environmental Systems Research Institute) that operate on server, desktop and mobile platforms. The following list provides procured and installed ArcGIS software supported on Windows Server 2008 and Windows 7 operating systems.

#### **ArcGIS Server Enterprise 10:**

ArcGIS Server is a comprehensive platform for delivering enterprise GIS applications that are centrally managed and support multiple-users.

The ArcGIS Server Enterprise procured by ENTRO is the standard edition which has been installed on ENTRO-KBASE2 server.

The ArcGIS Server includes the server manager and ArcSDE as parts of a server-based GIS. The ArcGIS server manager helps to share geographic information in many ways (publishing a map, globe or other GIS resources as services as well as creating web applications). A web browser is required to open the ArcGIS Server Manager, accessed through the LAN (<http://entro-kbase2/GeoInfo/Manager.aspx>). Usernames and passwords have been assigned to administrators (currently three admins including this project's consultant) to log into the server manager.

#### **ArcSDE 10:**

ArcSDE is the spatial database engine software installed on ENTROKBASE server using the option ArcSDE for Microsoft SQL Server (see section 6.2). It is used as an RDBMS (Relational Database Management System) connector for other ESRI software to store and retrieve GIS data within SQL Server. The SQL server has been installed on the same server before the ArcSDE.

#### **ArcGIS Desktop:**

ArcGIS Desktop is essential GIS software installed on some client computers in ENTRO, including on a desktop computer assigned for the current project. It is provided with three product levels, namely ArcView, ArcEditor and ArcInfo (in increasing order of functionality level). Besides these, the two recently obtained desktop extensions, 3D Analyst & Spatial Analyst, allow additional functionality to the

core desktop GIS. The ArcGIS Administrator helps to check whether one of the above product levels with the extensions are available or not (i.e. in use or borrowed).

The ArcGIS Desktop includes comprehensive professional GIS application that support a number of GIS tasks, including mapping, data compilation, analysis, geodatabase management, and geographic information sharing. Essential applications incorporated in ArcGIS Desktop include ArcMap, ArcCatalog, ArcGlobe, ArcScene, ArcToolbox, and Model Builder.

ArcMap 10 and ArcCatalog 10 are the most commonly used application software by GIS professionals. ArcMap 10 is useful for performing various GIS analyses, manipulating GIS map layouts (creating, editing and viewing), exporting maps, etc. The ArcCatalog 10 is very important for GIS and related data management. Enterprise level geodatabases (GDBs) can be developed, edited and managed within ArcCatalog. ArcCatalog also provide a section for viewing datasets in available options (geographic, tabular, 3D). Creation, editing and exporting of metadata is also possible by customizing ArcCatalog options. The other two applications of ArcGIS Desktop are ArcScene 10 and ArcGlobe10 which are used for manipulation of generated raster 2D-3D surfaces, creation of animations, etc.

The available licenses for ArcGIS Desktop product levels and extensions are:

Type	Qty
Arc Info (concurrent use)	1
Arc Editor (concurrent use)	1
Arc View (concurrent use)	2
3D Analyst (extension)	2
Spatial Analyst (extension)	2

Note: The license manager is installed on ENTROKBASE server.

## 6.2. Microsoft SQL Server

Thematically organized geodatabases comprise various types of spatial and non-spatial datasets within multi-user relational databases. The Microsoft SQL Server 2008 installed on ENTROKBASE server comprises two spatial types (geography & geometry) which are both supported by ESRI. This provides users with powerful spatial-enabled applications to seamlessly consume, use and extend location-based data.

The following three are GDBs created with ArcSDE for SQL Server:

- GDB\_ENID (current project)
- GDB\_ENFPEW
- GDB\_ENTRO

The first two geodatabases (GDBs) are for EN Irrigation and Drainage, and EN Flood Preparedness and Early Warning which are being currently developed simultaneously. It is anticipated that the same exercise will continue for EN Power Trade, EN Watershed Management and EN Joint Multi-purpose Projects. Selected regional datasets from these GDBs will be archived in GDB\_ENTRO. Ultimately all GDBs will be archived in the envisioned central GDB\_ENTRO.

### **6.3. Google Earth Pro**

Google Earth Pro is the professional version of Google Earth software installed on several ENTRO desktop computers using the three available licenses recently procured by ENTRO. The 3D-globe navigation view is one of the advantages of having Google Earth. It also incorporates time-series satellite imageries covering the ENB and a primary database comprising borders and labels, roads, places, etc. Tours and other presentations have been prepared using this software (see Chapter 5). As high resolution imageries are available for some parts of the basin, it has also helped in digitizing infrastructure of major irrigation schemes and other necessary features.

### **6.4. ERDAS Imagine 2011**

ERDAS Imagine 2011 is essential image-processing or remote-sensing application software developed by ERDAS Inc. The license manager has been installed on ENTRO-KBASE2 server and the application software on desktop computer. Its use for processing base maps (particularly satellite imageries) such as making composite satellite imageries, pan-sharpening, mosaicking, image classification and other key analysis is highly recognized.

### **6.5. Global Mapper**

Global Mapper is RS-GIS software very useful for converting imageries, DEMs and other datasets into different data formats. It is also quite valuable for converting coordinating systems of various data types, and is particularly effective for raster datasets. Its use in quickly mosaicking base-maps should also be noted. As such it is strongly recommended that ENTRO procure this software.

### **6.6. Adobe Creative Suite**

Adobe Creative Suite (CS) incorporates a suite of application software developed by Adobe. Photoshop, Dreamweaver and Fireworks are required for image processing, animation works and developing web-based applications. Of particular relevance to this consultancy service, the Adobe Dreamweaver has been used for the development of the web-interface for the ENID KBase documentation. It is recommended that this suite of software is made available for ENTRO KM team.

## **6.7. PostGreSQL**

Postgres is publicly available free software which is commonly used by database specialists, GIS experts and IT support providers. Its application with ArcGIS is similar to Microsoft SQL, as both are capable of processing spatial datasets. PostGreSQL is one of the most commonly used database software within the Nile-DSS. Its use for ENID KBase development is considered for handling and manipulating hydro-meteorological data collected from Nile-DSS.

## **6.8. CropWat & Climwat**

CropWat is important software used for calculating effective rainfall, evapotranspiration and irrigation requirements, and for formulating irrigation scheduling and monitoring. Climwat comprises climatic station data for EN countries. It has been selected for archival as it will be used for future EN Irrigation and Drainage, and other related works.

## **6.9. Irrigation Tool Kit**

Is an irrigation tool with a web interface that provides regional and scheme/project-based irrigation and related information/data mostly synthesized from the ENID Studies. Its aim is to capture most of the non-spatial data. It has been organized by ENTRO knowledge management team; some pages under construction.

## **6.10. Other Software**

In addition to some of the above-mentioned tools, essential tools archived in the ENID KBase include the free versions of Adobe Reader and Google Earth software which are necessary for dealing with study documents/maps in pdf, and spatial knowledge products in Google Earth formats respectively.

## 7. Recommendations

As more data is required to be archived in the KBase, it is recommended to collect additional irrigation-related data that include digital and hardcopy maps, digital GIS map layers, satellite imageries, software, etc. Potential sources include relevant government institutions of the EN countries (such as national Ministries of Water/Irrigation/Agriculture, Geological Survey Institutes, Universities/Colleges, Research Centers, Statistical Agencies and Mapping Authorities) and resource study/mapping project-generated national, regional or global datasets.

It is further recommended that new collected vector GIS data are archived in the existing feature datasets of the ENID\_GDB depending on the data-theme type, while additional raster catalogs can be created for new raster datasets (like satellite imageries, standard topographic maps at a scale of 100,000 or 50,000 for the EN countries or a sub-basin, generated raster surfaces, etc.).

It is suggested that ENTRO make available essential software like Adobe Creative Suite, Global Mapper, Ulead, Macromedia, PCI Geomatica, ENVI, and other tools and extensions for future RS-GIS data processing and analysis, graphical and animation works, and web-site development. The necessity of having these software tools is highlighted not only for knowledge-base development but also for future anticipated modeling exercises.

It is also suggested to select documents and spatial knowledge products from the ENID K-Base and prepare informative contents for uploading on Nile IS and ENSAP/ ENTRO website upon approval of the resources.

In addition to available networked platforms, DVDs are essential portable and powerful tools for knowledge dissemination. Some of the deliverable knowledge products, particularly the recorded RS-GIS videos, have been distributed in DVDs. These videos have also been made available at the ENTRO library. Depending on ENTRO's desires as to how to provide country-based data for respective countries, it is further suggested that interactive DVDs are prepared by incorporating the web interface for the K-Base documentation with selected ENID resources (reports, maps, knowledge products, tools, etc.).

It is highly suggested that necessary resources and ample time is allocated to prepare complete and informative EN Irrigation & Drainage Atlas maps. Using archived and other captured data, it might become quarter a year project if maps like EN sub-catchments, landscape/relief, agro-climatic zones, eco-terrestrial regions, rainfall (seasonal), thermal zones, potential evapotranspiration (seasonal), soils, land cover, existing and potential irrigation schemes, existing and proposed dam sites, cropping pattern, NDVI (seasonal), CWR, IWR and others are professionally produced and published (using simple to advanced RS-GIS techniques and map creation skills) with the accompanying documentation.

It is strongly recommended to partly adopt the comprehensive data-theme classification used for the ENID Geodatabase (GDB\_ENID) for the intended project-based GDBs and for the envisaged central ENTRO Geodatabase (GDB\_ENTRO).

It is highly recommended that essential capacity building in RS-GIS is provided to ENTRO staff-members and immediate relevant stakeholders in order to bring about the required geo-spatial revolution in regional institutions like ENTRO.

It is strongly recommended that necessary time-series, irrigation-related, public domain raster datasets are downloaded from endorsed sites on a regular basis as these data can be used as an input to start an “irrigation monitoring system at ENTRO” in the future.

## 8. Annotated Bibliography

The annotated bibliography presented here include list of essential comprehensive studies and books selected for reference as well as brief profiles of documents recognized as relevant and supplementary for the development of the ENID KBase.

### Essential References

Comprehensives studies & books selected for reference include (in alphabetical order):

- **Abbay River Basin Integrated Development Master Plan Project, 1998-2000.**
  - Consultants: BCEOM in association with BRGM & ISL.
  - Report organized in volumes submitted to the Ministry of Water Resources, Ethiopia.
  
- **An Annotated Bibliography on the River Nile and its Economic, Political, Social and Cultural Role.**
  - Author: Terje Tvedt
  - Publisher: University of Bergen (2000)
  
- **Baro-Akobo River Basin Integrated Development Master Plan Study, 1997.**
  - Consultants: TAMS and ULG Consultants
  - Report organized in volumes submitted to the Ministry of Water Resources, Ethiopia.
  
- **Blue Nile Waters Study, 1978.**
  - Consultants: Coyne et Bellier, Alexander Gibb and Partners, Hunting Technical Services Limited, and MacDonald and Partners.
  - Report organized in volumes submitted to the Ministry of Irrigation and Hydro-Electric Energy, Sudan.
  
- **Land and Water Resources of the Blue Nile Basin, 1964.**
  - Consultants: USBR (United States Bureau of Reclamation)
  - Report organized in volumes submitted to the Imperial Ethiopian Government; currently available at the Ministry of Water & Energy library, Ethiopia.
  
- **Master Plan for Water Resources Development and Use, 1977-1981.**
  - Project executed by: International Bank for Reconstruction & Development (World Bank), financed by United Nations Development Program (UNDP)
  - Cooperating Agency: Ministry of Irrigation, Egypt
  
- **Tekeze River Basin Integrated Development Master Plan Project, 1997-1998.**
  - Consultants: NEDECO and DHV Consultants
  - Report organized in volumes submitted to the Ministry of Water Resources, Ethiopia.



- The Nile Basin, 1030's-1990's (also known as Encyclopedia in Nile-DSS; one of the main data sources for long-term hydro-meteorological data).
  - Main contributors: H.E. Hurst, R.P. Black and Y.M. Simaika for early volumes and Nile Control Staff for recent editions.

## Relevant Documents

For the present ENID Kbase development, relevant documents and maps refer to all irrigation and drainage studies conducted by ENTRO. Chapter 2 provides brief descriptions for all the ENID Studies while the list of all documents is given in Annex 5.

Project profiles for the Studies:

### *ENIDS General Profile 1*

Project Name: Eastern Nile Irrigation and Drainage Studies (ENIDS), 2008-2010.

Consultants: Consortium of consultants - BRLi of France, Metaferia Consulting Engineers (MCE) of Ethiopia and Shouraconsult of Sudan

#### ■ *ENID Regional Studies:*

- Inception
- Diagnostic and Planning (D&P)
- Cooperative Regional Assessment (CRA): Analysis
- Cooperative Regional Assessment (CRA): Finalization and Conclusion including Guidelines for Identification and Assessment of Irrigation & Drainage Projects

#### ■ *ENID National Studies (Field Investigations & Feasibility Studies):*

- Dinger Bereha (DB) Irrigation Project: Field Investigations
- Dinger Bereha (DB) Irrigation Project: Feasibility Study
- Wad Meskin (WM) Irrigation Project: Field Investigations
- Wad Meskin (WM) Irrigation Project: Feasibility Study

For these studies, necessary original data collected and generated during the study project have been made available and compiled as the author (of the current ENID K-Base documentation final report) was involved on the Eastern Nile Irrigation & Drainage Studies (ENIDS) in between 2008-2010, employed by the above-mentioned consortium of consultants as a GIS Consultant.

### *ENIDS General Profile 2*

Project Name: Eastern Nile Irrigation and Drainage Studies (ENIDS), 2010.

Consultants: SMEC (Snowy Mountains Engineering Corporation)

#### ■ *ENID National Studies (Pilot Studies on IWUEP):*

- Pilot Study on Improving Water Use Efficiency and Productivity on Selected Small Scale Irrigation Schemes in Ethiopia
- Pilot Study on Improving Water Use and Productivity on the Rahad Irrigation Scheme - Sudan

It is important to note here that the above ENIDS documents are considered as regionally approved legitimate resources of ENTRO.

### Supplementary Documents

For the purpose of the current project, supplementary studies may include significant studies conducted by ENTRO since its establishment other than ENID Studies. They are selected particularly to provide baseline and supplementary irrigation related data (list provided below).

- Joint Multipurpose Project (JMP) - One System Inventory (OSI) & JMP-1 Contributors: OSI separate compilation works for Egypt, Ethiopia and Sudan by different consultants on selected themes (water, socio-economic, environment-related compilations) followed by synthesis work for ENB; OSI Kit - interactive CD; Recent study JMP-1 SSEA (Strategic Social and Environmental Assessment) on Abay/Blue -Main Nile, 2011; OSI maps and other documents by ENTRO Staff
- Eastern Nile Watershed Management (ENWM), 2004-2007  
Contributors: various regional and country-based reports and maps prepared by different consultants and ENTRO staff
- Eastern Nile Power Trade (ENPT), 2007-2008.  
Contributors: EDF and Scott Wilson with participation of EPS, Tropics and YAM
- Eastern Nile Flood Preparedness & Warning (ENFPEW), 2006-2010  
Contributors: a number of reports and maps prepared by different consultants and ENTRO staff
- Eastern Nile Planning Model (ENPM), 2006.  
Contributors: Riverside Technology Inc.

Other important documents reviewed other than the above ENTRO projects include:

- Costs and Performance of Irrigation Projects: A Comparison of Sub-Saharan Africa and Other Developing Regions, 2007.  
(IWMI Research Report 109)
- Design, Development and Support in Implementation and Operation of Tana-Beles Basin Information System, 2011.  
(Ministry of Water and Energy, Ethiopia)
- Efficient Water Use in Agricultural Production (EWUAP)  
(NBI; Interactive CD containing national and regional reports)
- Establishment of a GIS and Data Management System at ENTRO, Phase 1: System Design & Development, 2009.  
(Dr. Wim Baastiensen consultancy report for ENTRO)
- Internal Evaluation of Efficient Water Use in Agricultural Production (EWUAP), 2009. (NBI Secretariat, Entebbe, Uganda)
- Nile Basin National Water Quality Monitoring Baseline Study Report for Egypt, 2005. (NBI, Nile Trans-boundary Environmental Action Project)

- Nile DST (Decision Support Tool), 2003.  
(Report and associated software developed by Georgia Water Resources Institute at Georgia Institute of Technology in collaboration with the Nile Basin Nations and Food and Agriculture Organization of United Nations/FAO of UN as part of Nile Basin Water Resources Project)
- Nile Water Science & Engineering Journal, 2010.  
(Publisher: The Nile Capacity Building Network for River Engineering)
- Remote Sensing for DSS in the Nile Basin Water Management: Inventory-Product definition-Way forward, 2008.  
(Dr. Wim Baastiannsen consultancy report for NBI)
- The Nile River Awareness Kit: Interactive CD  
(NBI, Nile Trans-boundary Environmental Action Project)
- The Role of the River Nile in Poverty Reduction and Economic Development in the Region, 2006.  
(The Nile Development Forum Proceedings, UN Conference Center, Addis Ababa)

## **Annex 1: Terms of Reference for the Development of GIS Database for the Eastern Nile Irrigation and Drainage Project**

### **The Nile Basin Initiative (NBI)**

#### **Eastern Nile Subsidiary Action Program (ENSAP)**

#### **Eastern Nile Technical Regional Office (ENTRO)**

#### **Terms of Reference for the Development of GIS database for the Eastern Nile Irrigation and Drainage Project**

### **1. Background**

The Nile Basin Initiative (NBI) is a transitional cooperative mechanism of the riparian states of the Nile.<sup>1</sup> The NBI seeks to reduce poverty, reverse environmental degradation, promote economic growth, and enhance regional peace and security through the achievement of its Shared Vision of “sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources”. To pursue the vision, the NBI launched a Strategic Action Program comprising two complementary sub-programs: the basin-wide Shared Vision Program (SVP) and the Subsidiary Action Program (SAP) to initiate investments at the sub-basin levels of the Nile Equatorial Lakes (NELSAP) and the Eastern Nile (ENSAP).

