Final Project Report - GIS PROGRAMMING (GEOG 392/676)

A GIS-based Visualization of Pollution and Community Park Land Suitability Analysis in Harris County, Texas

Report submitted by team members of Group 9

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Introduction

This project report proposes a suitable location for a new park in Harris County, Texas. This location is selected using GIS analysis considering the given specific criteria and requirements. The motivation for this project came from the adverse impacts caused by pollution in the regions of dense population in Harris County. The epicenter of the major pollution was from the regions of the Greater Houston due to this region's high population and infrastructure growth along with higher rates of petroleum processing units. Spatial modelling and GIS visualization can be used to assess likely outcomes of conservation decisions [1]. Both the spatiotemporal variability of air pollution and individual daily movement patterns in exposure and health risk assessment [2]. Fossil fuel-based emissions are a major source of urban air pollution and have been associated with a variety of adverse health outcomes [3]. The combination of GIS and logical tools proved to be successful as a help for stakeholders involved in the decision-making process [4]. Visualizing natural features prone to disasters from the oil sector spatially helps in environmental management with records of changes in affected areas, and also furnishes information on the pace at which resource extraction affects nature [5]. This solution of creating community parks allows for common recreational spaces for growing populations in the county and more spaces for safe outdoor activities enhancing the health of inhabitants.

The goal of this project is to convert an undeveloped land into a community park based on parameters that are deemed suitable for the park and the Harris County community. This helps to alleviate the issue of health hazards due to pollution for outdoor activities in the future.

The objective of this project is to build a new community park by converting an undeveloped land categorized as regions that have the least air pollution with a size between 30 to 100 acres. Because the new park is for the recreational use, the location of the park should be at least 2 miles away from all toxic chemical facilities. In addition, the proposed park should not be close to existing parks and maintain atleast half a miles distance from the existing park. To benefit more residents, the new community park should be in a neighbourhood with a population of at least ten thousand residents.

For this given task, GIS analysis is the best option as the task requires analysis of geographic locations along with their attributes. The project requires all the generated maps to be in the projection: UTM Zone 14N. A full-featured professional desktop GIS application from Esri called ArcGIS Pro was used to analyse and process the data. A Python-based toolbox was developed to achieve this goal.

Data description:

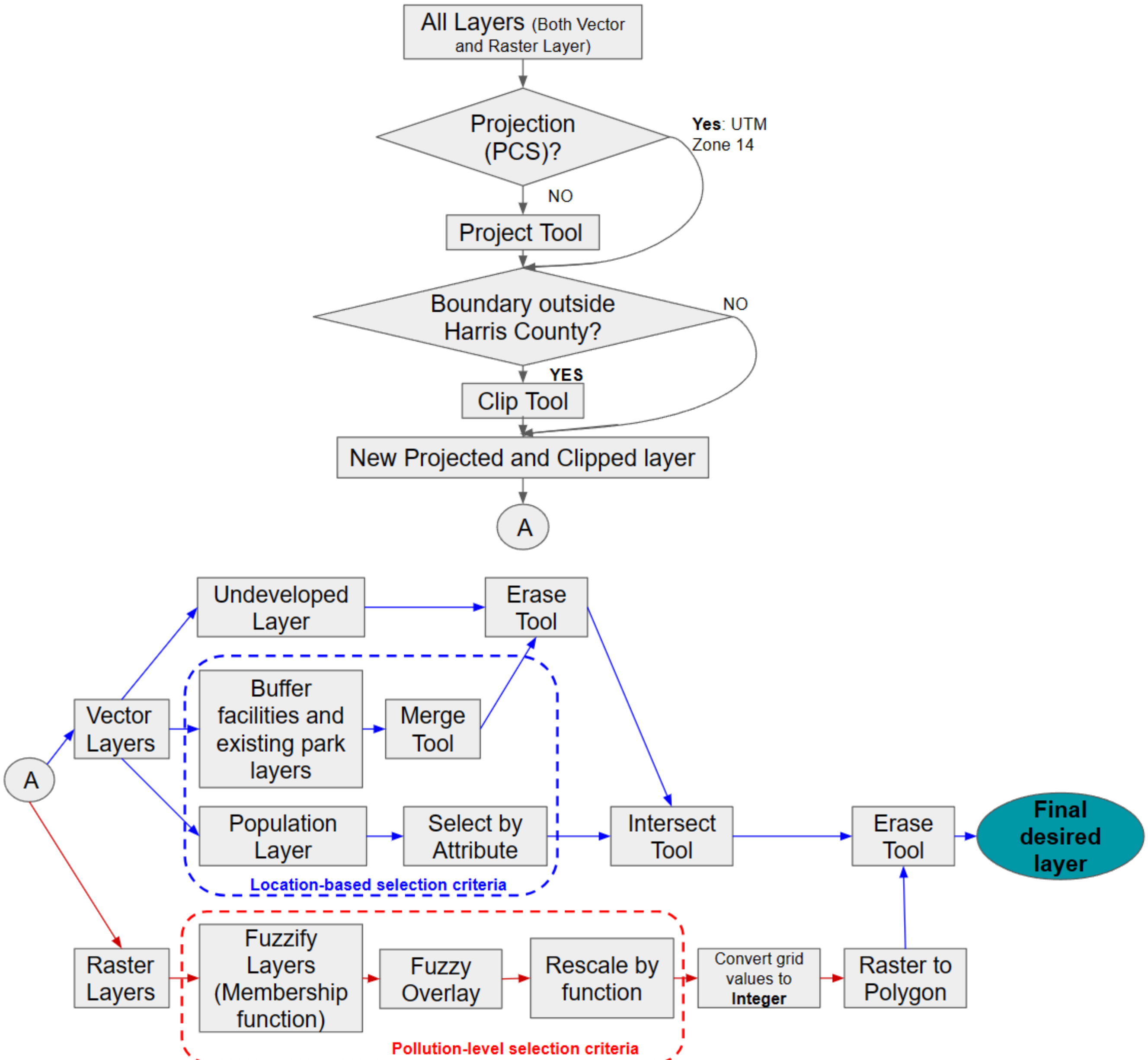
1. Harris_County_Boundary:
    a. Source: Harris County Apprisal District
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Polygon
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: NAD 1983 StatePlane Texas S Central FIPS 4204
2. Undeveloped_Land_Harris:
    a. Source: Not Available
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Polygon
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: NAD 1983 StatePlane Texas S Central FIPS 4204
3. Existing_Parks_Harris:
    a. Source: Houston-Galveston Area Council
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Point
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: NAD 1983 StatePlane Texas S Central FIPS 4204
4. Oil_Refineries_Harris:
    a. Source: Homeland Infrastructure Foundation-Level (HIFLD) Database
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Point
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: Not defined
5. Superfund_npl_Harris (Toxic facilities):
    a. Source: Not Available
    b. Data Type: Shapefile Feature Class

