

PARTNER: A Geospatial Solution for Evidence-Based Police Patrolling

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GEOG 596b

Background:

Project idea

- ▶ Personal Interest
 - ▶ Undergrad capstone was international money laundering scenarios
 - ▶ Close work with Department of State Diplomatic Security as an Embassy Guard
- ▶ Professional Interest
 - ▶ Imagery Analyst by trade
 - ▶ Recently completed Deployment to EUCOM building web applications

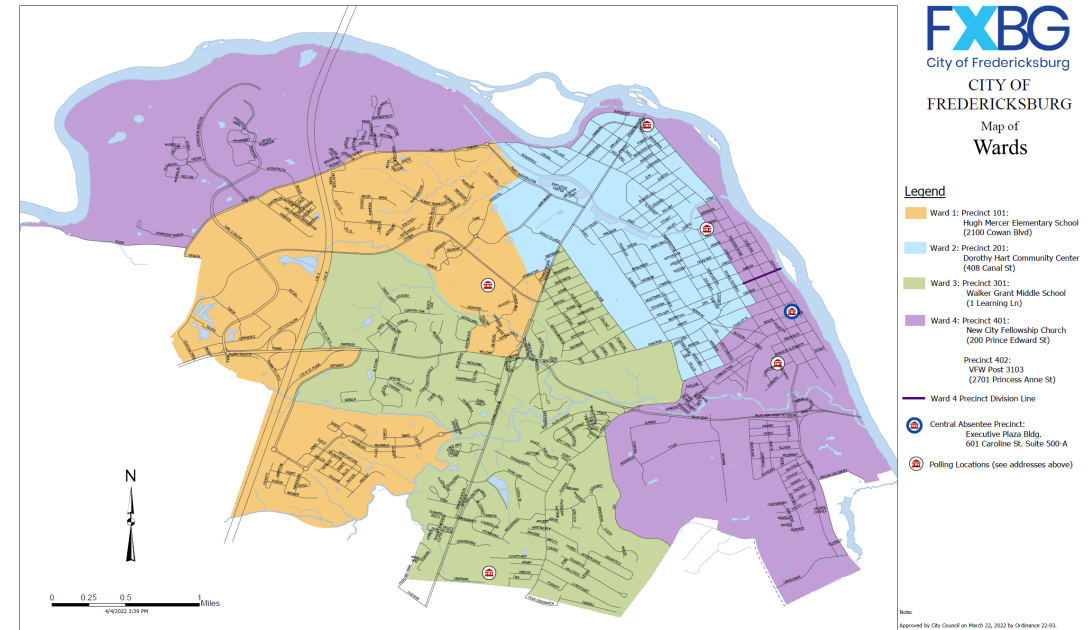
Background:

Problem Development

- ▶ Aid law enforcement in the following:
 - ▶ Community Transparency
 - ▶ Provide intelligence centered on historic data
 - ▶ Alleviate bias through evidence-based decision making
- ▶ Solution:
 - ▶ Develop a tool that leverages historical analysis to provide a patrol solution that allows information to be used in conjunction with a patrol officer's expertise.
 - ▶ A tool that performs route development based on hotspot analysis to “link” high-density crime areas

Project Area: 22401 - Fredericksburg, VA

- ▶ Fredericksburg is located 48 miles south of Washington, D.C. and 53 miles north of Richmond.
- ▶ Total area is approximately 10.5 square miles.
- ▶ As of the 2021 census, the population was 28,367.
- ▶ There are four zones that the police department uses as patrolling areas - not depicted



Goals and objectives

- Transparency of the Local Police Force

 - Community access to the tool and the underlying crime data

- Further hotspot analysis conducted for crime in an area

 - Typical analysis develops the hotspots and zonal analysis but does little to combine the results of analysis into something actionable

- Develop a solution that is mobile and repeatable

 - Design will need to include the various ways to share the output OR the tool

 - Automate the geoprocessing steps to minimize user input to facilitate user analysis

 - Design has the option to be applied to any police department or jurisdiction

METHODOLOGY

“The application of GIS is limited only by the imagination of those who use it”. ~ Jack Dangermond, Esri

Methodology: Data Acquisition

- ▶ Step 1: minimal data layers to start are required
- ▶ A road network
 - ▶ Road network provided by City GIS
- ▶ Crime points
 - ▶ Crimes were extracted from Police communication records provided by FOIA request