The NBI has achieved remarkable progress that has already yielded on-the-ground benefits. The governance and institutional structures and processes put in place have provided efficient mechanisms for constructive dialogue, planning and development among the riparian's. Significant investments in the Eastern Nile include the sub-regional Flood Preparedness and Early Warning Project, Eastern Nile Irrigation and Drainage Study, EN Watershed Management, EN Power Trade Study and the Ethiopia-Sudan Power Supply Interconnection Project.

#### **1.1 Eastern Nile Irrigation and Drainage Study (ENIDS)**

The Eastern Nile Irrigation and Drainage Study (ENIDS) is part of the Fast track project identified by ENSAP and is intended to contribute to the enhancement of food security and reduction of rural poverty. The project was funded by the African Development Bank with a total grant of 2.6 Million and the project was completed on 2010. The project has two major components. These are engineering component and Cooperative Regional Assessment (CRA) component.

The Engineering study has three phases. These are Inception, Diagnostics study phase and feasibility level phase. The diagnostics phase focused on the identification of fast

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<sup>1</sup> The NBI states include Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. Eritrea currently participates as Observer.

track projects in each of the three EN countries (up to 15,000 ha to be studied at feasibility level). The outcome of the multi-criteria analysis which was performed as part of the diagnostic study is the recommendation of two pilot projects in Ethiopia and Sudan for feasibility level study. These are Dinger Bereha project in Ethiopia and Wad Miskeen in Sudan. The detailed feasibility studies were conducted for both of the two projects as part of phase 3 of the engineering component.

The Cooperative Regional Assessment (CRA) was geared at enhancing the understanding of benefits and costs accruing to irrigation and drainage projects across the sub-basins countries. The CRA developed guidelines for the selection of irrigation projects having regional interest. From an institutional perspective, the outcome of the CRA study is a detailed assessment of the EN countries' policies for rural development, and identification of the appropriate institutional and legislative reforms for enhanced cooperation among the Eastern Nile countries for the medium and long term. The CRA study analysis was conducted on three phases. Phase 1 (Transboundary analysis) which focus on identifying the challenges and opportunities associated with irrigation development and management in the EN; Phase 2 (Distributive Analysis) was intended to i) analyse the distribution of costs and benefits likely to accrue to alternative irrigation and drainage scenarios, and ii) produce a suite of irrigation and drainage development scenarios; and Phase 3 (Institutional Analysis) which was intended to identify and examine the institutional implications of equitable, sustainable irrigation and drainage development in the Eastern Nile. This in turn is intended to reveal the institutional strengthening implications for current and future cooperative management of the Nile Basin.

## **2. Rationale and Objectives of the Consultancy Services:**

### **2.1 Rationale**

Significant knowledge was produced as part of the ENIDS. This include: (a) Detailed EN Irrigation projects profiles; (b) unit costs and cost estimates for irrigation infrastructures in the EN region; (c) Benefit-cost analysis and multi-criteria analysis for a number of existing and proposed irrigation schemes. However, such knowledge is not yet adequately captured and documented to better serve ENTRO and EN countries. In an attempt to mainstream the knowledge produced as part of the ENIDS, ENTRO staff developed the EN Irrigation Tool-Kit which focus on capturing the analytic tools. The irrigation tool-kit is aimed to capture most of the non-spatial data. The Tool-kit provides information about water availability, general guidelines for planning and design of irrigation projects and good practices for irrigation water management. However, the GIS maps and spatial knowledge produced as part of the project is not yet captured and there is a need to establish the GIS project baseline database.

## 2.2 Objectives

The objectives of this consultancy are to:

- Develop the geo-database for the EN irrigation and drainage using the software tools recently procured by ENTRO (ArcGIS Server, SQL Server and other available hardware resources).
- Produce spatial knowledge Products such as Map catalogue for the EN Irrigation and Drainage; and design a web interface for documenting, accessing and presenting the spatial data pertaining to irrigation in the EN region

## 3. Scope of the work and Description of Tasks

### 3.1 Scope of Work

The scope of this consultancy service encompasses two components:

#### *Component 1: Development of the EN Irrigation Geo-database:*

This shall include capturing and organizing the spatial knowledge pertaining to EN Irrigation and drainage; perform analysis and processing of GIS data; and develop meta-database for GIS maps and layers;

#### *Component 2: Development of Web Interface for accessing the Geo-database and Production of Knowledge Product*

This component shall include the design and development of web-base for accessing and presenting the Spatial Knowledge base and the production of knowledge products.

The production of regional and sub-regional maps that adequately summarizes the challenges and opportunities associated with the EN Irrigation development and management and the production of EN Irrigation Catalogue are key deliverables of this assignment.

### 3.2 Description of Tasks

#### *Task 1: Collect, and Organize GIS data*

In this task, the consultant shall collect, compile and organize the spatial data that are relevant to EN Irrigation development and management from the following sources:

- ENTRO Library and Knowledge Base Center
- Ministries of Irrigation and Water Affairs in the three EN countries
- Consultancy firms involved in the ENDIS project studies preparation (BRLi, MCE, Shoracocult, SMEC, etc.)
- Publically available sources such Google Earth, FAO, USGS, etc.

The type of spatial data to be collected would include satellite images, Digital Elevation models (DEMs), GIS Maps layers including shape files, raster files, and Autocad files for irrigation infrastructures and existing proposed irrigation schemes spatial data, maps and reports (both hard and soft copies). The spatial coverage of these data and information shall include both regional and sub-regional data as well as project related data such as Dinger Bereha, Wad Meskin, Tana area projects. The consultant shall then sort-out and arrange the available GIS data and produce inventory list of the available GIS data that are relevant to EN Irrigation project. The inventory list shall include the following data types:

- Relief and Topographic data including DEMs, Contours, etc.;
- Hydrography and hydrology data include: river or stream networks, sub-catchments, meteorological stations, hydrometric stations, etc. ;
- Infrastructure data include (towns, roads, railways, dams, other utilities, etc.);
- Administration data include (countries, states, provinces, regions, weredas, towns, etc.);
- Irrigation & Drainage infrastructures (canalization system and irrigation supply infrastructures, regulators, barrages, existing irrigation schemes, potential irrigation schemes, head works).

It is anticipated that the consultant shall submit an inception report by the completion of this task which outline data gaps and approach to fill in such gaps. In addition the consultant shall describe the methodology and approach for executing the remaining tasks. The set of deliverables for Task 1 shall include:

- Inventory list and presentation of the available data;
- Data gaps and procedure for filling these gaps;
- New data to be produced or generated if necessary (digitizing basic physical features, buy maps and scan, etc.)
- Well defined data directory structure prepared and presented;
- Proposed approach for designing the geodatabases and organization of data by themes

### **Task 2: Preliminary processing of the GIS data**

In this task, the consultant shall carry out preliminary analysis and processing of GIS data, which include the following activities:

- Terrain Processing and digitizing the relevant topographic and hydrographic features which include irrigation infrastructures such as canalization systems for large scale schemes;
- Data categorization (vector, raster, etc.)
- Geometry of shape files
- Spatial coverage of necessary GIS data
- Attribute data for key features
- Projection (coordinate system), etc.

It is anticipated by the completion of this task, the consultant shall produce Demo version of the Knowledge products which include the followings:

- Short-video showing the relief of the basin, particularly on the Abbay/Blue Nile river System, the important tributaries and the adjacent landscape;
- Short video showing the main irrigation schemes using satellite images as base map

### *Task 3: Configuration of Web Map Server and Development of the Geodatabase*

ENTRO has procured Standard Enterprise ArcGIS Server that has spatial database engine which works with PostgreSQL or SQL Server to handle enterprise level Geodatabase. ArcGIS Server has also web mapping capabilities to disseminate spatial data/maps using web technologies. Both ArcGIS Server and SQL Server will be installed and configured on ENTRO database server to work with web interface to be developed under Task 4.

The datasets collected and compiled from Tasks 1 and 2 shall be organized and documented in a Geodatabase using spatial database engine and SQL Server/ PostgreSQL. The envisaged Geodatabase shall involve well-structured and thematically organized feature datasets, raster catalogs, feature classes, raster datasets, toolboxes and other objects. All the elements of the Geodatabase shall be documented using metadata editor tool available in ArcGIS desktop. In general, the Geodatabase shall include the all datasets produced as part of the ENIDS studies and other Irrigation relevant spatial data compiled as part of Task 1.

### *Task 4: Development of Web Interface to Documents and Maps*

In this task, simple web interface shall be developed that help link to all the knowledge products, tools and maps to aid users navigate through the knowledge base. HTML based Map documents shall be published using ArcGIS Server to ENTRO Intranet.

### *Task 5: Production of Knowledge Products and Outreach Materials*

The set of knowledge products to be delivered as part of this consultancy shall include:

- Production of EN Irrigation Map Catalogue
- Metadatabase Report
- Outreach materials in terms of short-videos showing the relief, major irrigation schemes and irrigation infrastructures in the EN sub basins.

## **4. Time Frame**

The consultancy service, as detailed in the tasks described above, shall be completed within a period of 4 calendar months from commencement. This period includes the time for review and approval of draft reports).



## **5. Consultant Qualifications**

The consultant shall have a minimum of Bachelor degree in Information Technology and GIS applications with minimum of 5 years work experience on:

- Recognized technical expertise in Geodatabase development and GIS application in water resources planning and development;
- Experience from similar assignments (such as previous involvements on the ENID studies preparation) is desirable;
- Experience with database management systems such as PostgreSQL is desirable.
- Operational experience on a multi-server area network.

## **6. Level of Effort and Remuneration**

The total level of effort encompasses 80 working days and the consultant shall receive a day rate USD, resp. Birr. ENTRO will cover all reimbursable costs relating to travel for purposes of the consultancy service.

## **7. Administration**

The contract is formally administered by GIZ. The Consultant shall report to ENTRO on technical issues through the Senior Water Resources Planner/Head. All deliverables listed shall be first sent to the Senior Water Resources Planner and ENTRO will be coordinating the review process and quality assurance jointly with GIZ. During the inception the consultant is expected to spend time as necessary at ENTRO to consult with staff on the requirement analysis and need assessment.

## Annex 2: ENTRO & NBI Information Resources

Essential ENID study documents, regional baseline data (such as catchment and infrastructure), and irrigation and drainage related data of Ethiopia, Sudan, and Egypt are required for the development of ENID KBase (including the ENID Geodatabase) and creation of knowledge products. Some of the available ENTRO & NBI information resources from which the current project benefited include:

- ***ENTRO shared networked storage:***

This refers to shared data stored on ENTRO's networked storage, which can be accessed through servers such as ENTROKBASE, ENTRO-KBASE2 and others. Relevant data (study documents, RS-GIS datasets, maps, tools, etc.) have been taken from, and essential software installed on, these servers. Collected data and information pertinent to this project are presented in various places of this report (main document and annexes).

- ***ENTRO Intranet & ENSAP Website:***

ENTRO Intranet is an internal document management and record keeping system developed to serve internal users such as ENTRO Staff, library users and other permitted visitors. This intranet has been set-up to help encourage interaction among staff, improve efficiency and share information, among others. The network is controlled and managed by ENTRO IT staff. It can be accessed through the local area network (LAN) using a web browser (URL: <http://entrokbase/>). As part of the current consultancy service, selected text contents and maps have been recently uploaded on the Irrigation and Drainage (I&D) section.

On the other hand, ENSAP website developed by ENTRO, is accessible for public use. It can be accessed through the World Wide Web by navigating to <http://ensap.nilebasin.org/> (link also provided on the intranet). This site provides essential information about the several ENSAP projects, some of the socio-economic developmental works in the EN countries and some of available knowledge resources. Also offered therein are recent news, interviews, press releases, etc. It has been recently updated by ENTRO's Social Development and Communication Unit and IT staff members.

- ***ENTRO Library:***

Studies conducted by ENTRO (such as ENIDS, ENFPEW, ENWM, ENPT, JMP-OSI, etc.) and other pertinent documents are available in the library, mostly as hard copies (some project study documents are also available electronically). The library has also registered access to scientific journals from ENTRO through IP sensitive subscription. Catalogue for ENTRO documents and other reference text books is provided as a link on the ENTRO Intranet-library section that offers a list of available materials.

- ***Nile DSS:***

Nile DSS (Decision Support System) is one of the components of Water Resources Planning and Management (WRPM) project, currently active within the NBI project office in Addis Ababa. Some spatial and related non-spatial data relevant to this current project as well as for future use have been made available after an official request made by ENTRO. Data provided include validated watershed boundaries, hydro-meteorological time series data (from Ethiopian Master Plans, Nile DST and The Nile Basin Encyclopedias with rainfall & river discharge data), few NBI previous studies, downloaded remote sensing data, etc.

- ***Nile-IS:***

Nile-IS is a web-based information system (IS) developed and recently launched by NBI-Sec together with WRPM project. The extranet can be accessed over the World Wide Web by navigating to <http://nileis.nilebasin.org>. This system is required to provide a mechanism for systematic storage, retrieval, exchange and analysis of relevant Nile Basin information. The network is being administered by NBI-Sec IT staff in Entebbe, Uganda. Recent calls for participation have been forwarded to ENTRO to contribute contents to various sections and also provide suggestions and comments. It is envisaged that some necessary text contents, maps and knowledge products are selected from the ENID KBase to be uploaded on the system upon approval of the documents.

- ***The Internet and Publicly Available Data:***

Publicly, readily and freely available data on the internet include global, regional and project-based RS-GIS datasets relevant to this project. Other materials made available for use include application software, tools, manuals, etc. Potential sources for some known global and regional RS-GIS datasets have been provided in Dr. Wim Baastiannsen reports and in few other reports available in ENTRO library and staff offices (see Chapter 8). There are still quite a lot of freely and commercially available RS-GIS data to be downloaded from various sources depending on our future requirements.

- ***ENTRO & NBI Staff Knowledge:***

Quite a number of studies have been conducted and huge data collected for Nile basin countries since the establishment of ENTRO and NBI. Consultations with ENTRO & NBI staff members greatly helped in identifying certain data sources and obtaining key information. It is important to note here that the information gathered have been used in capturing selected thematic-data related to I&D for the present KBase development.