    c. Geometry Type: Point
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: Not Defined
6. Facilities_all_Harris (Toxic facilities):
    a. Source: Not Available
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Point
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: North America Albers Equal Area Conic
7. Population_layer_Harris:
    a. Source: Harris County Apprisal District
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Polygon
    d. Geographic Coordinate System: NAD 1983
    e. Projected Coordinate System: NAD 1983 StatePlane Texas S Central FIPS 4204 (US Feet)
8. Fracking_wells_Harris:
    a. Source: Texas Railroad Commission
    b. Data Type: Shapefile Feature Class
    c. Geometry Type: Point
    d. Geographic Coordinate System: WGS 1984
    e. Projected Coordinate System: WGS 1984 Web Mercator
9. PM2_5_Avg_2016_Harris:
    a. Source: https://hub.arcgis.com/
    b. Data Type: Raster Feature Class
    c. Geographic Coordinate System: WGS 1984
    d. Projected Coordinate System: NA
    e. Average PM2.5 for the year 2016
10. EPA_Air_Toxicity_Cancer_Harris:
    a. Source: Harris County Apprisal District
    b. Data Type: Raster Feature Class
    c. Geographic Coordinate System: WGS 1984
    d. Projected Coordinate System: NA
11. Sentinel_B1_CH4_Harris:
    a. Source: Esri, European Space Agency
    b. Data Type: Raster Feature Class
    c. Geographic Coordinate System: WGS 1984
    d. Projected Coordinate System: NA
12. Heat_Severity_Unit_Harris:
    a. Source: Esri, European Space Agency
    b. Data Type: Raster Feature Class
    c. Geographic Coordinate System: WGS 1984
    d. Projected Coordinate System: NA

Methodology

1. ArcGIS Pro-based Python Toolbox used for programming and analysing the GIS data for the project. ArcPy, OS, and Time module are called as a part of programming.
2. Workspace location and overwrite output set. Check for the necessary license was performed.
3. Tool was labelled: Community Park Land Suitability tool by Group9.
4. A total of 12 parameters were set and called.
5. Progressor and Messages were added to the Python toolbox.
6. Open all GIS data provided in the folder "Resources" and check each data's property to inspect the coordinate system.
7. If the data or layer is not in the requested projection, then use the **project** tool (Data Management Tools under Geoprocessing) to project data or layer to the requested projection. The projected layers are saved.
8. The Harris County layer is used as a reference for the extent of coverage of Harris County boundaries on other layers.
9. A **Clip** tool (Analysis tools under Geoprocessing) was used to clip the unbounded layers (mentioned in the previous point) to Harris County boundaries. Saved as new layers.
10. In order to satisfy the requirement that the proposed park should be atleast 2 miles away from the toxic facilities, the clipped superfund_npl layer and facilities_all layer are combined together using the **Merge** tool (under Data Management Tools).
11. To mark the region around toxic chemical facilities within 2 2-mile radius, the **Buffer** tool (under Analysis Toolbox) is used.
12. Similarly, the requirement of the project is to propose a park atleast 0.5 miles away existing park. Here also **Buffer** tool is also used to mark the region around the existing park with 0.5 miles.
13. Now the newly saved buffer layers of toxic facilities and existing parks are combined into a single layer using the **Merge** tool.
14. The newly merged prohibited regions layer is erased from the new layer. The **Erase** tool under Overlay toolsets is used.
15. A new field is added to the Population data by clicking Add in the attribute table window to include the 10% population growth. Then using the select by attribute option, the population greater than 10000 is filtered.
16. To find the regions with a population greater than 10000, the new table mentioned in point is joined with population layer with a common unique identifying number (FIPS). **Add Join** tool under Data Management Tools is used.
17. Add a **new field** called **Acres** in the attribute table of the new layer mentioned in the point. Right-click the field select the **Calculate Geometry** tool and use international acres to find the areas of new regions in acres. The regions greater than 30 acres are selected by using condition Acres>=50 and the new layer is saved.
18. Add Basemap (Imagery) to the table of contents and increase transparency to 30% for the new layer mentioned in the point.
19. Visually check for the regions with built-up areas and where the park cannot be built.
20. The polygon is **modified** to consider the condition that the proposed park size should be between 30-100 acres.

