

GEOGRAPHIC INFORMATION SYSTEMS INTERACTED MICROZONATION STUDIES



Authors: [Çağatay Karıptaş](#), Zoran Milutinovic, Hassan Al Mulla and Ali Megahed

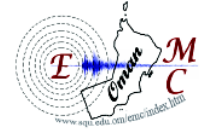


**SULTAN QABOOS UNIVERSITY
EARTHQUAKE MONITORING CENTER**



**8th Gulf Seismic Forum
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GEOGRAPHIC INFORMATION SYSTEMS INTERACTED MICROZONATION STUDIES

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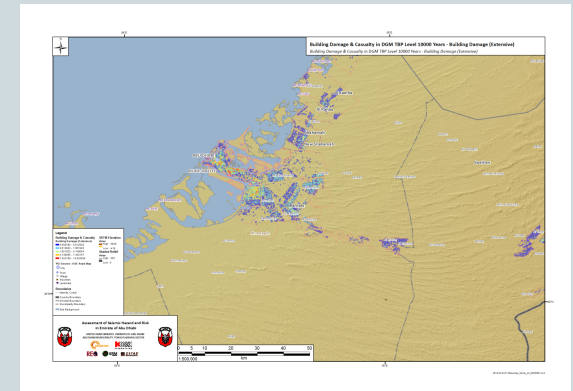
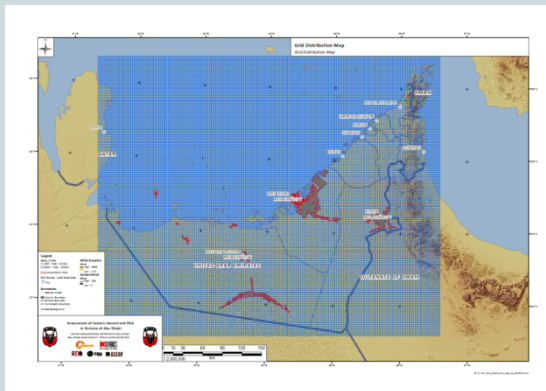
Dr. Ali Megahed, Abu Dhabi Municipality, Abu Dhabi, UAE (email: ali.megahed@adm.abudhabi.ae.)



Introduction



Overview of Seismic Hazard & Risk Analysis & Geographical Information Systems (GIS)



Geographic Information System environment can be used to manage seismic hazard & loss estimation analysis outputs as an important tool and it has many useful features to carry out statistical and spatial analysis efficiently for ground science related studies. In context of Abu Dhabi Seismic Hazard and Risk Assessment (ADSHRA) Project an integrated seismological GIS data model which is associated to many different seismic analysis outputs by predefined relationships has been established, also specific applications of GIS has been developed for management, maintenance and modification of Seismic Database Products which includes data update mechanism for system sustainability.

Project Scope



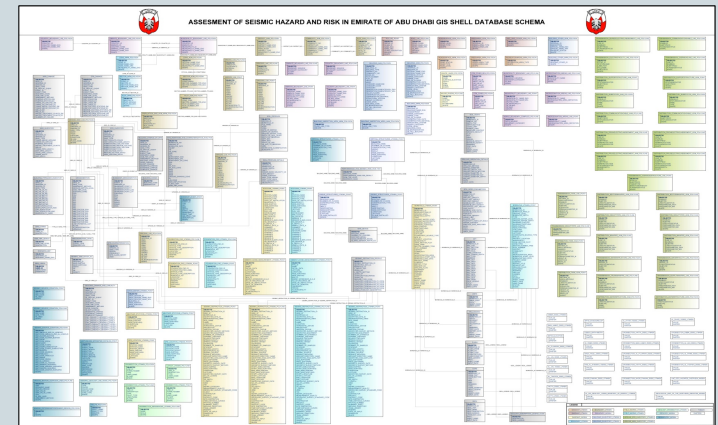
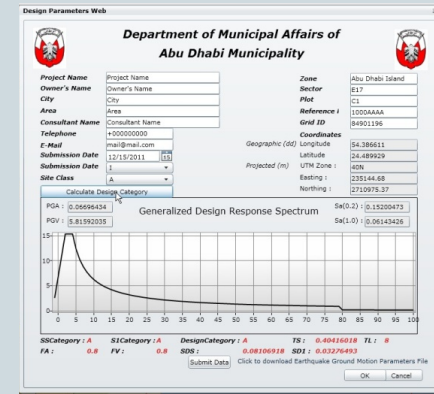
- Project Structure, broken down into 15 Tasks

TK-XX	PROJECT TASKS
01	Seismic Hazard Assessment and Seismic Zoning of United Arab Emirates
02	Site Amplification Studies and Microzonation
03	Liquefaction Susceptibility Studies and Microzonation
04	AD Seismic Design Parameters Web
05	Seismic Risk Analysis of Four Critical Importance Lifeline Systems
06	Seismic Risk Analysis of Critical Structures
07	AD Permanent Accelerograph Network
08	AD Seismic Monitoring Network
09	UAE. Ground Shaking Map (UAE-GSM) System
10	Structural Health Monitoring System for Unique Structures
11	UAE 3D Seismic Simulation Model to Simulate Long-Period Seismic Waves
12	Seismic Performance and Risk of ADM Tall Buildings to Simulated Long-Period Seismic Waves
13	Seismic Risk Assessment and Loss Estimation
14	AD Seismic Risk Monitoring and Management Centre (AD-SRMMC)
15	Seismic Data Base & GIS Shell for Management, Maintenance and Modification of Seismic Database Products
16	Coordinated Activities
17	Promotion, Validation & Public Awareness
18	Training and Transfer of Know-How
19	Build – Operate – Transfer (BOT) Services
20	Maintenance

ADSHRA - Assessment of Seismic Risk in Emirate of Abu Dhabi Project



- Following tasks, have been completed at the scope of project;
- **Task – 04** : Development of a Web page providing seismic [and wind] design parameters in format complying with ICC's 2006 International Building Code as well as requirements and potential provisions for seismic [and wind] design of tall and ultra tall buildings.
- **Task – 15** : Development of a suitable seismic database which include database development, management software and hardware, procedure of maintenance which also can be listed as;
 - Seismic Database Development
 - Database Management Software
 - Database Management Hardware
 - Procedure of Maintenance



TK-04 Seismic Design Parameters GIS-WEB Application



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Seismic Hazard Risk Assessment
-
Seismic Design Parameters Web



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User

Password

Login

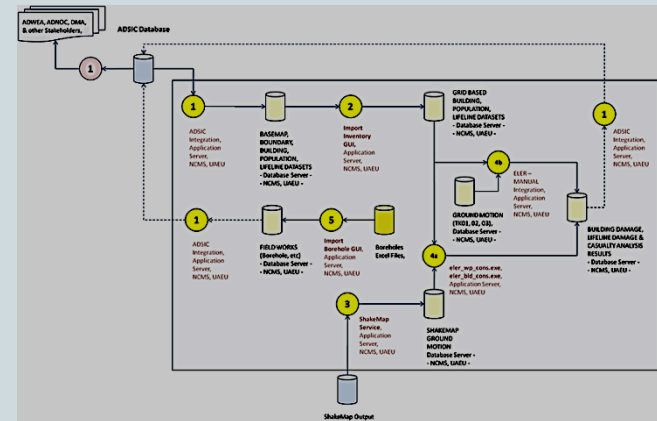
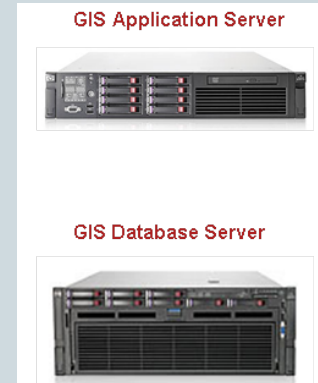
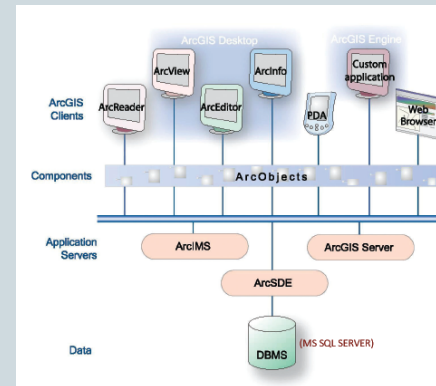
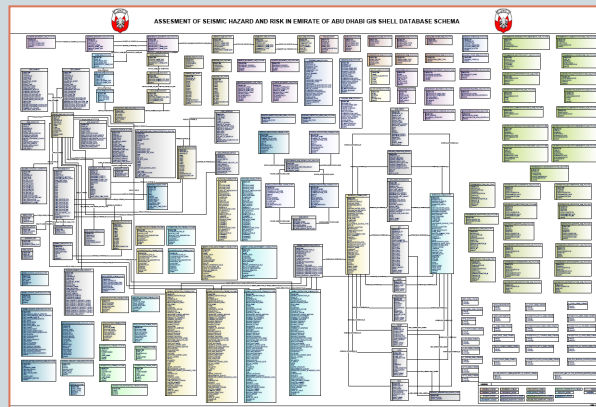
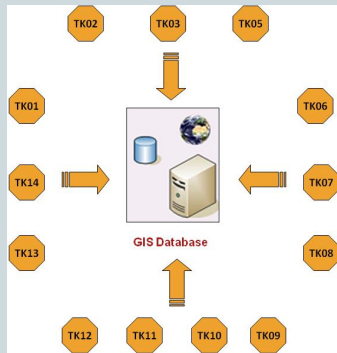


TK-15 Development of Seismic Database & GIS Shell



- **Task – 15** : Development of a suitable seismic database which include database development, management software and hardware, procedure of maintenance which also can be listed as;

