LECTURE 2
GIS SOFTWARE

Youngstown
STATE UNIVERSITY
IN YOUNGSTOWN, OHIO

CEEN 4800/6965 - Special Topics
Geographic Information Systems and Hydrologic & Hydraulic Modeling
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OUTLINE

◆ **Software types**

◆ **Software examples**

　◆ **ESRI software**

　◆ **Other software**

◆ **Software selection**

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SCOPE

◆ **There is a large number of GIS software products, not all of which can be discussed.**

◆ **Only representative examples of GIS software vendors and their main products are included in this lecture.**

IMPORTANCE

GIS Software represents less than 10% of the total GIS cost in most cases, yet people spend a lot of time in selecting the best software for their GIS needs.

Relative Cost of GIS Components

HARDWARE + SOFTWARE (15%)

- Base Mapping
- Conversion
- HW/SW
- Training
- O&M
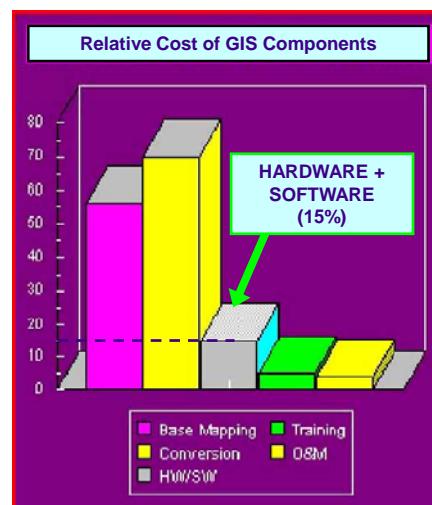
GIS SOFTWARE TYPES

- Based on GIS data
    - Vector software: work with vector type GIS data
    - Raster software: work with raster type GIS data
    - Vector/raster software: work with <u>both</u> data types
- Based on purpose
    - Mapping software: create GIS data and maps
    - Application software: use GIS data and maps for special applications (e.g., hydrologic modeling)
- Based on population of the city or system to be mapped
    - Desktop software
        - For small cities or systems with population < 50,000
    - Professional (Pro) or enterprise software
        - For large cities or systems with population > 50,000

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VECTOR GIS SOFTWARE
LARGE SYSTEMS

Software	Version / Year	(US$)	Vendor	Web site
ArcGIS®	9.2/2007	ArcView:$1,500 ArcEditor: $7,500 ArcInfo: $14,000 + $3,000/year maintenance fee	ESRI, Redlands, California	www.esri.com
GeoMedia Pro®	6.0/2005	7,000-8,000	Intergraph, Huntsville, Alabama	www.intergraph.com
MGE® (requires MicroStation 7, not supported on version 8)	8.0/2001	4,000-6,000 + 4,000-5,000 for MicroStation		
Smallworld®	4.0/2005	50,000-60,000	Smallworld Systems, Cambridge, UK	www.gepower.com

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VECTOR GIS SOFTWARE
SMALL SYSTEMS

Software	Version / Year	(US$)	Vendor	Web site
ArcView®	9.2 / 2007	1,400-1,600	ESRI, Redlands, California	www.esri.com
AutoCAD Map 3D® (requires AutoCAD®)	2008	5,000-5,500 (including AutoCAD)	Autodesk, San Rafael, California	www.autodesk.com
GeoMedia®	6.0 / 2005	1,400-1,600	Intergraph, Huntsville, Alabama	www.intergraph.com
MapInfo Professional®	9.0/2007	1,400-1,600	Pitney Bowes Troy, New York	www.mapinfo.com

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RASTER GIS SOFTWARE
LARGE SYSTEMS

Software	Version	(US$)	Vendor	Web site
ArcGIS Spatial Analyst®	9.2/2007	2,000-3,000	ESRI, Redlands, California	www.esri.com
MGE® (requires MicroStation®)	8.0/2001	4,000-6,000 + 4,000-5,000 for MicroStation	Intergraph, Huntsville, Alabama	www.intergraph.com
IMAGINE®	9.1/2006	Depends on options. Starting price is 5,000.	Leica Geosystems (formerly ERDAS) Atlanta, Georgia	www.erdas.com

• MGE has both vector and raster data analysis capability.