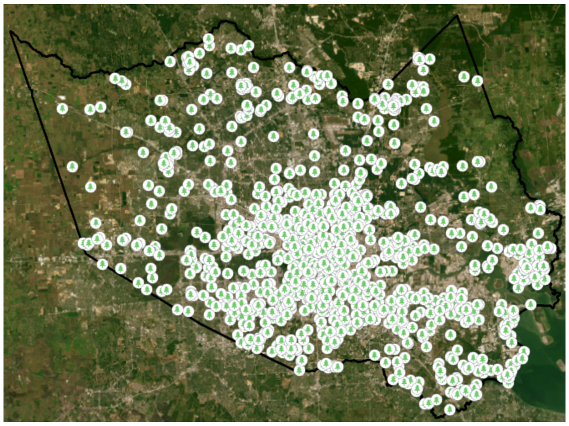
Flowchart:

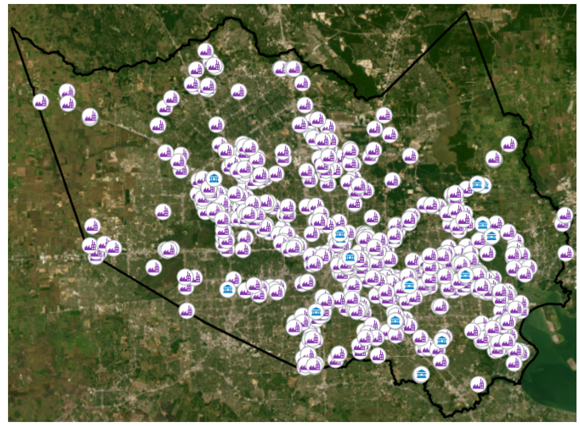


Results

1. Clip the unbounded layers to Harris County boundaries. The new vector and raster layers are saved after clipping.

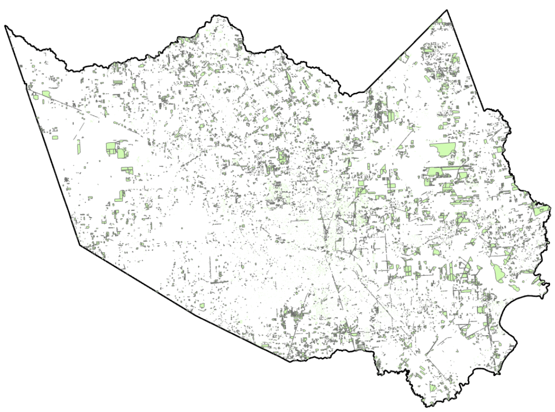
2. The number of existing parks changed from 2119 to 1166, TRI facilities reduced from 58261 to 780, and Superfund facilities reduced from 1761 to 16 after boundary clipping.

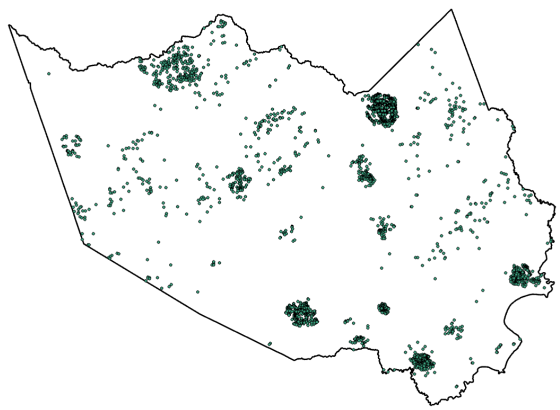




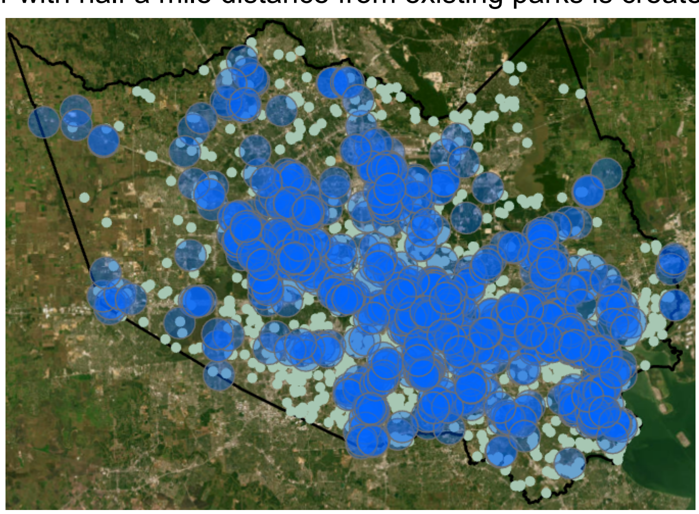
Intermediate map. Existing park and Superfunds and TRI facilities positions inside the Harris County boundary.

