Teacher Resources

Geospatial Technology I (8423)

Design Brief: Build a New High School (advanced)

Context
Your high school is overcrowded, and projected enrollment statistics show that the class sizes will continue to increase by 10 percent a year for several years. Therefore, the county has decided to build a new high school and reconfigure the boundaries of the school district.

Challenge
Your job is to conduct a preliminary study to find the best location within your county for the new high school. Using the data set that is provided, design the high school and the layout of the property, indicating the site of the high school.

Factors to consider in choosing the location:

- Size, location, and cost of land proposed for new site
- Proximity of the new site to your high school and other schools in the area
- Access to existing streets and the potential for locating connecting roads
- Zoning requirements and restrictions for the site

Factors to consider when developing the layout:

- The new school should accommodate 70 percent of the students currently enrolled in your school.
- There should be room for 40 percent expansion.
- Demographics of the county should be examined to identify areas with highest population of high school students.
- All sports facilities should be included on the site plan.
- The parking facility should be incorporated into the site plan.
- Buffer zones to adjacent residential areas should be planned for sound and lighting.

Objectives

- Identify the location and perform a site layout using GIS resources.
- Identify the zoning requirements for your site.
- Plan connecting roads by using a GIS.
- Plan excavating for the facilities and examine drainage and runoff issues. Indicate your findings by showing contour topography.
- Design a scale model for the high school including:
  1. houses/facilities in the buffer zone
  2. utilities/landscaping and their impact on the neighborhood

Material

- Computer lab equipment
- GIS software
- Data set
- CAD software
- Modeling materials, such as balsa wood or foam core, glue, X-Acto knives, plywood base

References

- GIS Internet resources showing roads, rivers, topography, land use, zoning
- Virginia View database

Evaluation

- Did you save and document your GIS project?
- Did you develop a slide presentation portfolio based on the five objectives?
- Did you justify your final site selection including zoning criteria?
- Did you incorporate the five objectives into your presentation?
- Did you prepare a one-page technical paper concerning drainage and runoff issues and solutions?
- Did your model support your GIS research?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area
Geospatial Technology

Applications

- Communications
- Construction

Grade Levels
10-12

Correlation to Geospatial Technology Tasks/Competencies
011, 021, 022, 023, 042, 043, 044, 045, 046, 047, 048, 049

Design Brief: Community Fire Hydrant

Context
Due to growth in the community during the past 20 years with more homes, businesses, and schools, the local fire support plan must be reviewed and updated.

Challenge
To begin, import a drawing of a school building to use as a spatial reference for the fire safety study. Analyze data to identify existing fire hydrant locations and proposed locations for new fire hydrants. The proposed locations for new fire hydrants must be within the area of service for the existing fire station. Your job is to create a map that shows the relationship between the local high school and fire protection resources. You must also recommend locations for additional fire hydrants where needed. Use geospatial reference data, and then import a CAD drawing into ArcMap. Finally, plot the map with the following elements:

- Existing roads and streets
- Traffic lights
- Stop signs
- Individual properties with existing structures (residential/commercial/governmental)
- Location of the community high school
- Location of the community fire station (option: collect with GPS)
- Location of existing fire hydrants and area of service

Objectives

- Create a map that contains the elements listed in the challenge.
- Import a given CAD drawing that will align with your shape files and aerial photo.
- Identify proposed locations for new fire hydrants.
- Create additional drawings to support your analysis.

Materials

- GIS software
- Existing shape files for the community
- Aerial photos of the community
- CAD drawing of community high school
- GPS units

References
County GIS data: Street maps to include the area served by the community fire station

Evaluation

- Do your drawings align with existing shape files?
- Does your analysis of the drawings identify the need for new fire hydrants?
- Does the analysis develop any recommendations for new fire hydrant locations?

- Are the recommendations illustrated on the drawings?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area
Geospatial Technology

Applications
Construction
Communication

Grade Levels
9-12

Correlation to Geospatial Technology Tasks/Competencies
014, 015, 016, 017, 018, 019, 021, 022, 023, 024, 025, 026 ,030, 041, 042,043, 044, 045, 046, 047, 048, 049, 050

Design Brief: Designing a New Biotechnology Lab with Site Selection

Context
In order to add biotechnology to the curriculum at your school, it will be necessary to add additional space to the current campus plan.

Challenge
Your school will be adding biotechnology to its curriculum, and your task is to find a location for the new lab. This lab will include an adjoining greenhouse that will enable study of the effect of biotechnology on agriculture. Create a site layout that includes the new lab and greenhouse. The biotechnology facility may be separate or attached to the existing school building.

Objectives

- Using GPS and GIS technologies, develop a map and plan of the school, including the property lines, location of buildings, athletic fields, utilities, and parking facilities. Consider the following:
    1. Location of trees and utilities
    2. Problems of sun blockage
    3. Levelness of ground
- Identify characteristics for the new lab's site location.
- Use GIS information to determine the geographic location of the site.
- Update the original map to show the proposed location of the new lab and greenhouse.
- Present results of the project, with supporting data, in the form of a visual GIS display.