## Annex 3: ENID RS-GIS Data: Inventory List and Description

### List and Description of ENID RS-GIS Datasets

#### A. Base Maps

#### Raster Catalog Name: ENID\_BM\_DEMs

#### DEMs (Digital Elevation Models)

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_AB_dem	Abay basin digital elevation model (DEM); resolution 50m	Raster dataset; ESRI grid	UTM 37N_WGS 84	Value (important field for elevation classification)	Data collected for ENIDs; resampled from SRTM 90m to 50m resolution
2	ENID_EN_dem	Eastern Nile digital elevation model (DEM); source is SRTM (Shuttle Radar Terrain Mission); resolution 90m	Raster dataset; ESRI grid	GCS_WGS 84	Value (important field for elevation classification)	Publicly available DEM dataset; requires checking whether corrections like gap/sink infilling have been carried out or not

#### Raster Catalog Name: ENID\_BM\_Landsat\_2000

#### Satellite Imageries

No	Name of the data/file	General description	Data type	Coordinate system	Spatial Resolution	Remarks
1	N-34-05_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 35N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
2	N-35-00_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 35N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
3	N-35-10_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 35N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
4	N-35-15_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 35N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
5	N-35-20_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 35N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
6	N-35-25_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 35N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
7	N-36-00_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
8	N-36-05_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
9	N-36-10_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
10	N-36-15_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
11	N-36-20_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
12	N-36-25_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset

13	N-36-30_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 36N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
14	N-37-05_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 37N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
15	N-37-10_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 37N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
16	N-37-15_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 37N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
17	N-38-00_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 38N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
18	N-38-05_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 38N_WGS 84	14.25m; pan-sharpened	Publicly available dataset
19	N-38-10_2000.sid	Landsat 7, year 2000 imagery; ETM+ bands 7 4.2 composite	Raster dataset; Sid / .sid	Mr UTM 38N_WGS 84	14.25m; pan-sharpened	Publicly available dataset

**Other Basemaps**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_ADM_AFR_countries.shp	African countries (political boundary as of year 2003); boundaries are not authoritative	ESRI Shp file; polygons	GCS_WGS 84	Name1 (important field for labeling), name2, area	Publicly available dataset (unknown source); political boundaries as of year 2003; boundaries are not authoritative; does not include recent changes
2	ENID_ADM_WRI_countries.shp	World countries; boundaries are not authoritative	ESRI shp file; polygons	GCS_WGS 84	Placename (labeling field)	Publicly available dataset (unknown source); political boundaries before 2010; boundaries are not authoritative; does not include recent changes
3	ENID_RLF_ENB_shaded_relief.tif	Eastern Nile basin shaded relief raster dataset; show the landscape in 3D; elevation data not available - values are rather from the shaded relief type as RGB	Raster dataset; tiff	GCS_WGS 84	Not applicable	Data from ENTRO archive; can be used as a basemap but does not allow elevation classification

Note:

See Physical Environment for ENID\_RLF data

See Socio-Economic Environment for ENID\_ADM data

**B. Physical Environment**

**Feature Dataset Name: ENID\_PhEnv**

**Hydrography & Hydrology (catchment boundary datasets, surface water-body datasets, and climatic and hydrometric gauging station datasets)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_HYD_AB_lakes_&_reservoirs.shp	Lakes and reservoirs of Abay basin	ESRI Shp file; polygons	GCS_WGS 84	Area, perimeter, island (code numbers) and name (names of the lakes and reservoirs except for the islands)	The geometry of the lakes (during wet and dry seasons) and the scale of digitizing need to be checked
2	ENID_HYD_AB_rivers_1.shp	Network of rivers and streams of Abay basin	ESRI shp file; polygons	GCS_WGS 84	River ID, level (1-4; important for showing the network on maps as main stream Abay, significant tributaries, and relatively smaller streams)	Data collected for ENIDS; important attribute field for mapping provided
3	ENID_HYD_AB_rivers_2.shp	Network of rivers and streams of Abay river basin; digitized from satellite imagery (Landsat?)	ESRI Shp file; polylines	GCS_WGS 84	River name (names of significant rivers and streams)	Data collected for ENID Studies; data generator to be identified
4	ENID_HYD_AB_rivers_3.shp	Network of major rivers and streams of Abay basin; subset of ENID_AB_rivers_1.shp (names included for selected river/stream segments)	ESRI shp file; polylines	GCS_WGS 84	River ID, level (1-4; important for showing the network on maps as main stream Abay, significant tributaries, and relatively smaller streams); names included for significant rivers/streams	Data collected for ENID Studies; important attribute field for mapping provided
5	ENID_HYD_AB_sub-catchments_1.shp	Sub-catchments of Abay basin	ESRI shp file; polygons	GCS_WGS 84	Area, subleg (names of the sub-basins as sub-legend)	Sub-catchment boundaries delineated similar to the Abay Master Plan Study
6	ENID_HYD_AB_sub-catchments_2.shp	Sub-basins of Abay basin delineated for modelling exercise	ESRI shp file; polygons	GCS_WGS 84	Sub-basin (name sj, area and sub-codes (subbasins code letters))	Sub-catchment boundaries delineated for modelling exercise; sub-catchment divisions differ from the Abay MP
7	ENID_HYD_EA_wetlands.shp	Wetlands in East Africa (part of Sudan, Ethiopia, Kenya, Uganda, part of Tanzania, part of Zaire)	ESRI shp file; polygons	GCS_WGS 84	Area, perimeter, class & classtx (code and text description), name & decrip	Data collected from ENTRO for ENIDS GIS works; attribute table fields needs editing
8	ENID_HYD_EGY_climatic_stations.shp	Climatic stations in Egypt; also included are few stations outside Egypt	ESRI shp file; points	GCS_WGS 84	Datatype, stationname(labeling field), x,y, data_param_e, data, current_st, numrecords, remarks	Data collected from WRPMP project (Nile DSS)
9	ENID_HYD_EGY_hydrometric_stations.shp	Hydrometric stations (stream gauging stations) in Egypt	ESRI shp file; points	GCS_WGS 84	Station (names of the stream gauging stations), lat, long	Data collected from ENTRO; update the status of the stations
10	ENID_HYD_EGY_rivers.shp	Network of rivers and streams in Egypt	ESRI shp file; polylines	GCS_WGS 84	Length, dlnhtype (coded number s, important field to classify)	Data collected from ENTRO for ENIDS GIS works; attribute table fields needs editing; does not show the two branches of the Nile in the deltaic region
11	ENID_HYD_EGY_wetlands.shp	Wetlands in Egypt; included are rivers, lakes, reservoirs and other bodies	ESRI Shp file; polygons	GCS_WGS 84	Area, perimeter, dhnptype & dlnhtstat (coded number s, important field to classify different levels of rivers/streams)	Data collected from ENTRO for ENIDS GIS works; attribute table fields needs editing; requires checking irrigation areas in the delta region included as part of the wetland database
12	ENID_HYD_ENB_lakes_&_reservoirs.shp	Lakes and reservoirs of Easter Nile basin	ESRI Shp file; polygons	GCS_WGS 84	Name (names of some rivers is provided), bufferedst (given therein are buffer distances for the reservoirs)	Data collected from ENTRO for ENIDS (CRA map preparation); requires identifying the original source of the data; check the geometry (see buffer zone in the attribute table)

13	ENID_HVD_ENB_rivers_1.shp	Network of rivers and streams of Eastern Nile basin	ESRI shp file; polylines	GCS_WGS 84	Name (labeling field; names of some important rivers provided)	Data collected from ENTRO for ENID Studies
14	ENID_HVD_ENB_rivers_2.shp	Network of rivers and streams of Eastern Nile basin	ESRI shp file; polylines	GCS_WGS 84	R_name (labeling field); names of the rivers/streams provided for most stream segments	Data collected from WRPMP project (Nile DSS); the stream network of Dinder and Rahad requires checking and editing
15	ENID_HVD_ENB_rivers_3.shp	Network of rivers and streams of Eastern Nile basin (modified version of the ENID_ENB_rivers_1)	ESRI shp file; polylines	GCS_WGS 84	Name (names of some rivers provided)	Data collected from ENTRO for ENIDS; requires checking the geometry of the river segments
16	ENID_HVD_ENB_sub-basins.shp	Eastern Nile sub-basins	ESRI shp file; polygons	GCS_WGS 84	Subbasin (names)	Data collected from ENTRO for ENIDS (CRA map preparation)
17	ENID_HVD_ENB_wetlands.shp	Wetlands (rivers, lakes, reservoirs, swamps, marshy areas, frequently inundated areas, etc) of the Eastern Nile basin and its immediate vicinity	ESRI shp file; polygons	GCS_WGS 84	Nam (not complete), Hyc (important field to classify lakes & reservoirs from other wetland types)	Data collected from ENTRO archive; publicly available dataset
18	ENID_HVD_ETH_climatic_stations	Climatic stations in Ethiopia	ESRI shp file; points	GCS_WGS 84	Subbasin, stationid, stationnam, dataparame, startdate, enddate, currentsta, latitude, longitude	Data collected from WRPMP project (Nile DSS); needs to check some of the locations of stations (some stations purposefully located outside the basin)
19	ENID_HVD_ETH_hydropmetric_stations_1.shp	Hydropmetric stations (stream gauging stations) in Ethiopia	ESRI shp file; points	GCS_WGS 84	Stationid, stationnam, dataparame, startdate, currentsta, lat, long, x, y	Data collected from WRPMP project (Nile DSS)
20	ENID_HVD_ETH_hydropmetric_stations_2.shp	Hydropmetric stations (stream gauging stations) in Ethiopia	ESRI shp file; points	GCS_WGS 84	Catchm_1, stn_no, riv_lake, site, remark, rivername, etc	Data collected during ENIDS works; data from Ministry of Water and Energy of Ethiopia (modified)
21	ENID_HVD_ETH_hydropmetric_stations_3.shp	Hydropmetric stations (stream gauging stations) in Ethiopia	ESRI shp file; points	GCS_WGS 84	Num, river, lat, long	Abay Master Plan data; requires updating the status of the stations
22	ENID_HVD_ETH_inland_water.shp	Inland water bodies of Ethiopia	ESRI Shp file; polygons	GCS_WGS 84	Type, desc & dtype (text description and number code for perennial and non-perennial)	Data collected from ENTRO for ENIDS GIS works; requires identifying the original source of the data; attribute table fields needs editing (few errors such as a perennial marshy area in the rift valley designated as non-perennial)
23	ENID_HVD_NB_wetlands.shp	Wetlands (rivers, lakes, reservoirs, swamps, marshy areas, frequently inundated areas, etc) of the Nile basin and its vicinity	ESRI shp file; polygons	GCS_WGS 84	Nam (not complete), Hyc (important field to classify lakes & reservoirs from other wetland types)	Data from ENTRO archive; publicly available dataset
24	ENID_HVD_SDM_climatic_stations.shp	Climatic stations in Sudan (few stations in neighbouring countries)	ESRI shp file; points	GCS_WGS 84	Stationnam, latitude, longitude, stationalt, current_st	Data collected from WRPMP project (Nile DSS)
25	ENID_HVD_SDM_hydropmetric_stations.shp	Hydropmetric stations (stream gauging stations) in Sudan	ESRI shp file; points	GCS_WGS 84	Nationalid, name, latitude, longitude, type, startdate	Data collected from WRPMP project (Nile DSS)
26	ENID_HVD_SDM_rivers.shp	Network of rivers and streams of the Blue Nile, White Nile and Main Nile system in north and south Sudan, and its immediate vicinity (neighbouring countries)	ESRI shp file; polylines	GCS_WGS 84	Length, WBSUDSPC_1 code (field that help to classify the river into segments of Main Nile, Blue Nile, White Nile, Abbara river, etc and their tributaries during mapping)	Publicly available dataset (important attribute field for mapping provided); rivers/streams extend into neighbouring countries beyond Sudan's boundary
27	ENID_HVD_SDM_reservoirs.shp	All reservoirs in Sudan	ESRI shp file; polygons	GCS_WGS 84	Name (important field for labeling), bufferedist (buffer distance included as numbers)	Data collected from ENTRO for ENIDS GIS works; buffer distances not consistent
28	ENID_HVD_IB_rivers.shp	Network of rivers/streams of Rekeze basin	ESRI shp file; polylines	GCS_WGS 84	flw_cod (field that help to classify the river/stream system into different level); name (names for some important rivers/streams provided)	Data collected from ENTRO for ENID Studies

**Geology (country & watershed-based geological datasets)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_GEO_EGY_geology.shp	Geology of Egypt; lithological units	ESRI shp file; polygons	GCS_WGS 84	Geology, min_faocda, min_vegeta, attribute table cleaning required (lithologic description not provided, unknown codes, etc.)	Data collected from ENTRO archive; publicly available dataset; requires some description for coded fields
2	ENID_GEO_ETH_geology.shp	Geology of Ethiopia; lithological units	ESRI shp file; polygons	GCS_WGS 84	ID, code (important field for classification)	Data extracted from Geological Map of Ethiopia (Ethiopian Geological Survey, 1:2,000,000 scale map)
3	ENID_GEO_SDN_geology.shp	Geology of Sudan; lithological units	ESRI shp file; polygons	GCS_WGS 84	Geology, min_faocda, min_vegeta, geol_name (important field for classification & legend)	Data collected from ENTRO archive; publicly available dataset; requires some description for coded fields
4	ENID_GEO_EMB_lithologic_units	Geology of the Eastern Nile Basin; lithological units	ESRI shp file; polygons	GCS_WGS 84	Mapunit, Dom1, Geology_su (important field for classification), landscape	Data from ENTRO Archive; publicly available dataset

**Landcover (country & watershed-based landcover datasets)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_LCO_AB_landcover.shp	Abay basin landcover	ESRI shp file; polygons	GCS_WGS 84	Cult, irrig, statfarm, urban, class (field for classification)	Landcover classification by Abay Master Plan study
2	ENID_LCO_TB_landcover.shp	Tekeze basin landcover	ESRI shp file; polygons	GCS_WGS 84	cultiv2, natveg, natvegnew (coded fields for classification)	Data collected for ENIDS; checked data with Tekeze Master Plan study; requires some text explanation for coded units
3	ENID_LCO_SDN_landcover.shp	Landcover classes of Sudan; extracted from publicly available FAO Africover landcover dataset; country boundary not authoritative	ESRI shp file; polygons	GCS_WGS 84	Lc_id, lc_desc, disp_desc (important fields for classification and labeling)	Publicly available FAO Africover landcover dataset; description for coded fields included in the attribute table
4	ENID_LCO_EGY_landcover.shp	Landcover classes of Egypt; extracted from publicly available FAO Africover landcover dataset; country boundary not authoritative	ESRI shp file; polygons	GCS_WGS 84	Lc_id, lc_desc, disp_desc (important fields for classification and labeling)	Publicly available FAO Africover landcover dataset; description for coded fields included in the attribute table
5	ENID_LCO_WRL_landcover	Global landcover classes of Globcover2009 (publicly available dataset); legend layer file (.lyr) available for landcover classification	Raster file; tiff	GCS_WGS 84	Value; use landcover classification layer to display the different classes and their description	Publicly available Globcover2009 landcover raster dataset; legend layer (.lyr) used for classification
6	ENID_LCO_WRL_terrestrial_ecoregions.shp	Global terrestrial ecoregion classification (publicly available dataset); legend layer file (.lyr) available for ecoregion classification	ESRI shp file; polygons	GCS_WGS 84	Eco_name (main classification and labeling field), G2000_regio_area_km2	Publicly available terrestrial ecoregion dataset; legend layer (.lyr) used for classification

**Relief (dataset of landscape type, shaded relief, slope and other related data)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_RLF_AB_slope.tif	Abay basin slope raster dataset	Raster file; tiff	GCS_WGS 84	Value, binvalues	Re-projected Abay basin slope raster dataset; data generated for the Abay Master Plan study; requires a legend layer file
2	ENID_RLF_EN_hillshade	Eastern Nile hillshade processed from SRTM EN DEM; resolution 90m	Raster dataset; ESRI grid	GCS_WGS 84	Value (hillshade value)	Processed from publicly available DEM dataset; values are hillshade values not elevation data



3	ENID_RLE_EN_landscape	Landscape units extracted from SEA database for Eastern Nile countries	ESRI shp file; polygon	GCS_WGS 84	Mapunit, DOM1, FAOCLASS, shape_area, etc	Data taken from ENTRO archive; data originally from SEA database (publicly available dataset)
4	ENID_RLE_ENB_shaded_relief.tif	Eastern Nile basin shaded relief raster dataset; show the landscape in 3D; elevation data not available - values are rather from the shaded relief type as RGB	Raster dataset; tiff	GCS_WGS 84	not-applicable	Data from ENTRO archive; can be used as a basemap but does not allow elevation classification

**Soils (soil datasets)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_SOL_EGY_soil_units.shp	Soils of Egypt (soil units)	ESRI shp file; polygons	GCS_WGS 84	Soil unit (different classifications); table's joining required for classification	Extracted from publicly available dataset
2	ENID_SOL_ETH_soil_units.shp	Soils of Ethiopia (soil units)	ESRI shp file; polygons	GCS_WGS 84	Soil unit (different classifications); table's joining required for classification	Extracted from publicly available dataset
3	ENID_GEO_SDN_soil_units.shp	Soils of Sudan (soil units)	ESRI shp file; polygons	GCS_WGS 84	Soil unit (different classifications); table's joining required for classification	Extracted from publicly available dataset

