

Introduction to

N-SPECT

**The Nonpoint-Source Pollution
and Erosion Comparison Tool**



Description

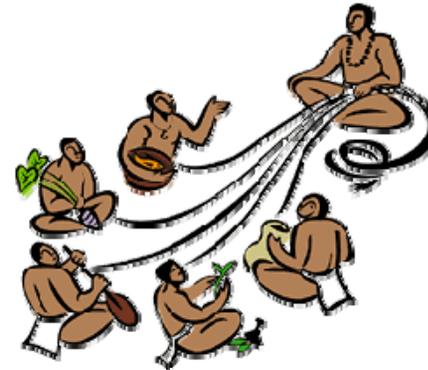
Introduction to N-SPECT

- Water quality screening tool
- Spatially distributed (raster-based) pollutant and sediment yield model
- Compares the effects of different land cover and land use scenarios on total yields
- User friendly graphical interface within ArcGIS

History

Introduction to N-SPECT

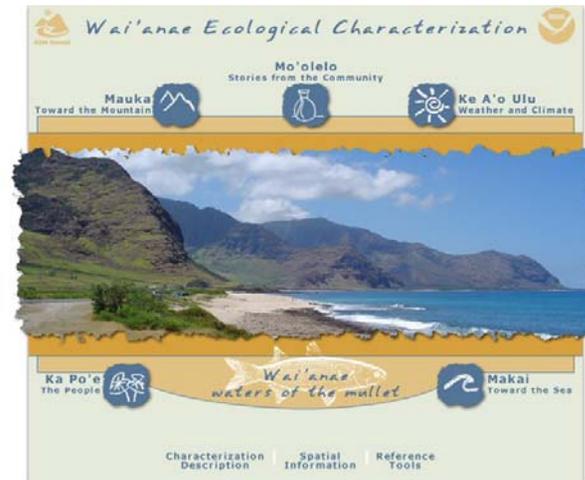
- Audience
 - Coastal managers
 - Land-use planners
 - Scientists
 - Teachers
- Development team
 - Dr. David L. Eslinger, Jamie Carter, Margaret VanderWilt, Bev Wilson, Ed Dempsey, Andrew Meredith
- Major contributors
 - Hawaii Coastal Zone Management Program
 - NOAA Coastal Services Center (CSC)
 - National Ocean Service Pacific Services Center
 - Hawaiian management community



History

- Hawaii managers needed a simple, quick screening tool
- Initially applied in Wai'anae region in Oahu, Hawaii
 - Current pressure from residential development
 - Sensitive coastal habitats
 - Ahupua'a management
- Component of CSC's landscape characterization in Hawaii (Wai'anae Ecological Characterization)

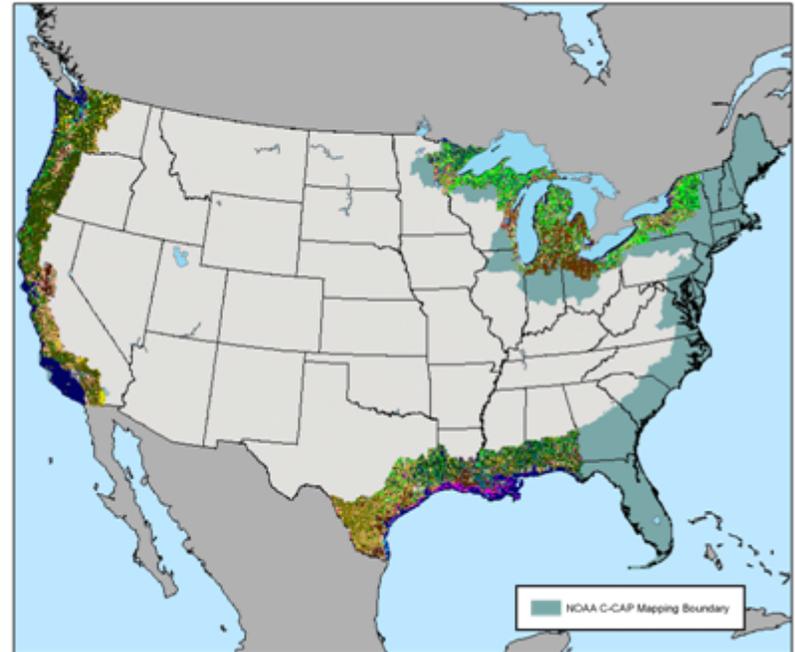
Introduction to N-SPECT



History

Introduction to N-SPECT

- Follow-on to CSC's activities with NEMO (Nonpoint Education for Municipal Officials)
- General tool - useful in other geographies



Functions

Introduction to N-SPECT

- Rainfall-runoff model
 - Soil Conservation Service (SCS) curve number technique
- Pollutant model
 - Event mean concentration coefficients
- Sediment yield model
 - Universal Soil Loss Equation (USLE)
 - Modified (MUSLE)
 - Revised (RUSLE)

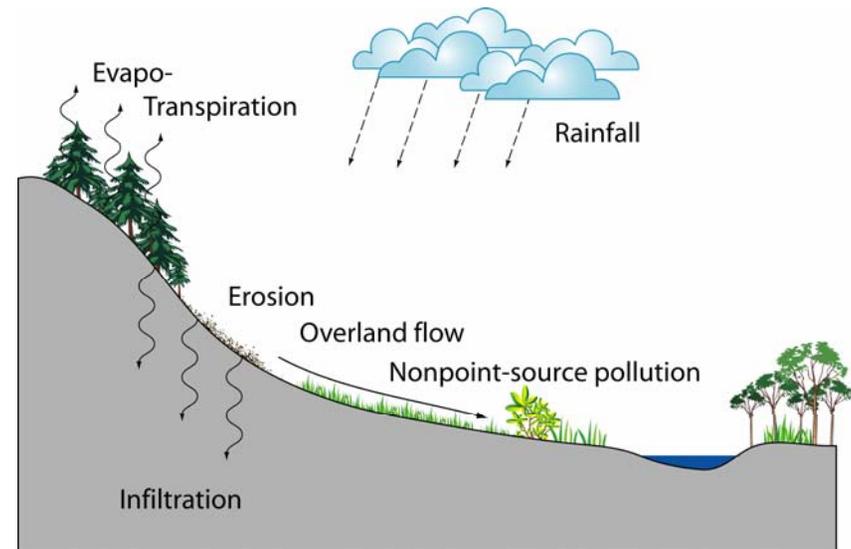


	<i>EVENT</i>	<i>ANNUAL</i>
RUNOFF MODEL	SCS RUNOFF CURVE NUMBER	MODIFIED SCS CURVE NUMBER
EROSION MODEL	MUSLE	RUSLE
NONPOINT-SOURCE MODEL	EVENT MEAN CONCENTRATION	EVENT MEAN CONCENTRATION