RASTER GIS SOFTWARE
SMALL SYSTEMS

Software	Version	(US$)	Vendor	Web site
ArcGIS Spatial Analyst®	9.2/2007	2,000-3,000	ESRI, Redlands, California	www.esri.com
MFworks® for GeoMedia®	2.6	800-1,000	Intergraph, Huntsville, Alabama	www.intergraph.com
Idrisi32®	2.0	1,400-1,600	Clark Labs, Worcester, Massachusetts	www.clarklabs.org
GRASS	5.0	Free	Baylor University, Waco, Texas	www.baylor.edu/grass/

GIS SOFTWARE USERS IN USA

1998 Data

2002 Data

59.9% respondents use ARC/INFO

	%
ARC/INFO	59.90%
ArcCAD	15.60%
ArcView	74.40%
Atlas	3.70%
AutoCAD	44.90%
FRAMME	0.60%
GeneMap	1.60%
GRASS	2.20%
IBM-GFIS	0.10%
IDRISI	3.40%
IMAGINE	7.30%
MapInfo P	13.90%
Maptitude	1.40%
IG MGE	5.90%
MicroGDS	0.70%
MicroStation	11.10%
MOSS	1.40%
Other	15.70%

◆ Based on an October 98 survey
◆ 5,200 respondents from 1,683 counties in 14 states

Source: Framework Data Survey, GeoInfo Systems, September 1999.

% Respondents

0% 10% 20% 30% 40% 50% 60% 70% 80%

GIS vendors by number of projects

ESRI	62%
Autodesk	11%
Bentley	11%
Intergraph	9%
Other	7%
Smallworld	0%

Source: Geospatial Technology Report 2002, GITA.

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GIS SOFTWARE MARKET SHARE

	1999	2001	2003	2004 (Est.)
Worldwide GIS revenues	$1.5 billion (up 10.6%)	$1.56 billion	$1.84 billion	$2.02 billion (up 9.7%)
Hardware			$70 million (4%)	
Software	$845 million		$1.175 billion (64%)	
Services			$447 million (24%)	
Data Products			$140 million (8%)	
Vendor	*Market Share (%)*			
ESRI	35.1	35	34	
Intergraph	28.3	13	13	
MapInfo	5.5	6		
Autodesk	4.7	7		
GE Smallworld	4.3	7		
ERDAS	2.1	6		

◆ **Source: Geographic Information Systems - Markets and Opportunities, Daratech, Inc., Cambridge, MA, www.daratech.com (Daratech is an independent marketing research firm).**

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ESRI

- **Environmental Systems Research Institute**
- **Established in 1969, Headquarters in Redlands, CA**
- **More than 2,900 employees worldwide**
- **11 domestic offices in USA**
- **Over 75 international distributors in more than 200 countries**
- **2004 revenues of over $560 million**
- **Average annual growth of more than 20%**
- **Software used by over 300,000 organizations worldwide**
- **No. 1 GIS software provider in the world**

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ESRI GIS SOFTWARE

◆ **Desktop GIS**
  ◆ **ArcGIS**
    ◆ **ArcView**
    ◆ **ArcEditor**
    ◆ **ArcInfo (old name ARC/INFO)**
  ◆ **ArcGIS Extensions**
◆ **Server / Enterprise GIS**
  ◆ **ArcGIS Server (formerly ArcSDE)**
  ◆ **ArcIMS**
◆ **Mobile GIS**
  ◆ **ArcPad**
◆ **Developer GIS**
  ◆ **ArcObjects**
  ◆ **ArcEngine**
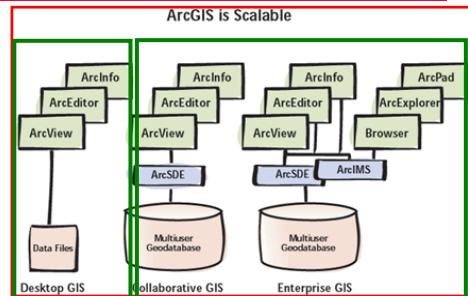
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ARCGIS PRODUCTS