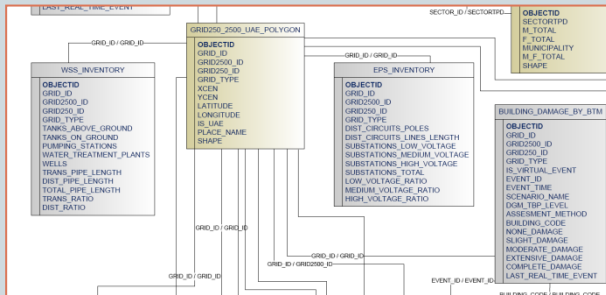
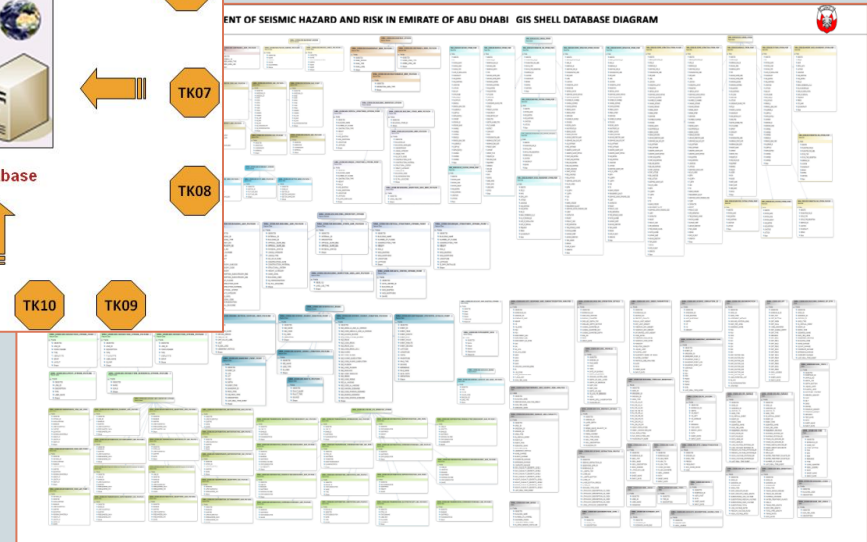
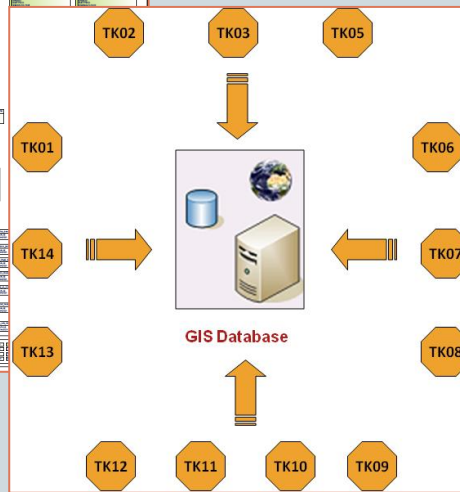
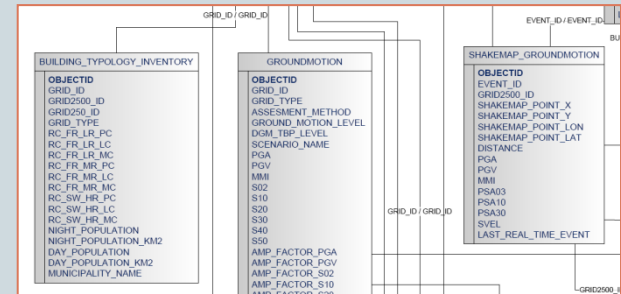
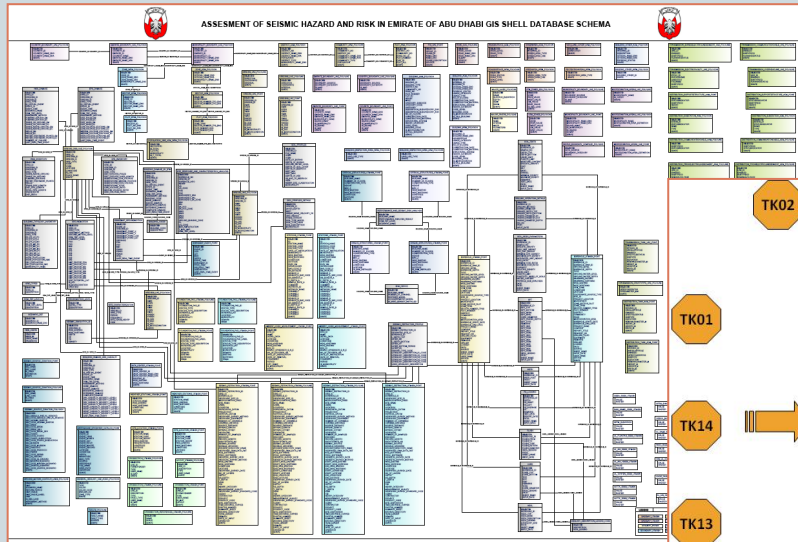
- Seismic Database Development
- Database Management Software
- Database Management Hardware
- Procedure of Maintenance



TK-15 Development of Seismic Database & GIS Shell



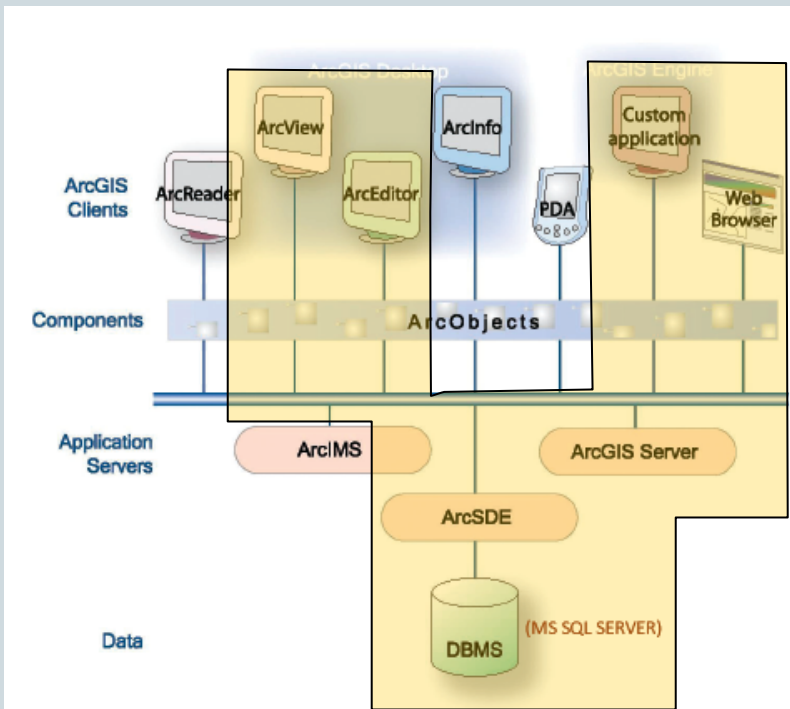
- Spatial Seismic Database



TK-15 Development of Seismic Database & GIS Shell



- Database Management Software – Technology, used



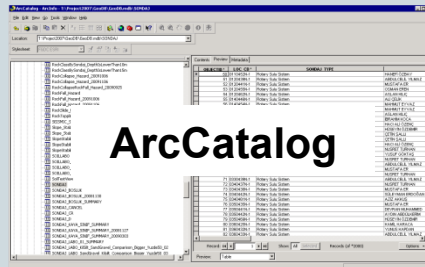
- Operating System : Windows Server 2008 R2 for both Application and Database Servers
- MS SQL Server is used in Dataserver as Relational Database Management System and ESRI ArcSDE will work together with MS SQL Server for the storage & management of geodatasets.
- WebApp is using the geodatasets in ArcSDEServer.
- In order to develop the interfaces and tools at WebApp .NET Framework Technology was used.
- ArcGIS Server for .net framework has been installed on Application Server to manage the services for GIS-Web Applications
- ArcSDE for Ms SQL Server 64 Bit has been installed in DB Server to keep Seismic Database.
- ArcEditor & Spatial Extension have been installed in App Server (NCMS) for GIS Analysis

TK-15 Development of Seismic Database & GIS Shell

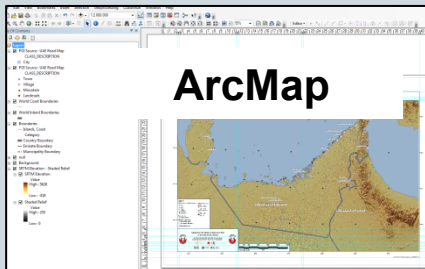


- Database Management Software – Technology, used

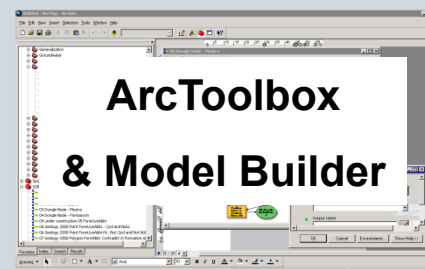
Arcview ArcGIS Desktop



ArcCatalog



ArcMap



ArcToolbox
& Model Builder

➤ArcGIS Desktop (Arcview) includes a suite of applications including ArcMap, ArcCatalog, ArcToolbox and Model Builder.

➤ArcMap is used for all mapping , editing tasks as well as for map based query and analysis.

➤ArcCatalog, provides an integrated unified view of all datafiles, geodatabases, maps, globes and GIS services

➤ArcToolbox and Model Builder are the cornerstones of the ArcGIS geoprocessing framework used for automating tasks and for spatial analysis

➤Users develop extensions and custom tools using standard Windows programming interfaces such as Visual Basic®(VB), .NET, and Visual C++®

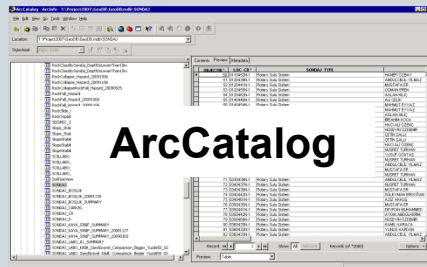
➤ARCGIS Desktop (Arcview) corresponds to the requests written in ToR for EAD-SHRA Dataset Browser, GIS Analysis Application & Cartographic Presentation.