Process

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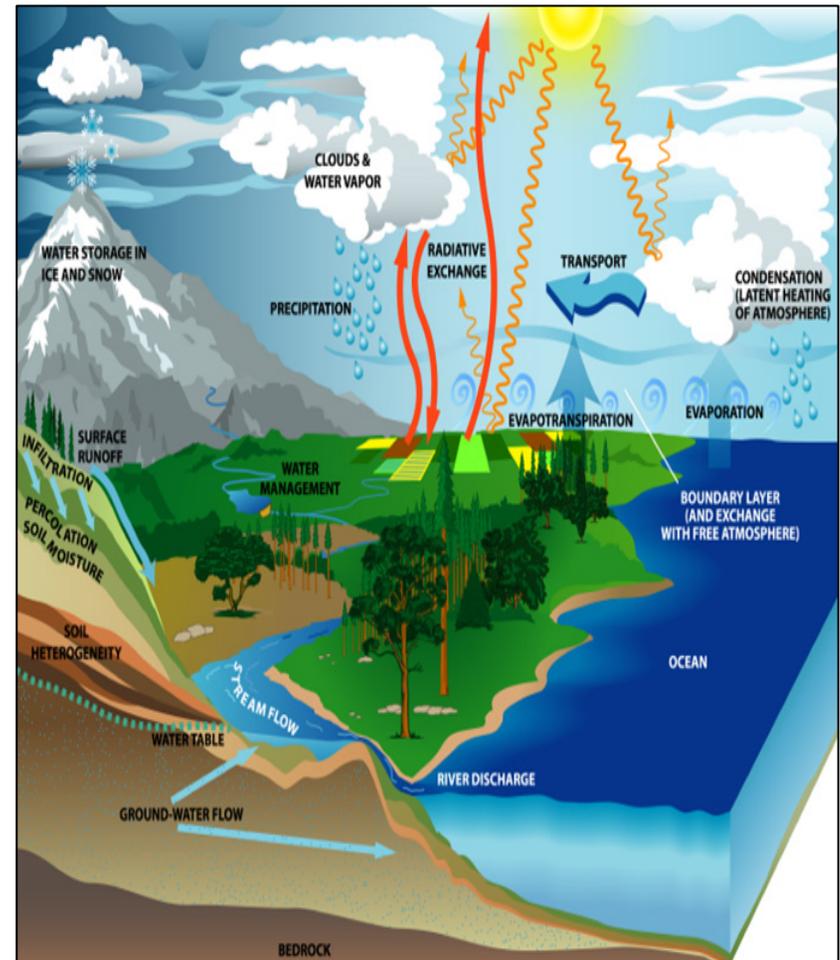
- *Topography* determines flow direction and slope
- *Soil characteristics, land cover, and precipitation* determine runoff
- *Runoff, land cover, and pollutant coefficients* determine pollutant loads
- *Runoff, topography, soil characteristics, and land cover* determine sediment loads



Assumptions/Limitations

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- Omitted processes
 - Atmospheric deposition
 - Groundwater processes
 - Stormwater drainage
 - Stream diversions
 - Snow melt
 - Landslides
- No time dependency on
 - Runoff dynamics
 - Sediment redeposition
 - Pollutant load