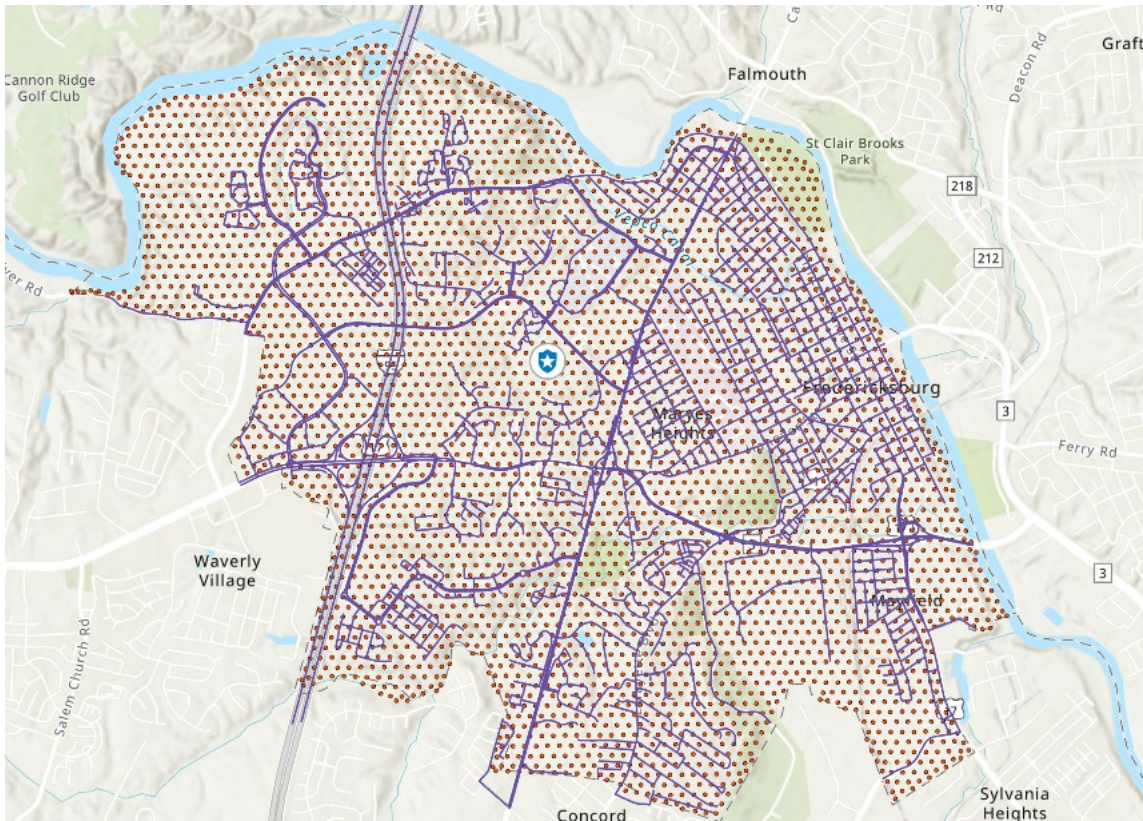
Nature

- ASSAULT
- B & E IN PROGRESS
- DOMESTIC
- DRUG ACTIVITY
- LARCENY
- NARCOTICS
- PROSTITUTION
- ROBBERY
- SEX OFFENSE
- STABBING
- STALKING
- VANDALISM