**C. Socio-Economic Environment**

**Feature Dataset Name: ENID\_SocioEcoEnv**

**Irrigation Schemes (datasets of existing and potential irrigation schemes)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_IRR_AB_existing_irrigation_schemes	Existing large-scale irrigation schemes in Abay Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	USBR code, name_of_p, type_of_w, river_conc, subbasin, gross_comm, net_area, water_requ, status	Data collected for ENIDS with irrigation schemes noted using USBR Blue Nile/Abay study conducted in the 60's; boundaries of the irrigation schemes need to be updated when better resolution satellite images are obtained
2	ENID_IRR_AB_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Abay Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	USBR code, name_of_p, type_of_w, river_conc, subbasin, gross_comm, net_area, water_requ, status	Data collected for ENIDS; potential irrigation schemes identified during the USBR Blue Nile (Abay) study conducted by the USBR to the Imperial Ethiopian government in the 60's and appraised during the Abay MP study in the late 90's; requires updating the status of the schemes
3	ENID_IRR_BAB_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Baro-Akobo Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	Area, perimeter, irr3(coded numbers)	Potential irrigation schemes identified during the Baro-Akobo MP study conducted in the late 90's by Ethiopian government
4	ENID_IRR_EGY_existing_irrigation_schemes	Existing irrigation schemes in Egypt	ESRI Shp file; polygons	GCS_WGS 84	FS; requires adding other relevant data in the attribute table	Extracted from data collected from Nile-Sec (State of the Basin report preparation); may require adjusting the irrigated areas based on large-canal command areas when more data/info is collected
5	ENID_IRR_EGY_existing_irrigation_schemes	Existing irrigation schemes in Egypt; lacks some of the irrigation schemes in the eastern part of the deltaic region	ESRI Shp file; polygons	GCS_WGS 84	Userlabel, lccode & lcclevel (coded letters and numbers); see Africover's user label abbreviation list	Created by selecting the irrigated areas from Egypt landcover data (acquired from the Africover database; included types are "cultivated terrestrial" and "cultivated aquatic or regularly flooded areas"); lacks some of the irrigation schemes in the eastern part of the deltaic region
6	ENID_IRR_EGY_existing_irrigation_schemes	Existing irrigation schemes in Egypt; same as ENID_EGY_existing_irrigation_schemes_2 but with inclusion of El-Salam west scheme from other database	ESRI Shp file; polygons	GCS_WGS 84	Userlabel, lccode & lcclevel (coded letters and numbers), name; see Africover's user label abbreviation list	Created by selecting the irrigated areas from Egypt landcover data (acquired from the Africover database; included types are "cultivated terrestrial" and "cultivated aquatic or regularly flooded areas") and by adding El-Salam west scheme from other database as it lacks some of the irrigation schemes in the eastern part of the deltaic region
7	ENID_IRR_EGY_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Egypt	ESRI Shp file; polygons	GCS_WGS 84	Name; requires adding other relevant data in the attribute table	Created during the present project by merging together the Toshka, El-Salam and West Delta potential irrigation schemes in Egypt; individual schemes digitized from available small-scale hardcopy maps during the ENID CRA studies
8	ENID_IRR_ETH_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes of Ethiopia in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS 84	USBR code, name_of_p, type_of_w, river_conc, subbasin, gross_comm, net_area, water_requ, status	Created by merging together the potential irrigation schemes in Abay, Tekeze and Baro-Akobo basins; attribute table cleaning required (harmonizing data from different sources)

9	ENID_IRR_NB_irrigated_areas_unrefined	Irriated areas in the Nile Basin extracted from satellite imageries using remote-sensing techniques; unrefined hence requires serious editing with ground truthing	ESRI Shp file; polygons	GCS_WGS 84	ID; attribute table cleaning required as important fields in the attribute table are not filled out; require grouping of entities to name schemes	Data collected from WRPAM project (Nile DSS); extracted from satellite imageries using remote-sensing techniques; data rated as unrefined hence requires serious editing with ground truthing (e.g. rain-fed agriculture areas reported as irrigated)
10	ENID_IRR_SDN_existing_irrigation_schemes_1	Existing large- & medium-scale irrigation schemes of Sudan in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS 84	ID and name (important field but not fully completed)	Digitized existing irrigation schemes from satellite imageries during ENIDS; some of the small schemes lack names in the attribute table; require naming of relatively smaller schemes; regarding the schemes
11	ENID_IRR_SDN_existing_irrigation_schemes_2	Existing large- & medium-scale irrigation schemes of Sudan in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS 84	FS; requires adding other relevant fields in the attribute table	Merging data collected from Nile-Sec (State of the Basin report preparation); data include digitized existing irrigation schemes (medium to large scale small holder irrigation and large scale commercial irrigation) from satellite imageries
12	ENID_IRR_SDN_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes of Sudan in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS 84	Name, remark	Potential irrigation schemes identified by studies made by Sudanese government; created during the present project by merging together the potential irrigation schemes of Sudan in Blue Nile and Abbara sub-basins; boundaries of the potential schemes are approximate - may require updating
13	ENID_IRR_TB_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Tekeze Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	Area, perimeter, potcol, scheme_name	Potential irrigation schemes identified during the Tekeze MP study conducted in the late 90's by the Ethiopian government

**Transport & Communication (datasets of roads, railways, airports/airfields and canals used for transport)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_TRC_AB_roads_1.shp	Road network in the Abay basin	ESRI Shp file; polylines	GCS_WGS 84	Length, type (year)	Data collected for ENIDS; data generated during the Abay Master Plan study
2	ENID_TRC_AB_roads_2.shp	Main roads in the Abay basin	ESRI Shp file; polylines	GCS_WGS 84	Length	Data collected for ENIDS; need to update the attribute table when more information is acquired
3	ENID_TRC_EGY_roads.shp	Road network in Egypt	ESRI Shp file; polylines	GCS_WGS 84	RdIntype, rdIntstat, shape_length	Data collected for ENIDS; publicly available data; need to have the info (in the attribute table) updated when more information is acquired
4	ENID_TRC_EGY_suez_canal.shp	Alignment of the Suez canal (from the Mediterranean Sea up to the Red Sea)	ESRI Shp file; polygons	GCS_WGS 84	Id	Data generated for ENID Studies; alignment of the Suez canal digitized from Landsat imagery (2000)
5	ENID_TRC_ENB_airports.shp	Airports/airfields in Eastern Nile basin	ESRI Shp file; points	GCS_WGS 84	nam, namdesc (labeling fields), usedescr (provide the use)	Data collected for ENIDS from ENTRO archive; publicly available dataset
6	ENID_TRC_ETH_roads_1.shp	Road network of Ethiopia in the Eastern Nile basin	ESRI Shp file; polylines	GCS_WGS 84	Etroad01_1_type, class (important fields for classification of road segments), length	Data extracted from Ethiopian road network dataset for EN basin
7	ENID_TRC_ETH_roads_2.shp	Road network of Ethiopia	ESRI Shp file; polylines	GCS_WGS 84	Etroad01_1_type, class (important fields for classification of road segments), source_shp, length	Data collected for ENIDS; data compiled from Woody Biomass Project (Ethiopia), and Eth roads digitized data (source of each segment provided in the attribute table)
8	ENID_TRC_NB_airports.shp	Airports/airfields in Nile Basin countries; also includes airports outside of the NB	ESRI Shp file; points	GCS_WGS 84	nam, namdesc (labeling fields), usedescr (provide the use of the airport)	Data collected for ENIDS from ENTRO archive; publicly available dataset
9	ENID_TRC_SDN_railways.shp	Main railways in Sudan	ESRI Shp file; polylines	GCS_WGS 84	RrIntype, rrIntstat, length	Data collected for ENIDS; publicly available data

10	ENID_TRC_SDN_roads.shp	Road network of Sudan	ESRI Shp file; polylines	GCS_WGS 84	Length, speed, cost, type_n (important field for road segment classification)	Data collected for ENIDS; publicly available data
11	ENID_TRC_TB_roads.shp	Road network in Tekeze basin	ESRI Shp file; polylines	GCS_WGS 84	Length, type, class (important field for road segment classification)	Data collected for ENIDS; data source to be investigated by inspecting available country-based studies

**Administration (country and local administrative boundary and city/town/settlement datasets)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_ADM_AB_towns.shp	Major towns in the Abay basin	ESRI Shp file; points	GCS_WGS 84	Origin, name_EMA, name_CSA, name (important field for labeling), electr, pop (year), x_coord, y_coord, airport	Data collected for ENIDS; data generated during the Abay Master Plan study; need to have the info in the attribute table updated when more information is acquired
2	ENID_ADM_AB_urban_areas.shp	Urban areas in Abay basin; digitized from 1:50,000 & 1:250,000 topomaps	ESRI Shp file; polygons	GCS_WGS 84	origine, name_ema, name_csa, name (important fields for labeling), townkey	Data collected for ENIDS; digitized from 1:50,000 & 1:250,000 topomaps (year not provided); data generated by the Abay Master Plan study project
3	ENID_ADM_AFR_countries.shp	African countries (political boundary as of year 2003); boundaries are not authoritative	ESRI Shp file; polygons	GCS_WGS 84	Name1 (important field for labeling), name2, area	Publicly available dataset; political boundaries as of year 2003; boundaries are not authoritative; does not include recent changes
4	ENID_ADM_EGY_governorates.shp	Administrative units (governorate s) of Egypt; boundaries are not authoritative	ESRI shp file; polygons	GCS_WGS 84	Name1_ (labeling field)	Data collected from ENTRO for ENIDS
5	ENID_ADM_EN_capital_cities.shp	Capital cities of Eastern Nile countries	ESRI Shp file; polygons	GCS_WGS 84	Name (important field for labeling), country	Data collected for ENIDS from ENTRO; requires attribute table cleaning (towns population data needs to be given for specific years)
6	ENID_ADM_EN_towns.shp	Major towns of Eastern Nile countries	ESRI Shp file; points	GCS_WGS 84	Lat, long, full_name2 (important field for labeling)	Data collected for ENIDS from ENTRO; requires explanation for some of the fields
7	ENID_ADM_ETH_towns.shp	Towns of Ethiopia	ESRI Shp file; points	GCS_WGS 84	Town_name (important field for labeling), wereda, zone, popurb, popnur, poptot, rain, elevation	Data collected for ENIDS; requires attribute table cleaning; requires explanation for some of the fields (towns population data - urban, rural and total - should be given a specific year)
8	ENID_ADM_SDN_towns.shp	Towns of Sudan; some towns & settlements not included	ESRI Shp file; points	GCS_WGS 84	Name (important field for labeling)	Data collected for ENIDS; requires to check if major towns of Sudan are not missing
9	ENID_ADM_ETH_weredas.shp	Administrative weredas of Ethiopia (as of year 2006); boundaries are not authoritative	ESRI shp file; polygons	GCS_WGS 84	W_name, w_name_new (labeling field)	Data collected from IWMI (International Water Management Institute); provide wereda boundaries and names as of year 2006
10	ENID_ADM_SDN_states.shp	Administrative units (states) of Sudan (before year 2011); boundaries are not authoritative	ESRI shp file; polygons	GCS_WGS 84	Stat_name, name (labeling field); requires limited editing	Data collected from ENTRO for ENIDS; provide administrative unit/state boundaries of Sudan (before year 2011); does not show recent changes
11	ENID_ADM_TB_towns.shp	Towns in Tekeze basin	ESRI Shp file; points	GCS_WGS 84	Name (important field for labeling), type, pop, class	Data collected for ENIDS

**Dams & Reservoirs (datasets of existing and proposed dam sites and associated reservoirs)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
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1	ENID_DAR_AB_dam.s.shp	Existing and proposed/identified dam sites in Abay Basin (Ethiopia); includes hydropower, irrigation and multi-purpose dams	ESRI Shp file; points	GCS_WGS 84	Name, project, status, storage, existing (important fields for labeling and classification)	Data collected for ENID Studies; includes existing and proposed/identified dam sites in Abay basin classified as hydropower, irrigation and multi-purpose; potential sites identified by Land & Water Resources of the Blue Nile/Abay Study (USBR 1964) and Abay Master Plan Study (BCEOM et al.1998)
2	ENID_DAR_BAB_dam.s.shp	Identified/proposed dam sites in Baro-Akobo basin	ESRI Shp file; points	GCS_WGS 84	Name (labeling field), prop	Data collected for ENIDS; includes identified/proposed/planned dam sites from the Baro-Akobo Master Plan study; updating required when more info is acquired
3	ENID_DAR_EGY_dams_&_barrages.shp	Existing dams and barrages in Egypt	ESRI Shp file; points	GCS_WGS 84	Id, x,y, name (important field for labeling), date	Existing dams (high and low Aswan) and a series of barrages on mainstream Nile river and its branches (in the deltaic region) in Egypt; Data collected for ENID Studies from ENTRO; the dates provided in the attribute table need to be checked.
4	ENID_DAR_SDN_existing_dam.s.shp	Existing dams in Sudan	ESRI Shp file; points	GCS_WGS 84	Id, x,y, name (important field for labeling), date	Data collected for ENID Studies from ENTRO; the date provided need to be confirmed correct
5	ENID_DAR_SDN_reservoir.s.shp	Reservoirs in Sudan	ESRI shp file; polygons	GCS_WGS 84	Name (important field for labeling), buffordist (buffer distance included as numbers)	Data collected from ENTRO for ENIDS GIS works; buffer distances not consistent
6	ENID_DAR_SDN_rumela_dam.shp	Rumela dam site; a potential dam site on Albara river	ESRI Shp file; point	GCS_WGS 84	Name (labeling field), desc.; may require to add more info as new fields	Data generated during ENID Studies for map preparation; included with other existing and identified/proposed dam sites in the ENB
7	ENID_DAR_TB_dam.s.shp	Existing and identified/proposed dam sites in Tekeze basin	ESRI Shp file; point	GCS_WGS 84	Dam_id, tektr, prop	Data collected for ENIDS; includes existing and identified/proposed dam sites from Tekeze Master Plan study
8	ENID_DAR_ENB_dam_sites.shp	Existing and identified/proposed/ planned dam sites on mainstream Abay-Nile and Tekeze-Albara in Eastern Nile basin; also included are identified dam sites on White Nile south of Malakal	ESRI Shp file; point	GCS_WGS 84	Object_id, name (labeling field); more info/data to be added as new fields	Data generated by compiling data from WRPM (Nile DSS) and other sources (such as existing and identified/proposed dam sites from USBR 1964, BCEOM et al. 1998 and Coyne et Bellier et al. 1978); includes identified dam sites on White Nile south of Malakal

Demographics ( census, projected estimates and related demographic datasets)						
No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_DMGC_EGAB_wereda_population.shp	Estimate of population (total & gender-based) for each wereda in Abay basin; included are years 2000 & 2008 Central Statistical Agency (CSA) population data; indicative population density values provided (wereda population divided by wereda area in per sons/sq.km); boundaries are not authoritative	ESRI shp file; polygons	GCS_WGS 84	wereda, male, female, ipop2000, densstv, pop_2008, den_2008	Data collected for ENIDS with year 2000 Central Statistical Agency (CSA) population data, updated by the project by including year 2008 data; care should be taken when using the data (wereda's divisions change over time but adopted one is the year 2000 and area percentage [%] used for partially included weredas in the basin for year 2008 data); strongly advised to check with CSA database
2	ENID_DMGC_EGY_governorate_population.shp	Count and estimates of population for each governorate of Egypt; included are census 1996 and estimates years 2001-2005 population data; boundaries are not authoritative	ESRI shp file; polygons	GCS_WGS 84	Name, cems_96, year (2001-2005), code, shape_area	Data collected from ENTRO for ENIDS

**D. Irrigation System**

**Feature Dataset Name: ENID\_IrrSys**

**Irrigation System (datasets of existing and potential irrigation schemes, irrigation infrastructure, cropping pattern, crop water requirements, costs, etc.)**

No	Name of the data/file	General description	Data type	Coordinate system	Important fields in the attribute table	Remarks
1	ENID_IS_AB_existing_irrigation_schemes	Existing large-scale irrigation schemes in Abay Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	USBR code, name_of_p, type_of_w, river_conc, subbasin, gross_comm, net_area, water_requ, status	Data collected for ENIDS with irrigation schemes noted using USBR Blue Nile/Abay study conducted in the 60's; boundaries of the irrigation schemes need to be updated when better resolution satellite imageries are obtained
2	ENID_IS_AB_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Abay Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	USBR code, name_of_p, type_of_w, river_conc, subbasin, gross_comm, net_area, water_requ, status	Data collected for ENIDS; potential irrigation schemes identified during the USBR Blue Nile (Abay) study conducted by the USBR to the Imperial Ethiopian government in the 60's and appraised during the Abay MP study in the late 90's; requires updating the status of the schemes
3	ENID_IS_BAB_potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Baro-Akobo Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	Area, perimeter, irr3 (coded numbers)	Potential irrigation schemes identified during the Baro-Akobo MP study conducted in the late 90's by Ethiopian government
4	ENID_IS_EGY_ELSalam_WestDelta_canals	Irrigation canals of El-Salam and West Delta existing and potential schemes in Egypt	ESRI Shp file; polylines	GCS_WGS 84	Name, Shape_Length	Data generated for Cooperative Regional Assessment (CRA) and Diagnosis and Planning (D&P) studies; digitized from geo-referenced hardcopy maps
5	ENID_IS_EGY_ELSalam_WestDelta_schemes	El-Salam and West Delta existing and potential schemes in Egypt	ESRI Shp file; polygons	GCS_WGS 84	Name, Shape_area	Data generated for Cooperative Regional Assessment (CRA) and Diagnosis and Planning (D&P) studies; digitized from geo-referenced hardcopy maps
6	ENID_IS_EGY_existing_irrigation_schemes_1	Existing irrigation schemes in Egypt	ESRI Shp file; polygons	GCS_WGS 84	FS; requires adding other relevant data in the attribute table	Extracted from data collected from Nile-Sec (State of the Basin report preparation); may require adjusting the irrigated areas based on large-canal command areas when more data/info is collected
7	ENID_IS_EGY_existing_irrigation_schemes_2	Existing irrigation schemes in Egypt; lacks some of the irrigation schemes in the eastern part of the deltaic region	ESRI Shp file; polygons	GCS_WGS 84	Userlabel, lccode & lcclevel (coded letters and numbers); see Africover's user label abbreviation list	Created by selecting the irrigated areas from Egypt landcover data (acquired from the Africover database; included types are "cultivated terrestrial" and "cultivated aquatic or regularly flooded areas"); lacks some of the irrigation schemes in the eastern part of the deltaic region