TK-15 Development of Seismic Database & GIS Shell

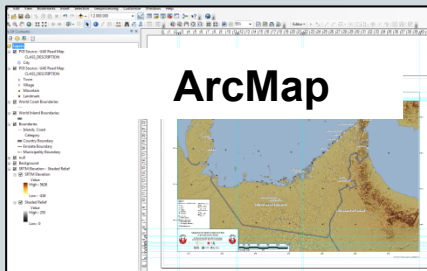


- Database Management Software – Technology, used

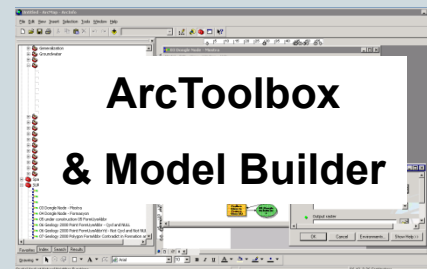
Arcview ArcGIS Desktop



ArcCatalog



ArcMap



ArcToolbox
& Model Builder

- **EAD- SHRA Data Set Browser**

- Zoom, Pan, set scale,
- Identify Features and their attributes
- Extensive Search Mechanism
- ... (specs defined in ToR)

- **GIS Analysis Application**

- Shall use a “project” as a container for the analysis (mxd. Application file)
- Logic Operations (AND, OR, NOT, NOR)
- General arithmetic operations
- ... (specs defined in ToR)

- **Cartographic Presentation**

- Labelling, Annotation
- Graphs & Charts
- Legend Generation and Editing
- ... (specs defined in ToR)

- **Database Update Mechanism**

- ShakeMap + ELER + Database Integration
- Import Inventory
- Import Borehole

TK-15 Development of Seismic Database & GIS Shell

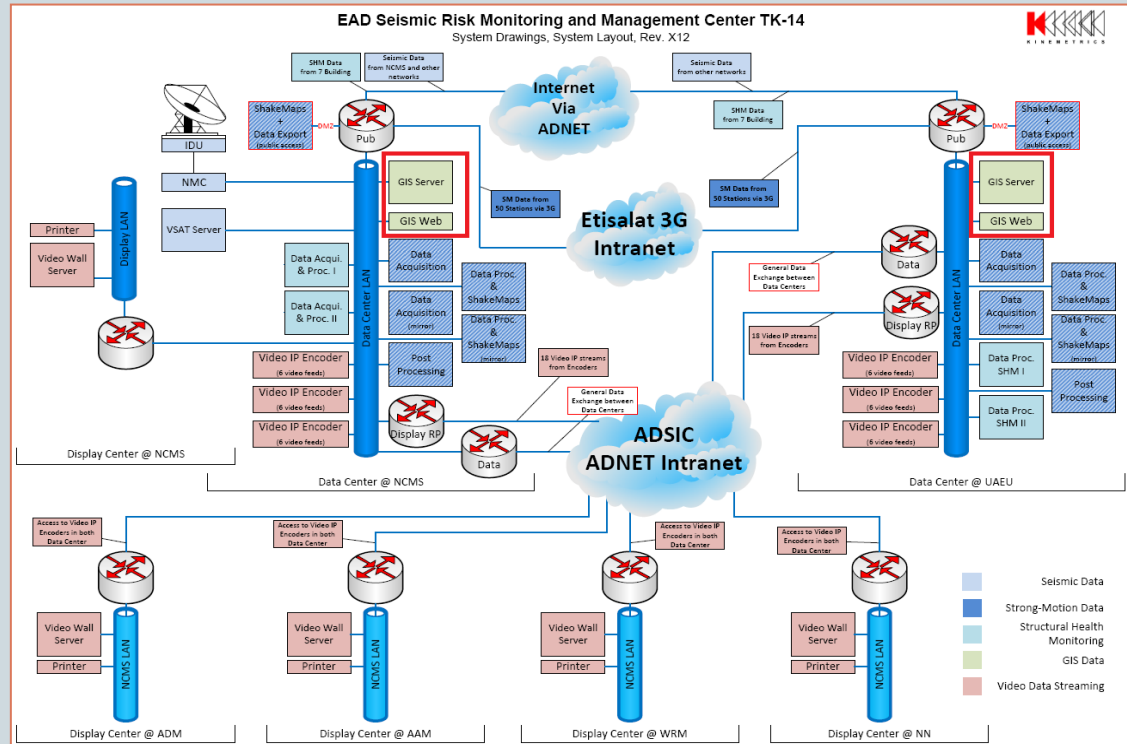


- Database Management Hardware

GIS Application Server



GIS Database Server



TK-15 Development of Seismic Database & GIS Shell



- Procedure of Maintenance

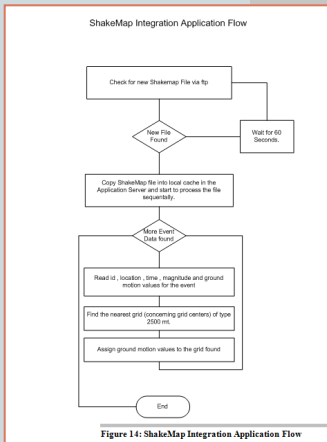
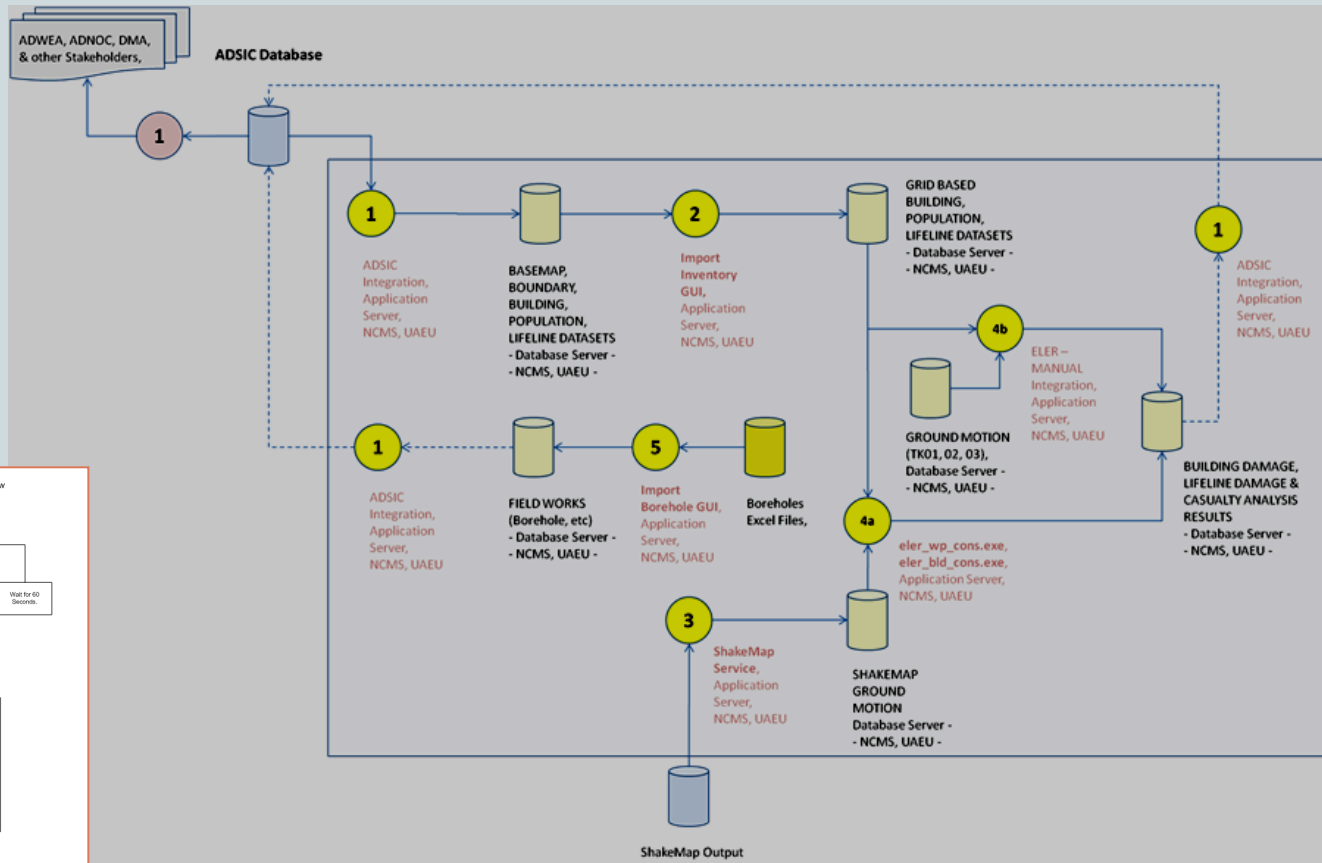
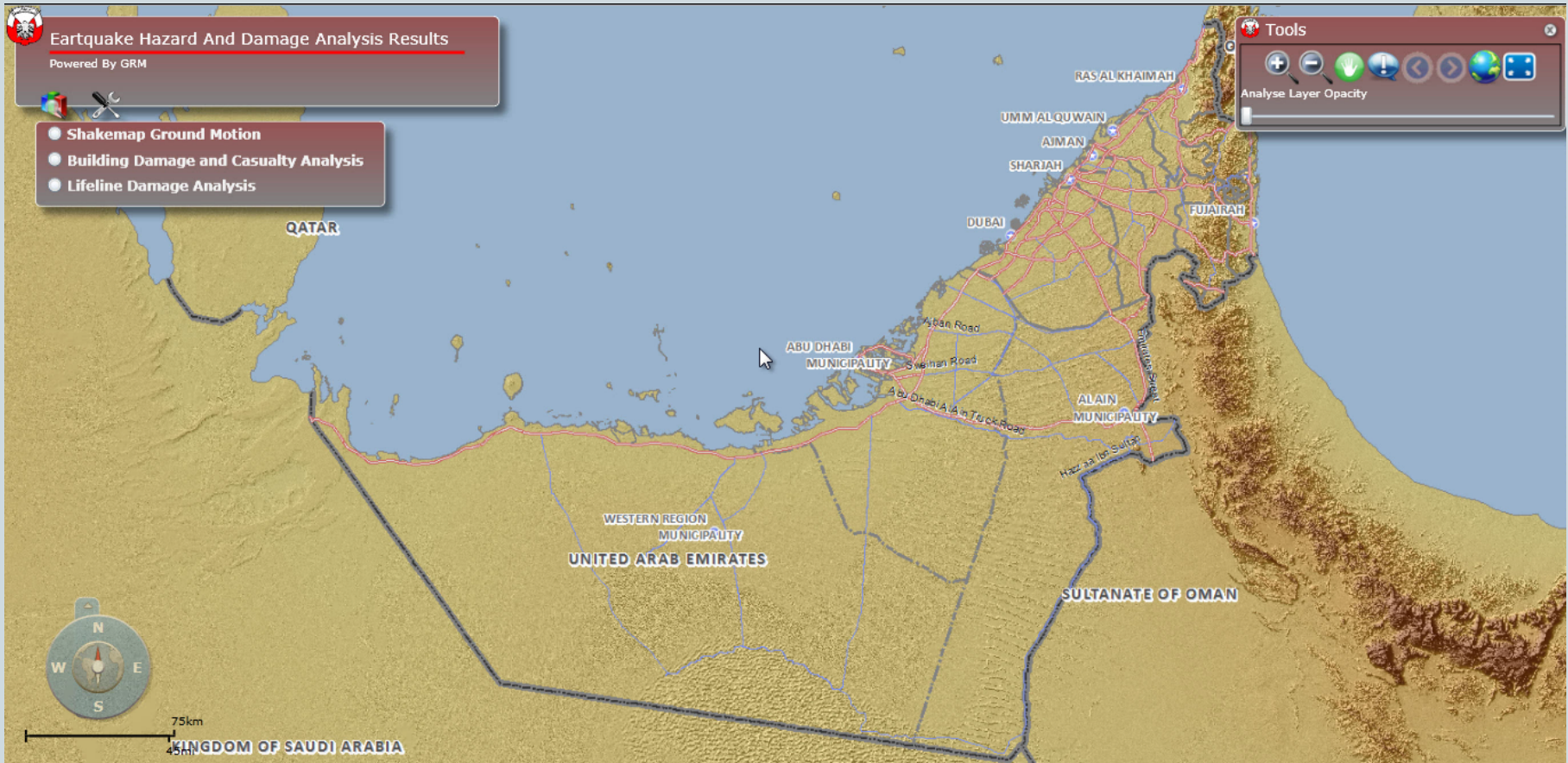