Report #	Call Time	Nature	Location	Prime Unit	Disp.	Close Time
	03/09/2022 10:55	MENTAL HEALTH	1225 PARCELL ST		COM	03/09/2022 11:06:06
	03/09/2022 11:53	VEHICLE STOP	808 CAROLINE ST	320	VWR	03/09/2022 11:55:35
	03/09/2022 11:08	ASSIST	2200 COWAN BLVD	308	ASTD	03/09/2022 12:07:19
	03/09/2022 11:11	VEHICLE STOP	904 PRINCESS ANNE ST	313	SUM	03/09/2022 11:20:36
	03/09/2022 11:25	MENTAL HEALTH	600 JACKSON ST		BOL	03/09/2022 11:41:52
	03/09/2022 00:56	POLICE	1280 CENTRAL PARK	339	ASTD	03/09/2022 11:47:07
	03/09/2022 10:21	FRAUD	1001 CADMUS CT	328	NOA	03/09/2022 11:21:23
2022001146	03/09/2022 10:24	HIT RUN ACCIDENT	1201 GATEWAY BLVD	308	RPT	03/09/2022 11:53:40
	03/09/2022 11:41	BOLO	SPOTSY ECO LEFT 600			03/09/2022 11:42:33
	03/09/2022 11:03	FOLLOW UP	LPO - IRBY		LOG	03/09/2022 11:26:17
	03/09/2022 12:03	FRAUD			ITC	03/09/2022 12:04:30
	03/09/2022 12:18	911 HANGUP	1301-100 SAM PERRY		MISD	03/09/2022 12:20:36
	03/09/2022 12:19	MENTAL HEALTH	TOWNSEND,SHEILA		LOG	03/09/2022 12:20:23
	03/09/2022 11:56	MENTAL HEALTH	600 JACKSON ST	313	ADVS	03/09/2022 12:16:04
	03/09/2022 12:34	CHECK WELFARE	1704 LAFAYETTE BLVD		DUP	03/09/2022 12:40:08
	03/09/2022 12:40	LARCENY	447 EMANCIPATION HWY		LOG	03/09/2022 12:49:15
	03/09/2022 12:40	FOLLOW UP	LPO - GREEN		LOG	03/09/2022 13:03:47
	03/09/2022 12:42	FOLLOW UP	LPO - JACKSON		LOG	03/09/2022 13:02:05
	03/09/2022 14:16	FOUND PROPERTY	1300 AUGUSTINE AVE	307	ADVS	03/09/2022 14:44:25
	03/09/2022 13:26	MVA PROPERTY	990 BLUE GRAY PKWY		ITC	03/09/2022 13:27:30
2022001149	03/09/2022 12:36	DRINKING IN PUBLIC	110 GOODLOE DR	336	RPT	03/09/2022 14:20:57
2022001157	03/09/2022 17:18	ASSAULT	1001 SAM PERRY BLVD	341	RPT	03/09/2022 18:06:11
2022001150	03/09/2022 13:45	VANDALISM	1901-A HOWARD AVE	313	RPT	03/09/2022 14:51:40
	03/09/2022 13:25	VEHICLE STOP	512 LAFAYETTE BLVD	517	WWR	03/09/2022 13:35:00
	03/09/2022 15:07	EMERGENCY	600 JACKSON ST		DUP	03/09/2022 15:08:32

Methodology:

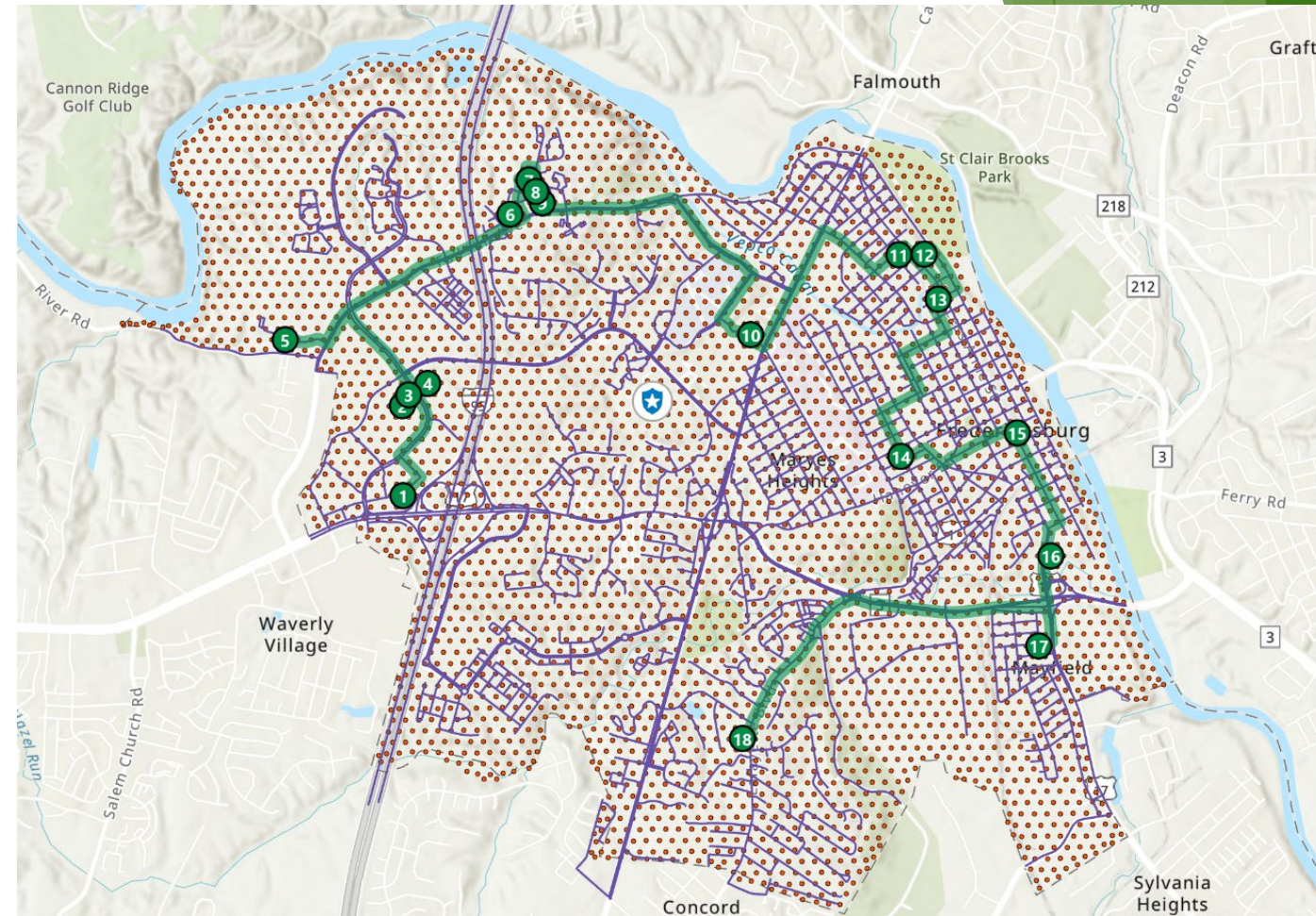
Areal Analysis



- ▶ Step 2: Create a tessellation in each zone
 - ▶ This is to aggregate the crime into equal-sized areas
 - ▶ Data was hexagonally binned using the City boundary obtained by the City GIS
- ▶ Step 3: Join Crimes to the Tessellation
 - ▶ *Summarize Incident Count* to have the crime types and count per record of tessellation
- ▶ Step 4: Convert the Tessellation polygons to points for ingestion to route development

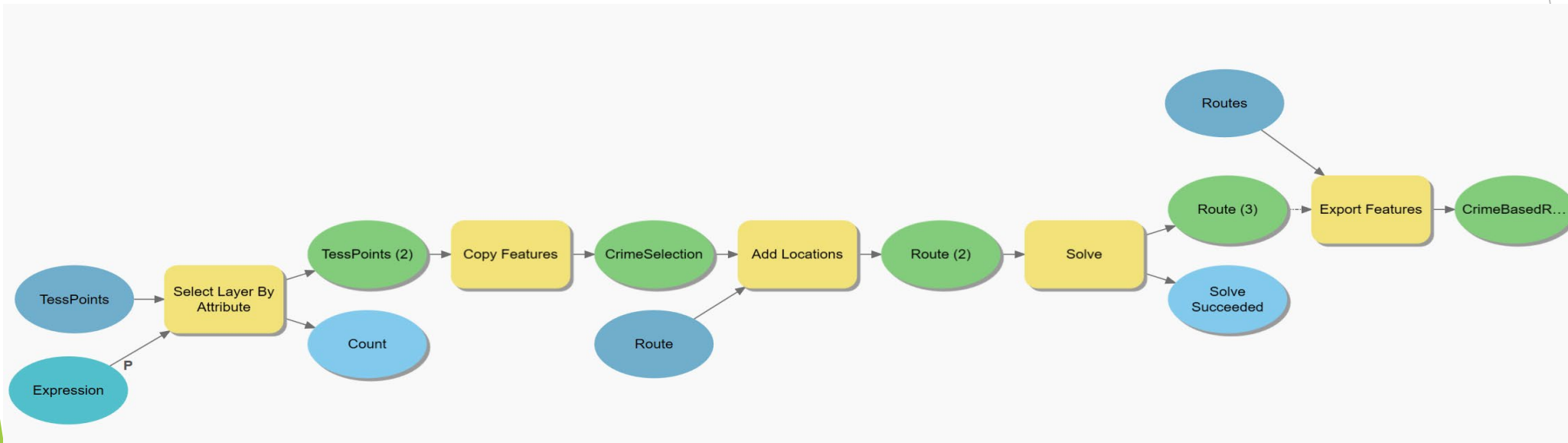
Methodology: Database infrastructure for Analysis