◆ **Three desktop products (modules)**
  1. **ArcView**
  2. **ArcEditor (includes ArcView)**
  3. **ArcInfo (includes ArcEditor)**
◆ **Functionality increases from ArcView to ArcInfo**

ArcView	ArcEditor	ArcInfo
Data access	ArcView	ArcEditor
Mapping	*Plus*	*Plus*
Customization	Coverage and	Advanced geoprocessing
Spatial query	geodatabase editing	Data conversion
Simple feature editing		Workstation ArcInfo

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ARCGIS COMPONENTS

◆ **ArcGIS Desktop is a suite of three integrated components**
  1. **ArcMap**
  2. **ArcCatalog**
  3. **ArcToolbox**

ArcMap

ArcCatalog

ArcToolbox
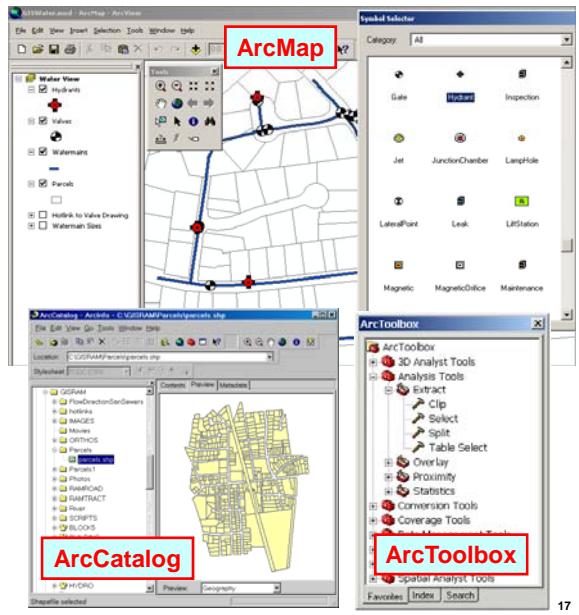
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ArcMap

◆ **Primary display application**

◆ **Perform map-based tasks**

   ◆ Displaying

   ◆ Editing

   ◆ Querying

   ◆ Analyzing

   ◆ Charting

   ◆ Reporting

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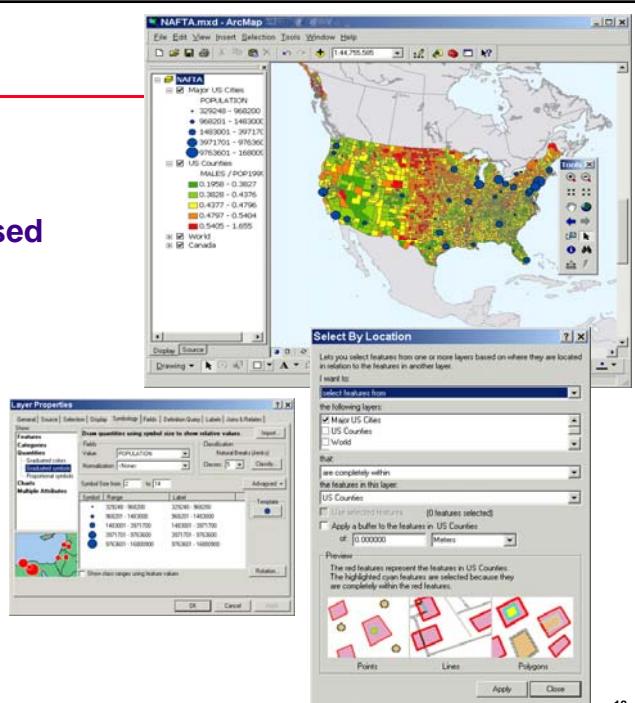
ArcCatalog

- ◆ **Like Windows Explorer**
- ◆ **Browse your data**
- ◆ **Manage your data**
- ◆ **Create and view data documentation (metadata)**

