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StreamStats:

A Web Site for Stream Information

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Outline

- Description of need for streamflow statistics and problems with providing them
- Description of StreamStats
- Status
- Implementation Process
- Regional StreamStats activities

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Examples of Streamflow Statistics

- 100-year flood
- Average annual streamflow
- Average streamflow for August
- 7-day, 10-year low flow
- 90-percent duration flow

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Uses of Streamflow Statistics

- Design of structures such as roads, bridges, culverts, dams, locks, and levees
- Water resources planning and management
- Flood-plain mapping for zoning and insurance rate setting
- Instream flow determinations for pollution control and habitat protection
- Design and permitting of facilities such as wastewater-treatment plants, hydropower plants, and water-supply reservoirs

Statistics for Gaged Sites

- Computed from streamflow records using standard methods
- Problems:
  - Statistics in old reports are sometimes difficult to obtain
  - USGS labor cost for information requests is high
  - Not possible to operate gaging stations everywhere streamflow statistics are needed

Estimates for Ungaged Sites

- Streamflow Statistics are estimated from regression equations that relate flows to basin characteristics.
- Examples of basin characteristics: Basin area, slope, shape, climate, vegetation cover, degree of urbanization, geology, . . .
- Usually developed on a State-by-State basis through the cooperative program

Example Regression Equation

- **Regression equations take the form:**

$$Q_{100} = 0.471A^{0.715}E^{0.827}SH^{0.472}$$

- **where:**

Q_{100}	**is the 100-year flood flow, cubic feet per second**
A	**is drainage area, in square miles**
E	**is mean basin elevation, in feet**
SH	**is a shape factor, dimensionless**

Problems with Regression Approach

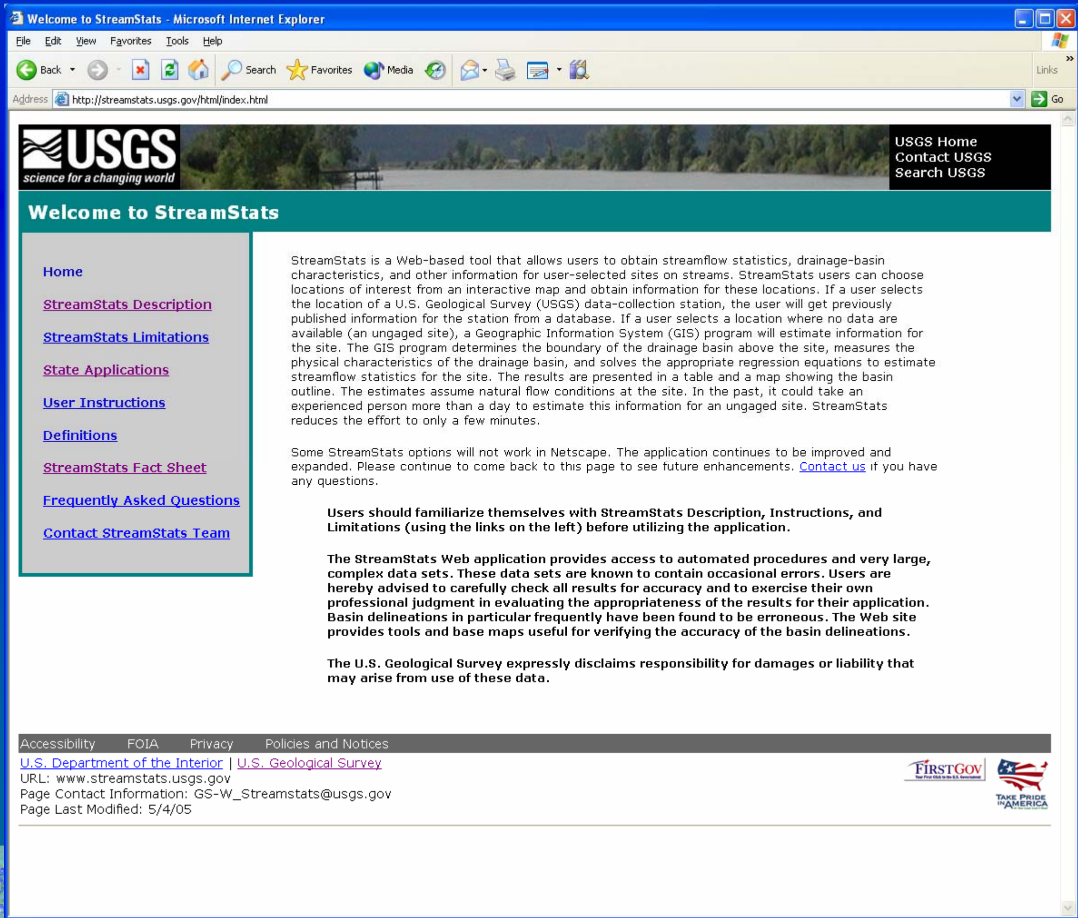
- Reports with equations can be difficult to identify and obtain
- Delineating basin boundaries and computing basin characteristics:
  - Is difficult,
  - Demands high-level skills,
  - Is very time consuming
  - Is error-prone
- Manual method can take several hours or more
- GIS methods require substantial investments of time, money, and data development
- Equations are often not used because of large efforts needed to determine basin characteristics