Figure 14: ShakeMap Integration Application Flow

TK-15 Development of Seismic Database & GIS Shell



- Procedure of Maintenance – Risk Monitoring Web



Feature Datasets in Seismic Database



<u>DATASET</u>	<u>CONTENT</u>
BASEMAP	land use, water surface, green area, transportation and point of interest (POI) information
BOUNDARY	administrative boundaries, cadastral information, microzonation areas, analysis grids and population information
BUILDING_INVENTORY	building inventory for Abu Dhabi, Al Ain, and Western Region Municipalities, Critical and Unique Structures Information
FIELD_WORKS	location of boreholes, ANM, accelerograph stations, seismic stations, weather stations, GPS stations
GEOLOGY_CROSSECTION	geological crosssections, digitized from different scale of geology maps gathered from Ministry of Energy
GEOLOGY	geological covers whole UAE and gathered from ADSIC
LIFELINE_EPS_INVENTORY	electricity network lines and structures at the scope of UAE
LIFELINE_WSS_INVENTORY	water network lines, structures and connections at the scope of UAE
SEISMOLOGY	fault lines, seismic zones, shake map event data, earthquake epicenter catalog
TOPOGRAPHY_DATA RASTER CATALOG	elevation, hill-shade and GEBCO dem information as grid data.
GEOLOGY_MAP_RASTERS	registered geological maps and crosssections gathered from different official organizations and associations.

Accessing, Querying, Mapping Seismic Database

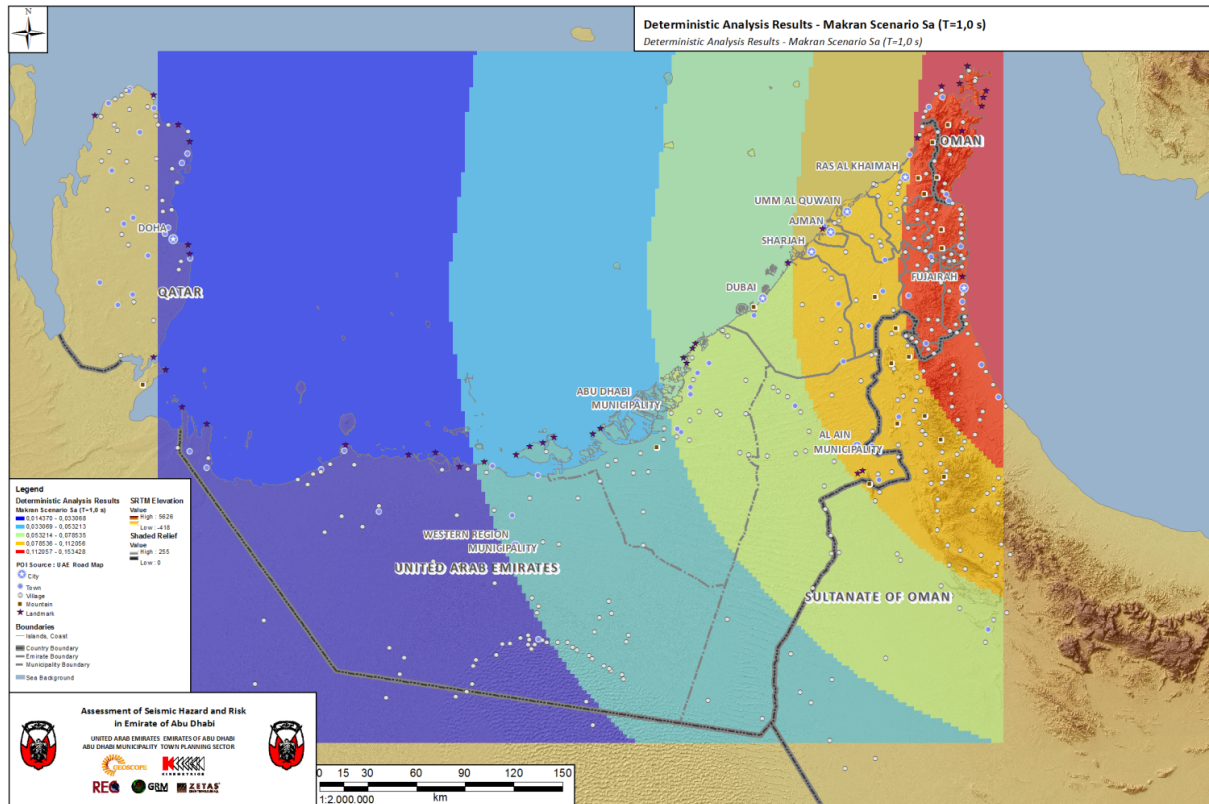


The screenshot displays the ArcMap interface with the following components:

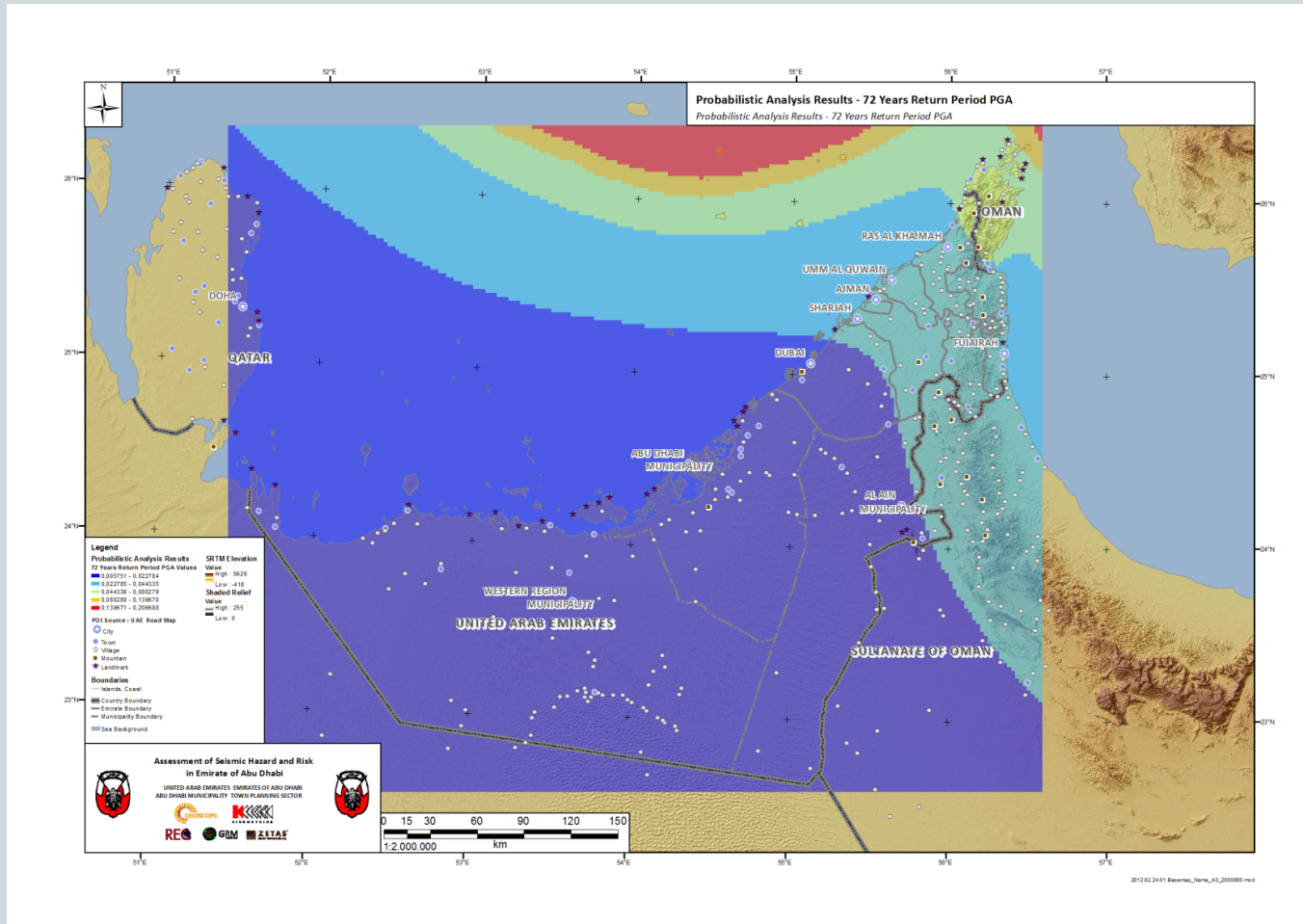
- Zoom, Pan Tools:** Located in the top toolbar, used for navigating the map.
- Layout Tools:** Located in the top toolbar, used for preparing the map for printing or export.
- Map Display Window:** The central area showing a map of the United Arab Emirates with a grid overlay.
- TOC (Table of Contents):** Located on the left, showing a list of layers including "POI Source: UAE Road Map", "City", "Town", "Village", "Mountain", "Landmark", "World Coast Boundaries", "World Inland Boundaries", "Boundaries", "Islands, Coast", "Country Boundary", "Emirate Boundary", "Municipality Boundary", "null", "Background", "SRTM Elevation - Shaded Relief", and "SRTM Elevation".
- Catalog Window:** Located on the right, showing a list of data sources and their types. The selected layer is "SHRA_GISDB.SDE.GROUND_MOTION_CONTOUR_LINES_POLYLINE".