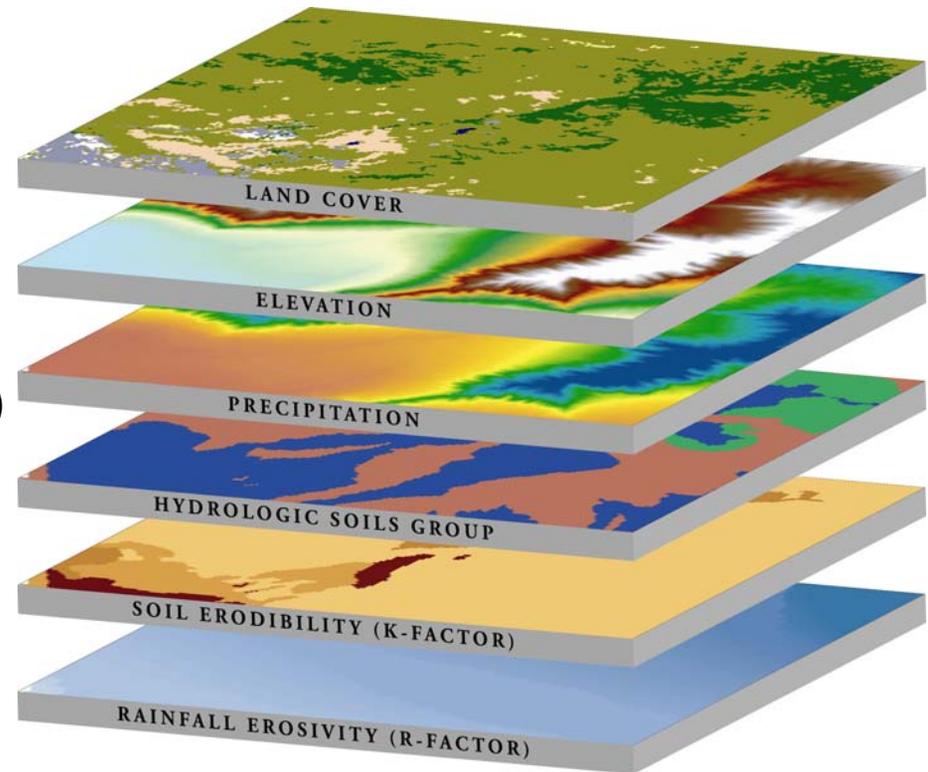


Source: NASA Earth Science Enterprise

Data Needs

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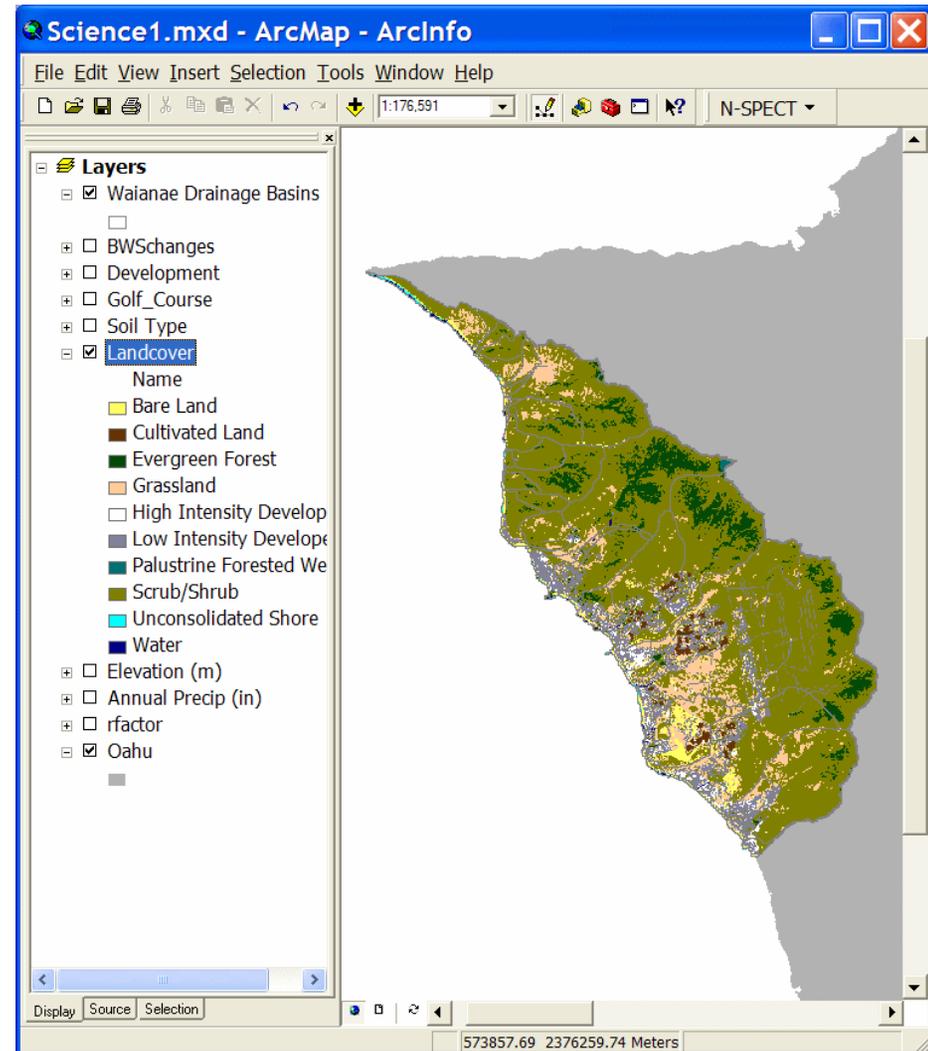
- Nationally derived
 - Land cover data
 - Topography
 - Soils data
- Locally derived
 - Precipitation
 - Rainfall erosivity (R-factor)
 - Pollutant coefficients
 - Water quality standards



Land Cover

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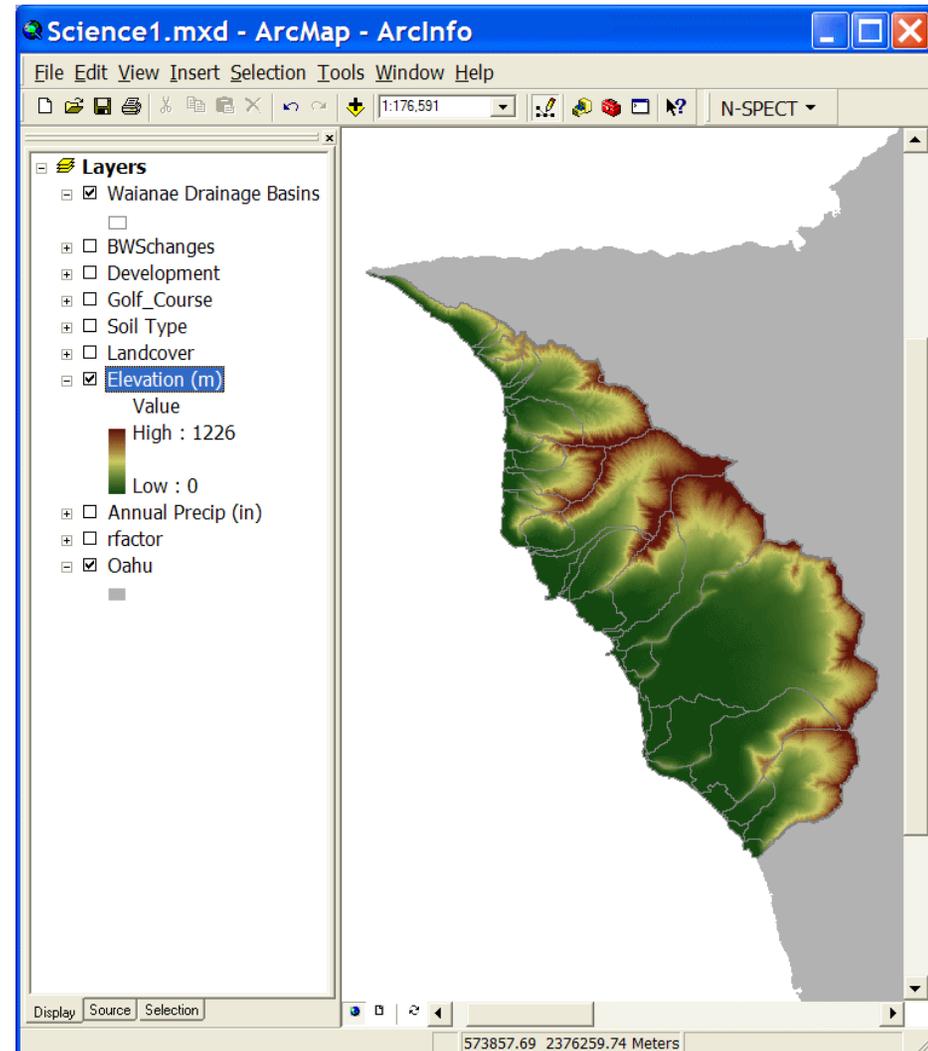
- Foundation for runoff quantity, sediment yield, pollutant yield
- Default
 - Coastal Change Analysis Program (C-CAP)
 - 30 m resolution
- Flexible
 - Can easily substitute any land cover grid



Topography

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- Defines flow direction, stream networks, watersheds
- Default
 - U.S. Geological Survey (USGS) 30 m resolution digital elevation model
- Resolution impacts processing speed and file size



Soils

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- Runoff and erosion estimates are dependent upon soils and land cover
- Default
 - SSURGO soils[†]
 - County level resolution
- Hydrologic group
 - Infiltration rate
- K-factor
 - Soil erodibility

Science1.mxd - ArcMap - ArcInfo

File Edit View Insert Selection Tools Window Help

Layers

- ☑ Waianae Drainage Basins
- ☐ BWSChanges
- ☐ Development
- ☐ Golf_Course

Land Cover Types

Options Help

Land Cover Type: CCAP

Description: CCAP Landcover

Classification		SCS Curve Numbers				RUSLE	
Value	Name	CN-A	CN-B	CN-C	CN-D	Cover-Factor	Wet
2	High Intensity Developed	0.89	0.92	0.94	0.95	0	<input type="checkbox"/>
3	Low Intensity Developed	0.61	0.75	0.83	0.87	0.03	<input type="checkbox"/>
4	Cultivated Land	0.67	0.78	0.85	0.89	0.24	<input type="checkbox"/>
5	Grassland	0.39	0.61	0.74	0.8	0.05	<input type="checkbox"/>
7	Evergreen Forest	0.3	0.55	0.7	0.77	0.004	<input type="checkbox"/>
9	Scrub/Shrub	0.3	0.48	0.65	0.73	0.014	<input type="checkbox"/>
10	Palustrine Forested Wetland	0	0	0	0	0.003	<input type="checkbox"/>
16	Unconsolidated Shore	0	0	0	0	0.5	<input type="checkbox"/>
17	Bare Land	0.77	0.86	0.91	0.94	0.7	<input type="checkbox"/>
18	Water	0	0	0	0	0	<input checked="" type="checkbox"/>