8	ENID_IS_EGY_existing_irrigation_mes_3_shp	Existing irrigation schemes in Egypt; same as ENID_EGY_existing_irrigation_schemes_2 but with inclusion of El-Salam west scheme from other database	ESRI Shp file; polygons	GCS_WGS84	Userlabel, lccode & klevel (coded letters and numbers), name; see Africover's user label abbreviation list	Created by selecting the irrigated areas from Egypt landcover data (acquired from the Africover database; included types are "cultivated terrestrial" and "cultivated aquatic or regularly flooded areas") and by adding El-Salam west scheme from other database as it lacks some of the irrigation schemes in the eastern part of the deltaic region
9	ENID_IS_EGY_potential_irrigation_mes	Potential large- & medium-scale irrigation schemes in Egypt	ESRI Shp file; polygons	GCS_WGS84	Name; requires adding other relevant data in the attribute table	Created during the present project by merging together the Toshka, El-Salam and West Delta potential irrigation schemes in Egypt; individual schemes digitized from available small-scale hardcopy maps during the ENID CRA studies
10	ENID_IS_EGY_Toshka_canals	Irrigation canals of Toshka scheme in Egypt	ESRI Shp file; poly/lines	GCS_WGS84	Name, Shape_Length	Data generated for Cooperative Regional Assessment (CRA) and Diagnosis and Planning (D&P) studies; digitized from geo-referenced hardcopy maps
11	ENID_IS_EGY_Toshka_scheme	Toshka scheme in Egypt	ESRI Shp file; polygons	GCS_WGS84	Shape_Area	Data generated for Cooperative Regional Assessment (CRA) and Diagnosis and Planning (D&P) studies; digitized from geo-referenced hardcopy maps
12	ENID_IS_ETH_potential_irrigation_mes	Potential large- & medium-scale irrigation schemes of Ethiopia in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS84	USBR code, name_of_p_type_of_w_river_conc, subbasin, gross_comm, net_area, water_requ, status	Created by merging together the potential irrigation schemes in Abay, Tekeze and Baro-Akobo basins; attribute table cleaning required (harmonizing data from different sources)
13	ENID_IS_NB_irrigated_areas_unrefined	Irrigated areas in the Nile Basin extracted from satellite imageries using remote-sensing techniques; unrefined hence requires serious editing with ground truthing	ESRI Shp file; polygons	GCS_WGS84	ID; attribute table cleaning required as important fields in the attribute table are not filled out; require grouping of entities to name schemes	Data collected from WRPM project (Nile DSS); extracted from satellite imageries using remote-sensing techniques; data rated as unrefined hence requires serious editing with ground truthing (e.g. rain-fed agriculture areas reported as irrigated)
14	ENID_IS_SDN_existing_irrigation_mes_1	Existing large- & medium-scale irrigation schemes of Sudan in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS84	ID and name (important field but not fully completed)	Digitized existing irrigation schemes from satellite imageries during ENIDS; some of the small schemes lack names in the attribute table; requires naming of relatively smaller schemes; regarding the schemes
15	ENID_IS_SDN_existing_irrigation_mes_2	Existing large- & medium-scale irrigation schemes of Sudan in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS84	FS; requires adding other relevant fields in the attribute table	Merging data collected from Nile-Sec (State of the Basin report preparation); data include digitized existing irrigation schemes (medium to large scale small holder irrigation and large scale commercial irrigation) from satellite imageries
16	ENID_IS_SDN_Gezira_Managil_canals	Canals of Gezira-Managil irrigation scheme in Sudan	ESRI Shp file; poly/lines	GCS_WGS84	Name, Shape_Length	Digitized from high resolution satellite imageries provided in Google Earth Pro; both sides of each canal digitized in detail
17	ENID_IS_SDN_Meina_pumping_station	Meina pumping station (near Singa town) for Rahad I scheme in Sudan	ESRI Shp file; point	GCS_WGS84	Name	Digitized from high resolution satellite imageries provided in Google Earth Pro

ENID_ID	IS	SDM	NorthWest	Sennar	cana	Canals of North-West Sennar scheme in Sudan	ESRI Shp file; polylines	GCS_WGS 84	Name, Shape_Length	Digitized from high resolution satellite imageries provided in Google Earth Pro; both sides of each canal digitized in detail
19	ENID_IS_SDM	potential_irrigation_schemes	potential_large-&_medium-scale_irrigation_schemes_of_Sudan_in_Eastern_Nile_Basin			Potential large- & medium-scale irrigation schemes of Sudan in Eastern Nile Basin	ESRI Shp file; polygons	GCS_WGS 84	Name, remark	Potential irrigation schemes identified by studies made by Sudanese government; created during the present project by merging together the potential irrigation schemes of Sudan in Blue Nile and Atbara sub-basins; boundaries of the potential schemes are approximate - may require updating
20	ENID_IS_SDM	Rahad_cana	Canals of Rahad I scheme in Sudan; includes the supply canal from Singa to Abu Rakham			Canals of Rahad I scheme in Sudan; includes the supply canal from Singa to Abu Rakham	ESRI Shp file; polylines	GCS_WGS 84	Name, Shape_Length	Digitized from high resolution satellite imageries provided in Google Earth Pro; both sides of each canal digitized in detail
21	ENID_IS_SDM	Rahad_supply_cana	Supply canal (from Meina pumping station near Singa to Abu Rakham) for Rahad I scheme in Sudan			Supply canal (from Meina pumping station near Singa to Abu Rakham) for Rahad I scheme in Sudan	ESRI Shp file; polylines	GCS_WGS 84	Name, Shape_Length	Digitized from high resolution satellite imageries provided in Google Earth Pro; both sides of each canal digitized in detail
22	ENID_IS_SDM	Sennar_intake_sites	Sennar intake sites in Sudan, digitized from high-resolution satellite imageries			Sennar intake sites in Sudan, digitized from high-resolution satellite imageries	ESRI Shp file; polylines	GCS_WGS 84	Name, Shape_Length	Digitized from high resolution satellite imageries provided in Google Earth Pro
23	ENID_IS_TB	potential_irrigation_schemes	Potential large- & medium-scale irrigation schemes in Tekeze Basin (Ethiopia)			Potential large- & medium-scale irrigation schemes in Tekeze Basin (Ethiopia)	ESRI Shp file; polygons	GCS_WGS 84	Area, perimeter, potcol, scheme_name	Potential irrigation schemes identified during the Tekeze MIP study conducted in the late 90's by the Ethiopian government

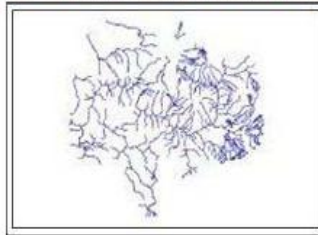
Note: Cropping pattern, crop water requirements and costs are provided as tabular data extracted from the ENID Studies



## Annex 4: Metadata for Selected ENID Feature Datasets

### ENID\_PhyEnv

File Geodatabase Feature Class



#### Tags

ENID, Physical Environment, Geology, Relief, Hydrography & Hydrology, Soils, Land Cover, Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro, Akobo, Sobat

#### Summary

Prepared for Eastern Nile Irrigation and Drainage (ENID) K-Base development project. The ENID Physical Environment (PhyEnv) category comprises main data themes like Geology (GEO), Relief (RLF), Hydrography & Hydrology (HYD), Soils (SOL) and Landcover (LCO).

#### Description

#### Credits

Eastern Nile Technical Regional Office (ENTRO)

#### Access and use limitations

Access and use of the data requires permission from ENTRO.

#### ArcGIS Metadata ►

##### Resource Identification ►

###### CITATION

TITLE ENID\_PhyEnv

PRESENTATION FORMAT digital map

**TAGS FOR SEARCHING** ENID, Physical Environment, Geology, Relief, Hydrography & Hydrology, Soils, Land Cover, Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro, Akobo, Sobat

**PLACE KEYWORDS** Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro, Akobo, Sobat

**THEME KEYWORDS** Physical Environment, Geology, Relief, Hydrography & Hydrology, Soils, Land Cover

**KEYWORDS** 002

**THESAURUS**

ABSTRACT (DESCRIPTION)

ENID PhyEnv Main Data-Themes:a) Geology (GEO) - includes country-based geological vector data extracted from national and publicly available datasets;b) Relief (RLF) - includes datasets of landscape, processed slope data, shaded/colored relief raster datasets and other related data; c) Hydrography and Hydrology (HYD) - include the surface water bodies (rivers, lakes, reservoirs, swamps, marshy areas, etc.), watershed boundaries, and climatic and hydrometric station datasets;d) Soils (SOL) - includes sub-regional country- and watershed-based soil data extracted mainly from publicly available datasets and from basin studies. Soil data generated during ENIDS for FI, FS and Pilot Studies are organized separately;Land Cover (LCO) - includes country-based land-cover and eco-region datasets extracted from publicly available land cover datasets (FAO Africover, Globcover 2009 & Terrestrial Ecoregion). Also included are watershed-based datasets from Abay and Tekeze Master Plan studies.Naming:ENID\_Data-Theme\_Watershed or Country/Region\_Name of the Data; Example: ENID\_HYD\_ENB\_rivers\_1.shp(number at the end indicates the existence of other similar layer); Refer to the ENID Kbase Documentation (available at Eastern Nile Technical Regional Office - ENTRO).

PURPOSE (SUMMARY)

Prepared for Eastern Nile Irrigation and Drainage (ENID) K-Base development project. The ENID Physical Environment (PhyEnv) category comprises main data themes like Geology (GEO), Relief (RLF), Hydrography & Hydrology (HYD), Soils (SOL) and Landcover (LCO).

DATASET LANGUAGES English (UNITED STATES)

DATASET CHARACTER SET utf8 - 8 bit UCS Transfer Format

RESOURCE CONSTRAINTS

CONSTRAINTS

LIMITATIONS OF USE

Access and use of the data requires permission from ENTRO.

SPATIAL REPRESENTATION TYPE vector

PROCESSING ENVIRONMENT Microsoft Windows Server 2008 R2 Version 6.1 (Build 7600) ; ESRI ArcGIS 10.0.2.3200

OTHER EXTENT INFORMATION

GEOGRAPHIC EXTENT

BOUNDING RECTANGLE

\* EXTENT TYPE Extent used for searching

WEST LONGITUDE 33.842972

EAST LONGITUDE 39.514549

NORTH LATITUDE 14.311906

SOUTH LATITUDE 7.099977

\* EXTENT CONTAINS THE RESOURCE Yes

CREDITS

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HOURS OF SERVICE 9:00 - 17:00 Addis Ababa Local Time, Monday – Friday

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CONTACT'S POSITION IT Manager  
CONTACT'S ROLE point of contact

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## Spatial Representation ▼

## Reference System ▼

## Distribution Information ►

DISTRIBUTION FORMAT

FORMAT NAME File Geodatabase Feature Class  
FORMAT VERSION unknown

TRANSFER OPTIONS

TRANSFER SIZE 0.001

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## Metadata Details ►

METADATA LANGUAGE English

METADATA CHARACTER SET utf8 - 8 bit UCS Transfer Format

SCOPE OF THE DATA DESCRIBED BY THE METADATA dataset

SCOPE NAME dataset

**METADATA CONTACT**

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HOURS OF SERVICE 9:00 - 17:00 Addis Ababa Local Time, Monday - Friday  
LAST UPDATE 2011-11-10  
MAINTENANCE  
UPDATE FREQUENCY as needed

NAME OF THE METADATA STANDARD USED ArcGIS Metadata  
VERSION OF THE METADATA STANDARD 1.0

*Hide ▲*

**ESRI Metadata and Item Properties ▼**

**ESRI Spatial Information ►**

**EXTENT IN THE ITEM'S COORDINATE REFERENCE**

**BOUNDING RECTANGLE**  
\* WEST LONGITUDE -179.999989  
\* EAST LONGITUDE 588839.625000  
\* NORTH LATITUDE 1623869.500000  
\* SOUTH LATITUDE -89.891973  
\* EXTENT CONTAINS THE RESOURCE Yes

**COORDINATE REFERENCE**

TYPE **Geographic**  
GEOGRAPHIC COORDINATE REFERENCE GCS\_WGS\_1984  
COORDINATE REFERENCE DETAILS  
GEOGRAPHIC COORDINATE SYSTEM  
WELL-KNOWN IDENTIFIER 4326  
X ORIGIN -399.9999999999989  
Y ORIGIN -399.9999999999989  
XY SCALE 100000000.0000001  
Z ORIGIN -100000  
Z SCALE 10000  
M ORIGIN -100000  
M SCALE 10000  
XY TOLERANCE 8.9831528411952133e-009  
Z TOLERANCE 0.001  
M TOLERANCE 0.001  
HIGH PRECISION true

LEFT LONGITUDE -180  
WELL-KNOWN TEXT GEOGCS["GCS\_WGS\_1984",DATUM["D\_WGS\_1984",SPHEROID  
["WGS\_1984",6378137.0,298.257223563]],PRIMEM["Greenwich",0.0],UNIT  
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**ESRI Feature Class** ▼

**ESRI Thumbnails and Enclosures** ▼

## ENID\_SocioEco

File Geodatabase Feature Class



### Tags

ENID, Socio Economic, Administration, Dams, Reservoirs, Demography, Transport, Communication, Irrigation Schemes, Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro, Akobo, Sobat

### Summary

Prepared for Eastern Nile Irrigation and Drainage (ENID) K-Base Development project. The ENID Socio-Economic (PhyEnv) category comprises main data-themes such as Administration (ADM), Dams & Reservoirs (DAR), Demographics (DMG), Transport & Communication (TRC) and Irrigation Schemes (IRR)

### Description

#### Credits

Eastern Nile Technical Regional Office (ENTRO)

#### Access and use limitations

Access and use of the data requires permission from ENTRO.

### ArcGIS Metadata ▶

#### Resource Identification ▶

##### CITATION

TITLE ENID\_SocioEco

PRESENTATION FORMAT digital map

TAGS FOR SEARCHING ENID, Socio Economic, Administration, Dams, Reservoirs, Demography, Transport, Communication, Irrigation Schemes, Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro, Akobo, Sobat

PLACE KEYWORDS Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro, Akobo, Sobat

THEME KEYWORDS ENID, Socio Economic, Administration, Dams, Reservoirs, Demography, Transport, Communication, Irrigation Schemes

KEYWORDS 002  
THESAURUS

ABSTRACT (DESCRIPTION)

ENID SocioEco Main Data-Themes: 1) Administration (ADM) - admin datasets include cities, towns, settlements, weredas/zones/states/provinces/governorates of EN countries and other related data; 2) Dams & Reservoirs (DAR) - include watershed-based and country-based existing and potential/ identified proposed dam sites. The barrages on the Nile in Egypt are also incorporated; 3) Demographics (DMG) Country- & watershed-based demographic data are archived here: intended to provide counts/estimates of the population for administrative units of a country or a sub-basin (using fields like total, gender, age, etc.). Archived data include several years' population data for Egypt (in a single attribute table of a shape file), Abay basin population data by wereda (Central Statistical Agency/CSA 2000 & 2008 data) and others; 4) Transport & Communication (TRC) - The transport and communication datasets include roads, railways, airports/airfields (available for the whole Nile basin in a single shape file) and navigation canals (e.g. Suez canal); presented as country- and watershed-based (availability of data depends on studied project-scopes); 5) Irrigation Schemes (IRR) - Existing irrigation schemes and potential/identified irrigation areas of EN countries are archived here. Naming:ENID\_Data-Theme\_Watershed or Country/Region\_Name of the Data; Example: ENID\_DAR\_ENB\_dams.shp (number at the end indicates the existence of other similar layer); Refer to the ENID Kbase Documentation (available at Eastern Nile Technical Regional Office - ENTRO).