StreamStats Web Application

- Provides estimates of streamflow statistics, basin and climatic characteristics, and other information for user-selected points on ungaged streams
- Automatically measures basin and climatic characteristics for ungaged sites using GIS
- Provides published streamflow statistics, basin and climatic characteristics, and other information for data-collection stations

StreamStats Web Page

- http://streamstats.usgs.gov
  - Under construction
  - Description of application
  - Links to state applications
  - Links to documentation



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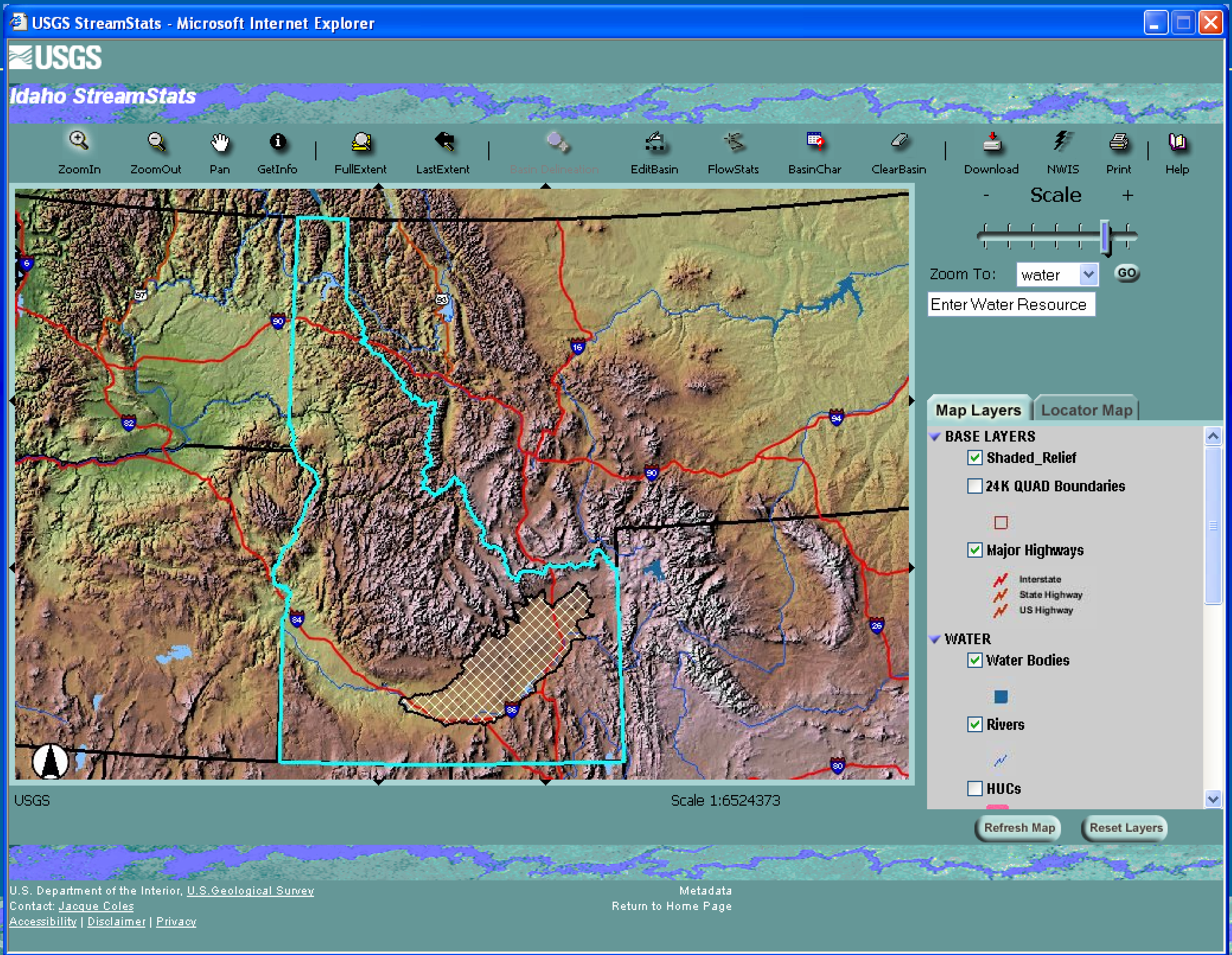
User Interface at Startup