Name	Type
SHRA_GISDB.SDE.EARTHQUAKE_EPICENTER_CATALOG_POINT	SDE Feat
SHRA_GISDB.SDE.FAULTS_POLYLINE	SDE Feat
SHRA_GISDB.SDE.GROUND_MOTION_CONTOUR_LINES_POLYLINE	SDE Feat
SHRA_GISDB.SDE.MAKRAN_DETERMINISTICSCENARIO_REGION...	SDE Feat
SHRA_GISDB.SDE.SEISMIC_SOURCE_ZONATION_POINT	SDE Feat
SHRA_GISDB.SDE.SEISMIC_SOURCE_ZONATION_POLYGON	SDE Feat
SHRA_GISDB.SDE.SEISMIC_SOURCE_ZONATION_POLYLINE	SDE Feat
SHRA_GISDB.SDE.SHAKEMAP_EVENT_POINT	SDE Feat
SHRA_GISDB.SDE.SHAKEMAP_GROUND_MOTION_POINT	SDE Feat

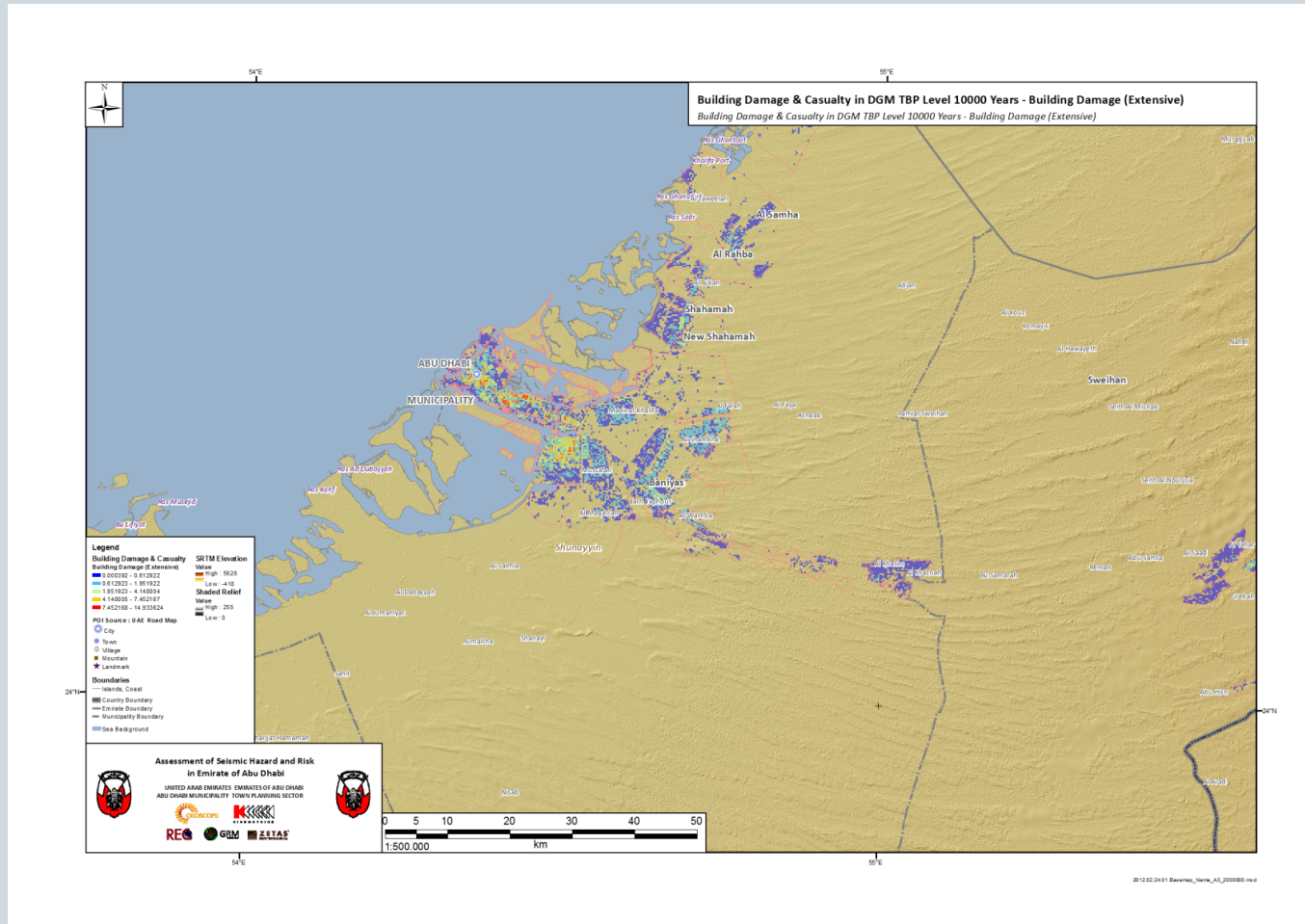
Project Analysis Results - Products



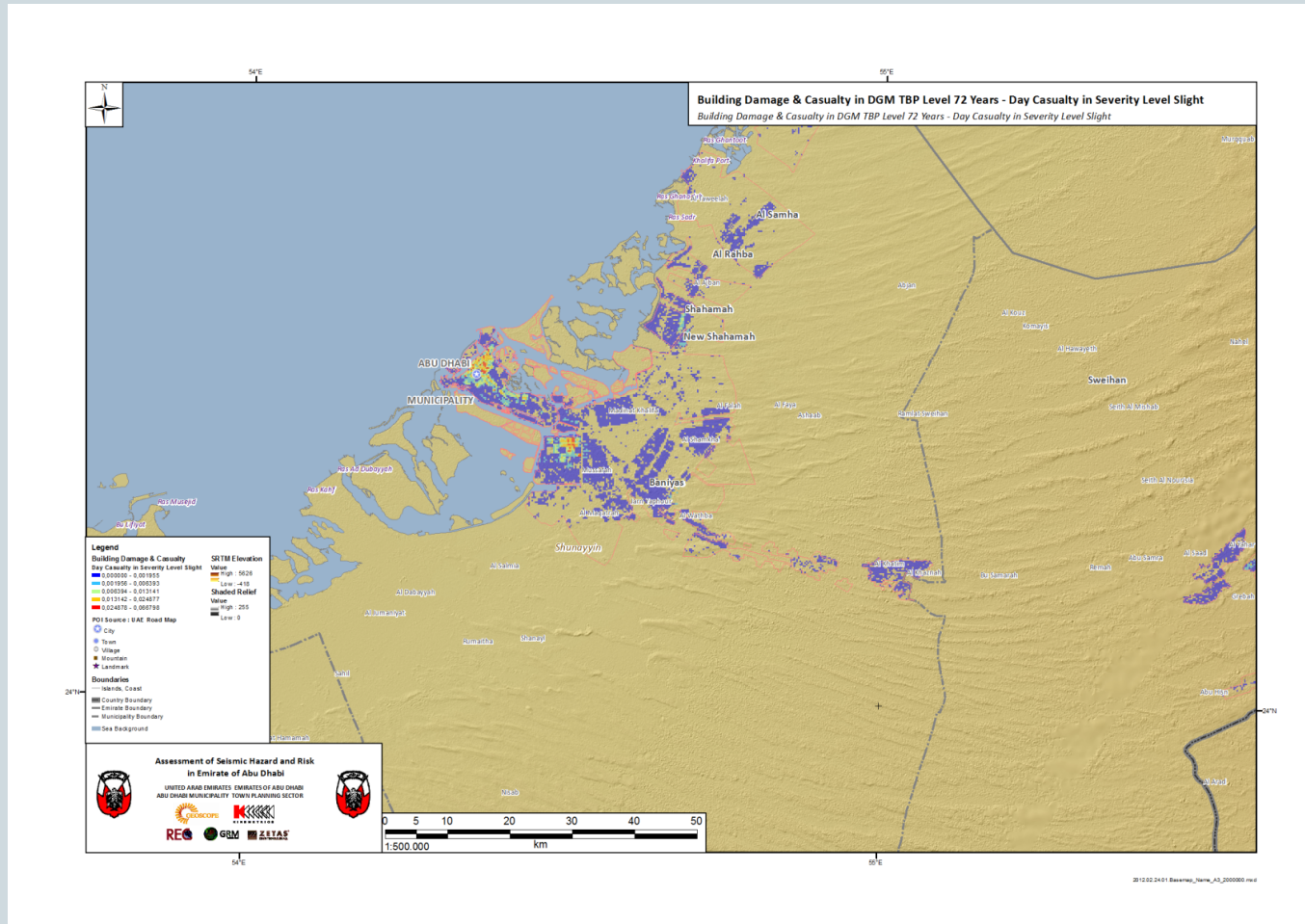
Project Analysis Results - Products



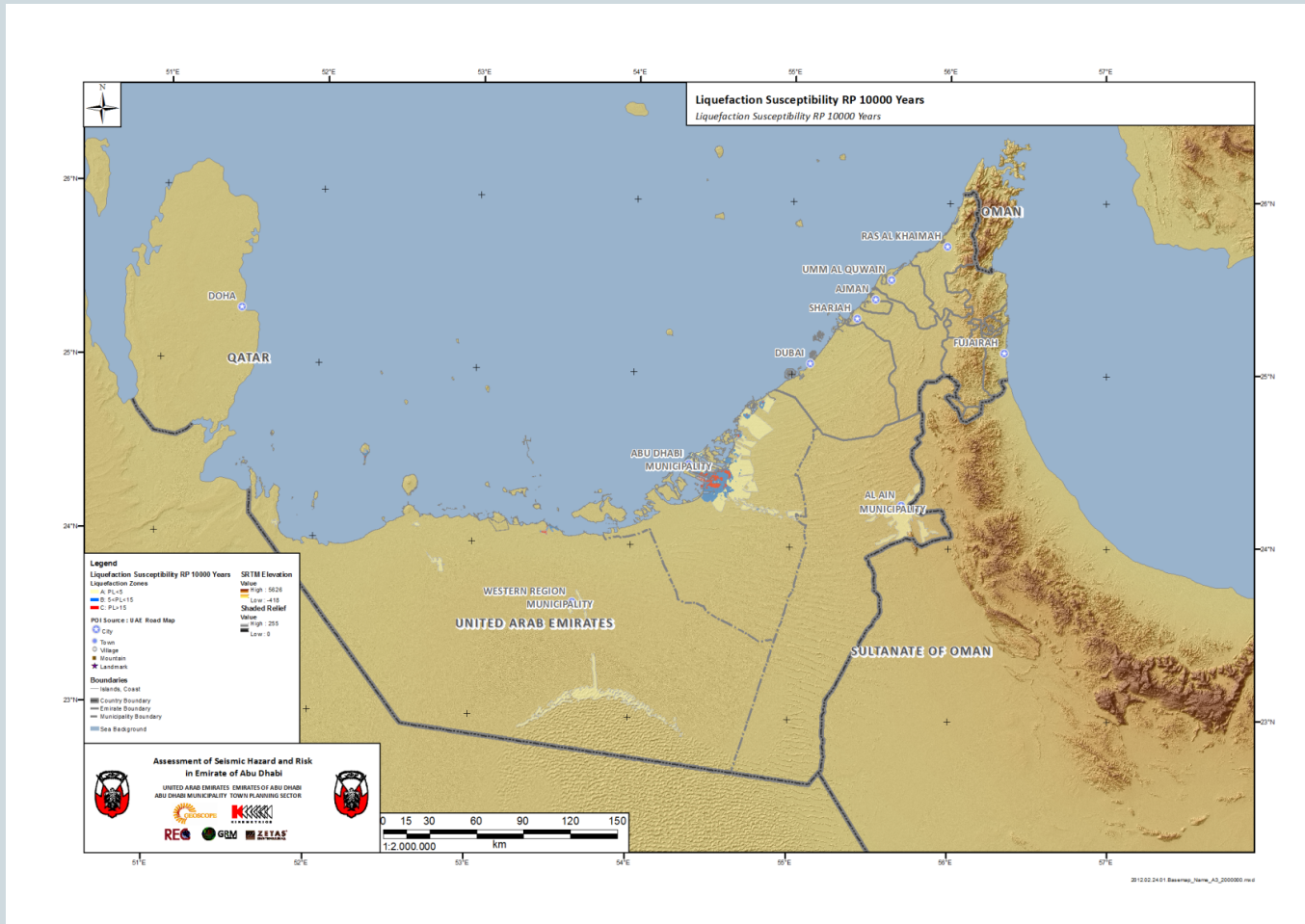