3. The new layer containing data on Oil refineries, Fracking wells, Superfunds and TRI layers is saved. The merged facilities number 795.
4. Vector layers containing Undeveloped_land and Fracking wells are analysed.

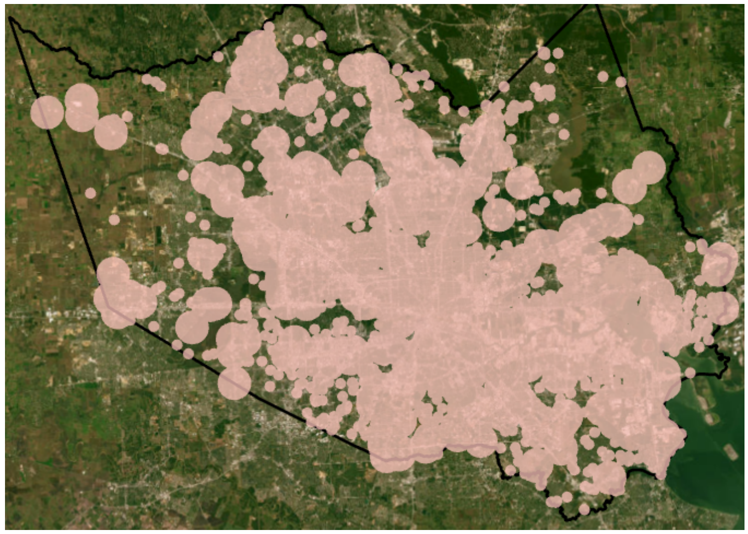




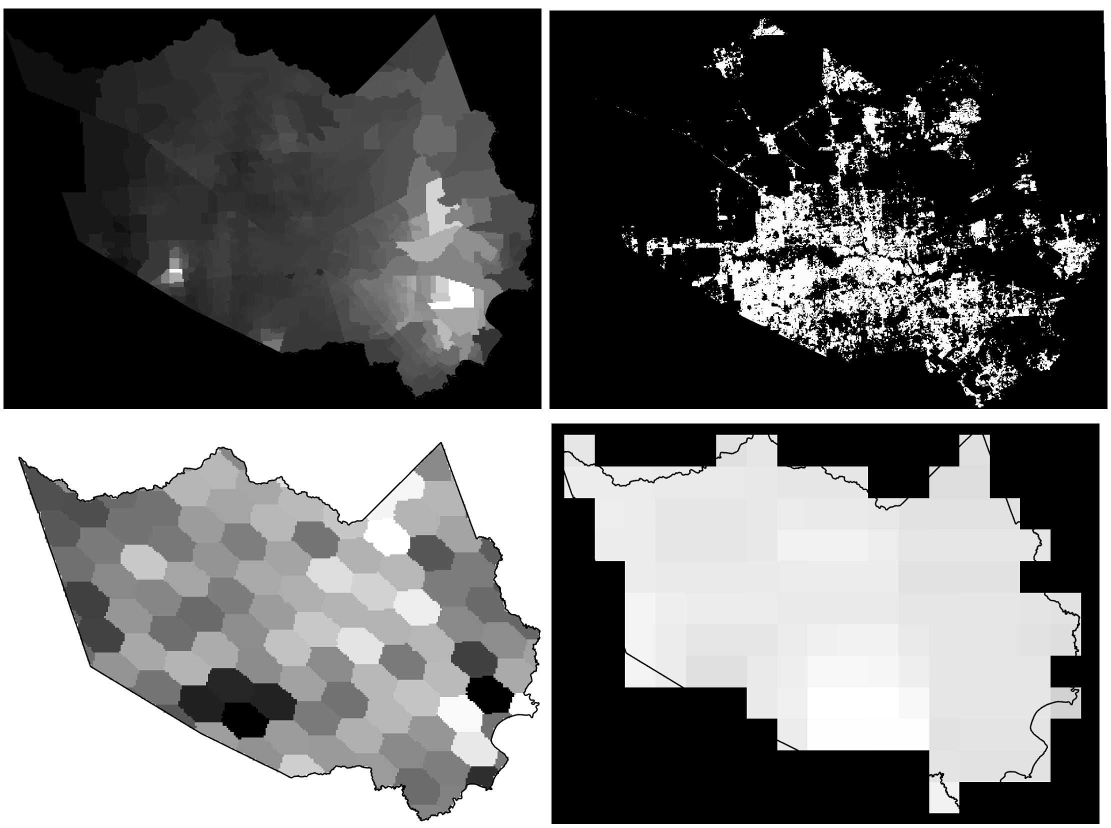
5. The buffer layer with a 2-mile distance is created for toxic industrial facilities.
6. A new buffer layer with half a mile distance from existing parks is created.