PURPOSE (SUMMARY)

Prepared for Eastern Nile Irrigation and Drainage (ENID) K-Base Development project. The ENID Socio-Economic (PhyEnv) category comprises main data-themes such as Administration (ADM), Dams & Reservoirs (DAR), Demographics (DMG), Transport & Communication (TRC) and Irrigation Schemes (IRR)

DATASET LANGUAGES English (UNITED STATES)

DATASET CHARACTER SET utf8 - 8 bit UCS Transfer Format

RESOURCE CONSTRAINTS

CONSTRAINTS

LIMITATIONS OF USE

Access and use of the data requires permission from ENTRO.

SPATIAL REPRESENTATION TYPE vector

PROCESSING ENVIRONMENT Microsoft Windows Server 2008 R2 Version 6.1 (Build 7600) ; ESRI ArcGIS 10.0.2.3200

OTHER EXTENT INFORMATION

GEOGRAPHIC EXTENT

BOUNDING RECTANGLE

\* EXTENT TYPE Extent used for searching

WEST LONGITUDE 33.842972

EAST LONGITUDE 39.514549

NORTH LATITUDE 14.311906

SOUTH LATITUDE 7.099977

\* EXTENT CONTAINS THE RESOURCE Yes

CREDITS

Eastern Nile Technical Regional Office (ENTRO)

POINT OF CONTACT

INDIVIDUAL'S NAME Jemal Dagnev

ORGANIZATION'S NAME Eastern Nile Technical Regional Office (ENTRO)

CONTACT'S POSITION IT Manager

CONTACT'S ROLE point of contact

CONTACT INFORMATION

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E-MAIL ADDRESS jdagne@nilebasin.org

HOURS OF SERVICE 9:00 - 17:00 Addis Ababa Local Time, Monday – Friday

POINT OF CONTACT

INDIVIDUAL'S NAME Robel Tilaye  
ORGANIZATION'S NAME Eastern Nile Technical Regional Office (ENTRO)  
CONTACT'S POSITION GIS Specialist/Water Resources Engineer  
CONTACT'S ROLE point of contact

CONTACT INFORMATION

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COUNTRY ETHIOPIA  
E-MAIL ADDRESS rtilaye@nilebasin.org

HOURS OF SERVICE 9:00 - 17:00 Addis Ababa Local Time, Monday – Friday

Hide ▲

## Spatial Representation ▼

## Reference System ▼

## Distribution Information ►

DISTRIBUTION FORMAT

FORMAT NAME File Geodatabase Feature Class  
FORMAT VERSION unknown

TRANSFER OPTIONS

TRANSFER SIZE 0.001

Hide ▲

## Metadata Details ►

METADATA LANGUAGE English  
METADATA CHARACTER SET utf8 - 8 bit UCS Transfer Format



SCOPE OF THE DATA DESCRIBED BY THE METADATA **dataset**  
SCOPE NAME **dataset**

**METADATA CONTACT**

INDIVIDUAL'S NAME **Gedion Tsegaye Sahle**  
ORGANIZATION'S NAME **Eastern Nile Technical Regional Office (ENTRO)**  
CONTACT'S POSITION **Geo- & Hydro-Information Management Specialist / RS-GIS Expert**  
CONTACT'S ROLE **author**

**CONTACT INFORMATION**

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HOURS OF SERVICE **9:00 - 17:00 Addis Ababa Local Time, Monday - Friday**  
LAST UPDATE **2011-11-10**  
MAINTENANCE  
UPDATE FREQUENCY **as needed**

NAME OF THE METADATA STANDARD USED **ArcGIS Metadata**  
VERSION OF THE METADATA STANDARD **1.0**

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## **ESRI Metadata and Item Properties ▼**

### **ESRI Spatial Information ►**

**EXTENT IN THE ITEM'S COORDINATE REFERENCE**

**BOUNDING RECTANGLE**

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\* EAST LONGITUDE **608938.437500**  
\* NORTH LATITUDE **1411918.000000**  
\* SOUTH LATITUDE **-40.403892**  
\* EXTENT CONTAINS THE RESOURCE **Yes**

**COORDINATE REFERENCE**

TYPE **Geographic**

GEOGRAPHIC COORDINATE REFERENCE **GCS\_WGS\_1984**

**COORDINATE REFERENCE DETAILS**

**GEOGRAPHIC COORDINATE SYSTEM**

WELL-KNOWN IDENTIFIER **4326**  
X ORIGIN **-399.9999999999989**  
Y ORIGIN **-399.9999999999989**  
XY SCALE **1000000000.0000001**  
Z ORIGIN **-100000**  
Z SCALE **10000**  
M ORIGIN **-100000**  
M SCALE **10000**

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Z TOLERANCE 0.001
M TOLERANCE 0.001
HIGH PRECISION true
LEFT LONGITUDE -180
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*Hide ▲*

**ESRI Feature Class ▼**

**ESRI Thumbnails and Enclosures ▼**

## ENID\_IrrSys

File Geodatabase Feature Class



### Tags

Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro-Akobo, Sobat, Nile Delta, Gezira, AlJazira, Managil, Rahad, Meina, Sennar, Irrigation Infrastructure, Intake, Canal, Pumping Station, Cost

### Summary

Prepared for Eastern Nile Irrigation and Drainage (ENID) K-Base Development project. The ENID\_IrrSys category comprises the irrigation system (IS) as the main data-theme that include irrigation schemes, infrastructure, cost, cropping pattern, water requirement, etc.

### Description

#### Credits

Eastern Nile Technical Regional Office (ENTRO)

#### Access and use limitations

Access and use of the data requires permission from ENTRO.

### ArcGIS Metadata ▶

#### Resource Identification ▶

##### CITATION

TITLE ENID\_IrrSys

PRESENTATION FORMAT digital map

**TAGS FOR SEARCHING** Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro-Akobo, Sobat, Nile Delta, Gezira, AlJazira, Managil, Rahad, Meina, Sennar, Irrigation Infrastructure, Intake, Canal, Pumping Station, Cost

**PLACE KEYWORDS** Eastern Nile, Egypt, Ethiopia, Sudan, Abay, Blue Nile, White Nile, Main Nile, Tekeze, Atbara, Baro-Akobo, Sobat, Nile Delta

**THEME KEYWORDS** Irrigation System, Irrigation Infrastructure, Intake Structure, Canal, Pumping Station, Cost, Cropping Pattern, Crop Water Requirement, Irrigation Water Requirement

KEYWORDS 002

THESAURUS

**ABSTRACT (DESCRIPTION)**

ENID\_IrrSys: existing irrigation schemes and potential/identified irrigation areas of EN countries, and other available irrigation-related data such as irrigation infrastructure (canals, intake structures, pumping stations, etc.), costs, cropping pattern, crop water requirements, irrigation water requirements, etc. Data sources include national studies listed below and the ENID CRA-D&P studies (Cooperative Regional Assessment - Diagnosis and Planning; 2008-2010). Also incorporated are those generated as part of this project (digitized irrigation infrastructure features from high resolution satellite imageries and maps). The country-based project-specific ENID Field Investigations and Feasibility Studies are however archived separately. National Studies (in alphabetical order): Abay Master Plan (BCEOM et al., 1998; Ethiopia), Baro-Akobo Master Plan (TAMS and ULG, 1997; Ethiopia), Blue Nile Waters Study (Coyne et Bellier et al., 1978; Sudan), Land and Water Resources of the Blue Nile Basin (USBR, 1964; Ethiopia), Master Plan for Water Resources Development and Use (World Bank, 1977-81; Egypt) and Tekeze Master Plan (NEDECO and DHV, 1998; Ethiopia) and others.  
Naming: ENID\_Data-Theme\_Watershed or Country/Region\_Name of the Data;  
Example: ENID\_IS\_SDN\_existing\_irrigation\_schemes\_1.shp (if a number is provided at the end, it indicates the existence of other similar layer as an option); Refer to the ENID Kbase Documentation (available at Eastern Nile Technical Regional Office - ENTRO).

**PURPOSE (SUMMARY)**

Prepared for Eastern Nile Irrigation and Drainage (ENID) K-Base Development project. The ENID\_IrrSys category comprises the irrigation system (IS) as the main data-theme that include irrigation schemes, infrastructure, cost, cropping pattern, water requirement, etc.

**DATASET LANGUAGES** English (UNITED STATES)

**DATASET CHARACTER SET** utf8 - 8 bit UCS Transfer Format

**RESOURCE CONSTRAINTS****CONSTRAINTS****LIMITATIONS OF USE**

Access and use of the data requires permission from ENTRO.

**SPATIAL REPRESENTATION TYPE** vector

**PROCESSING ENVIRONMENT** Microsoft Windows Server 2008 R2 Version 6.1 (Build 7600) ; ESRI ArcGIS 10.0.2.3200

**OTHER EXTENT INFORMATION****GEOGRAPHIC EXTENT****BOUNDING RECTANGLE**

\* **EXTENT TYPE** Extent used for searching

**WEST LONGITUDE** 33.842972

**EAST LONGITUDE** 39.514549

**NORTH LATITUDE** 14.311906

**SOUTH LATITUDE** 7.099977

\* **EXTENT CONTAINS THE RESOURCE** Yes

**CREDITS**

Eastern Nile Technical Regional Office (ENTRO)

**POINT OF CONTACT**

**INDIVIDUAL'S NAME** Jemal Dagnev

**ORGANIZATION'S NAME** Eastern Nile Technical Regional Office (ENTRO)

**CONTACT'S POSITION** IT Manager

**CONTACT'S ROLE** point of contact

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HOURS OF SERVICE 9:00 - 17:00 Addis Ababa Local Time, Monday – Friday

POINT OF CONTACT

INDIVIDUAL'S NAME Robel Tilaye  
ORGANIZATION'S NAME Eastern Nile Technical Regional Office (ENTRO)  
CONTACT'S POSITION GIS Specialist/Water Resources Engineer  
CONTACT'S ROLE point of contact

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POSTAL CODE P.O. Box 27173-1000  
COUNTRY ETHIOPIA  
E-MAIL ADDRESS [rtilaye@nilebasin.org](mailto:rtilaye@nilebasin.org)

HOURS OF SERVICE 9:00 - 17:00 Addis Ababa Local Time, Monday – Friday

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**Spatial Representation ▼**

**Reference System ▼**

**Distribution Information ►**

DISTRIBUTION FORMAT

FORMAT NAME File Geodatabase Feature Class  
FORMAT VERSION unknown

TRANSFER OPTIONS

TRANSFER SIZE 0.001

Hide ▲

**Metadata Details ►**

METADATA LANGUAGE English  
METADATA CHARACTER SET utf8 - 8 bit UCS Transfer Format

SCOPE OF THE DATA DESCRIBED BY THE METADATA **dataset**  
SCOPE NAME **dataset**

**METADATA CONTACT**

INDIVIDUAL'S NAME **Gedion Tsegaye Sahle**  
ORGANIZATION'S NAME **Eastern Nile Technical Regional Office (ENTRO)**  
CONTACT'S POSITION **Geo- & Hydro-Information Management Specialist / RS-GIS Expert**  
CONTACT'S ROLE **author**

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POSTAL CODE **P.O. Box 24911 / 1000**  
COUNTRY **ETHIOPIA**  
E-MAIL ADDRESS **gtsegaye@nilebasin.org**  
E-MAIL ADDRESS **gtshsig@gmail.com**

HOURS OF SERVICE **9:00 - 17:00 Addis Ababa Local Time, Monday - Friday**  
LAST UPDATE **2011-11-10**  
MAINTENANCE  
UPDATE FREQUENCY **as needed**

NAME OF THE METADATA STANDARD USED **ArcGIS Metadata**  
VERSION OF THE METADATA STANDARD **1.0**

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## **ESRI Metadata and Item Properties ▼**

### **ESRI Spatial Information ►**

**EXTENT IN THE ITEM'S COORDINATE REFERENCE**

**BOUNDING RECTANGLE**  
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\* EAST LONGITUDE **40.012714**  
\* NORTH LATITUDE **31.593388**  
\* SOUTH LATITUDE **-4.229218**  
\* EXTENT CONTAINS THE RESOURCE **Yes**

**COORDINATE REFERENCE**

TYPE **Geographic**  
GEOGRAPHIC COORDINATE REFERENCE **GCS\_WGS\_1984**  
COORDINATE REFERENCE DETAILS  
GEOGRAPHIC COORDINATE SYSTEM  
WELL-KNOWN IDENTIFIER **4326**  
X ORIGIN **-399.9999999999989**  
Y ORIGIN **-399.9999999999989**  
XY SCALE **100000000.0000001**  
Z ORIGIN **-100000**  
Z SCALE **10000**  
M ORIGIN **-100000**  
M SCALE **10000**  
XY TOLERANCE **8.9831528411952133e-009**

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Z TOLERANCE 0.001
M TOLERANCE 0.001
HIGH PRECISION true
LEFT LONGITUDE -180
WELL-KNOWN TEXT GEOGCS["GCS_WGS_1984",DATUM["D_WGS_1984",SPHEROID
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["Degree",0.0174532925199433],AUTHORITY["EPSG",4326]]
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*Hide ▲*

**ESRI Feature Class ▼**

**ESRI Thumbnails and Enclosures ▼**

## Annex 5: List of ENID Study Documents (graphical display)

### ENID\_Studies

#### +--ENID\_Cooperative\_Regional\_Assessment

- | +--ENID\_CRA\_Phase\_I
  - | | ENID\_Inception\_Report.doc
  - | | ENID\_Inception\_Report.pdf
  - | | ENID\_Inception\_Report\_Appendices.doc
  - | | ENID\_Inception\_Report\_Appendices.pdf
  - | | ENID\_Inception\_Report\_Appendix\_8.1.pdf
  - | | ENID\_Inception\_Report\_Appendix\_8.2.pdf
  - | | ENID\_Inception\_Report\_Appendix\_8.3.pdf
  - | | ENID\_Inception\_Report\_Figure\_9.2.pdf
  - | | ENID\_Inception\_Report\_Figure\_9.2.xls
  - | | ENID\_Technical\_Note\_No\_1.doc
  - | | ENID\_Technical\_Note\_No\_1.pdf
- | +--ENID\_CRA\_Phase\_II
  - | | ENID\_CRA\_Analysis\_Report.doc
  - | | ENID\_CRA\_Analysis\_Report.pdf
- | +--CRA\_Maps\_jpg
  - | | Map\_01\_Irrigation\_Development\_Zones\_in\_the\_Eastern\_Nile\_Basin\_Location\_Map.jpg
  - | | Map\_02\_Irrigation\_Projects\_in\_Lake\_Tana\_&\_Beles\_Subbasins\_IDZ\_1.jpg
  - | | Map\_03\_Irrigation\_Projects\_in\_Didesa-Anger-Fincha\_Subbasins\_IDZ\_2.jpg
  - | | Map\_04\_Irrigation\_Projects\_in\_Blue\_Nile\_plus\_Rahad-Dinder\_Subbasins\_IDZ\_3.jpg
  - | | Map\_05\_Irrigation\_Projects\_in\_Tekeze-Atbara\_Subbasins\_IDZ\_4.jpg
  - | | Map\_06\_Irrigation\_Projects\_in\_Baro-Akobo-Sobat\_Subbasins\_IDZ\_5.jpg
  - | | Map\_07\_Toshka\_Irrigation\_Project\_in\_Egypt\_IDZ\_6.jpg
  - | | Map\_08\_ElSalam\_Canal\_&\_West\_Delta\_Irrigation\_Projects\_in\_Egyptian\_Nile\_Subbasin\_IDZ\_7.jpg
  - | | Map\_09\_Proposed\_Hydroelectric\_Dams\_on\_Abay\_River.jpg
- | \--CRA\_Maps\_pdf
  - | | Map\_01\_Irrigation\_Development\_Zones\_in\_the\_Eastern\_Nile\_Basin\_Location\_Map.pdf
  - | | Map\_02\_Irrigation\_Projects\_in\_Lake\_Tana\_&\_Beles\_Subbasins\_IDZ\_1.pdf
  - | | Map\_03\_Irrigation\_Projects\_in\_Didesa-Anger-Fincha\_Subbasins\_IDZ\_2.pdf
  - | | Map\_04\_Irrigation\_Projects\_in\_Blue\_Nile\_plus\_Rahad-Dinder\_Subbasins\_IDZ\_3.pdf
  - | | Map\_05\_Irrigation\_Projects\_in\_Tekeze-Atbara\_Subbasins\_IDZ\_4.pdf
  - | | Map\_06\_Irrigation\_Projects\_in\_Baro-Akobo-Sobat\_Subbasins\_IDZ\_5.pdf
  - | | Map\_07\_Toshka\_Irrigation\_Project\_in\_Egypt\_IDZ\_6.pdf
  - | | Map\_08\_ElSalam\_Canal\_&\_West\_Delta\_Irrigation\_Projects\_in\_Egyptian\_Nile\_Subbasin\_IDZ\_7.pdf
  - | | Map\_09\_Proposed\_Hydroelectric\_Dams\_on\_Abay\_River.pdf
- | \--ENID\_CRA\_Phase\_III
  - | | ENID\_CRA\_Finalization\_and\_Conclusion\_Report.doc
  - | | ENID\_CRA\_Finalization\_and\_Conclusion\_Report.pdf
  - | | ENID\_CRA\_Guidelines\_for\_Identification\_and\_Assessment\_of\_Irrigation\_&\_Drainage\_Projects.doc
  - | | ENID\_CRA\_Guidelines\_for\_Identification\_and\_Assessment\_of\_Irrigation\_&\_Drainage\_Projects.pdf