- ▶ Step 5: Prepare to create a network dataset
 - ▶ Create a Feature dataset and add the road network
 - ▶ Create a network dataset
 - ▶ Create a Route Network Analysis Layer
- ▶ Step 6: Import points to the Route Analysis Layer
 - ▶ To identify which points, Select from the tessellation points a crime count that is higher than average *Add Locations* tool will import the selection as Stops to the Route Analysis Layer
- ▶ Step 7: *Solve* the Route
 - ▶ On the order of point ingestion, a route can be developed
- ▶ Conclusion: Route creation with “stops” at each hotspot generated within the tessellation, unique to each zones data.



PARTNER MODEL

Preliminary Analytic Routing for Neighborhood Emergency Response



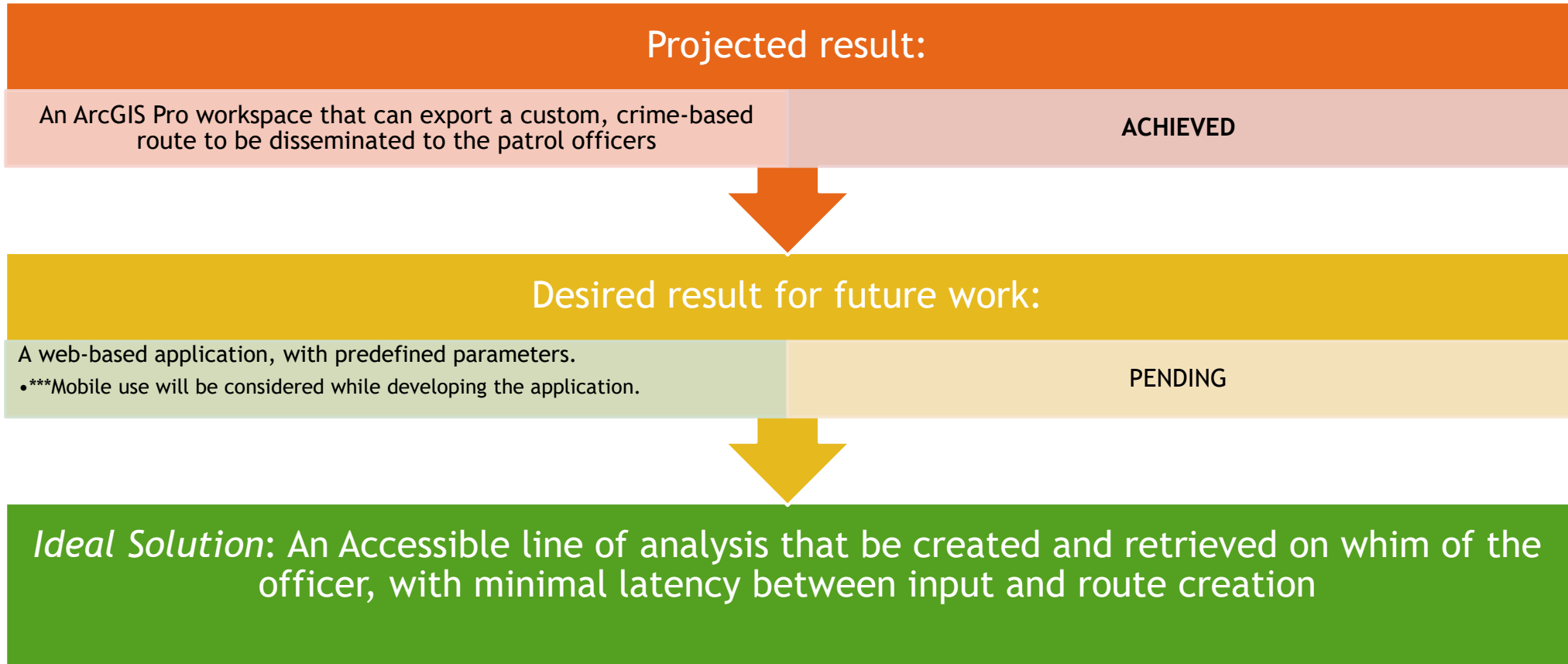
Demonstration

The screenshot displays the ArcGIS Desktop interface with the following components:

- Map View:** Shows a map of a residential area with a green polygon representing a crime hot spot. A brown route with numbered stops (1-23) is overlaid on the polygon. Labels include 'Falmouth', 'Waverly Village', 'Five Mile Fork', and 'Little Falls'.
- Contents Panel:** Shows the 'Drawing Order' for 'Map2', including 'Route', 'Stops', 'Routes', 'Point Barriers', 'Line Barriers', and 'Polygon Barriers'.
- Geoprocessing Panel:** Shows a 'PossibleWorkflow' with a 'Where' clause: 'B & E IN P is ab'. A 'Run' button is visible at the bottom right of the panel.
- Table View:** Displays a table of selected features (23 total) with the following columns: OBJECTID, Shape, GRID_ID, ASSAULT, B & E IN PROGRESS, DOMESTIC, DRUG ACTIVITY, LARCENY, NARCOTICS, PROSTITUTION, ROBBERY, SEX OFFENSE. The first three rows are visible:

OBJECTID	Shape	GRID_ID	ASSAULT	B & E IN PROGRESS	DOMESTIC	DRUG ACTIVITY	LARCENY	NARCOTICS	PROSTITUTION	ROBBERY	SEX OFFENSE
1	Point	EC-276	0	0	0	0	0	0	0	0	0
2	Point	EZ-287	1	0	0	2	0	0	0	0	0
3	Point	ES-280	0	0	0	0	0	0	0	0	0
- Status Bar:** Shows '23 of 3,816 selected' and 'Filters: 100%'.

Results



Future Work:

Web and Mobile Application - ArcGIS Navigator

- ▶ Step 1: Develop/condition the data in the ArcGIS Pro environment
- ▶ Step 2: Run *PARTNER*
 - ▶ This used ModelBuilder to make a single process
- ▶ Step 3: *Share as Route Layer*
 - ▶ Can be used as a mobile app or Web App
 - ▶ Can be ingested into ArcGIS Navigator
 - ▶ Directions must be enabled when the *Solve* tool is completed
- ▶ Step 4: Open ArcGIS Navigator
 - ▶ Retrieve the unique route assigned within the group

Future Work:

Web and Mobile Alternative

- ▶ Step 1: Develop/condition the data in the ArcGIS Pro environment
- ▶ Step 2: Run *PARTNER*
- ▶ Step 3: Share *PARTNER* as Geoprocessing Service
 - ▶ A *geoprocessing history* is required to share a toolbox/script/model
- ▶ Step 4: Access ArcGIS Online and begin creating a web application
 - ▶ A web map with the network and route analysis layers may be required for the tool to work. Future iterations will explore the leeway with this approach
- ▶ Step 4: Add *PARTNER* as a widget to a web application
 - ▶ AGOL is able to take a Geoprocessing Service and convert it to a widget without the additional Java Script
 - ▶ Routes can be generated on demand by WebApp users

Lessons Learned



Geocoding Issues

- ▶ *ArcInsight*: ArcInsight is a tool on the ArcGIS Online portal with a license. One of the options within the tool is to geocode tables to display on a map.
 - ▶ This option created two tables that could not be joined outside of the ArcInsight environment
 - ▶ Future iterations of PARTNER may require this to be the option for establishing the map.
- ▶ *Geocodio*: This tool is a free online geocoding service after a user signs up.
 - ▶ Batch geocoding was limited to 500 records per iteration
 - ▶ More table manipulation is required for use with large datasets
- ▶ *Feature Manipulation Engine*: Feature Manipulation Engine (FME) is a standard tool analysts use for processing and geoprocessing data.
 - ▶ When the crime data was ingested, various error codes were presented. This may be a feasible option, but a solution was not reached for this study.
- ▶ *Other Options*:
 - ▶ [Geoapify](#)
 - ▶ [GitHub](#)
 - ▶ [Cvs2Geo](#)

Dataset Development

- ▶ Feature Dataset & Network Dataset
 - ▶ Both of these elements within a specified map are essential for PARTNER to operate.
 - ▶ Without these steps, PARTNER will not read any of the input data
- ▶ Route Analysis Layer
 - ▶ The Route Analysis Layer builds off the feature dataset and Network dataset. Unless the previous two layers are created, the route analysis layer will not know where to “look” and will cause more locational identification issues.
 - ▶ Error codes are not indicative or informative this is the issue.

Questions?