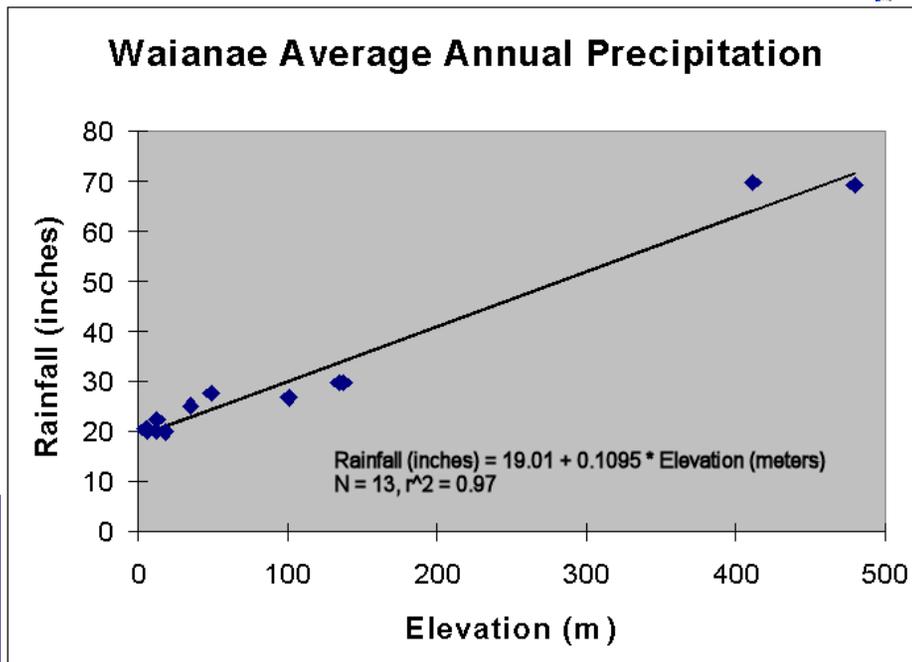
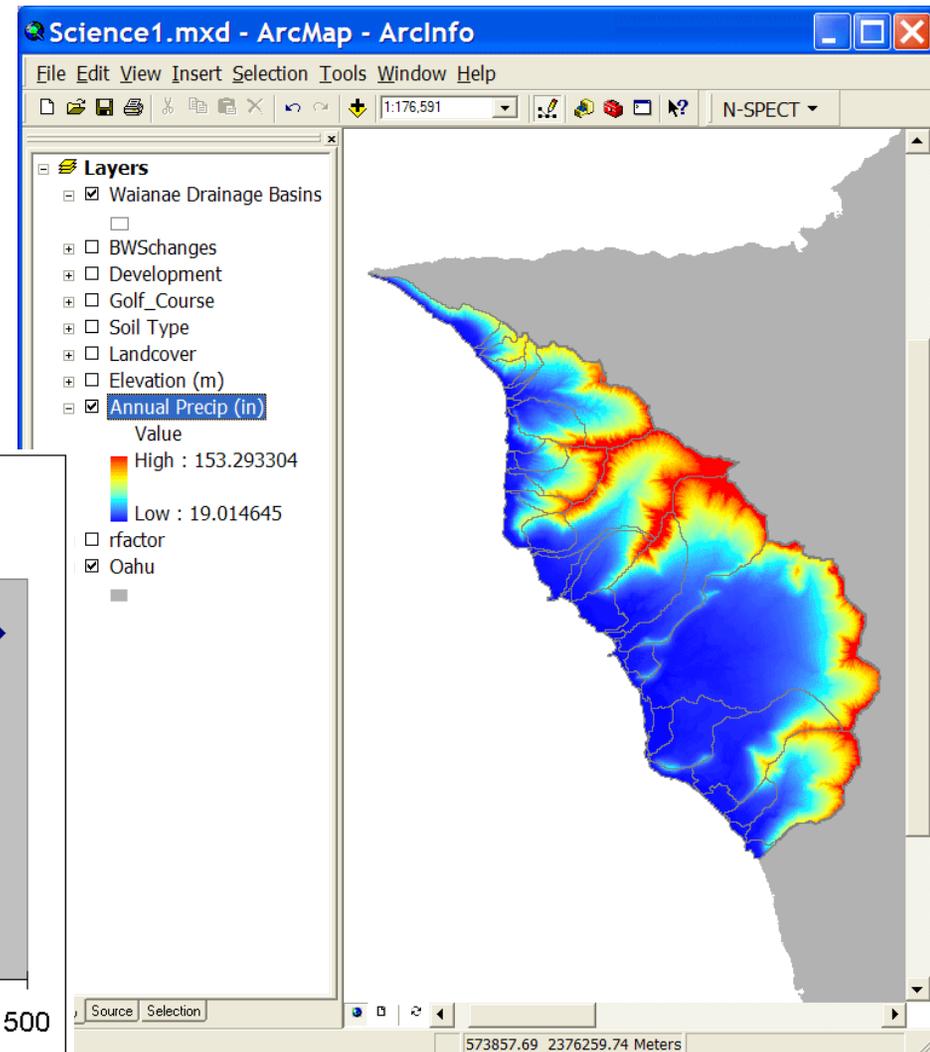
Restore Defaults Save Cancel

[†] Soil Survey Geographic Database provided by the Natural Resources Conservation Service

Precipitation

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- Derived from point estimates or modeled
- Annual grids
 - Average annual rainfall
- Event grids
 - Event rainfall



Pollutants

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- Pollutant coefficients
 - Event mean concentrations
 - Land cover specific
- Default
 - Nitrogen
 - Phosphorus
 - Lead
 - Zinc
- User-definable
 - Pollutants
 - Coefficients

Pollutants

Pollutants Coefficients Help

Pollutant Name: Nitrogen

Coefficients | Water Quality Standards

Coefficient Set: NitSet Land Cover Type: CCAP

Description: Nitrogen Coeff Set

Value	Class	Coefficients			
		Type1	Type2	Type3	Type4
2	High Intensity Developed	2.22	0	0	0
3	Low Intensity Developed	1.77	0	0	0
4	Cultivated Land	2.68	0	0	0
5	Grassland	2.48	0	0	0
7	Evergreen Forest	1.25	0	0	0
9	Scrub/Shrub	1.25	0	0	0
10	Palustrine Forested Wetland	1.1	0	0	0
16	Unconsolidated Shore	0.97	0	0	0
17	Bare Land	0.97	0	0	0
18	Water	0	0	0	0