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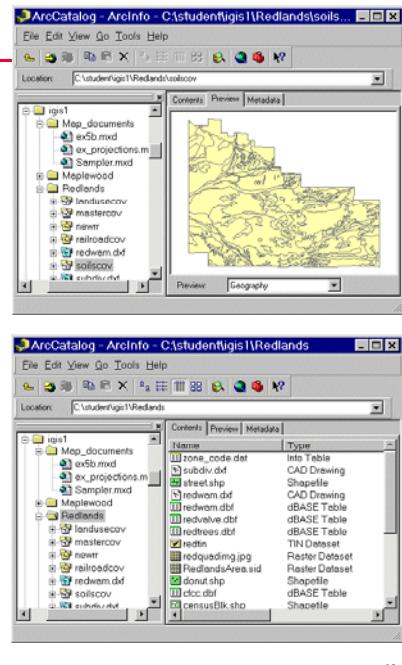
ArcToolbox

- ◆ **Available in ArcMap and ArcCatalog**
- ◆ **Geographic processing functions**
  - ◆ Data management, analysis, and conversion
  - ◆ Available tools vary between ArcGIS products

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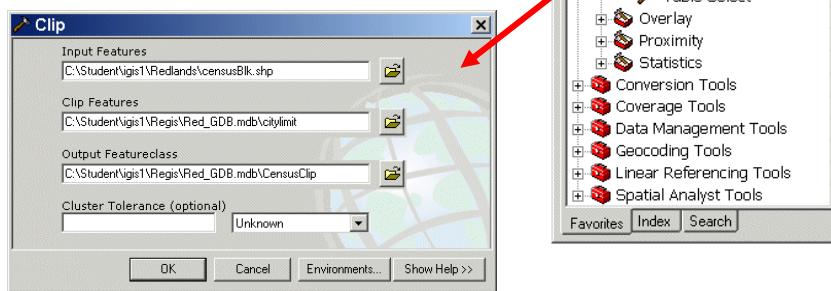
ARCGIS GEODATABASE

- ◆ Geodatabase = <u>geo</u>graphic <u>database</u>
- ◆ Stores <u>both</u> geographic and attribute data in the <u>same</u> Relational Database Management System (RDBMS) file
- ◆ Two types:
    - ◆ Personal geodatabase
        - ◆ Stores data in Microsoft Access files
        - ◆ Only one user can edit the database at a given time
        - ◆ Requires ArcView or higher license
    - ◆ Multiuser
        - ◆ Stores data in commercial RDBMS packages (e.g. Microsoft SQL Server or Oracle)
        - ◆ Several users can edit the same database simultaneously
        - ◆ Requires ArcInfo and ArcGIS Server products

ArcGIS Server

- ◆ **Formerly ArcSDE (Spatial Database Engine)**
- ◆ **Used for storing and managing a multi-user geodatabase stored in a commercial RDBMS**
- ◆ **Supports**
    - ◆ **Oracle**
    - ◆ **Microsoft SQL Server**
   - ◆ **Informix**
    - ◆ **IBM DB2**

EXTENSIONS

◆ **Programs that run inside a GIS package to expand software capabilities for special applications.**

　◆ **Spatial Analyst Extension is used to add raster capability for hydrologic modeling.**

◆ **Also known as "add-on" modules.**
◆ **Can be toggled on/off as needed.**
◆ **Usually cost additional money.**
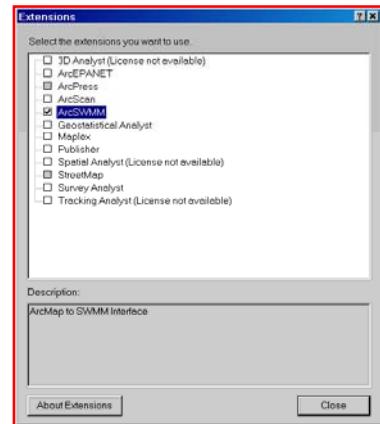
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ArcGIS EXTENSIONS

◆ ***ArcMap GPS support (Free!)***
◆ ***ArcHydro: hydrologic modeling support (Free!)***
◆ ***ArcGIS Spatial Analyst ($2,500): raster data analysis and hydrologic modeling***
◆ ***ArcGIS 3D Analyst ($2,500): 3d visualization***
◆ ***ArcGIS Network Analyst ($2,500): transportation planning***
◆ **ArcGIS Geostatistical Analyst ($2,500)**
◆ **ArcGIS Schematics**
◆ **ArcGIS Survey Analyst**
◆ **ArcGIS Tracking Analyst**
◆ **ArcGIS Data Interoperability**
◆ **ArcGIS Publisher**
◆ **ArcGIS StreetMap ($500)**
◆ **ArcPress for ArcGIS ($300)**
◆ **ArcScan for ArcGIS**
◆ **Maplex for ArcGIS**
◆ **ArcGIS Business Analyst**
◆ **ArcGIS Military Analyst**
◆ **Job Tracking for ArcGIS (JTX) (ArcEditor, ArcInfo)**
◆ **Production Line Tool Set (PLTS) for ArcGIS (ArcEditor, ArcInfo)**
◆ **ArcWeb Services**