7. The new merged prohibited regions layer is created.

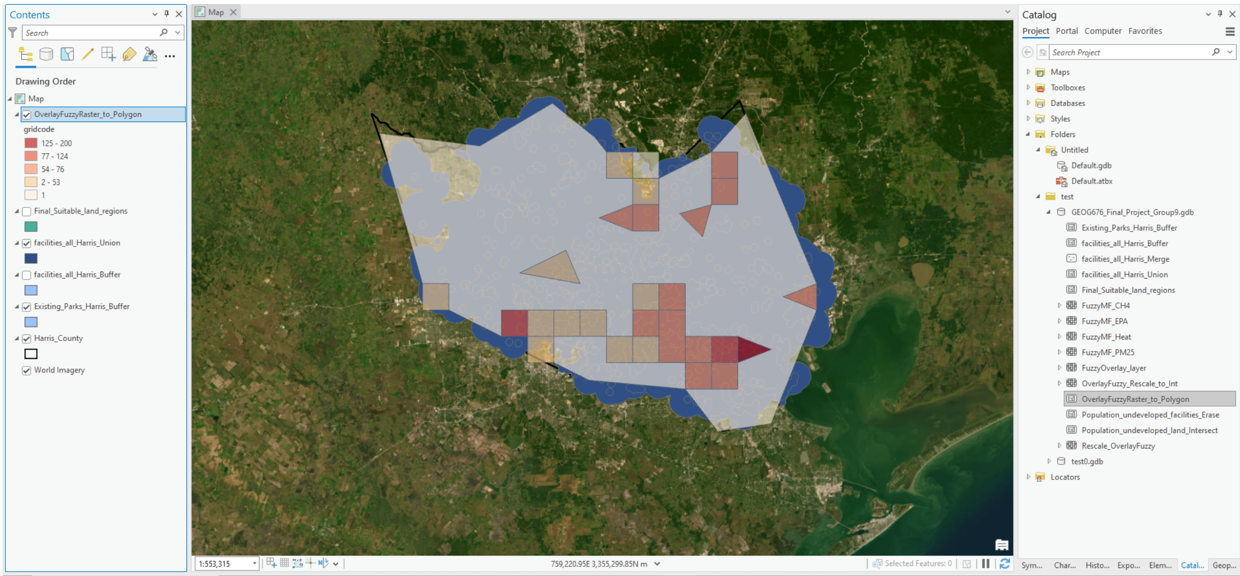


8. The new table containing areas greater than 10000 is saved as new data. The regions were reduced from 770 to 151 regions.
9. The new layer of regions having a population greater than 10000 is saved.
10. Raster layers are converted to fuzzified layers using fuzzy membership tool.



11. The new intersecting zone layer is saved.
12. The regions greater than 50 acres are selected by using conditions greater than 30 acres and less than 100 acres. The new layer is saved.

13. Defuzzified raster layer after fuzzy overlay tool is saved as a new layer.



14. The final layer for proposed park regions are saved in “Final_Suitable_Land_Regions”.

Discussions

The project shows the complexity of the selection of suitable land for the construction of a new community park with given constraints. After applying all the requirements, the 23 regions were suitable for the new community park out of which only eight regions had an area greater than 30 acres. It was interesting to find some regions selected had ongoing construction or had buildings even after using undeveloped land regions as one of the selection criteria. After superimposing selected regions over aerial imagery, those regions which had developments were discarded. So it is highly recommended to double-check the regions with the latest data to avoid bias and mistakes. After all the consideration, three locations were selected with suitable areas. But, out of three locations, larger plots are more suitable for the new community park because the location is near to residential area and has good road connectivity. Both locations are suitable for new park development with the purpose of recreational activity and reducing the effect of air pollution risks.

Conclusions

A suitable region was found using the custom-developed Python-based toolbox with the given vector and raster data to convert undeveloped land into a community park based on parameters that are deemed suitable for the park and the Harris County community. This helps to alleviate the issue of health hazards due to pollution for outdoor activities in the future.

References

1. Juliusson, L. M., & Doherty, K. E. (2017). Oil and gas development exposure and conservation scenarios for greater sage-grouse: Combining spatially explicit modelling with GIS visualisation provides critical information for management decisions. Applied Geography, 80, 98-111.

2. Park, Y. M., & Kwan, M. P. (2017). Individual exposure estimates may be erroneous when spatiotemporal variability of air pollution and human mobility are ignored. Health & place, 43, 85-94.

3. Zhang, X., Craft, E., & Zhang, K. (2017). Characterizing spatial variability of air pollution from vehicle traffic around the Houston Ship Channel area. Atmospheric Environment, 161, 167-175.