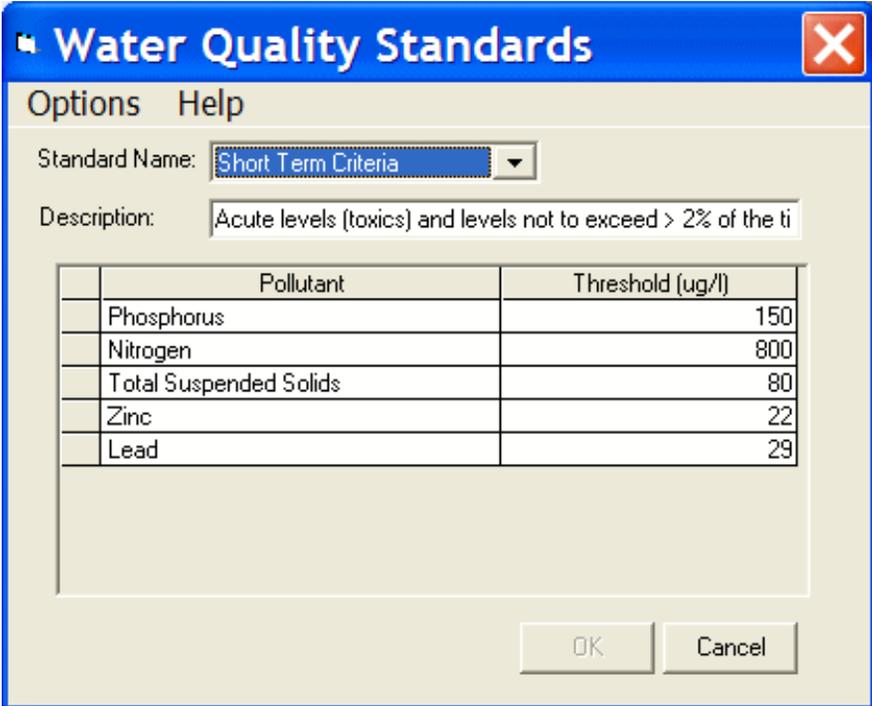
OK Cancel

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Water Quality Standards

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- User-defined standards
 - Annual or event-specific
 - Regulatory or target
- Final pollutant loads are compared with standards to assess water quality



Water Quality Standards

Options Help

Standard Name:

Description:

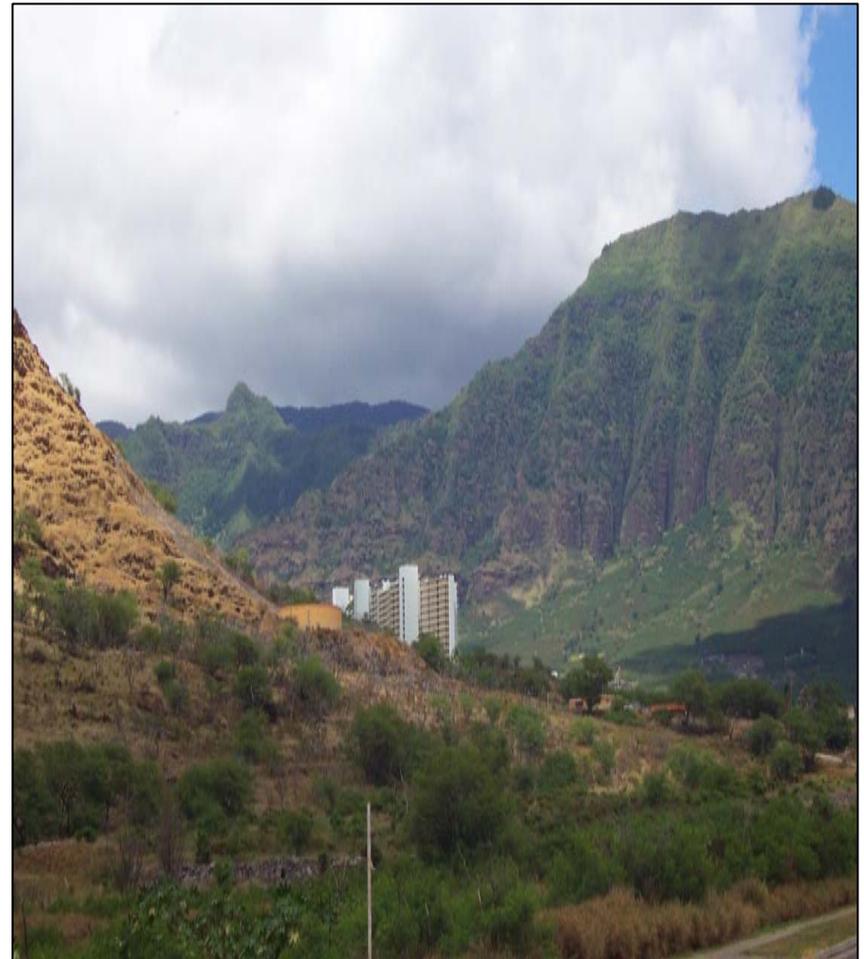
Pollutant	Threshold (ug/l)
Phosphorus	150
Nitrogen	800
Total Suspended Solids	80
Zinc	22
Lead	29

OK Cancel

Example Application

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- Makaha Valley, Oahu, Hawaii
- Annual time scale
- “What-if” scenario
 1. Baseline
 2. Land cover change
 - New residential development
 3. Comparison



Interface

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- ArcGIS toolbar
- Easy to use
- GIS functionality

The screenshot displays the N-SPECT software interface within an ArcGIS environment. The main window, titled 'Science1.mxd - ArcMap - ArcInfo', shows a map of the Waianae coastline with a topographic overlay. A context menu is open over the map, offering options: 'Run Analysis...', 'Advanced Settings', and 'Help...'. In the foreground, the 'Waianae' dialog box is open, showing various configuration options for the analysis.

Waianae Dialog Box Configuration:

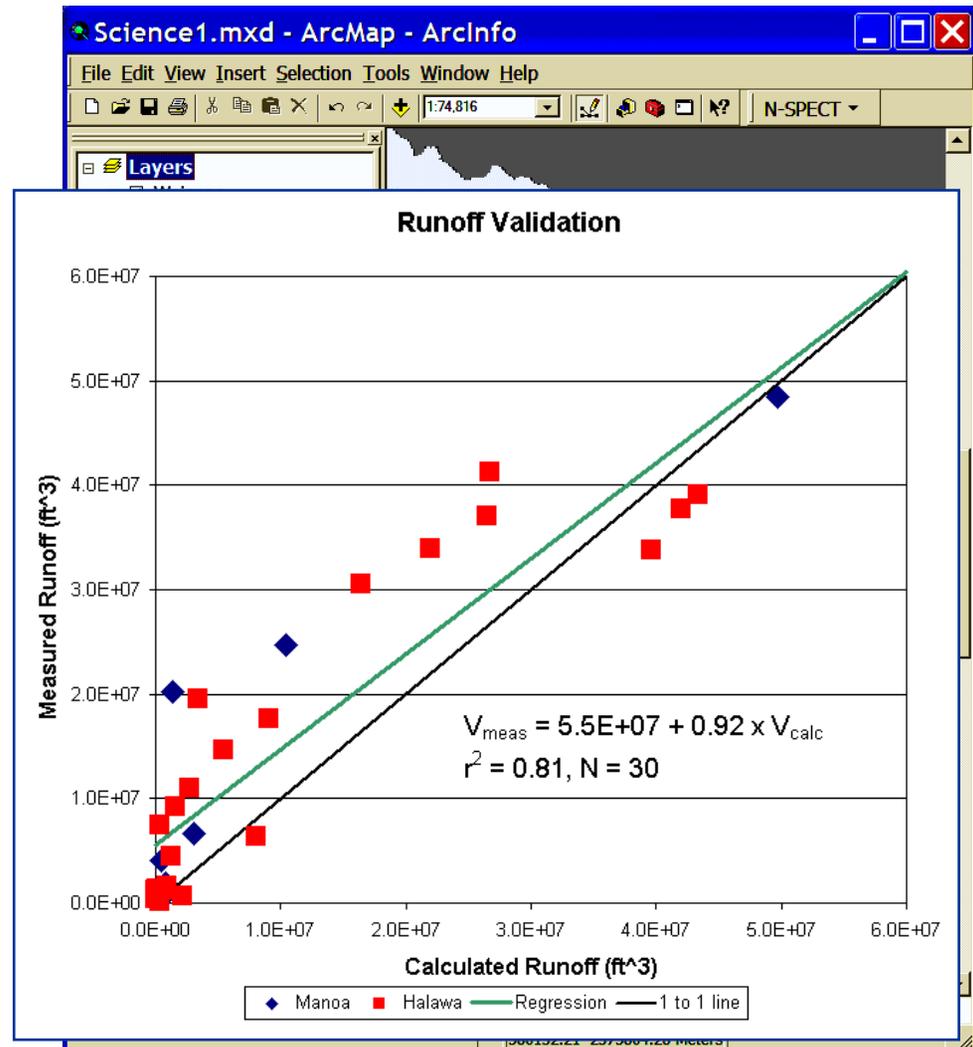
- Project Information:** Name: Waianae, Working Directory: C:\NSPECT\workspace
- Land Cover:** Grid: Landcover, Grid Units: meters, Type: CCAP
- Soils:** Soils Definition: Waianae, Hydrologic Soils Data Set: C:\NSPECT\WaianaeData\SOILS1
- Miscellaneous:** Selected Polygons Only (unchecked), Layer: Development, Local Effects Only (unchecked)
- Precipitation Scenario:** Name: Annual Precipitation
- Watershed Delineation:** Name: Waianae
- Water Quality Standard:** Name: Long Term Criteria
- Options:** Calculate Erosion for Annual Type Precipitation Scenario (checked), K Factor Dataset: C:\NSPECT\WaianaeData\SOILSK1
- Rainfall Factor:** Use GRID: rfactor (selected), Use Constant Value: (empty)

Buttons at the bottom of the dialog box: Run, Cancel

Baseline Runoff

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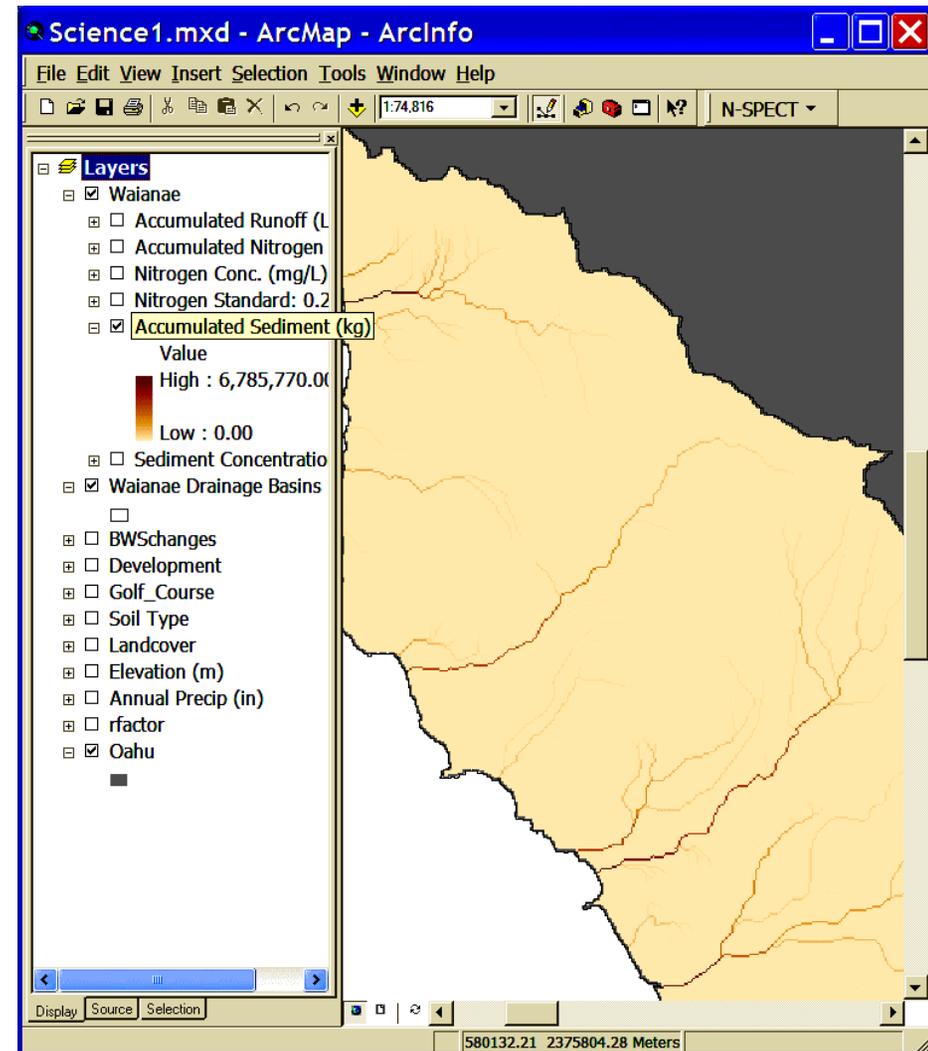
- Flow directions derived from topography
- Precipitation grid provides amount of rainfall
- Uses soils and land cover data to estimate volume of runoff
- Validated