Ungaged Site Process

1. User selects point on stream network
2. Point is transferred to a cell in a flow-direction grid derived from a DEM
   ☛ DEM usually is preprocessed to conform to mapped streams and previously determined drainage boundaries
3. GIS determines drainage boundary and presents it for review in map frame
4. Boundary can be edited if errors are found
5. GIS computes drainage area and other basin characteristics
6. Basin characteristics are inserted into regression equations to compute flow estimates
7. Flow estimates appear in pop-up window with error estimates

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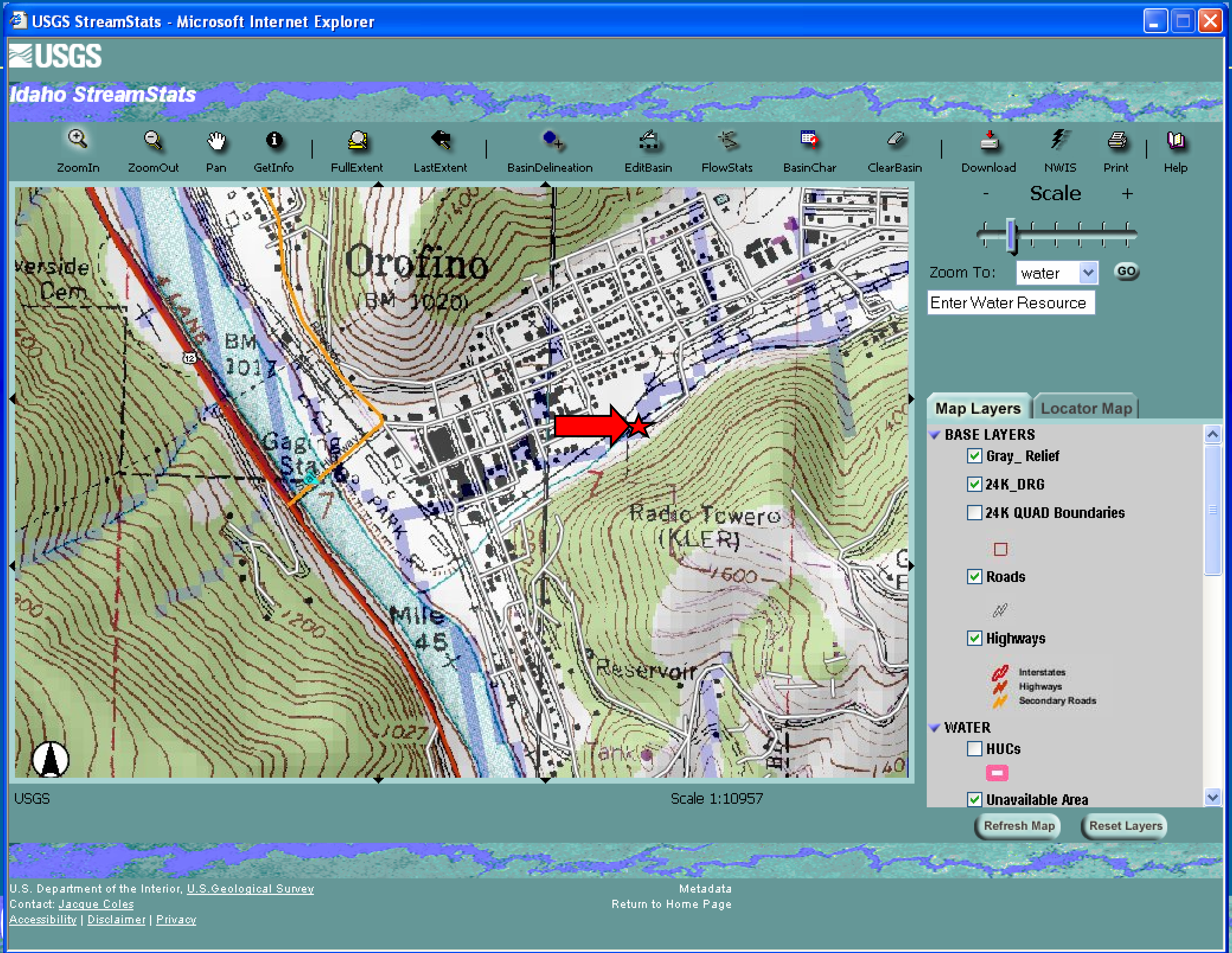
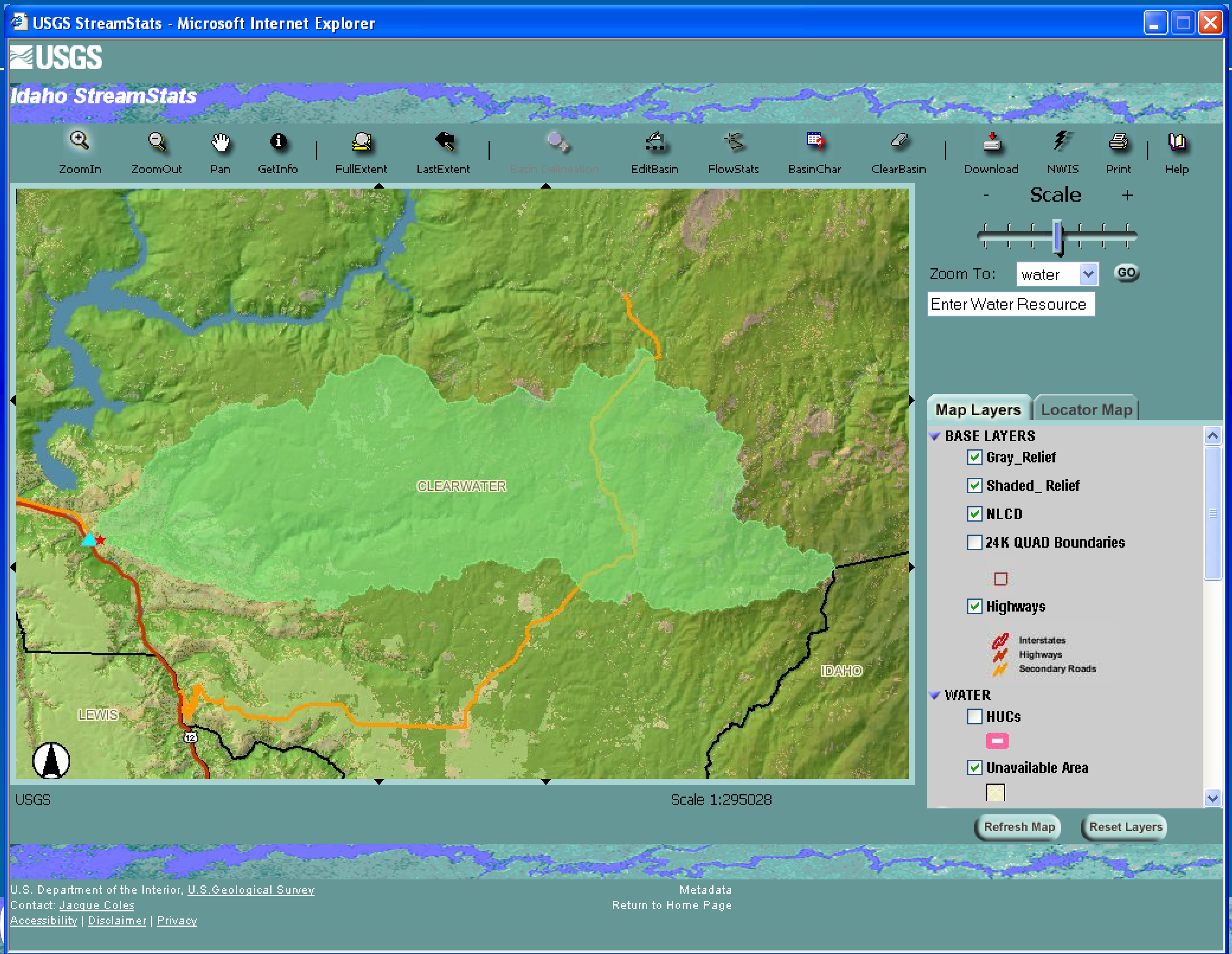
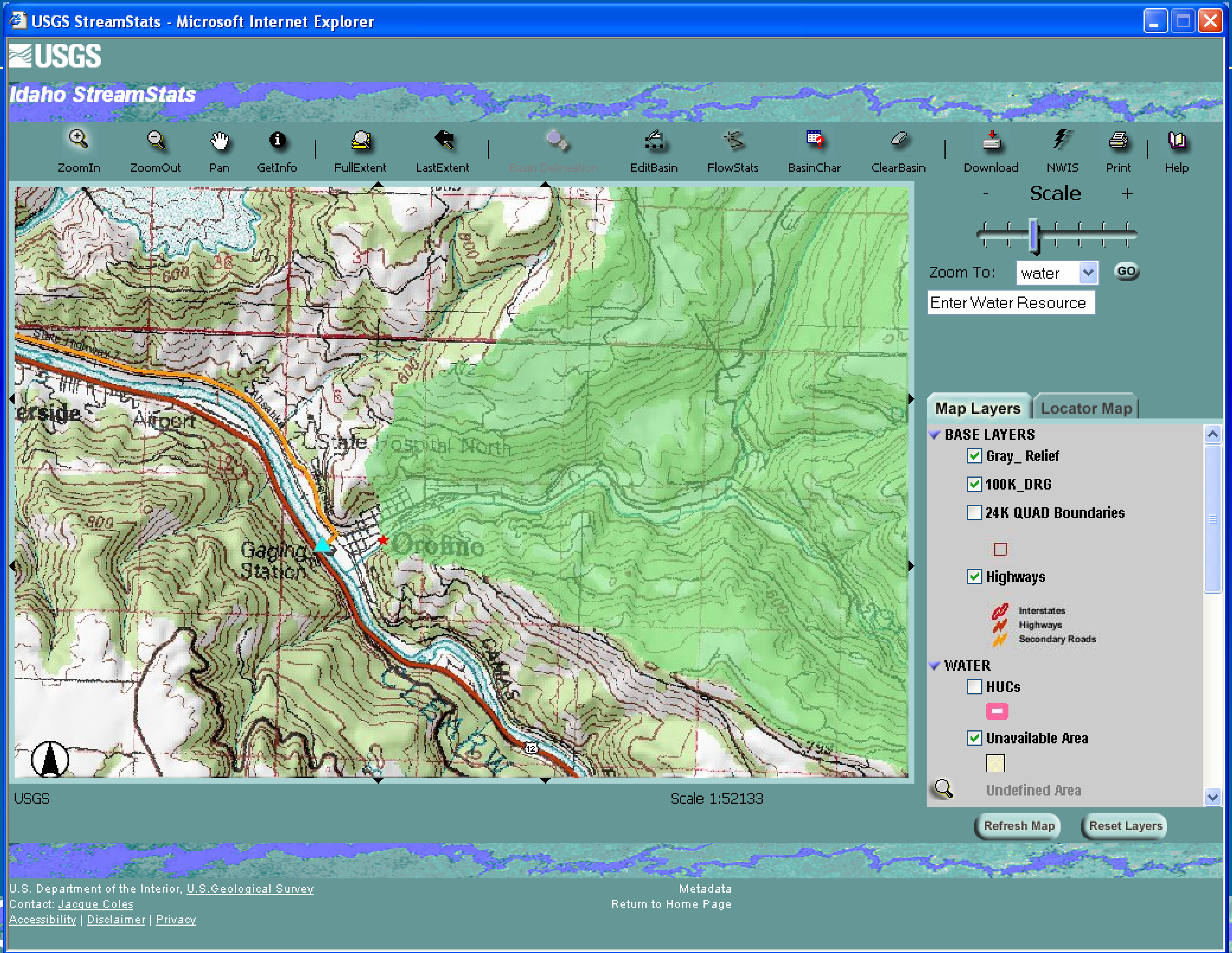
Ungaged Site Selection