Project Analysis Results - Products



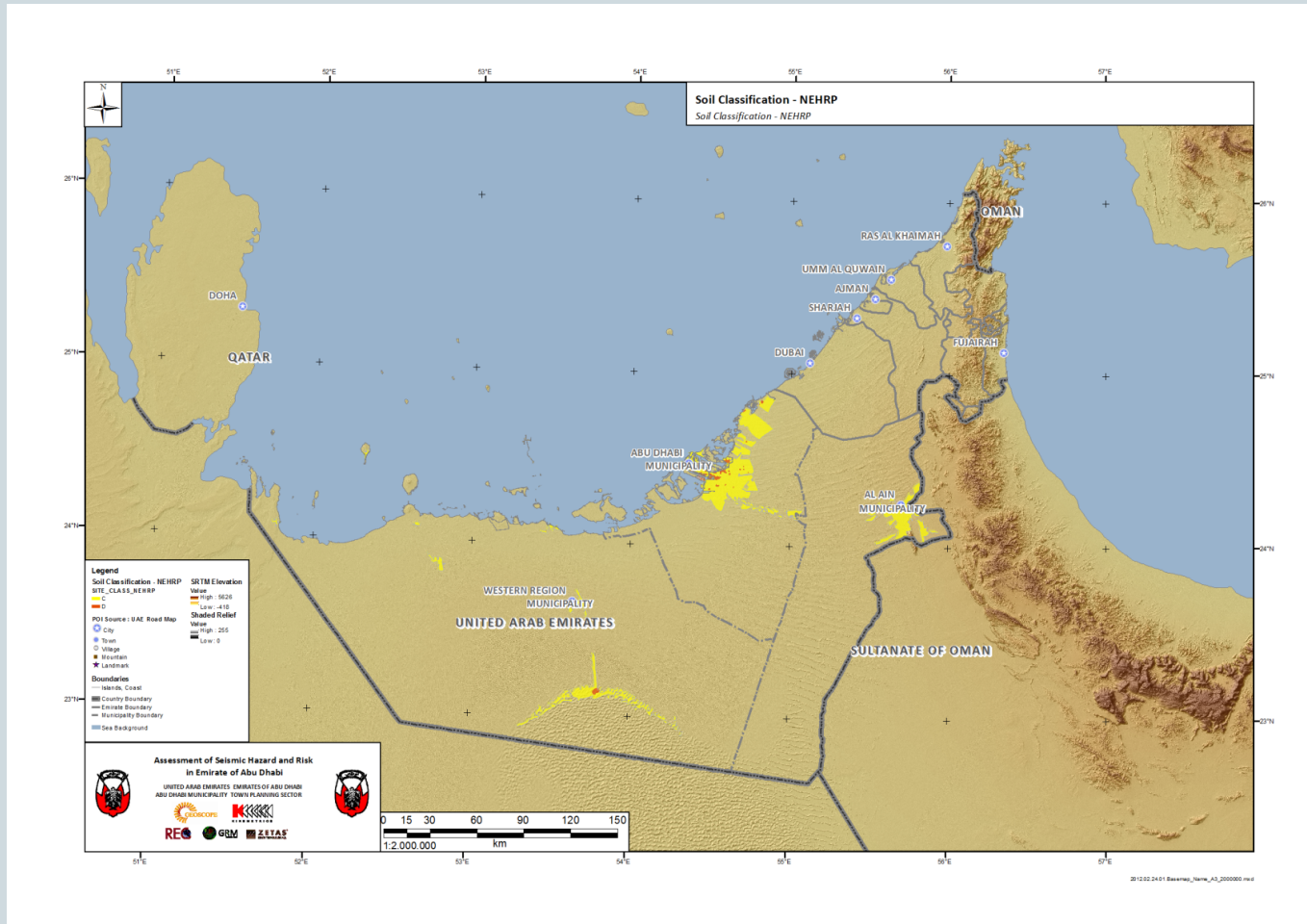
Project Analysis Results - Products



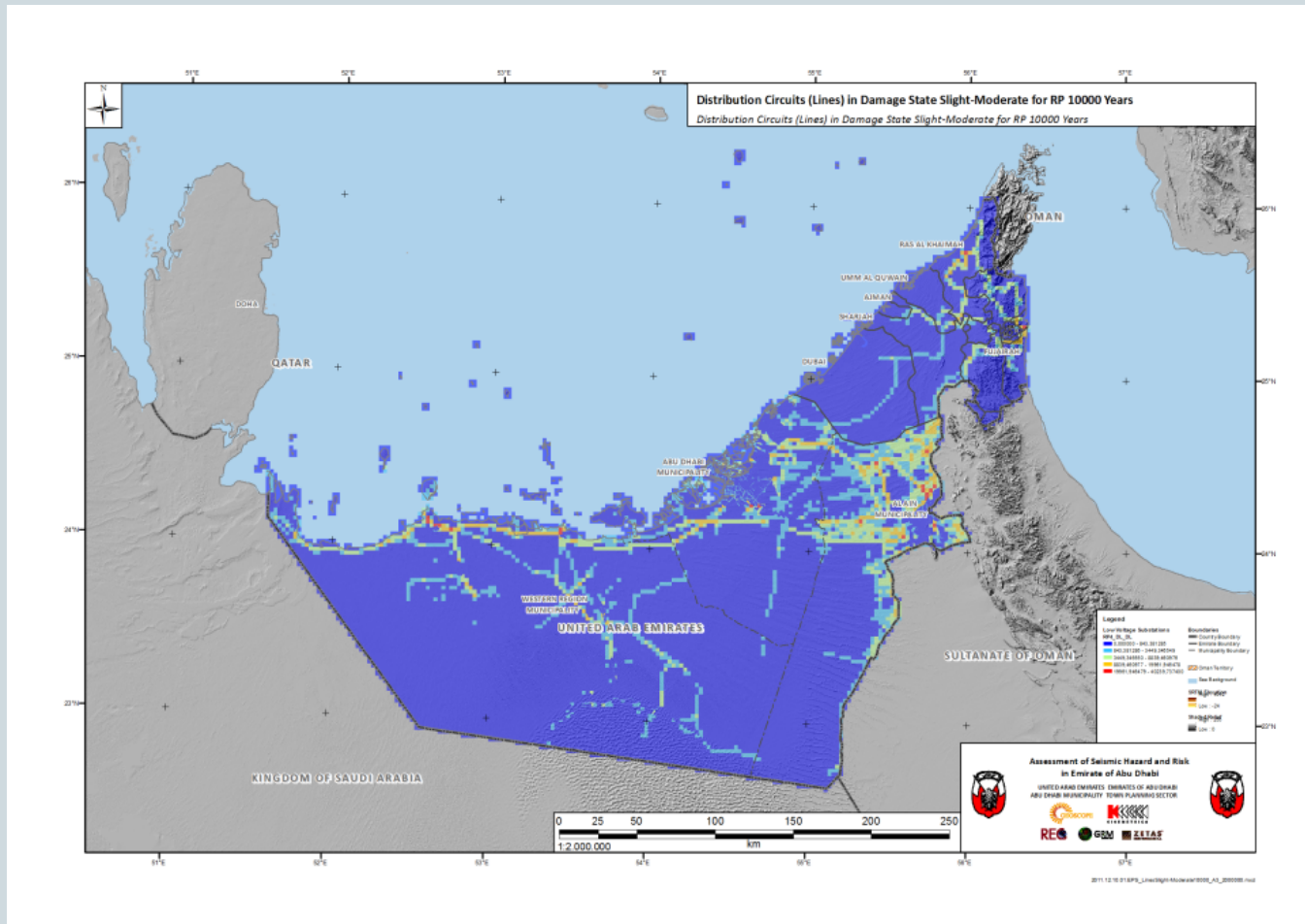
Project Analysis Results - Products



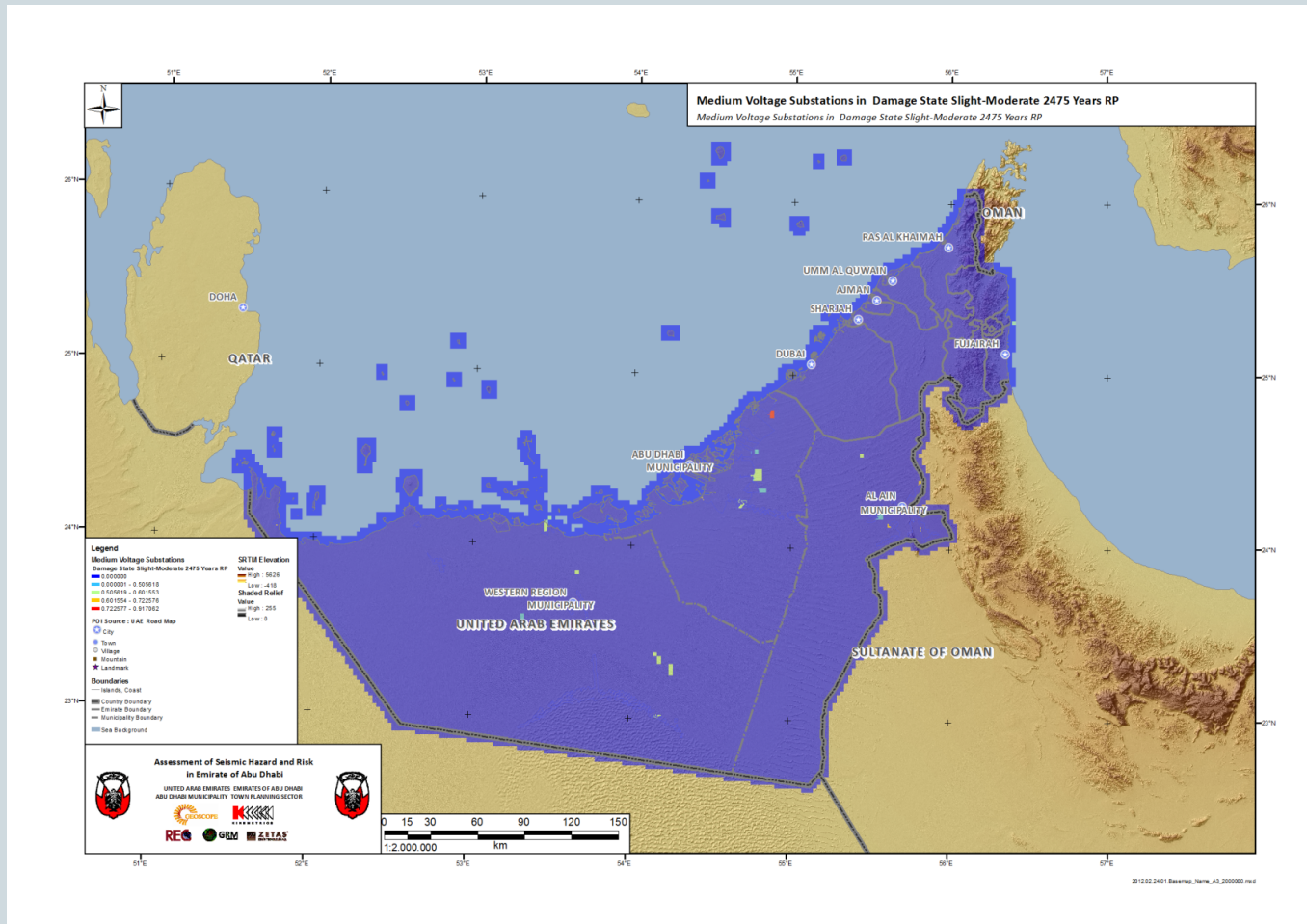
Project Analysis Results - Products



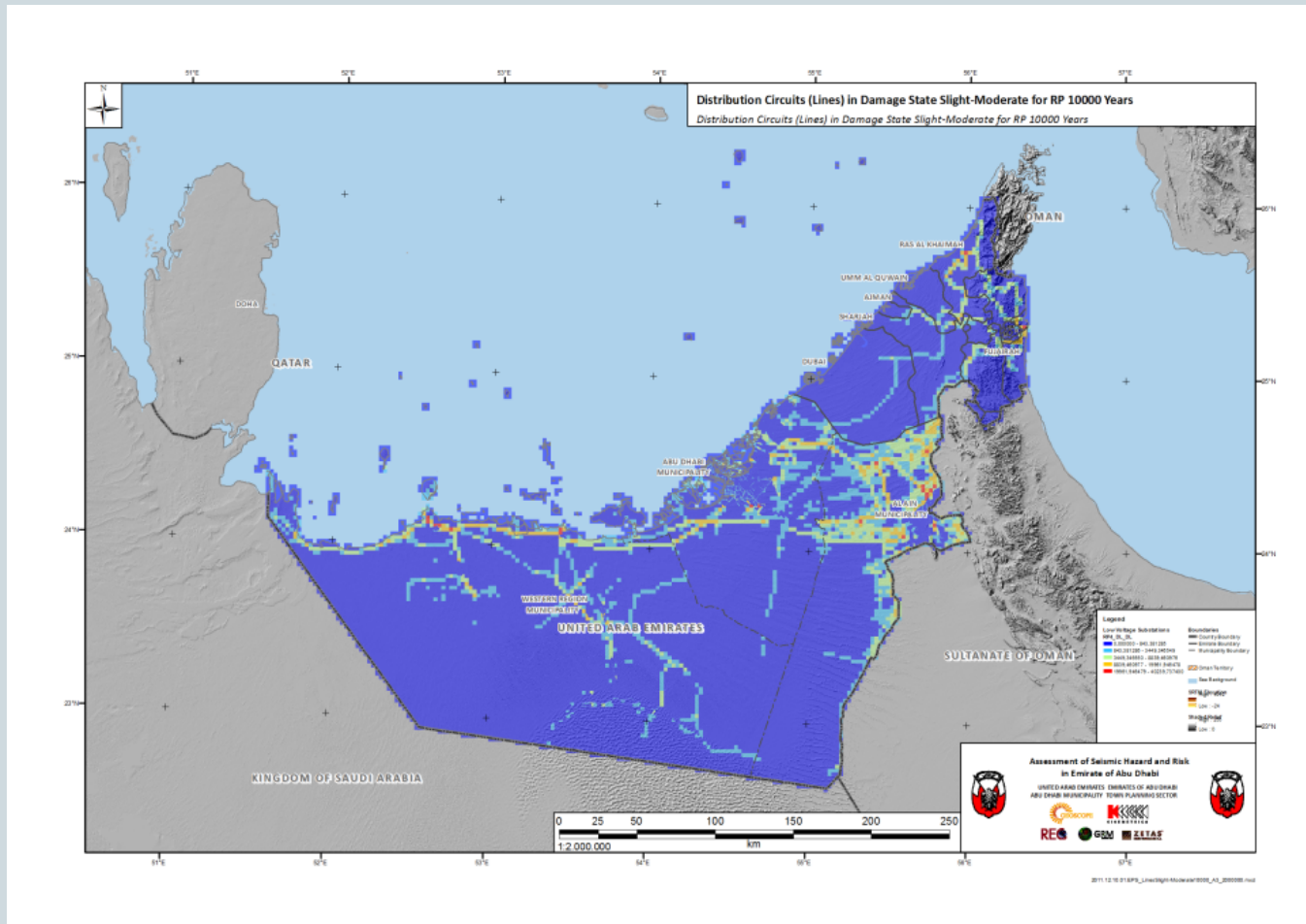
Project Analysis Results - Products



Project Analysis Results - Products



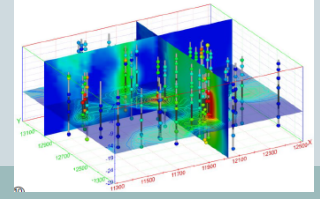
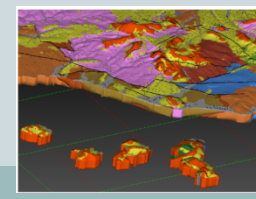
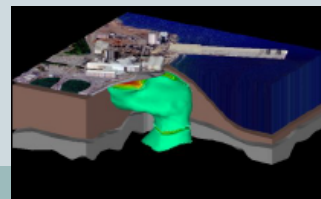
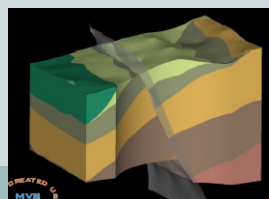
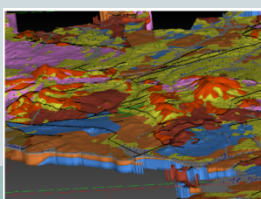
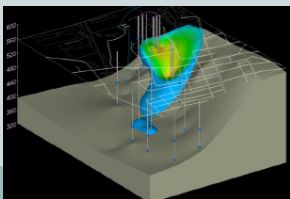