4. Nadal, M., Cadiach, O., Kumar, V., Poblet, P., Mari, M., Schuhmacher, M., & Domingo, J. L. (2011). Health risk map of a petrochemical complex through gis-fuzzy integration of air pollution monitoring data. Human and Ecological Risk Assessment: An International Journal, 17(4), 873-891.

5. Merem, E., Robinson, B., Wesley, J. M., Yerramilli, S., & Twumasi, Y. A. (2010). Using GIS in ecological management: green assessment of the impacts of petroleum activities in the State of Texas. International Journal of Environmental Research and Public Health, 7(5), 2101-2130.

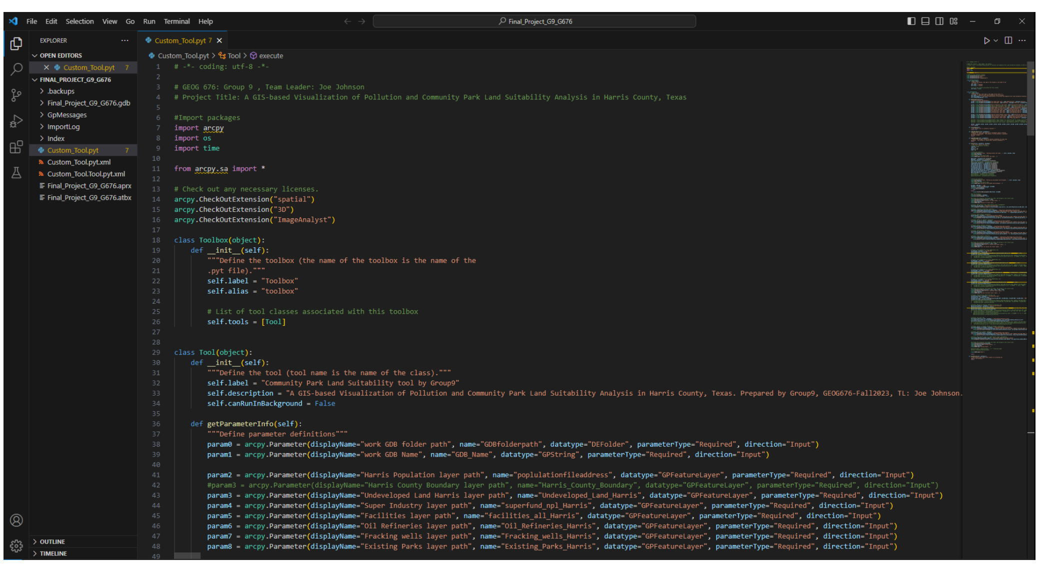
6. Korstanje, J. (2022). Erase. In *Machine Learning on Geographical Data Using Python: Introduction into Geodata with Applications and Use Cases* (pp. 175-199). Berkeley, CA: Apress.

7. https://pro.arcgis.com/

Final Map (Next page)

A GIS-based Visualization of Pollution and Community Park Land Suitability Analysis in Harris County, Texas