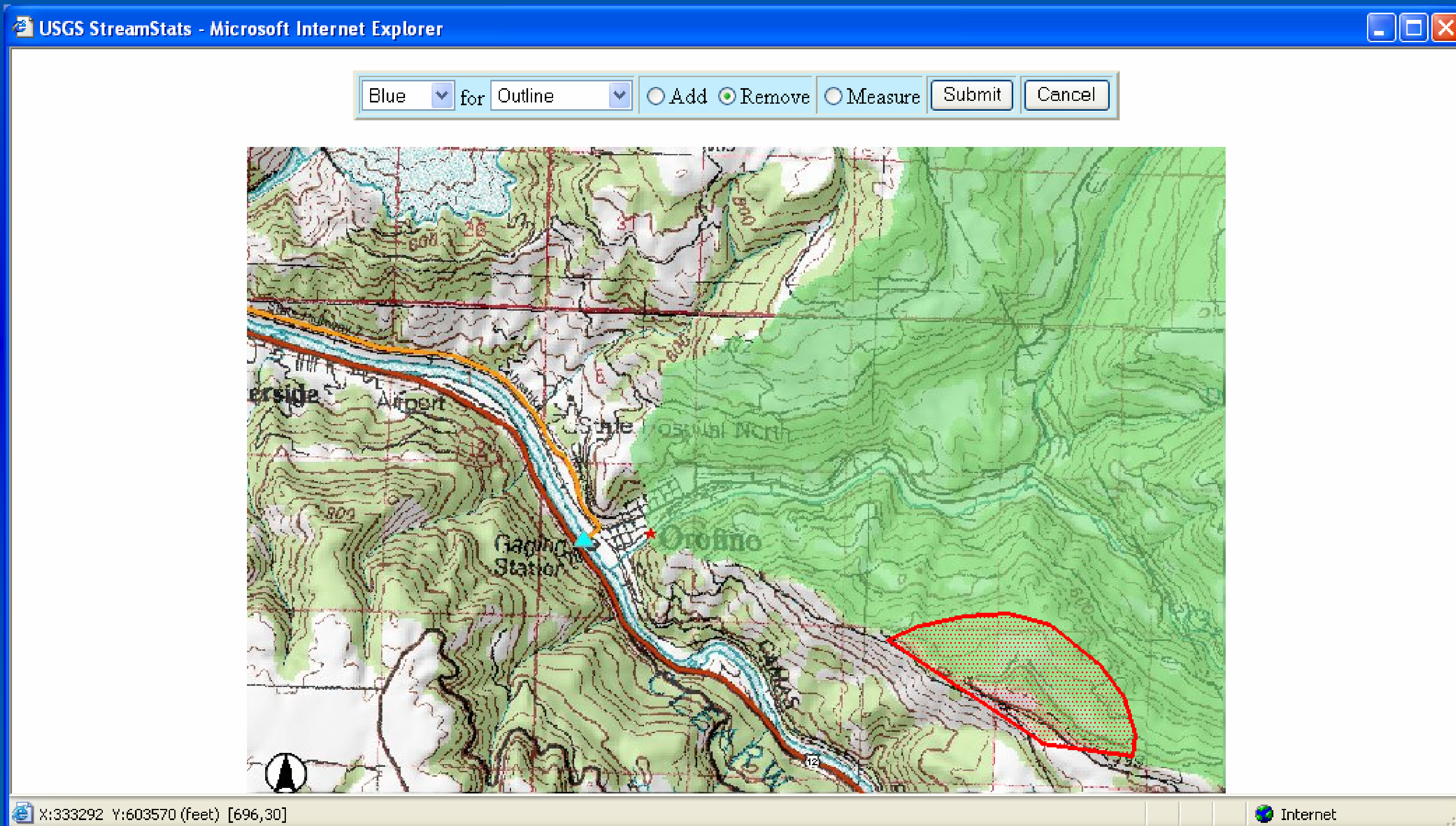
Basinwide View of Boundary



Zoom In to Check Boundary



Edit Boundary



Example Output for Ungaged Site

Streamstats Report - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Streamflow Statistics Report

Date: Tue Jun 7 2005 08:12:18
Site Location: Idaho
Latitude: 46.4792
Longitude: -116.2492
Drainage Area: 198 mi2

Peak Flow Basin Characteristics

100% Peak Flow Region 4 (198 mi2)

Parameter	Value	Min	Max
Drainage Area (mi2)	198	2.3	13418.3
Mean Basin Elevation (ft)	3270	2955.8	7461.3

Low Flow Basin Characteristics

100% Low Flow Region 4 (198 mi2)

Parameter	Value	Min	Max
Drainage Area (mi2)	198	4	13418.3
Mean Basin Slope from 30m DEM (percent)	20.8	18.7	57.2
Mean Annual Precipitation (in)	37.2	15.9	64.6
Mean Basin Elevation (ft)	3270 (below min value 3528.6)	3528.6	7461.3
Percent Forest (percent)	87.2	4.8	93

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
Peak-Flow Statistics					
Q1.5	1200	73		392	3680
Q2	1590	67		562	4480
Q2.33	1790	64		654	4890
Q5	2730	56		1110	6720
Q10	3610	52		1550	8400
Q25	4870	49		2190	10900
Q50	5850	48		2670	12800
Q100	6900	47		3180	15000

Streamstats Report - Microsoft Internet Explorer

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Q200	8030	47		3710	17400
Q500	9710	47		4460	21100