Materials

- GPS unit with interface
- GIS software
- GPS download software
- Internet access

References

- An introductory manual to GIS
- Local and state government terrain-related data, road data, and local orthophotography

Evaluation

- Did you create an original site layout of the school campus?
- Did you select a suitable location for the lab?
- Have you updated the site layout to include the new lab's location?
- Have you prepared the results of the project, with supporting data, in the form of a visual GIS display?

- How accurate is the data?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area
Geospatial Technology

Applications
Biotechnology
Biology
Environmental Science

Grade Levels
9-12

Correlation to Geospatial Technology Tasks/Competencies
014, 015, 016, 017, 018, 020, 023, 026, 033, 042, 043, 044, 045, 046, 048, 049, 050

Design Brief: Tackling Bucks

Context

NFL teams are businesses, and their owners want to maximize profits. To boost the bottom line, they need to think about a variety of revenue sources including attendance, merchandise, and concessions. Some team owners may not be developing their attendance to the maximum possible levels.

Challenge

Your group has been asked to create a ranking for potential revenue earnings of all 32 NFL teams.

Factors to consider include:

- Identify the population count within a 30-mile radius of the team's stadium. Depending on the available statistics, you may alternatively use population in the metropolitan areas of each team's stadium or population in the county and adjoining counties of the stadium.
- Identify the median income within this radius.
- For purposes of this study, all teams should be located within the contiguous 48 states.

Note: This project could be applied to Major League Baseball teams, to NBA teams, or to other major sports teams.

Objectives

- Identify the location of each NFL stadium by latitude and longitude.
- Enter the latitude and longitude coordinate data into ArcMap.
- Identify a 100-mile-radius buffer zone around each stadium.
- Obtain U.S. census data for the year 2000 and for the most current year available. Determine total population, median income, and the growth rate of population for each of your stadium areas. Additional information, such as total attendance figures for the past season(s) at each of your stadiums and ticket prices can also be added to enhance your study.
- From the above, plus any other factors you may wish to consider, rank the NFL teams in terms of their potential revenue.
- Find an alternate U.S. location outside a 60-mile radius of another team's stadium that would produce a better result.

Materials

- GIS software (ArcGIS)
- U.S. census data
- NFL stadium data

References

All of your data may be obtained from the Internet. Good sources for U.S. census data and NFL data include:

http://www.esri.com/tiger
http://www.census.gov/

Evaluation

- Can you defend your ranking?
- What are your results?
- How do your statistics support your results?
- Does the map that you have created support your analysis?

Primary Area

Geospatial Technology

Applications

Planning
Construction

Grade Levels

9-12

Correlation to Geospatial Technology Tasks/Competencies

014, 023, 026, 033, 041, 042, 043, 044, 045

Design Brief: Homeland Security

Context

Because homeland security is a priority in the United States, a special commission has been established in each state with the specific task of providing localities with a plan in case of a natural disaster or terrorist act.

Challenge

Working in groups, students must develop a plan to react to a disaster, natural or otherwise.

- Identify vulnerable assets (fire stations, government buildings, water sources, or other infrastructure).
- Rank the assets based on their vulnerability/importance to the community.
- Determine which hospitals and large public buildings can handle (1) casualties in large numbers and (2) emergency shelter.
- Determine the main evacuation routes and alternate routes for traffic flow for major events (hurricanes, floods).
- Access a local government site such as the City of Norfolk's "Interactive Mapper" https://norfolk.gov/1596/Geographic-Information-Systems. Review the available information presented through layers, data, and search tools created and assembled by software like AutoCAD Map and ESRI ArcMAP or, as in this example, an Arc IMS server (an online GIS).

Objectives

- Interpret aerial photography.
- Develop a comprehensive community inventory of potential homeland security targets.
- Interpret GIS data.
- Analyze GIS data and draw conclusions.

Materials

- GIS software
- Computer lab

References

- GIS textbook
- County-provided GIS data themes

Potential Data Needs

Roads, infrastructure, hospitals, military bases, water supplies, historically significant landmarks, government buildings, public shelters

Evaluation

- Does the group's plan provide a critical analysis of its research?
- Does the group's plan address each of the items listed in the Challenge above?
- Are the results of the group's plan clearly communicated using the GIS?

Primary Area
Geospatial Technology

Applications
Transportation
Planning
Communication

Grade Levels
9-12

Correlation to Geospatial Technology Tasks/Competencies
030, 035, 040, 041, 043, 044, 045, 049

Design Brief: Housing Development Site Suitability

Context

In planning a new housing development, developers must investigate many sources of information and meet various criteria before deciding whether building the development is possible, and if so, where to build it.

Challenge

Your work team must find a site for a new housing development in your area.

The following criteria for the site selection must be met:

- The land must be undeveloped.
- The area should be between 10 and 30 acres.