3D ANALYST

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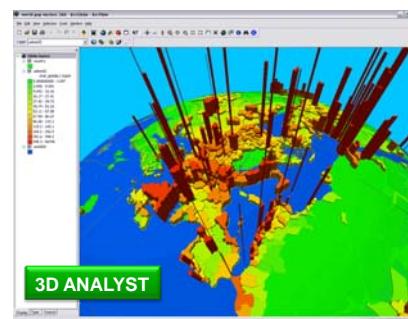
AUTOCAD MAP 3D

- ◆ **Autodesk's desktop GIS product**

- ◆ **Old names: AutoCAD Map, Autodesk Map**

- ◆ **Perfect for the loyal AutoCAD users**

  - ◆ **2 million installations worldwide**

  - ◆ **Why learn a new system?**

  - ◆ **Basically a new menu in AutoCAD**

DWG File

Database Table

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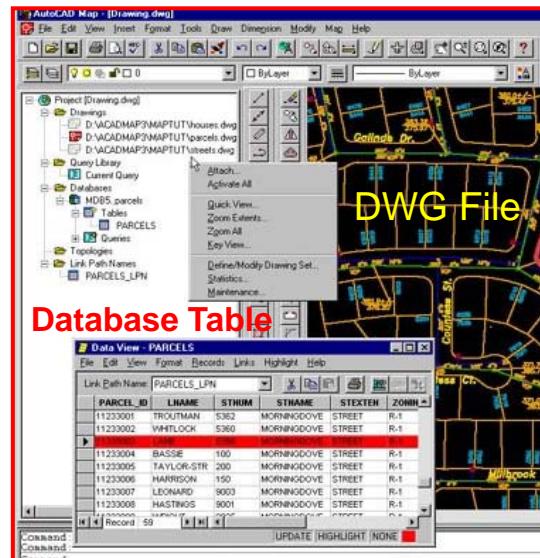
INTERGRAPH GEOMEDIA

◆ **Supports open (non-proprietary) standards**

◆ **Provides direct access to all major GIS/CAD data formats without data translation**

◆ **Works directly with industry-standard relational databases (e.g., Microsoft Access) without additional software**