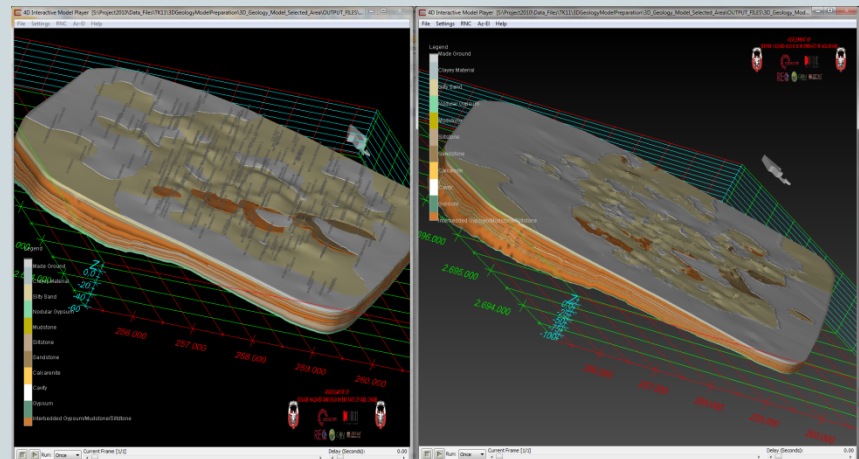
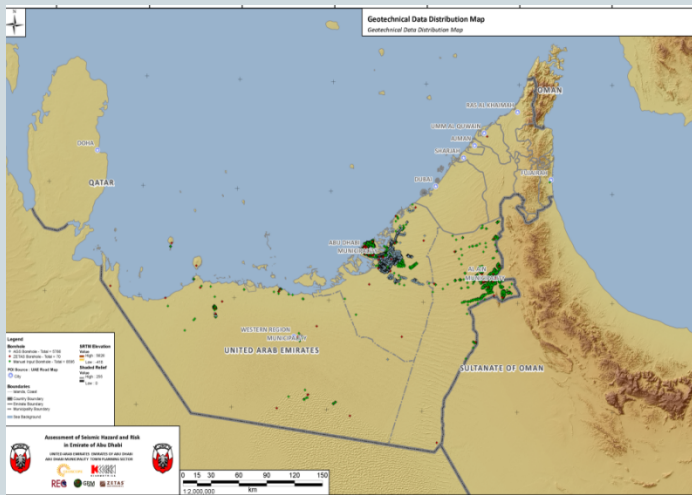
Project Analysis Results - Products



3D Geology Modelling from AGS Borehole Data by EVS-PRO Software



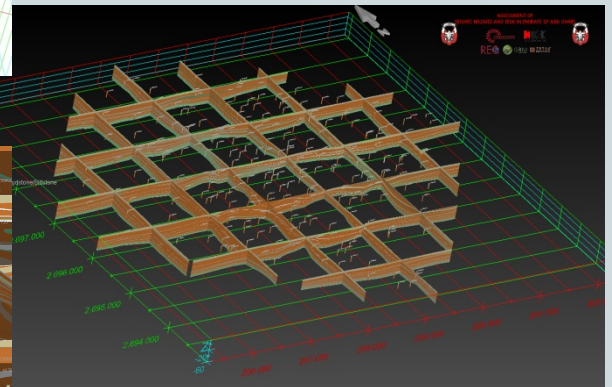
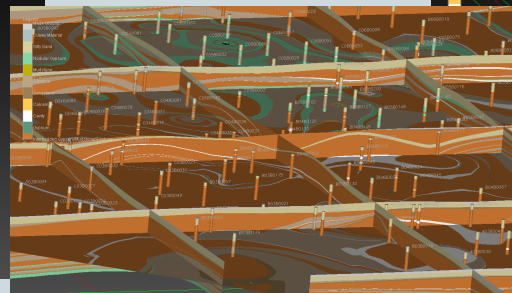
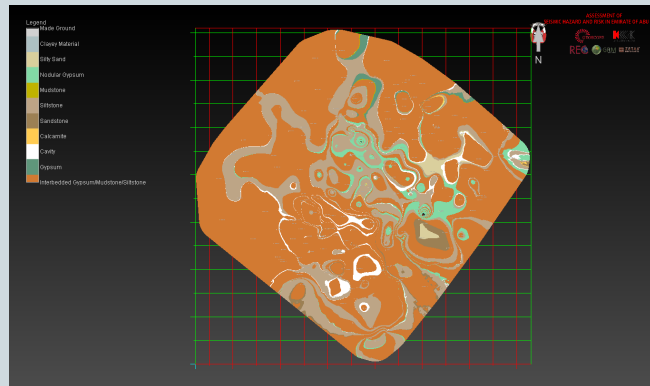
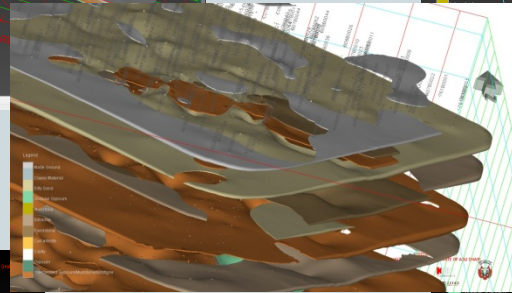
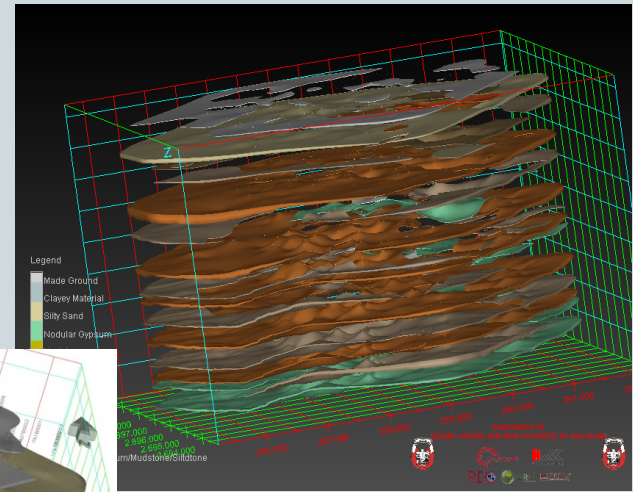
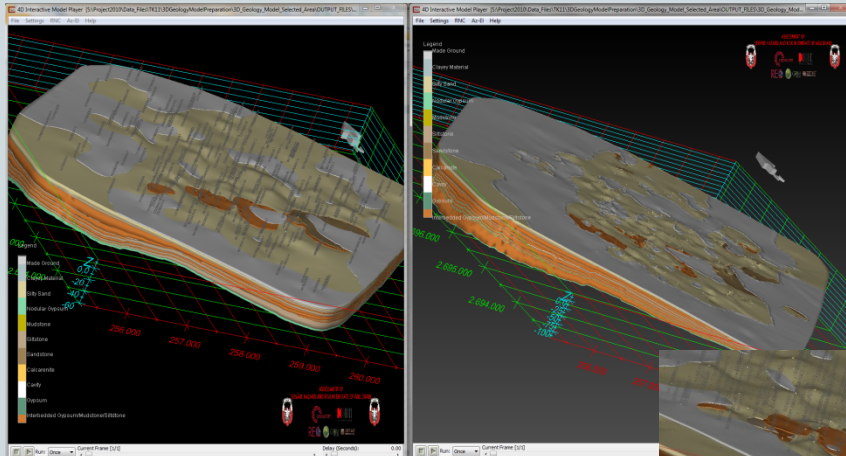
- Environmental Visualization System Pro (EVS-PRO)
- 3-D Analysis and Visualization for Earth Sciences
- Environmental Decision Support Software



3D GEOLOGY MODELLING FROM BOREHOLE DATA BY CTECH EVS-PRO SOFTWARE



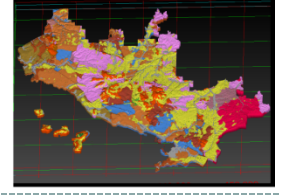