It will be up to your team to set the criteria for distances from schools, businesses, and utilities. Use GIS data from ArcMap, the Internet, and local sources. Once a site is found, use GPS units to ground truth your site. Document all attributes that might affect your selection. These attributes include, but are not limited to, landforms, boulders, animals, trees, and bodies of water. Create a map of the site with the GPS waypoints and attributes. Incorporate all data into an interactive map for a presentation. During the presentation, either try to persuade the class that this would be a reasonable place for a new development or present arguments that demonstrate the unsuitability of the site even though it meets the criteria. Factors to consider:

- Impact on the watershed
- Impact on wildlife
- State and local zoning requirements
- Impact on transportation infrastructure

Other suggested criteria may include:

- The development should be on relatively flat land.
- The development should be located within 1,000 feet of an existing road.
- The development should be located at least 3 miles from an airport.
- No structures should be built within an existing stream, river, or pond.
- Soils should be classified as dry and perkable.

Objectives

- Use GIS software to locate a site that meets the criteria.
- Use GPS data to create a map in GIS.
- Work cooperatively to create a project.
- Use public speaking skills to present persuasive arguments.
- Produce an interactive map.
- Use GIS data to interpret spatial relationships.

Materials

- GPS units
- GIS software
- Computer equipment
- Internet access

References

- GIS instructional resources showing
    1. roads
    2. water (above and below ground level)
    3. land use and local orthography.
- Local information on zoning and utilities

Evaluation

- Did the selected site meet the criteria?
- Was responsible decision-making demonstrated during the presentation?
- Were the presentations and conclusions supported by data?
- What are the potential impacts on the local community?

Primary Area
Geospatial Technology

Applications
Transportation
Environmental
Planning

Grade Levels
9-12

Correlation to Geospatial Technology Tasks/Competencies
014, 015, 017, 018, 033, 034, 035, 042, 044, 045, 047, 049

Design Brief: We Must Get to Work!

Context

Weather conditions often cause environmental problems for communities. These problems need to be analyzed and anticipated. Transportation issues arise that necessitate the development of alternative plans to keep traffic flowing.

Challenge

Over the weekend, Hurricane Elvira struck, causing major flood and road damage in the coastal area of Virginia's Hampton Roads. The Midtown tunnel was flooded, and officials determined that it would be unusable for the next 30 days. Residents must find alternative routes to work. Your work location is the Norfolk Naval Station, which is located at the northern end of Hampton Boulevard. Your carpool meets at the intersection of College Drive and Townpoint Road.

You have been hired as a GIS consultant to find an alternate route for your carpool.

Objectives

- Identify/select the Midtown tunnel that flooded.
- Determine the route taken using the tunnel.
- Develop two alternate ways to work.
- Calculate distance, costs, and times for each route.
- Calculate the differences from your normal route.
- Prepare a map showing all routes.
- Prepare a visual presentation representing the differences between routes.

Materials

- GIS software
- Presentation materials
- Data dictionary
- Data files for counties.shp and streets.shp
- Internet access

References

GIS software manual

Evaluation

- Did you produce a GIS map that displays routes as layers?
- Did you identify alternate routes?
- What is the best route, and how did you determine it?
- Have you prepared a visual presentation explaining differences between routes?
- How accurate is the data?
- Do you have the appropriate data to support your recommendations?

- How would your recommendations affect the community?

Primary Area
Geospatial Technology

Applications
Transportation

Grade Levels
9-12

Correlation to Geospatial Technology Tasks/Competencies
023, 033, 034, 041, 042, 043, 044, 045, 048, 049, 050

Design Brief: Why Not a Fast-Food Restaurant?

Context

In the fast-food restaurant industry, opening additional franchises is the key to growth. The three critical elements in siting a new restaurant are: location, location, location.

Challenge

As a member of a site research team, you must determine the requirements for building a fast-food restaurant and compare it with other restaurants in your locality.

Objectives

- Browse a well-known fast food restaurant's web page to determine the extent of its franchises.
- Determine the requirements for ownership of a restaurant, costs to construct the building, and the number and types of jobs that would be created by opening a restaurant.
- Use GIS data to determine the commercially zoned parcels in the county.
- Determine the assessed values of these properties.
- Use GIS to determine the best location for a restaurant with consideration of the environmental impact.
- Plot actual locations of parcels, and coordinate these to maps.
- Plan, construct, and organize a presentation of your results for the board of supervisors.

Materials

- GIS software
- LCD projector
- Laptop computer with slide presentation software
- Internet access

References

- GIS software manual
- Local state and government road files
- Local orthophotography
- Zoning information
- Demographic data by census tract or census block

Evaluation

- Have you listed the requirements for the construction of a restaurant (franchise requirements, county requirements)?
- Have you identified the costs to construct the building?
- Have you identified the number and types of jobs that would be created?
- Does your GIS data determine the commercially zoned parcels in the locality?

- Did you identify environmental impacts for your location and how they influenced your decision?
- Are you prepared to present your results to the board of supervisors?
- Do you have the appropriate data to support your recommendations?
- How would your recommendations affect the community?

Primary Area
Geospatial Technology

Applications
Construction
Communications

Grade Levels
9-12

Correlation to Geospatial Technology Tasks/Competencies
011, 022, 023, 026, 030, 033, 034, 036, 043, 044, 045, 048, 049, 050