Annexure:



```python
    def execute(self, parameters, messages):
        """The source code of the tool."""
        # Define our progressor variables
        readTime = 2.5
        start = 0
        maximum = 100
        step = 20

        # Setup the progressor
        arcpy.SetProgressor("step", "Checking project and layer...", start, maximum, step)
        time.sleep(readTime)
        # Add message to the results pane
        arcpy.AddMessage("Checking project and layer...")

        GDB_Folder = parameters[0].valueAsText
        GDB_Name = parameters[1].valueAsText
        popln_layer_Harris = parameters[2].valueAsText
        #Harris_County_Boundary = parameters[3].valueAsText
        Undeveloped_Land_Harris = parameters[3].valueAsText
        superfund_npl_Harris = parameters[4].valueAsText
        facilities_all_Harris = parameters[5].valueAsText
        Oil_Refineries_Harris = parameters[6].valueAsText
        Fracking_wells_Harris = parameters[7].valueAsText
        Existing_Parks_Harris = parameters[8].valueAsText
        Sentinel_B1_CH4_Harris_tif = parameters[9].valueAsText
        EPA_Air_Toxicity_Cancer_Harris_tif = parameters[10].valueAsText
        Heat_Sererity_Unit_Harris_tif = parameters[11].valueAsText
        PM2_5_Avg_2016_tif = parameters[12].valueAsText
        #bufferRadius1 = parameters[14].valueAsText
        #bufferRadius2 = parameters[15].valueAsText
        #poplulationfilter = parameters[16].valueAsText


        # Setup the progressor
        arcpy.SetProgressor("step", "Setting up environment and workspace...", start, maximum, step)
        time.sleep(readTime)
        # Add message to the results pane
        arcpy.AddMessage("Setting up environment and workspace...")

        WorkGDB = GDB_Name + ".gdb"
        database = os.path.join(GDB_Folder, WorkGDB)
        arcpy.env.overwriteOutput = True
        if arcpy.Exists(database):
            pass
        else:
            arcpy.CreateFileGDB_management(GDB_Folder, WorkGDB)
```

```python
        #Set the workspace
        arcpy.env.workspace = database
        arcpy.env.overwriteOutput = False

        #Increment the progressor and change the label; add message to the results pane
        arcpy.SetProgressorPosition(start + step)
        arcpy.SetProgressorLabel("Analysis of vector data...")
        time.sleep(readTime)
        arcpy.AddMessage("Analysis of vector data...")

        # Process: Make Feature Layer (Make Feature Layer) (management)
        Population_GT_10K_layer = "Population_GT_10K_layer"
        arcpy.management.MakeFeatureLayer(in_features=popln_layer_Harris, out_layer=Population_GT_10K_layer, where_clause="POP2010 >= 10000")

        # Process: Intersect (Intersect) (analysis)
        Population_undeveloped_land_Intersect = database + "/Population_undeveloped_land_Intersect"
        with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
            arcpy.analysis.Intersect(in_features=[[Population_GT_10K_layer, ""], [Undeveloped_Land_Harris, ""]], out_feature_class=Population_undeveloped_land_Intersect)

        # Process: Merge (Merge) (management)
        Output_Dataset = database + "/facilities_all_Harris_Merge"
        with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
            arcpy.management.Merge(inputs=[facilities_all_Harris, Oil_Refineries_Harris, superfund_npl_Harris, Fracking_wells_Harris], output=Output_Dataset, field_mappings="FACN \"FACN\" tr

        # Process: Buffer (2) (Buffer) (analysis)
        facilities_all_Harris_Buffer = database + "/facilities_all_Harris_Buffer"
        with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
            arcpy.analysis.Buffer(in_features=Output_Dataset, out_feature_class=facilities_all_Harris_Buffer, buffer_distance_or_field= "2 Miles", dissolve_option="ALL")

        # Process: Buffer (Buffer) (analysis)
        Existing_Parks_Harris_Buffer = database + "/Existing_Parks_Harris_Buffer"
        with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
            arcpy.analysis.Buffer(in_features=Existing_Parks_Harris, out_feature_class=Existing_Parks_Harris_Buffer, buffer_distance_or_field= "0.5 Miles", dissolve_option="ALL")

        # Process: Union (Union) (analysis)
        facilities_all_Harris_Union = database + "/facilities_all_Harris_Union"
        with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
            arcpy.analysis.Union(in_features=[[facilities_all_Harris_Buffer, ""], [Existing_Parks_Harris_Buffer, ""]], out_feature_class=facilities_all_Harris_Union, gaps="NO_GAPS")

        # Process: Erase (Erase) (analysis)
        Population_undeveloped_facilities_Erase = database + "/Population_undeveloped_facilities_Erase"
        with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
            arcpy.analysis.Erase(in_features=Population_undeveloped_land_Intersect, erase_features=facilities_all_Harris_Union, out_feature_class=Population_undeveloped_facilities_Erase)
```

```python
    #Increment the progressor and change the label; add message to the results pane
    arcpy.SetProgressorPosition(start + step + step)
    arcpy.SetProgressorLabel("start to fuzzify the raster layers...")
    time.sleep(readTime)
    arcpy.AddMessage("start to fuzzify the raster layers...")