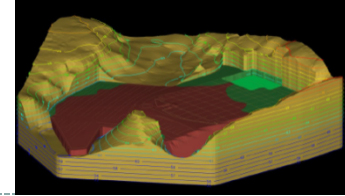
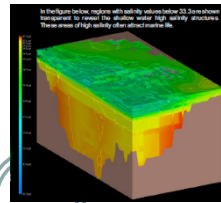
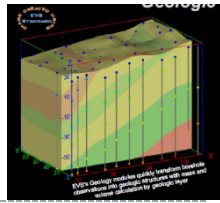
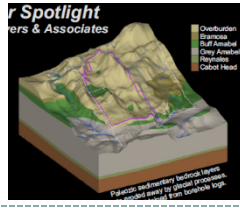
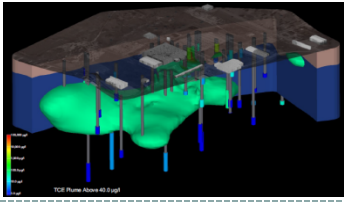
GRM
Letişim ve Bilgişim



CONCLUSION



- As a system, microzonation study analysis has been designed and integrated into a GIS platform which contains conceptually designed suitable seismic database including database, management hardware and software, data model and procedure for regular maintenance to support and facilitate the GIS based decision making process in urban/regional planning and architectural and structural design.



Thank you for your attendance.

Questions?