◆ **It is a product-suite like ArcGIS**

   ◆ **GeoMedia: Basic GIS functionality like ArcView**

   ◆ **GeoMedia Professional: Advanced GIS functionality like ArcInfo**

   ◆ **Grid: Raster data analysis like Spatial Analyst**

   ◆ **WebMap Pro: Web-based mapping like ArcIMS**

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INTERGRAPH GIS SOLUTIONS

GEOSPATIAL HYDROLOGY TOOLKIT FOR HEC-HMS MODELING USING GEOMEDIA GRID

GRID CALCULATOR IN GEOMEDIA GRID

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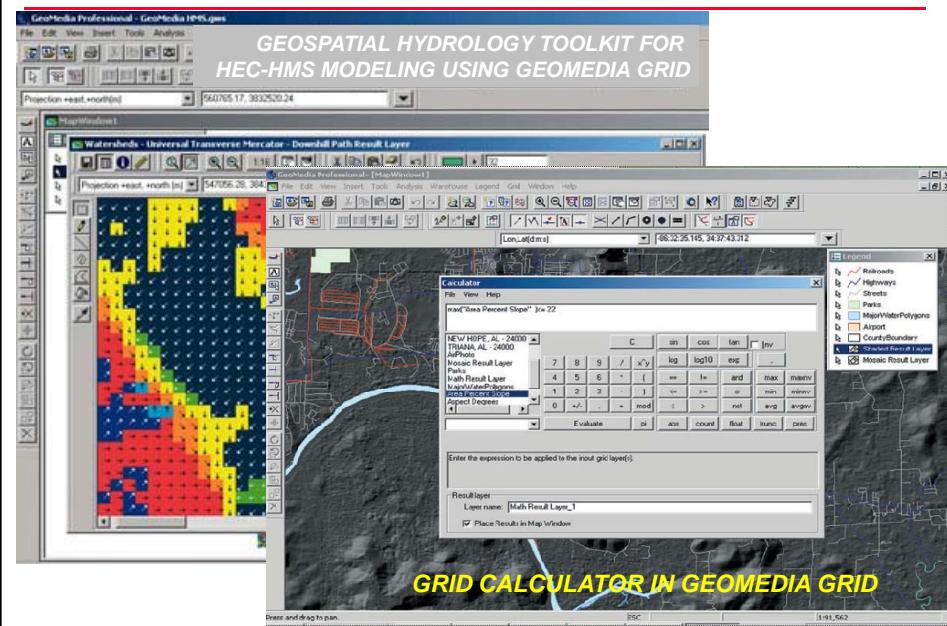
MAPINFO GIS SOLUTIONS

- ➤ **Popular in business industry**
  - ➤ **Demographic analysis for marketing**
  - ➤ **Location intelligence: the best place to open the next McDonald's or Macy's**
  - ➤ **Not common in Engineering community**
- ➤ **Product suite**
  - ➤ **MapInfo Professional®: Software for mapping and geographic analysis.**
  - ➤ **MapInfo MapXtreme®:** _**Internet mapping**_ **server for the deployment of mapping applications.**
  - ➤ **MapInfo DriveTime®: A software module for creating** _**drive-time**_ **polygons around any location.**
  - ➤ **MapInfo SpatialWare®: An information management tool for storing, managing, and manipulating** _**location-based**_ **data.**
  - ➤ **MapInfo MapXtend®: A developer tool for creating location-based** _**wireless handheld**_ **applications.**
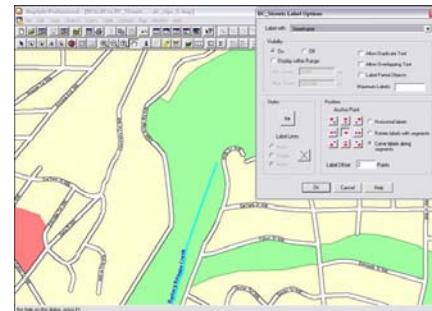
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IDRISI

- ◆ **Clark Labs, Clark University, Worcester, MA**
- ◆ **Raster GIS; popular in remote sensing community**
- ◆ **Automatic delineation of streams and watersheds from Digital Elevation Model (DEM) data**
- ◆ **Development of distributed hydrologic models**
  - ◆ **Estimate SCS Runoff Curve numbers**
  - ◆ **Estimate runoff using Manning's equation**
- ◆ **Not very user-friendly; more suitable for academic use.**
- ◆ **IDRISI images can be manipulated by user codes (FORTRAN, etc.)**
- ◆ **Cost $1,500**
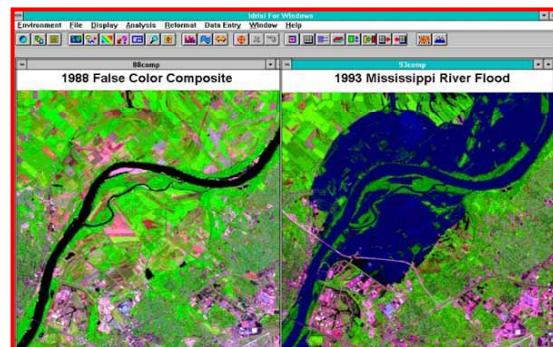
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APPLICATION SOFTWARE

IMAGE PROCESSING SOFTWARE

◆ **For enhancing raster GIS data (aerial photographs, satellite imagery, etc.)**