Baseline Erosion

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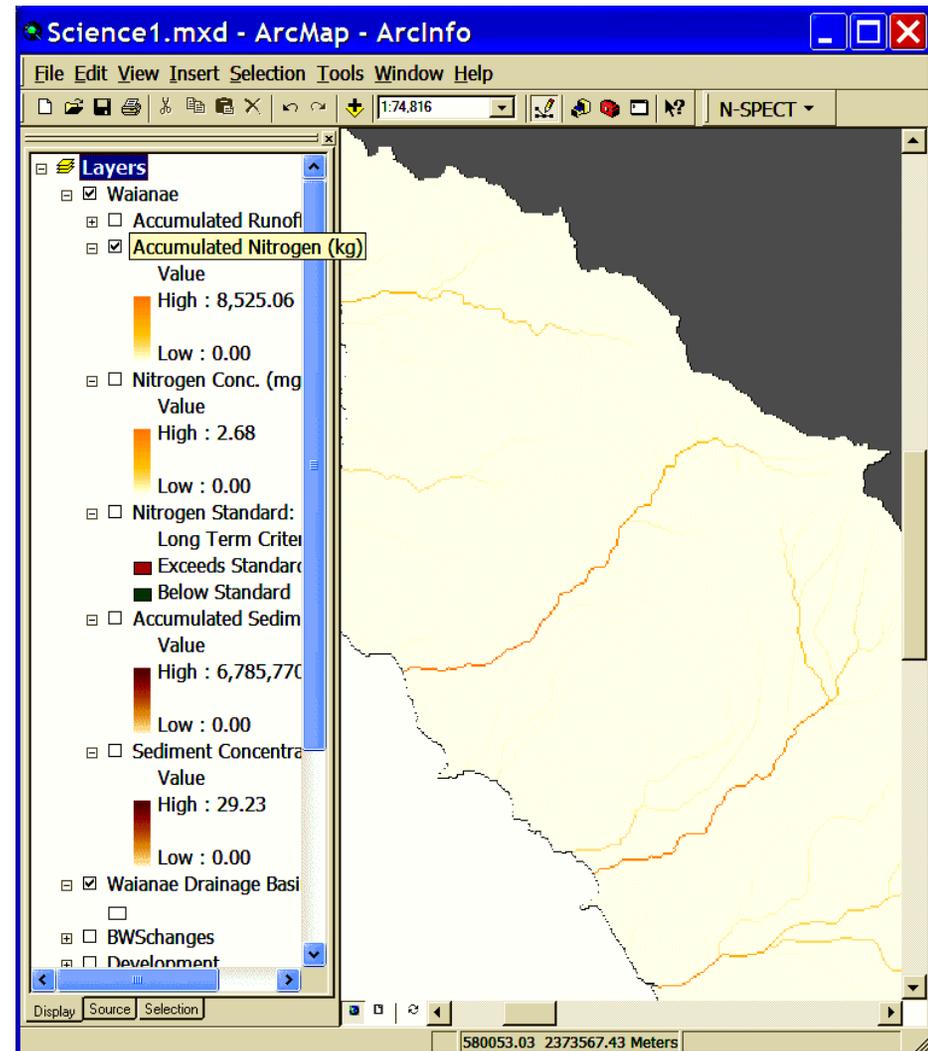
- Estimates total annual sediment load delivered to coast
- Provides a conservative estimate
 - A “worst-case” scenario



Baseline Nitrogen

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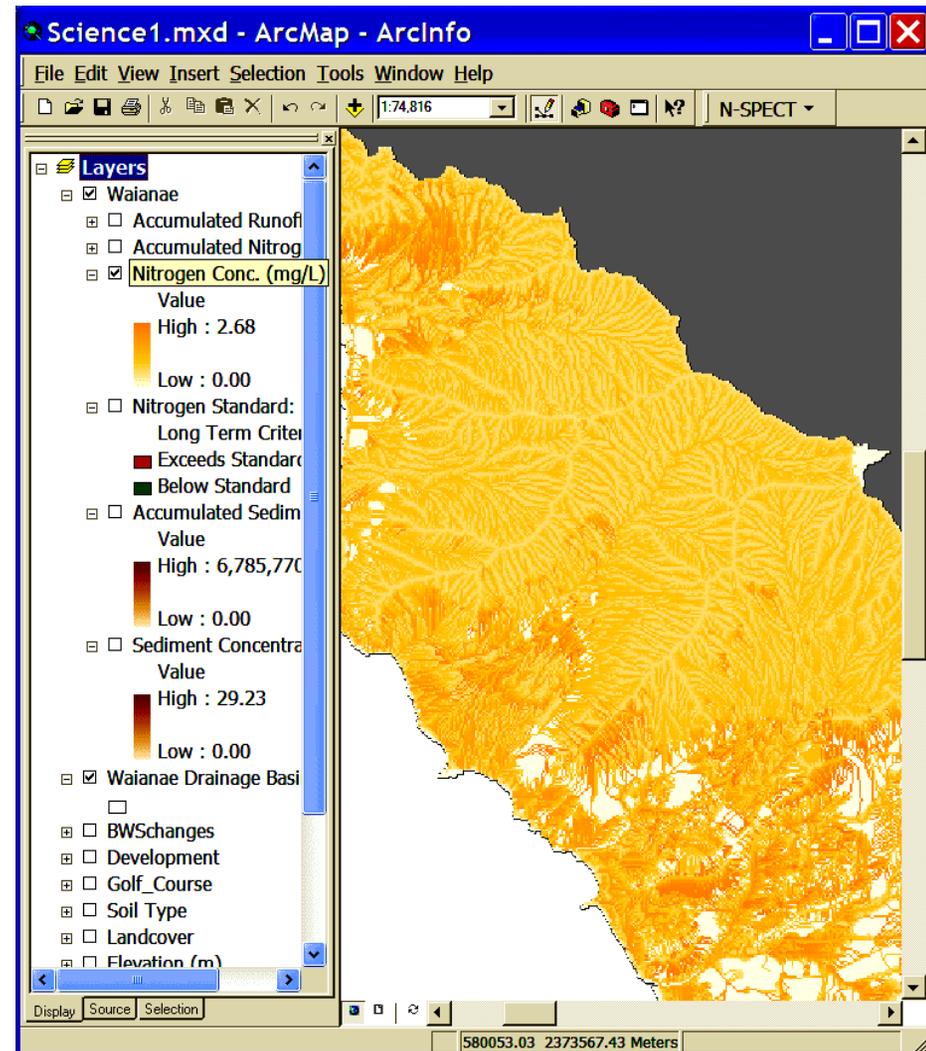
- Estimates total annual pollutant load delivered to coast
- Includes sum of contributions to any particular point