#### +--ENID\_Diagnosis\_&\_Planning

- | +--ENID\_D&P\_Annex\_A
  - | | ENID\_D&P\_Annex\_A\_Project\_Descriptions.doc
  - | | ENID\_D&P\_Annex\_A\_Project\_Descriptions.pdf
  - | | Map\_02\_Irrigation\_Projects\_in\_Lake\_Tana\_&\_Beles\_Subbasins.pdf
  - | | Map\_03\_Irrigation\_Projects\_in\_Didesa-Anger-Fincha\_Subbasins.pdf
  - | | Map\_04\_Irrigation\_Projects\_in\_Blue\_Nile\_plus\_Rahad-Dinder\_Subbasins.pdf
  - | | Map\_05\_Irrigation\_Projects\_in\_Tekeze-Atbara\_Subbasins.pdf
  - | | Map\_06\_Irrigation\_Projects\_in\_Baro-Akobo-Sobat\_Subbasins.pdf
- | \--ENID\_D&P\_Main\_Report
  - | | ENID\_D&P\_Main\_Report.doc
  - | | ENID\_D&P\_Main\_Report.pdf
  - | | Map\_01\_Location\_of\_Subbasins\_Studied\_Projects.pdf



- +--D&P\_Appendix\_1\_GIS\_Database
  - | D&P\_Appendix\_1\_Geographic\_Information\_System\_Database.doc
  - | D&P\_Appendix\_1\_Geographic\_Information\_System\_Database.pdf
- +--D&P\_Appendix\_2\_Cost\_Sheets\_of\_Irrigation\_Projects
  - | D&P\_Appendix\_2\_Coverpage.doc
  - | D&P\_Appendix\_2\_Coverpage.pdf
  - | D&P\_Appendix\_2\_Table\_of\_Contents.doc
  - | D&P\_Appendix\_2\_Table\_of\_Contents.pdf
  - | D&P\_ETH\_Angar\_Subbasin.pdf
  - | D&P\_ETH\_Angar\_Subbasin.xls
  - | D&P\_ETH\_Baro\_Akobo\_Subbasin.pdf
  - | D&P\_ETH\_Baro\_Akobo\_Subbasin.xls
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  - | D&P\_ETH\_Lake\_Tana\_Subbasin.pdf
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  - | D&P\_ETH\_Rahad\_Dinder\_Subbasin.pdf
  - | D&P\_ETH\_Rahad\_Dinder\_Subbasin.xls
  - | D&P\_ETH\_Tekeze\_Subbasin.pdf
  - | D&P\_ETH\_Tekeze\_Subbasin.xls
  - | D&P\_Multi\_Criteria\_Analysis.xls
  - | D&P\_SDN\_Irrigation\_Projects\_in\_Sudan.doc
  - | D&P\_SDN\_Irrigation\_Projects\_in\_Sudan.pdf
- +--D&P\_Appendix\_3\_Cost\_&Benefit\_Analyses
  - | D&P\_Appendix\_3\_Supporting\_Information\_for\_Cost\_and\_Benefit\_Analyses.doc
  - | D&P\_Appendix\_3\_Supporting\_Information\_for\_Cost\_and\_Benefit\_Analyses.pdf
- \--D&P\_Appendix\_4\_Crop\_Water\_Requirements
  - | D&P\_Appendix\_4\_Supporting\_Information\_for\_Crop\_Water\_Requirements.doc
  - | D&P\_Appendix\_4\_Supporting\_Information\_for\_Crop\_Water\_Requirements.pdf
  - | D&P\_Appendix\_4a.doc
  - | D&P\_Appendix\_4a.pdf
  - | D&P\_Appendix\_4b.doc
  - | D&P\_Appendix\_4b.pdf
  - | D&P\_Appendix\_4c.doc
  - | D&P\_Appendix\_4c.pdf
  - | D&P\_Appendix\_4d.doc
  - | D&P\_Appendix\_4d.pdf
- +--ENID\_Feasibility\_Studies**
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      - | | | DB\_FS\_Executive\_Summary.pdf
    - | | +--DB\_FS\_Volume\_1\_Main\_Report
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      - | | | DB\_FS\_Volume\_1\_List\_of\_Contents\_and\_Abbreviations.pdf
      - | | | DB\_FS\_Volume\_1\_Main\_Report.doc
      - | | | DB\_FS\_Volume\_1\_Main\_Report.pdf
    - | | +--DB\_FS\_Volume\_2\_Annexes\_1-3
      - | | | DB\_FS\_Volume\_2\_Coverpage.doc
      - | | | DB\_FS\_Volume\_2\_Coverpage.pdf
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| | | | DB_FS_Annex_1_Climate_Hydrology_and_Groundwater_Resources.pdf
| | | |
| | | +-DB_FS_Annex_2
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| | | | DB_FS_Annex_2_Coverpage.pdf
| | | | DB_FS_Annex_2_Topographic_Surveys_and_Mapping.doc
| | | | DB_FS_Annex_2_Topographic_Surveys_and_Mapping.pdf
| | | |
| | | \-DB_FS_Annex_3
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| | | | DB_FS_Field_Investigations_Auger_Database.xls
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| | | | Fig_2_Slope_Map_A3.pdf
| | | | Fig_3_Topography_A3.pdf
| | | | Fig_4_Landuse_A3.pdf
| | | | Fig_5_Soil_Map_A3.pdf
| | | | Fig_6_LUTA_A3.pdf
| | | | Fig_7_LUTB_A3.pdf
| | | | Fig_8_LUTC_A3.pdf
| | | | Fig_9_LUTD_A3.pdf
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| | | | DB_FS_Volume_3_Coverpage.pdf
| | | | DB_FS_Volume_3_List_of_Contents_and_Abbreviations.doc
| | | | DB_FS_Volume_3_List_of_Contents_and_Abbreviations.pdf
| | | |
| | | +-DB_FS_Annex_4
| | | | DB_FS_Annex_4_Coverpage.doc
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| | | |
| | | +-DB_FS_Annex_5
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  - Figure\_C4\_Abu\_Rakham\_Settling\_Ponds.pdf
  - Figure\_C5\_Automation\_of\_Major\_2.pdf
  - Figure\_C6\_ADV\_Regulator\_on\_Major.pdf
  - Figure\_C7\_ADV\_Regulator\_on\_Minor.pdf
  - Figure\_C8\_Proposed\_Downstream\_Control\_on\_Major.pdf
  - Figure\_C9\_Proposed\_Downstream\_Control\_on\_Minor.pdf
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  - Figure\_C11\_Design\_and\_Layout\_of\_Minor\_40.pdf

## Annex 6: ENID Map Catalogue

ENID Map Catalogue			
I ENID CRA/D&P (Cooperative Regional Assessment/Diagnosis & Planning): Maps			
<i>Album: CRA/D&amp;P Maps - Irrigation Development Zones/IDZs &amp; Hydropower/HP</i>			
File Name	Format	Map Scale	Paper Size
Map01_IDZ_in_the_Eastern_Nile_Basin_Location_Map	pdf, jpg, mxd	1:9,000,000	A3
Map02_Irrigation_Projects_in_Lake_Tana_&_Beles_Subbasins_IDZ 1	pdf, jpg, mxd	1:1,000,000	A3
Map03_Irrigation_Projects_in_Didesa_Anger_&_Fincha_Subbasins_IDZ 2	pdf, jpg, mxd	1:1,000,000	A3
Map04_Irrigation_Project_in_Blue_Nile_plus_Rahad_&_Dinder_Subbasins_IDZ 3	pdf, jpg, mxd	1:2,000,000	A3
Map05_Irrigation_Projects_in_Tekeze_Atbara_Subbasins_IDZ 4	pdf, jpg, mxd	1:1,500,000	A3
Map06_Irrigation_Projects_in_Baro_Akobo_Sobat_Subbasins_IDZ 5	pdf, jpg, mxd	1:1,500,000	A3
Map07_Tushka_Irrigation_Project_in_Egyptian_Nile_Subbasin_IDZ 6	pdf, jpg, mxd	1:1,500,000	A3
Map08_El_Salam_Canal_&_West_Delta_Irrigation_Projects_in_Egyptian_Nile_Subbasin_IDZ 7	pdf, jpg, mxd	1:2,000,000	A3
Map09_Proposed_Hydroelectric_Dams_on_Abay_River	pdf, jpg, mxd	1:2,500,000	A3
	pdf, jpg, mxd	1:3,500,000	A4
<i>Notes:</i>			
<i>The IDZ maps are originally prepared on A3 size layouts (see original map scales). They have been printed on A4 size paper to fit the ENID CRA study documents (scale texts were purposefully excluded leaving the scale bars to serve).</i>			
II ENID Field Investigations: Maps & Drawings			
II A ETH_FL_Dinger_Bereha			
<i>Album: DB_FL_Topo_Maps</i>			
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TM-3_Topography_of_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
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Volume Cover Page and Table of Contents

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**Album: DB\_FI\_Soils\_LandSuitab\_Geotech\_Maps**

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LS-1S_Land_Suitability_Surface_Irrigated_Onions_25K	pdf, jpg, mxd	1:25,000	A1

LS-20_Land_Suitability_Overhead_Irrigated_Beans_25K	pdf, jpg, mxd	1:25,000	A1
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LS-45_Land_Suitability_Surface_Irrigated_Maize_25K	pdf, jpg, mxd	1:25,000	A1
LS-50_Land_Suitability_Overhead_Irrigated_Citrus_25K	pdf, jpg, mxd	1:25,000	A1
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*pdf & doc*

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SO-04_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-05_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-06_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-07_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-08_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-09_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-10_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1

Volume Cover Page and Table of Contents

WM\_FI\_Volume\_III\_Maps\_&\_Drawings\_File\_Box\_2\_Coverpage\_&\_TOC

pdf & doc

III ENID Feasibility Studies: Maps & Drawings

III A ETH\_FS\_Dinger\_Bereha

**Album: DB\_FS\_IrrSys\_Maps\_A1**

File Name	Format	Map Scale	Paper Size
GE-01_Location_of_Boreholes_Test_Pits_and_Quarry_Sites_25K	pdf, jpg, mxd	1:25,000	A1
LO-01_Location_of_Headworks_Main_Canal_and_Irrigation_System_50K	pdf, jpg, mxd	1:50,000	A1
LO-02_Layout_of_Irrigation_System_in_Command_Area_25K	pdf, jpg, mxd	1:25,000	A1
LO-03_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-04_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-05_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-06_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-07_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-08_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-09_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-10_Layout_of_Irrigation_System_in_Command_Area_10K	pdf, jpg, mxd	1:10,000	A1
LO-11_Main_Canal_Alignment_10K	pdf, jpg, mxd	1:10,000	A1
LO-12_Main_Canal_Alignment_10K	pdf, jpg, mxd	1:10,000	A1
LS-01_Land_Suitability_25K	pdf, jpg, mxd	1:25,000	A1
SO-01_Soils_25K	pdf, jpg, mxd	1:25,000	A1

Volume Cover Page and Table of Contents

DB\_FS\_Volume\_Maps\_&\_Drawings\_A1\_Coverpage\_&\_TOC

pdf & doc

**Album: DB\_FS\_Drawings\_A3**

File Name	Format	Paper Size
CO01_Modular_Canal_Offtake	pdf, jpg, dwg	A3
CSP01_Cross_Sections_Primary_Canal	pdf, jpg, dwg	A3
CSS01_Cross_Drainage_Structures	pdf, jpg, dwg	A3
CSS02_Cross_Drainage_Structures	pdf, jpg, dwg	A3
GW01_Gauging_Weir	pdf, jpg, dwg	A3
HW01_Headworks	pdf, jpg, dwg	A3
HW02_Headworks	pdf, jpg, dwg	A3
HW03_Headworks	pdf, jpg, dwg	A3
ISO1_Inverted_Siphon	pdf, jpg, dwg	A3
ISO2_Inverted_Siphon	pdf, jpg, dwg	A3
LO-01_Location_of_Headworks_Main_Canal_and_Irrigation_System_A3v	pdf, jpg, mxd	A3



LO-02_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-03_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-04_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-05_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-06_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-07_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-08_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-09_Layout_of_Irrigation_System_in_Command Area_A3v	pdf, jpg, mxd	A3
LO-10_Layout_of_Irrigation_System in Command Area_A3v	pdf, jpg, mxd	A3
LO-11_Main_Canal_Alignment_A3v	pdf, jpg, mxd	A3
LO-12_Main_Canal_Alignment_A3v	pdf, jpg, mxd	A3
LS01_Long_Sections_Canals	pdf, jpg, dwg	A3
LS02_Long_Sections_Canals	pdf, jpg, dwg	A3
LS03_Long_Sections_Canals	pdf, jpg, dwg	A3
LS04_Long_Sections_Canals	pdf, jpg, dwg	A3
LS05_Long_Sections_Canals	pdf, jpg, dwg	A3
LS06_Long_Sections_Canals	pdf, jpg, dwg	A3
LS07_Long_Sections_Canals	pdf, jpg, dwg	A3
LS08_Long_Sections_Canals	pdf, jpg, dwg	A3
LS09_Long_Sections_Canals	pdf, jpg, dwg	A3
PS01_Pump_Station	pdf, jpg, dwg	A3
RE01_Reservoir	pdf, jpg, dwg	A3
SW01_Side_Weir	pdf, jpg, dwg	A3

**Notes:**

*The drawings are prepared using AutoCAD (dwg files).*

*The irrigation system and main canal GIS map layouts are originally prepared on A1 size paper. They have been reduced to be presented on A3 size paper (A3v). The scale bar is valid. The scale text has been purposefully excluded due to the reduction in paper size.*

*Volume Cover Page and Table of Contents*

*DB\_FS\_Volume\_Maps\_&\_Drawings\_A3\_Coverpage\_&\_TOC*

*pdf & doc*

**III B SDN\_FS\_Wad\_Meskin**

**Album: WM\_FS\_Topo\_IrrSys\_Maps\_A1-A0**

File Name	Format	Scale	Paper Size
TO-01_Topomap_Dinder_Barrage_1Kf	pdf, jpg, mxd	1:1,000	A1
TO-02_Topomap_Khor_Al_Atshan_1.25K	pdf, jpg, mxd	1:1,250	A1
TO-03_Topomap_Rahad_Barrage_1K	pdf, jpg, mxd	1:1,000	A1

TO-04_Layout_of_Irrigation_System_25K	pdf, jpg, mxd	1:25,000	A1
TO-05_Layout_of_Irrigation_System_25K	pdf, jpg, mxd	1:25,000	A1
TO-06_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-07_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-08_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-09_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-10_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-11_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-12_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-13_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-14_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-15_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-16_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-17_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
TO-18_Layout_of_Irrigation_System_10K	pdf, jpg, mxd	1:10,000	A1
<i>Volume Cover Page and Table of Contents</i>			
<i>WM_FS_Volume_Maps_&amp; Drawings_A1-A0_File_Box_1_Coverpage_&amp;_TOC</i>			
<i>pdf &amp; doc</i>			

File Name	Format	Scale	Paper Size
LS-01_Land_Suitability_Map_25K	pdf, jpg, mxd	1:25,000	A0
LS-02_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-03_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-04_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-05_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-06_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-07_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-08_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-09_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
LS-10_Land_Suitability_Map_10K	pdf, jpg, mxd	1:10,000	A1
PO-01_Project_Overall_Map_400K	pdf, jpg, mxd	1:400,000	A1
SO-01_Soil_Map_25K	pdf, jpg, mxd	1:25,000	A0
SO-02_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-03_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-04_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-05_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-06_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1

SO-07_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-08_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-09_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1
SO-10_Soil_Map_10K	pdf, jpg, mxd	1:10,000	A1

*Volume Cover Page and Table of Contents*

*WM\_FS\_Volume\_Maps\_& Drawings\_A1-A0\_File\_Box\_2\_Coverpage\_&\_TOC*

*pdf & doc*

**Album: WM\_FS Drawings\_A3**

File Name	Format	Paper Size
DB01_Salsal_Barrage_Dinder_River	pdf, jpg, dwg	A3
DB02_Salsal_Barrage_Dinder_River	pdf, jpg, dwg	A3
FL01_Field_Layout	pdf, jpg, dwg	A3
KA01_Khor_Atshan_Crossing	pdf, jpg, dwg	A3
LC01_Link_Canal_Alignment_and_Profile	pdf, jpg, dwg	A3
LC02_Link_Canal_Alignment_and_Profile	pdf, jpg, dwg	A3
LC03_Link_Canal_Alignment_and_Profile	pdf, jpg, dwg	A3
LC04_Link_Canal_Alignment_and_Profile	pdf, jpg, dwg	A3
LS01_Long_Sections_of_Canals_Main_Canal	pdf, jpg, dwg	A3
LS02_Long_Sections_of_Canals_Main_Canal	pdf, jpg, dwg	A3
LS03_Long_Sections_of_Canals_Main_Canal	pdf, jpg, dwg	A3
LS04_Long_Sections_of_Canals_Main_Canal	pdf, jpg, dwg	A3
LS05_Long_Sections_of_Canals_Main_Canal	pdf, jpg, dwg	A3
LS06_Long_Sections_of_Canals_Major_Canal	pdf, jpg, dwg	A3
LS07_Long_Sections_of_Canals_Major_Canal	pdf, jpg, dwg	A3
LS08_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS09_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS10_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS11_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS12_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS13_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS14_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS15_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS16_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS17_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS18_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS19_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS20_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3

LS21_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS22_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS23_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
LS24_Long_Sections_of_Canals_Minor_Canal	pdf, jpg, dwg	A3
RB01_Rahad_Barrage	pdf, jpg, dwg	A3
RB02_Rahad_Barrage	pdf, jpg, dwg	A3
RB03_Rahad_Barrage	pdf, jpg, dwg	A3
RB04_Rahad_Barrage	pdf, jpg, dwg	A3

Notes:

The drawings are prepared using AutoCAD (dwg files).

