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Title: GIS Field Mapping Experience – Water Quality Assessment of the Occoquan River in Virginia

Pedagogical Overview

To create an effective and inclusive learning environment, I prioritize understanding my students' needs and expectations. By seeking direct input on teaching methods, I tailor my approach to optimize the learning experience. This feedback loop has led to the integration of experiential learning, collaborative activities, and advanced technology integration (e.g. GIS).

In this project, I utilize Mason small grants (Impact Funds) to bridge the gap between theoretical GIS conceptual models and real-world spatial problem-solving. Students move through the entire project management lifecycle: identifying goals, breaking down objectives, primary data collection, spatial analysis, and implementation of results.

Project Objective

This assignment provides hands-on experience in water quality assessment using field sampling, laboratory analysis, GIS software, and statistical methods. Students investigate the spatial variation of water quality parameters at different distinct locations within the Occoquan River and develop a Water Quality Index (WQI) for each.

Study Area & Site Selection

For this project, the study area consists of George Mason's Potomac Science Center in Woodbridge along the banks of the Occoquan River including adjacent stream systems. Water samples were taken at various locations within the study area to ensure a comprehensive spatial analysis.

Required Materials

- **Hardware:** Pro DSS handheld water quality meter (provided by the Potomac Science Center), Laptop.
- **Software:** GIS software (ArcGIS Pro or QGIS), Microsoft Excel.

- **Field Gear:** Field notebook, pens, and appropriate Personal Protective Equipment (PPE).

Phase I: Field Data Collection

1. Site Preparation

- Identify and obtain legal permission to access designated water resource locations.
- At each location, establish a linear transect along the waterbody.

2. Sampling Design

- Collect samples every 30 meters along the established transect.
- Establish a minimum of 5–8 sampling points per location.
- Mark and record each sampling point using the Pro DSS handheld meter.

3. Data Acquisition

- Use the Pro DSS meter to record coordinates (Latitude/Longitude) and gather real-time measurements:
 - **Parameters:** pH, Dissolved Oxygen (%) (DO), Dissolved Oxygen (mg/L) Temperature (°C), Pressure (mmHg), Turbidity (NTU), Specific Conductivity ($\mu\text{S}/\text{cm}$) (SPC), and Depth (m).
- Document site characteristics in the field notebook:
 - Adjacent land use and vegetation cover.
 - Potential pollution sources (e.g., drainage pipes, visible runoff).
 - Weather conditions (Date, time, temperature, precipitation).

Phase II: Data Analysis and GIS Mapping

1. Data Compilation

- Organize all field measurements and GPS coordinates into a structured spreadsheet (e.g. Microsoft Excel) to serve as the GIS attribute table.

2. GIS Preparation

- Import coordinates into GIS software to create a point layer.
- Develop a base map of the study area, including water resources and sampling locations.
- Join/Relate the Excel attribute table to the spatial point layer.

3. Spatial Analysis

- **Interpolation:** Generate spatial variation maps for each parameter (Temp, pH, DO, TDS, Turbidity) using the Inverse Distance Weighting (IDW) technique. This visualizes how water quality fluctuates across the study area.
- **Cartography:** Ensure all maps include professional elements: legends, scale bars, and standardized labels.

4. Water Quality Index (WQI) Calculation

- Calculate the WQI for each sampling location using an established method (e.g., the Weighted Arithmetic Index).
- Document the weighting procedure used to integrate multiple parameters into a single representative value.
- Append the final WQI values to the GIS attribute table for final mapping.

5. Regulatory Comparison

- Compare physicochemical values against EPA and State water quality standards.
- Identify specific sampling points where parameters exceed recommended safety limits.

Phase III: Professional Report & Reflection

Students prepare a comprehensive technical report structured as follows:

1. **Introduction:** Importance of water quality and study area description.
2. **Materials and Methods:** Detailed sampling design, GIS techniques, and WQI formulas.
3. **Results:** Presentation of field data, descriptive statistics, correlation analysis, and IDW spatial maps.
4. **Discussion:** Interpretation of spatial variations, the impact of land use, and comparisons between locations.
5. **Conclusion:** Summary of findings and management recommendations.
6. **Appendices:** Raw data, laboratory reports, and statistical outputs.

Final Reflection: At the end of the semester, students present their projects. This

presentation focuses on the interplay between theory and field experience. Students must identify one specific way the field experience either altered or confirmed their understanding of GIS conceptual models and explain the reasoning behind this shift in perspective.