Software	Version	(US$)	Vendor	Web site
IMAGINE®	9.1/2006	Depends on options, starting at 5,000	Leica Geosystems (formerly ERDAS)	www.erdas.com
Image Analysis®	1.2/2007	2,000-3,000	Leica and ESRI	www.erdas.com
GeoExpress (formerly MrSID®)	6.1/2006	1,000–3,500	LizardTech	www.lizardtech.com
Geomatica®	N/A	N/A	PCI Geomatics	www.pcigeomatics.com
ENVI®	3.4	3,500-4,500	Research Systems	www.rsinc.com
ER Mapper®	6.1	4,000-6,000	Earth Resources Mapping	www.ermapper.com
Image Analyst® for MicroStation	N/A	N/A	Z/I Imaging Corporation	www.ziimaging.com

GeoEXPRESS (MrSID)

- ◆ **Raster images are very large**
- ◆ **Compressed images loose resolution**
- ◆ **Tradeoff between image size and resolution**
- ◆ **MrSID (Multi-resolution Seamless Image Database)**
  - ◆ **A new image file type (.SID) from Lizardtech**
  - ◆ **World's highest compression ration (100 max, 40 avg.)**
  - ◆ **18GB of Washington DC orthophotos on one CD (650 MB)**
  - ◆ **708 sheets (16 GB) of Mecklenburg County (N. Carolina) orthophotos on one CD**

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# INTERNET GIS SOFTWARE

- ◆ **Store and access your GIS data on the Internet**
- ◆ **Examples:**
  - ◆ **ESRI: ArcIMS, RouteMap and ArcExplorer**
  - ◆ **Autodesk: MapGuide**
  - ◆ **Intergraph: GeoMedia Web Map**
  - ◆ **MapInfo: MapXtreme and MapXsite**
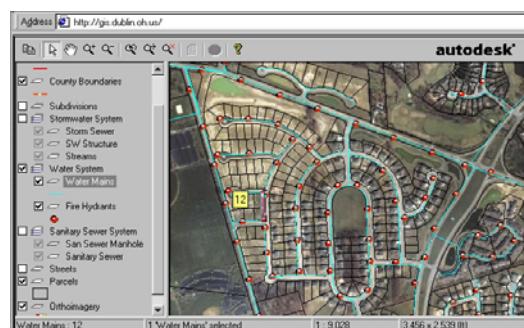
Dublin (Ohio) water, wastewater, and stormwater system Internet GIS created using Autodesk's MapGuide software www.dublin.oh.us/gis/.

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ASSET MANAGEMENT SOFTWARE

Software	Vendor	Web site
CASS WORKS	RJN Group, Inc	www.rjn.com
Cityworks	Azteca Systems	www.azteca.com
FRAMME	Intergraph	www.intergraph.com
GBA Water Master and Sewer Master	GBA Master Series	www.gbamasterseries.com
GeoWater and GeoWasteWater	MicroStation	www.bentley.com
Infrastructure management System (IMS)	Hansen Information Technologies	www.hansen.com
WATERview and SEWERview	CarteGraph Systems	www.cartegraph.com

WATER SYSTEM MODELING SOFTWARE

Software	Vendor	Web site
CEDRA AVWater	CEDRA Corporation	www.cedra.com
WaterGEMS WaterCAD Cybernet	Haestad Methods	www.haestad.com
InfoWater H_2OMAP Water H_2ONET	MWH Soft	www.mwhsoft.com
MIKE NET	DHI Water & Environment	www.dhi.dk
InfoWorks InfoNet HydroWorks	Wallingford Software	www.wallingfordsoftware.com
PIPE2000	University of Kentucky	www.kypipe.com
SynerGEE	Advantica Stoner	www.stoner.com

SEWER SYSTEM MODELING SOFTWARE

Software	Vendor	Web site
CEDRA AVSand	CEDRA Corporation	www.cedra.com
InfoSWMM H₂OMAP Sewer	MWH Soft	www.mwhsoft.com
InfoWorks InfoNet HydroWorks	Wallingford Software	www.wallingfordsoftware.com
Mike Urban Mouse GIS	DHI, Inc.	www.dhisoftware.com
PCSWMM GIS	Computational Hydraulics Int.	www.computationalhydraulics.com
SewerGEMS SewerCAD and StormCAD	Haestad Methods	www.haestad.com
XP-SWMM	XP-Software	www.xpsoftware.com