    # Process: Fuzzy Membership (Fuzzy Membership) (sa)
    FuzzyMF_EPA = database + "/FuzzyMF_EPA"
    Fuzzy_Membership = FuzzyMF_EPA
    FuzzyMF_EPA = arcpy.sa.FuzzyMembership(EPA_Air_Toxicity_Cancer_Harris_tif, FuzzyLinear(0, 255))
    FuzzyMF_EPA.save(Fuzzy_Membership)
    #with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[
    #    FuzzyMF_EPA = arcpy.sa.FuzzyMembership(EPA_Air_Toxicity_Cancer_Harris_tif, [["LINEAR", 0, 255]], "NONE")
    #    FuzzyMF_EPA.save(Fuzzy_Membership)

    # Process: Fuzzy Membership (2) (Fuzzy Membership) (sa)
    FuzzyMF_Heat = database + "/FuzzyMF_Heat"
    Fuzzy_Membership_2_ = FuzzyMF_Heat
    FuzzyMF_Heat = arcpy.sa.FuzzyMembership(Heat_Sererity_Unit_Harris_tif, FuzzyLinear(0, 245))
    FuzzyMF_Heat.save(Fuzzy_Membership_2_)
    #with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[
    #    FuzzyMF_Heat = arcpy.sa.FuzzyMembership(Heat_Sererity_Unit_Harris_tif, [["LINEAR", 0, 245]], "NONE")
    #    FuzzyMF_Heat.save(Fuzzy_Membership_2_)

    # Process: Fuzzy Membership (3) (Fuzzy Membership) (sa)
    FuzzyMF_PM25 = database + "/FuzzyMF_PM25"
    Fuzzy_Membership_3_ = FuzzyMF_PM25
    FuzzyMF_PM25 = arcpy.sa.FuzzyMembership(PM2_5_Avg_2016_tif, FuzzyLinear(5.7755103111267, 8.9484844207764))
    FuzzyMF_PM25.save(Fuzzy_Membership_3_)
    #with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[
    #    FuzzyMF_PM25 = arcpy.sa.FuzzyMembership(PM2_5_Avg_2016_tif, [["LINEAR", 5.7755103111267, 8.9484844207764]], "NONE")
    #    FuzzyMF_PM25.save(Fuzzy_Membership_3_)

    # Process: Fuzzy Membership (4) (Fuzzy Membership) (sa)
    FuzzyMF_CH4 = database + "/FuzzyMF_CH4"
    Fuzzy_Membership_4_ = FuzzyMF_CH4
    FuzzyMF_CH4 = arcpy.sa.FuzzyMembership(Sentinel_B1_CH4_Harris_tif, FuzzyLinear(0, 234))
    FuzzyMF_CH4.save(Fuzzy_Membership_4_)
    #with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[
    #    FuzzyMF_CH4 = arcpy.sa.FuzzyMembership(Sentinel_B1_CH4_Harris_tif, [["LINEAR", 0, 234]], "NONE")
    #    FuzzyMF_CH4.save(Fuzzy_Membership_4_)

    #Increment the progressor and change the label; add message to the results pane
    arcpy.SetProgressorPosition(start + step + step + step + step)
    arcpy.SetProgressorLabel("Overlay fuzzified raster layers...")
    time.sleep(readTime)
```

```python
    arcpy.AddMessage("Overlay fuzzified raster layers...")

    # Process: Fuzzy Overlay (Fuzzy Overlay) (sa)
    FuzzyOverlay_layer = database + "/FuzzyOverlay_layer"
    Fuzzy_Overlay = FuzzyOverlay_layer
    FuzzyOverlay_layer = arcpy.sa.FuzzyOverlay([FuzzyMF_EPA, FuzzyMF_Heat, FuzzyMF_PM25, FuzzyMF_CH4], "AND", 0.9)
    FuzzyOverlay_layer.save(Fuzzy_Overlay)
    #with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
    #    FuzzyOverlay_layer = arcpy.sa.FuzzyOverlay([FuzzyMF_EPA, FuzzyMF_Heat, FuzzyMF_PM25, FuzzyMF_CH4], "AND", 0.9)
    #    FuzzyOverlay_layer.save(Fuzzy_Overlay)

    # Process: Rescale by Function (Rescale by Function) (sa)
    Rescale_OverlayFuzzy = database + "/Rescale_OverlayFuzzy"
    Rescale_by_Function = Rescale_OverlayFuzzy
    Rescale_OverlayFuzzy = arcpy.sa.RescaleByFunction(FuzzyOverlay_layer, TfLinear(0, 7, "#", "#", "#", "#"), 1, 200)
    Rescale_OverlayFuzzy.save(Rescale_by_Function)

    # Process: Int (Int) (3d)
    OverlayFuzzy_Rescale_to_Int = database + "/OverlayFuzzy_Rescale_to_Int"
    arcpy.ddd.Int(in_raster_or_constant=Rescale_OverlayFuzzy, out_raster=OverlayFuzzy_Rescale_to_Int)
    OverlayFuzzy_Rescale_to_Int = arcpy.Raster(OverlayFuzzy_Rescale_to_Int)
    #with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"G
    #    arcpy.ddd.Int(in_raster_or_constant=Rescale_OverlayFuzzy, out_raster=OverlayFuzzy_Rescale_to_Int)
    #    OverlayFuzzy_Rescale_to_Int = arcpy.Raster(OverlayFuzzy_Rescale_to_Int)

    # Process: Raster to Polygon (Raster to Polygon) (conversion)
    OverlayFuzzyRaster_to_Polygon = database + "/OverlayFuzzyRaster_to_Polygon"
    with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"Gr
        arcpy.conversion.RasterToPolygon(in_raster=OverlayFuzzy_Rescale_to_Int, out_polygon_features=OverlayFuzzyRaster_to_Polygon)

    # Process: Erase (2) (Erase) (analysis)
    Final_Suitable_land_regions = database + "/Final_Suitable_land_regions"
    with arcpy.EnvManager(outputCoordinateSystem="PROJCS[\"WGS_1984_UTM_Zone_14N\",GEOGCS[\"GCS_WGS_1984\",DATUM[\"D_WGS_1984\",SPHEROID[\"WGS_1984\",6378137.0,298.257223563]],PRIMEM[\"Gr
        arcpy.analysis.Erase(in_features=Population_undeveloped_facilities_Erase, erase_features=OverlayFuzzyRaster_to_Polygon, out_feature_class=Final_Suitable_land_regions)

    # Process: Make Feature Layer (2) (Make Feature Layer) (management)
    Final_btw30_150Acres_suitable_regions = "Final_btw30_150Acres_suitable_regions"
    arcpy.management.MakeFeatureLayer(in_features=Final_Suitable_land_regions, out_layer=Final_btw30_150Acres_suitable_regions, where_clause="Shape_Area >= 210 And Shape_Area < 1000")


    #Increment the progressor and change the label; add message to the results pane
    arcpy.SetProgressorPosition(maximum)
    arcpy.SetProgressorLabel("saving project...")
    time.sleep(readTime)
    arcpy.AddMessage("saving project...")

    arcpy.AddMessage("Done!")
```