Streamflow Statistics

Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
Mean Annual Flow Statistics					
Qa	278				
January Flow-Duration Statistics					
Jan_Q20	271				
Jan_Q50	91.4				
Jan_Q80	44.9				
February Flow-Duration Statistics					
Feb_Q20	445				
Feb_Q50	164				
Feb_Q80	72.8				
March Flow-Duration Statistics					
Mar_Q20	867				
Mar_Q50	396				
Mar_Q80	174				
April Flow-Duration Statistics					
Apr_Q20	1590				
Apr_Q50	1110				
Apr_Q80	693				
May Flow-Duration Statistics					
May_Q20	1310				
May_Q50	858				
May_Q80	527				
June Flow-Duration Statistics					
Jun_Q20	362				
Jun_Q50	182				
Jun_Q80	83.8				
July Flow-Duration Statistics					
Jul_Q20	67				
Jul_Q50	38				
Jul_Q80	25.8				
August Flow-Duration Statistics					
Aug_Q20	54.8				
Aug_Q50	34.2				
Aug_Q80	21.5				

Data-Collection Station Process

1. USGS data-collection stations are displayed in a map frame in user's web browser
2. User zooms in and selects a station of interest
3. Previously published information for the station is retrieved from StreamStatsDB
4. Pop-up window appears showing the information and references
5. User may also link to NWIS-Web

(Implementation expected by June 2005)

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Mock-up Data-Collection Site Output

USGS StreamStats - Microsoft Internet Explorer

Address Z:\OSW\Streamstats\SampleGagedOutput.htm

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Streamflow Statistics Report

USGS Station Number 01094500

Station Name NORTH NASHUA RIVER NEAR LEOMINSTER, MA

Click here to link to available data on NWIS-Web for this site.

Descriptive Information

Station Type	Gaging Station, continuous record
Regulated?	True
Period of Record	1935-present
Remarks	Regulated at low flow by mills. Flow includes diversion to basin for municipal supplies.
Latitiude, degrees	42.50176
Longitude, degrees	-71.72257
Hydrologic unit code	01070004
Local Basin	11-Nashua
County	027-Worcester
MCD	35075-Leominster city
Directions to station	1.3 miles upstream from Wekepeke Brook

Physical Characteristics

Characteristic Name	Value	Units	Citation Number
Area_of_Lakes_and_Ponds	3.3	square miles	12
Drainage_Area	110	square miles	12
Mean_Basin_Elevation	870	inches per hour	12
Mean_Basin_Slope_ft_per_mi	40.7	feet per mile	12
Total_Stream_Length	22.7	miles	12

USGS StreamStats - Microsoft Internet Explorer

Address Z:\OSW\Streamstats\SampleGagedOutput.htm

Mean_Basin_Slope_ft_per_mi 40.7 feet per mile 12
Total_Stream_Length 22.7 miles 12

Streamflow Statistics

Statistic Name	Discharge, in cubic feet per second	Citation Number
Peak-Flow Statistics		
Mean_Annual_Flood	683	12
10-Year_Peak_Flood	4,760	12
25-Year_Peak_Flood	6,560	12
50-Year_Peak_Flood	8,160	12
100-Year_Peak_Flood	9,990	12
500-Year_Peak_Flood	15,400	12
Low-Flow Statistics		
7-Day_2-Year_Low_Flow	45.4	22
7-Day_10-Year_Low_Flow	35.3	22
Flow-Duration Statistics		
10-Percent_Duration	418	16
25-Percent_Duration	229	22
50-Percent_Duration	126	16
70-Percent_Duration	74.2	22
75-Percent_Duration	67.3	22
90-Percent_Duration	49	16
95-Percent_Duration	43.8	22
99-Percent_Duration	34	22

Citations

Citation Number	Citation Name
12	Murphy, P.J., 2001, Evaluation of mixed-population flood-frequency analysis: American Society of Civil Engineers, Journal of Hydrologic Engineering, v. 6, no. 1, p. 62-70
22	Wandle, S.W., Jr., and Fontaine, R.A., 1984, Gazetteer of Hydrologic Characteristics of Streams in Masssachusetts--Merrimack River Basin: U.S. Geolological Survey Water-Resources Investigations Report 84-4284.
16	Socolow, R.S, Leighton,C.R, Zanca, J.L., and Ramsbey, L.R., Water Resources Data Massachusetts and Rhode Island Water Year 1997: U.S. Geological Survey Water-Data Report MA-RI-97-1.