STORMWATER, WATERSHED, AND HYDROLOGIC MODELING SOFTWARE

Software	Vendor	Web site
Hydro Extension	ESRI	www.esri.com
Mike SHE Mike 11 GIS Mike Basin	DHI Water & Environment	www.dhi.dk
HEC-Geo HMS & HEC-Geo RAS	Hydrologic Engineering Center (HEC)	www.hec.usace.army.mil/software/
BASINS	U.S. EPA	www.epa.gov/OST/BASINS/
GIS Hydro	University of Texas at Austin	www.ce.utexas.edu/prof/maidment/
Watershed Modeling System	Brigham Young University	www.ems-i.com
River Modeling System (RMS) and RiverCAD	Boss International	www.bossintl.com

SOFTWARE SELECTION

SOFTWARE SELECTION

◆ **Conduct Needs Assessment**

◆ **Needs assessment compares software and develops a decision matrix of user needs (applications) and available software to help select the most appropriate software**

 ◆ **Compare software with each other**

 ◆ **Compare software with your needs**

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GIS SOFTWARE COMPARISON
(COMPARE WITH OTHER PRODUCTS)

Features	Software No. 1	Software No. 2	Software No. 3
General			
Software Name			
Vendor			
Latest Version			
Year			
Number of installations			
Price			
Platform			
Workstation			
PC			
Operating System			
Windows NT			
Windows XP			
Windows 2000			
Windows 98			
UNIX			
Linux			
Hardware Demand			
RAM			
Disk Space			
Processor			
Other			
CAD Packages Required			
AutoCAD			
MicroStation			
Other			
Capabilities			
Vector			
Raster			
Topology			
Georeferencing			
Image processing			
Street geocoding			
Customization			
Support for H&H modeling			
Support for facilities management			
Scripting language name			
Other			

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GIS SOFTWARE COMPARISON

- **Based on Homework Solution from Sheeba Khan, 2006.**

Features	ArcGIS/Arc View	GeoMedia Pro	Autodesk Map
General			
Vendor	ESRI	Intergraph	Autodesk
Latest Version No.	9.1 (9.2 to be launched)	06.00.34.07	3D-2007
Latest Version Year	2005	2006	2006
Number of Installations	Above 2 million	N/A	Above 2 million
Price per License	ArcView:$1500 ArcEditor:$7000 ArcInfo:$14000	30 day free trial $200 Student $7495 Commercial	30 day free trial available. Latest $5,295 Upgrade from 2006,$745 Upgrade from2005,$995 Upgrade from2004, $2245
Operating System			
Hardware Platform	Personal Computer	Personal Computer	Personal Computer
Operating System	Windows 2000 or Windows XP (Home Edition and Professional), Internet Explorer 6.0	Windows 2000 SP4, XP SP2, Internet Explorer 5.5 or higher	Microsoft Windows XP Professional or Home Edition (SP2), or Windows 2000 (SP4) Blocked Installation on Windows NT and Win 9x, and Windows 2000 SP1, SP2.
Hardware Demand (Systems Requirement)			
RAM	512MB min, 1 GB recommended	512 MB	512 MB RAM
Disk Space		400MB	1.5 GB free disk space for installation
Processor	Intel Pentium or Intel Xeon	Pentium III or equivalent microprocessor - minimum	Intel Pentium IV recommended
Other	CPU Speed 1.0 GHz recommended or higher Swap Space 300MB minimum	SVGA display required (single monitor recommended; minimum 800x600 resolution and 16-bit color; 1024x786 resolution and 32-bit color recommended) Access to CD-ROM	1024x768 video display with true color MS-Mouse compliant pointing device CD-ROM drive (any speed)

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SAMPLE SOFTWARE SELECTION MATRIX
(COMPARE WITH YOUR NEEDS)

Dept. / Software	ArcView	ArcInfo	Spatial Analyst	Network Analyst	3D Analyst	SDE	Arc Objects
Planning and Engineering	✔	✔			✔	✔	✔
Operations & Maintenance	✔			✔		✔	✔
Infrastructre Management & Construction	✔			✔		✔	✔
Water Resources & Hydrology	✔	✔	✔				
Finance and Administration	✔						

More Information in GIS Tools (Red) Book

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