Volume Cover Page and Table of Contents

WM\_FS\_Volume\_Maps\_&\_Drawings\_A3\_Coverpage\_&\_TOC

pdf & doc

**IV ENID Pilot Studies: Maps & Drawings**

**IV A ETH\_PS\_IWUEP (Improved Water Use Efficiency & Productivity)**

**Album: ETH\_PS\_IWUEP\_Drawings**

File Name	Format	Paper Size
Figure_C1_Robi_River_Dyke_and_Weir_Section	pdf, jpg	A4
Figure_C2_Robi_River_Dyke_and_Weir	pdf, jpg	A4
Figure_C3_Robi_River_Drain_Section	pdf, jpg	A4
Figure_C4_Geray_Weir	pdf, jpg	A4
Figure_C5_Geray_Main_Canal	pdf, jpg	A4
Figure_C6_Geray_Sluice_Gate_Regulator	pdf, jpg	A4
Figure_C7_Gereb_Mihiz_Dam	pdf, jpg	A4

Notes:

Drawings are only available in pdf & jpg formats; AutoCAD dwg files not obtained.

**IV B SDN\_PS\_IWUEP (Improved Water Use Efficiency & Productivity)**

**Album: SDN\_PS\_IWUEP\_Drawings**

File Name	Format	Paper Size
Figure_C1_Meina_Pump_Station_Re-Modelling	pdf, jpg	A4
Figure_C2_Rahad_Scheme_Level_Impounded_Furrow_Irrigation	pdf, jpg	A4
Figure_C3_Dinder_Aqueduct_Syphon_Replacement	pdf, jpg	A4
Figure_C4_Abu_Rakham_Settling_Ponds	pdf, jpg	A4

Figure_C5_Automation_of_Major_2	pdf, jpg	A4
Figure_C6_ADV_Regulator_on_Major	pdf, jpg	A4
Figure_C7_ADV_Regulator_on_Minor	pdf, jpg	A4
Figure_C8_Proposed_Downstream_Control_on_Major	pdf, jpg	A4
Figure_C9_Proposed_Downstream_Control_on_Minor	pdf, jpg	A4
Figure_C10_Design_and_Layout_of_Minor_35	pdf, jpg	A4
Figure_C11_Design_and_Layout_of_Minor_40	pdf, jpg	A4

*Notes:*

*Drawings are only available in pdf & jpg formats; AutoCAD dwg files not obtained.*

## Annex 7: List of ENID ArcMap Layout Files (.mxd)

### +--ENID\_CRA\_D&P

- | Map\_01\_Irrigation\_Development\_Zones\_in\_the\_Eastern\_Nile\_Basin\_Location\_Map.mxd
- | Map\_02\_Irrigation\_Projects\_in\_Lake\_Tana\_&\_Beles\_Subbasins\_IDZ\_1.mxd
- | Map\_03\_Irrigation\_Projects\_in\_Didesa\_Anger\_&\_Fincha\_Subbasins\_IDZ\_2.mxd
- | Map\_04\_Irrigation\_Project\_in\_Blue\_Nile\_plus\_Rahad\_&\_Dinder\_Subbasins\_IDZ\_3.mxd
- | Map\_05\_Irrigation\_Projects\_in\_Tekeze\_Atbara\_Subbasins\_IDZ\_4.mxd
- | Map\_06\_Irrigation\_Projects\_in\_Baro\_Akobo\_Sobat\_Subbasins\_IDZ\_5.mxd
- | Map\_07\_Toshka\_Irrigation\_Project\_in\_Egypt\_IDZ\_6.mxd
- | Map\_08\_ElSalam\_Canal\_&\_West\_Delta\_Irrigation\_Projects\_in\_Egyptian\_Nile\_Subbasin\_IDZ\_7.mxd
- | Map\_09\_Proposed\_Hydroelectric\_Dams\_on\_Abay\_River.mxd

### +--ENID\_Feasibility\_Studies

- | +--ETH\_FS\_Dinger\_Bereha
  - | | GE-01\_Boreholes\_Test\_Pits\_and\_Quarry\_Sites\_25K.mxd
  - | | LO-01\_Headworks\_Main\_Canal\_and\_Irrigation\_System\_50K.mxd
  - | | LO-02\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_25K.mxd
  - | | LO-03\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-04\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-05\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-06\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-07\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-08\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-09\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-10\_Layout\_of\_Irrigation\_System\_in\_Command\_Area\_10K.mxd
  - | | LO-11\_Main\_Canal\_Alignment\_10K.mxd
  - | | LO-12\_Main\_Canal\_Alignment\_10K.mxd
  - | | LS-01\_Land\_Suitability\_25K.mxd
  - | | SO-01\_Soils\_25K.mxd

### \--SDN\_FS\_Wad\_Meskin

- | +--WM\_FS\_Soils\_LandSuitab
  - | | LS-01\_Land\_Suitability\_Map\_25K.mxd
  - | | LS-02\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-03\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-04\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-05\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-06\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-07\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-08\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-09\_Land\_Suitability\_Map\_10K.mxd
  - | | LS-10\_Land\_Suitability\_Map\_10K.mxd
  - | | SO-01\_Soil\_Map\_25K.mxd
  - | | SO-02\_Soil\_Map\_10K.mxd
  - | | SO-03\_Soil\_Map\_10K.mxd
  - | | SO-04\_Soil\_Map\_10K.mxd
  - | | SO-05\_Soil\_Map\_10K.mxd
  - | | SO-06\_Soil\_Map\_10K.mxd
  - | | SO-07\_Soil\_Map\_10K.mxd
  - | | SO-08\_Soil\_Map\_10K.mxd
  - | | SO-09\_Soil\_Map\_10K.mxd
  - | | SO-10\_Soil\_Map\_10K.mxd

### \--WM\_FS\_Topo\_IrrSys

- | | PO-01\_Project\_Overall\_Map\_400K.mxd
- | | TO-01\_Topomap\_Dinder\_Barrage\_1K.mxd
- | | TO-02\_Topomap\_Khor\_Atshan\_1.25K.mxd
- | | TO-03\_Topomap\_Rahad\_Barrage\_1K.mxd
- | | TO-04\_Layout\_of\_Irrigation\_System\_25K.mxd
- | | TO-05\_Layout\_of\_Irrigation\_System\_25K.mxd
- | | TO-06\_Layout\_of\_Irrigation\_System\_10K.mxd
- | | TO-07\_Layout\_of\_Irrigation\_System\_10K.mxd
- | | TO-08\_Layout\_of\_Irrigation\_System\_10K.mxd
- | | TO-09\_Layout\_of\_Irrigation\_System\_10K.mxd

- | TO-10\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-11\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-12\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-13\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-14\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-15\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-16\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-17\_Layout\_of\_Irrigation\_System\_10K.mxd
- | TO-18\_Layout\_of\_Irrigation\_System\_10K.mxd
- |
- | \-ENID\_Field\_Investigations
- | +--ETH\_FI\_Dinger\_Bereha
- | | +--DB\_FI\_Soils\_LandSuitab\_&\_Geotech
- | | | GE-01\_Boreholes\_Test\_Pits\_and\_Quarry\_Sites\_25K.mxd
- | | | LS-1O\_Land\_Suitability\_Overhead\_Irrigated\_Onions\_25K.mxd
- | | | LS-1S\_Land\_Suitability\_Surface\_Irrigated\_Onions\_25K.mxd
- | | | LS-2O\_Land\_Suitability\_Overhead\_Irrigated\_Beans\_25K.mxd
- | | | LS-2S\_Land\_Suitability\_Surface\_Irrigated\_Beans\_25K.mxd
- | | | LS-3O\_Land\_Suitability\_Overhead\_Irrigated\_Sesame\_25K.mxd
- | | | LS-3S\_Land\_Suitability\_Surface\_Irrigated\_Sesame\_25K.mxd
- | | | LS-4O\_Land\_Suitability\_Overhead\_Irrigated\_Maize\_25K.mxd
- | | | LS-4S\_Land\_Suitability\_Surface\_Irrigated\_Maize\_25K.mxd
- | | | LS-5O\_Land\_Suitability\_Overhead\_Irrigated\_Citrus\_25K.mxd
- | | | LS-5S\_Land\_Suitability\_Surface\_Irrigated\_Citrus\_25K.mxd
- | | | SO 1-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 2-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 3-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 4-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 5-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 6-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 7-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO 8-8\_Soils\_and\_Profile\_Pits\_10K.mxd
- | | | SO-02\_Auger\_Hole\_Points\_and\_InSitu\_Physical\_Tests\_25K.mxd
- | | |
- | | | \-DB\_FI\_Topo
- | | | | TM-10\_Topography\_of\_Diversion\_Site\_1.5K.mxd
- | | | | TM-11\_Main\_Canal\_Alignment\_and\_CrossSections\_10K.mxd
- | | | | TM-12\_Main\_Canal\_Alignment\_and\_CrossSections\_10K.mxd
- | | | | TM-13\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-14\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-15\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-16\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-17\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-18\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-19\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-1\_Topography\_of\_Command Area\_10K.mxd
- | | | | TM-20\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-21\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-22\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-23\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-24\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-25\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-26\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-27\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-28\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-29\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-2\_Topography\_of\_Command Area\_10K.mxd
- | | | | TM-30\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-31\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-32\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-33\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-34\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-35\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-36\_Topography\_of\_Command Area\_5K.mxd
- | | | | TM-37\_Detailed\_Topography\_of\_Pump\_Station\_Site\_2K.mxd
- | | | | TM-38\_Detailed\_Topography\_of\_Sample\_Block\_A\_5K.mxd
- | | | | TM-39\_Detailed\_Topography\_of\_Sample\_Block\_B\_5K.mxd

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|      TM-3_Topography_of_Command_Area_10K.mxd
|      TM-40_Detailed_Topography_of_Sample_Block_B_5K.mxd
|      TM-4_Topography_of_Command_Area_10K.mxd
|      TM-5_Topography_of_Command_Area_10K.mxd
|      TM-6_Topography_of_Command_Area_10K.mxd
|      TM-7_Topography_of_Command_Area_10K.mxd
|      TM-8_Topography_of_Command_Area_10K.mxd
|      TM-9_General_Topography_Layout_50K.mxd
|
|--SDN_FI_Wad_Meskin
|  +--SDN_FI_Soils_&_LandSuitab
|  |  LS-01_Land_Suitability_Map_25K.mxd
|  |  LS-02_Land_Suitability_Map_10K.mxd
|  |  LS-03_Land_Suitability_Map_10K.mxd
|  |  LS-04_Land_Suitability_Map_10K.mxd
|  |  LS-05_Land_Suitability_Map_10K.mxd
|  |  LS-06_Land_Suitability_Map_10K.mxd
|  |  LS-07_Land_Suitability_Map_10K.mxd
|  |  LS-08_Land_Suitability_Map_10K.mxd
|  |  LS-09_Land_Suitability_Map_10K.mxd
|  |  LS-10_Land_Suitability_Map_10K.mxd
|  |  SO-01_Soil_Map_25K.mxd
|  |  SO-02_Soil_Map_10K.mxd
|  |  SO-03_Soil_Map_10K.mxd
|  |  SO-04_Soil_Map_10K.mxd
|  |  SO-05_Soil_Map_10K.mxd
|  |  SO-06_Soil_Map_10K.mxd
|  |  SO-07_Soil_Map_10K.mxd
|  |  SO-08_Soil_Map_10K.mxd
|  |  SO-09_Soil_Map_10K.mxd
|  |  SO-10_Soil_Map_10K.mxd
|  |
|  |--SDN_FI_Topo_&_IrrSys
|  |  TO-01_Topomap_Dinder_Barrage_1K.mxd
|  |  TO-02_Topomap_Khor_Atshan_1.25K.mxd
|  |  TO-03_Topomap_Rahad_Barrage_1K.mxd
|  |  TO-04_Layout_of_Irrigation_System_25K.mxd
|  |  TO-05_Layout_of_Irrigation_System_25K.mxd
|  |  TO-06_Layout_of_Irrigation_System_10K.mxd
|  |  TO-07_Layout_of_Irrigation_System_10K.mxd
|  |  TO-08_Layout_of_Irrigation_System_10K.mxd
|  |  TO-09_Layout_of_Irrigation_System_10K.mxd
|  |  TO-10_Layout_of_Irrigation_System_10K.mxd
|  |  TO-11_Layout_of_Irrigation_System_10K.mxd
|  |  TO-12_Layout_of_Irrigation_System_10K.mxd
|  |  TO-13_Layout_of_Irrigation_System_10K.mxd
|  |  TO-14_Layout_of_Irrigation_System_10K.mxd
|  |  TO-15_Layout_of_Irrigation_System_10K.mxd
|  |  TO-16_Layout_of_Irrigation_System_10K.mxd
|  |  TO-17_Layout_of_Irrigation_System_10K.mxd
|  |  TO-18_Layout_of_Irrigation_System_10K.mxd

```



## Annex 8: List of ENID AutoCAD Drawing Files (dwg)

### ENID Feasibility Studies

#### +--ETH\_FS\_Dinger\_Bereha

- | C001\_Modular\_Canal\_Offtake.dwg
- | CSP01\_Cross\_Sections\_Primary\_Canal.dwg
- | CSS01\_Cross\_Drainage\_Structures.dwg
- | CSS02\_Cross\_Drainage\_Structures.dwg
- | GW01\_Gauging\_Weir.dwg
- | HW01\_Headworks.dwg
- | HW02\_Headworks.dwg
- | HW03\_Headworks.dwg
- | IS01\_Inverted\_Siphon.dwg
- | IS02\_Inverted\_Siphon.dwg
- | LS01\_Long\_Sections\_Canal.dwg
- | LS02\_Long\_Sections\_Canal.dwg
- | LS03\_Long\_Sections\_Canal.dwg
- | LS04\_Long\_Sections\_Canal.dwg
- | LS05\_Long\_Sections\_Canal.dwg
- | LS06\_Long\_Sections\_Canal.dwg
- | LS07\_Long\_Sections\_Canal.dwg
- | LS08\_Long\_Sections\_Canal.dwg
- | LS09\_Long\_Sections\_Canal.dwg
- | PS01\_Pump\_Station.dwg
- | RE01\_Reservoir.dwg
- | SW01\_Side\_Weir.dwg

#### \--SDN\_FS\_Wad\_Meskin

- DB01\_Salsal\_Barrage\_Dinder\_River.dwg
- DB02\_Salsal\_Barrage\_Dinder\_River.dwg
- FL01\_Field\_Layout.dwg
- KA01\_Khor\_Atshan\_Crossing.dwg
- LC01\_Link\_Canal\_Alignment\_and\_Profile.dwg
- LC02\_Link\_Canal\_Alignment\_and\_Profile.dwg
- LC03\_Link\_Canal\_Alignment\_and\_Profile.dwg
- LC04\_Link\_Canal\_Alignment\_and\_Profile.dwg
- LS01-05\_Long\_Sections\_of\_Canals\_Main\_Canal.dwg
- LS06-07\_ & 17-24\_Long\_Sections\_of\_Canals\_Major\_&\_Minor\_Canals.dwg
- LS08-16\_Long\_Sections\_of\_Canals\_Minor\_Canals.dwg
- RB01\_Rahad\_Barrage.dwg
- RB02\_Rahad\_Barrage.dwg
- RB03\_Rahad\_Barrage.dwg
- RB04\_Rahad\_Barrage.dwg