Baseline Nitrogen

Introduction to N-SPECT

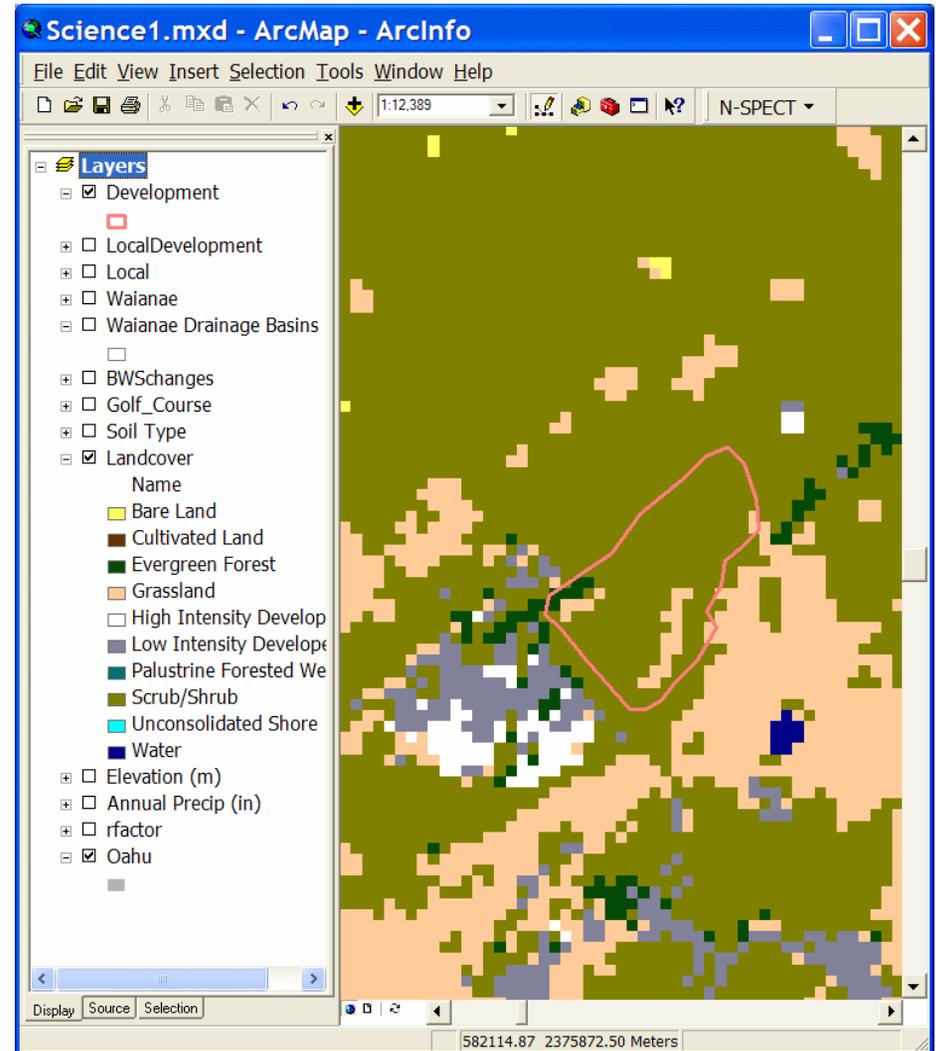
- Estimates total annual pollutant concentration
- Focuses attention on source areas



Land Cover Change Scenario

Introduction to N-SPECT

- Develop a subdivision
- Change scrub/shrub vegetation to low intensity development



Nitrogen (Pre-Change)

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- Baseline
 - Scrub/shrub

The screenshot displays the ArcMap interface with the following components:

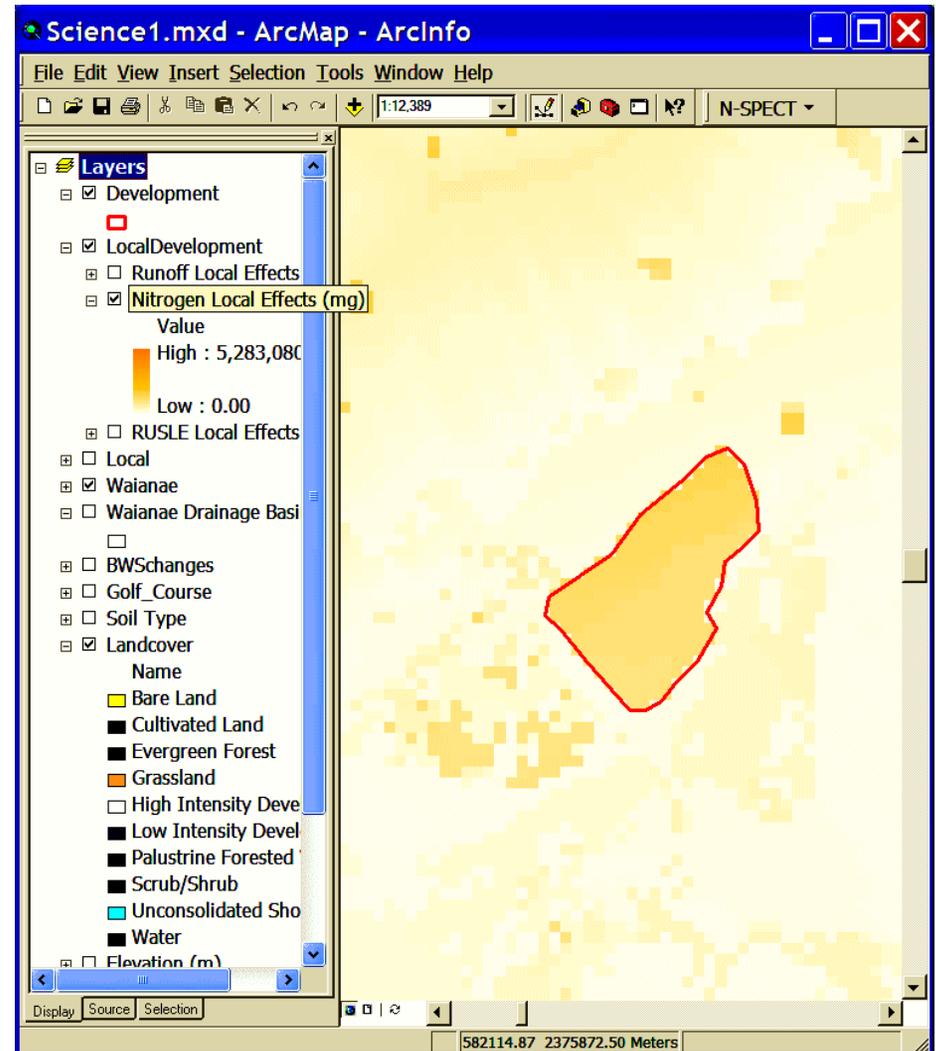
- Layers Panel:** Shows a list of layers including 'Development', 'LocalDevelopment', 'Local', 'Runoff Local Effects', and 'Nitrogen Local Effects (mg)'. The 'Nitrogen Local Effects (mg)' layer is selected and highlighted with a red box. Below it, a legend indicates 'Value High : 5,283,080' and 'Low : 0.00'.
- Map View:** Shows a yellow-toned map with a red outline highlighting a specific area.
- Development Dialog Box:** Opened in the foreground, showing settings for the 'Development' layer. It includes fields for 'Name', 'Working Directory', 'Grid', 'Grid Units', 'Type', 'Soils Definition', 'Hydrologic Soils Data Set', 'Precipitation Scenario', 'Watershed Delineation', and 'Water Quality Standard'. A table at the bottom shows the 'Change area layer' and 'Change to class' options.

Apply	Change area layer	Change to class
<input checked="" type="checkbox"/>	Development	Low Intensity Developed

Nitrogen (Post-Change)

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- Land cover change
 - Low intensity residential
- Compare baseline estimate to the estimated load after a change in land cover
- Estimated 138 percent increase in nitrogen load from this area



Resources

Introduction to N-SPECT

- N-SPECT help files
- User manual
- Technical guide
- Tutorial
- Advanced applications
- Web site
 - www.csc.noaa.gov/nspect
- List server
 - n-spect@csc.noaa.gov
- Technical Support
 - Jamie Carter
(808) 525-5387
Jamie.Carter@noaa.gov
 - Dave Eslinger
(843) 740-1270
Dave.Eslinger@noaa.gov