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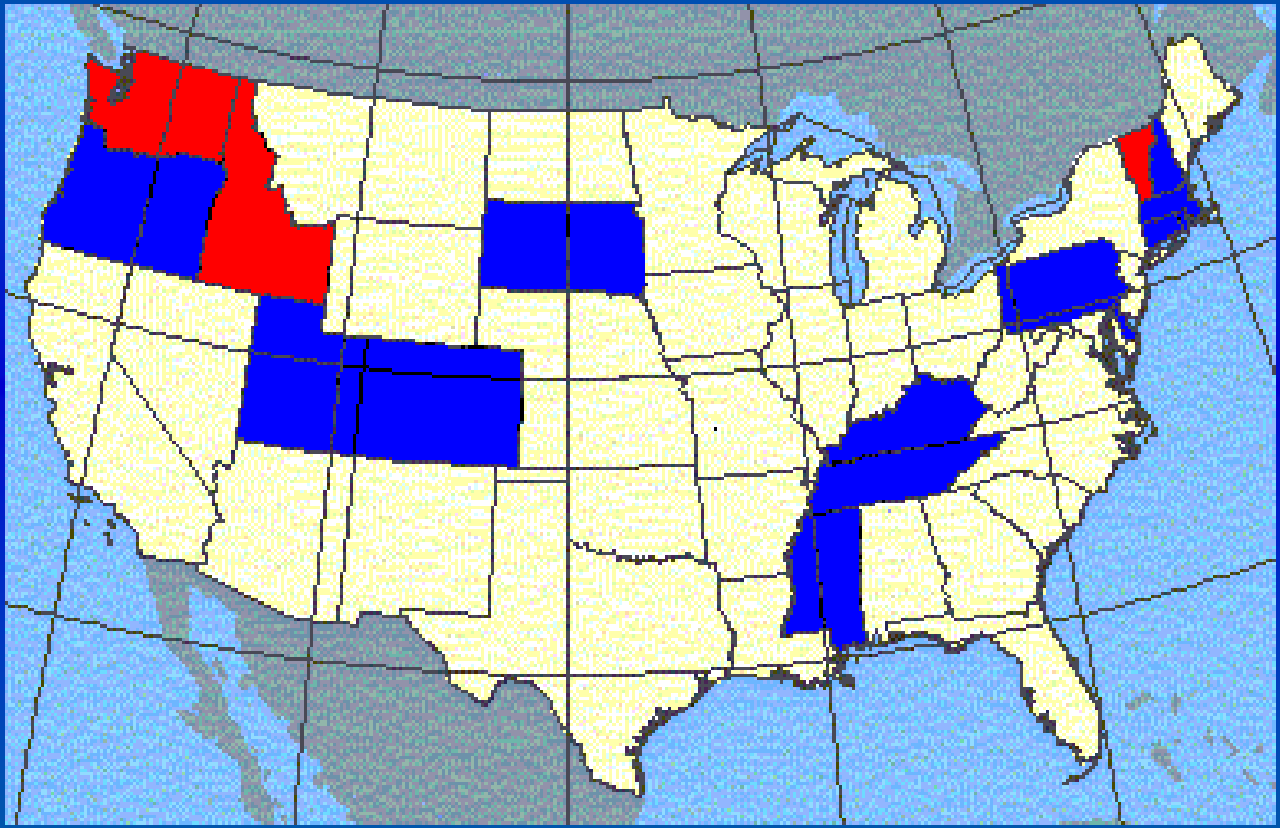
StreamStats Benefits

- Cost — Time to delineate drainage boundaries and compute basin characteristics is reduced from hours to minutes
- Accuracy — Measurement errors not introduced; some measurements much better; others about the same as manual methods
- Consistency — Important for statistical validity
- Accessibility — Special equipment and/or expertise not needed to obtain estimates

Status



Available to Public

Work in progress

State Implementation Process

- Usually done through cooperative agreements between Water Science Centers and local agencies
- Populate and quality assure StreamStatsDB
- Generate and format GIS datasets
- Test and report on accuracy of basin and climatic characteristics and equation results
- Potentially develop new equations, using GIS data to measure basin characteristics
- Possibly fund any required customization
- USGS HQ and WSC concurrence to put on Web
- Full national implementation will take several years

Mid-Atlantic Activities

- Pennsylvania
  - Peak-flow equations implemented by Sept. ’05
  - Will also include low-flow equations when ready
- Delaware
  - Peak-flow equations implemented by March ’06
- GIS datasets prepared
  - All of Chesapeake Bay drainage

Want StreamStats in Your State?

- Contact your local USGS Water Science Center Chief
- Find names and contact information at http://water.usgs.gov/district_chief.html