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DATA TO POLICY 2020

Motivation (Quick Recap!)

- Voting is important, and every eligible voter should have EASY and CONVENIENT access to voting
- Shelby County v. Holden, section 4(b) of the Voting Rights Act
- In some states we are seeing decreasing voting locations along with extreme wait times and traveling distances



The Original Coverage Formula

- Had two conditions that could cause a state or jurisdiction to be covered and require oversight by DOJ before enacting voting laws
 - If a state or jurisdiction had a "test or device" that restricted the ability of people to register to vote
 - Being able to pass a literacy test
 - Establish that they had good moral character
 - Have another registered voter vouch for their qualifications
 - If less than 50% of people of voting age were registered to vote on November 1, 1964 or less than 50% of people eligible voted in the presidential election of November 1964
- In 1970 there was another subsection added citing a date of November 1968 instead of 1964 for having a test or device and levels of voter registration.
- In 1972 the coverage formula was expanded the list of “test and device” to include the practice of providing any election information in only English in places where members of a single language minority constituted more than five percent of the citizens of voting age.

Why could our program be used as a new coverage formula?

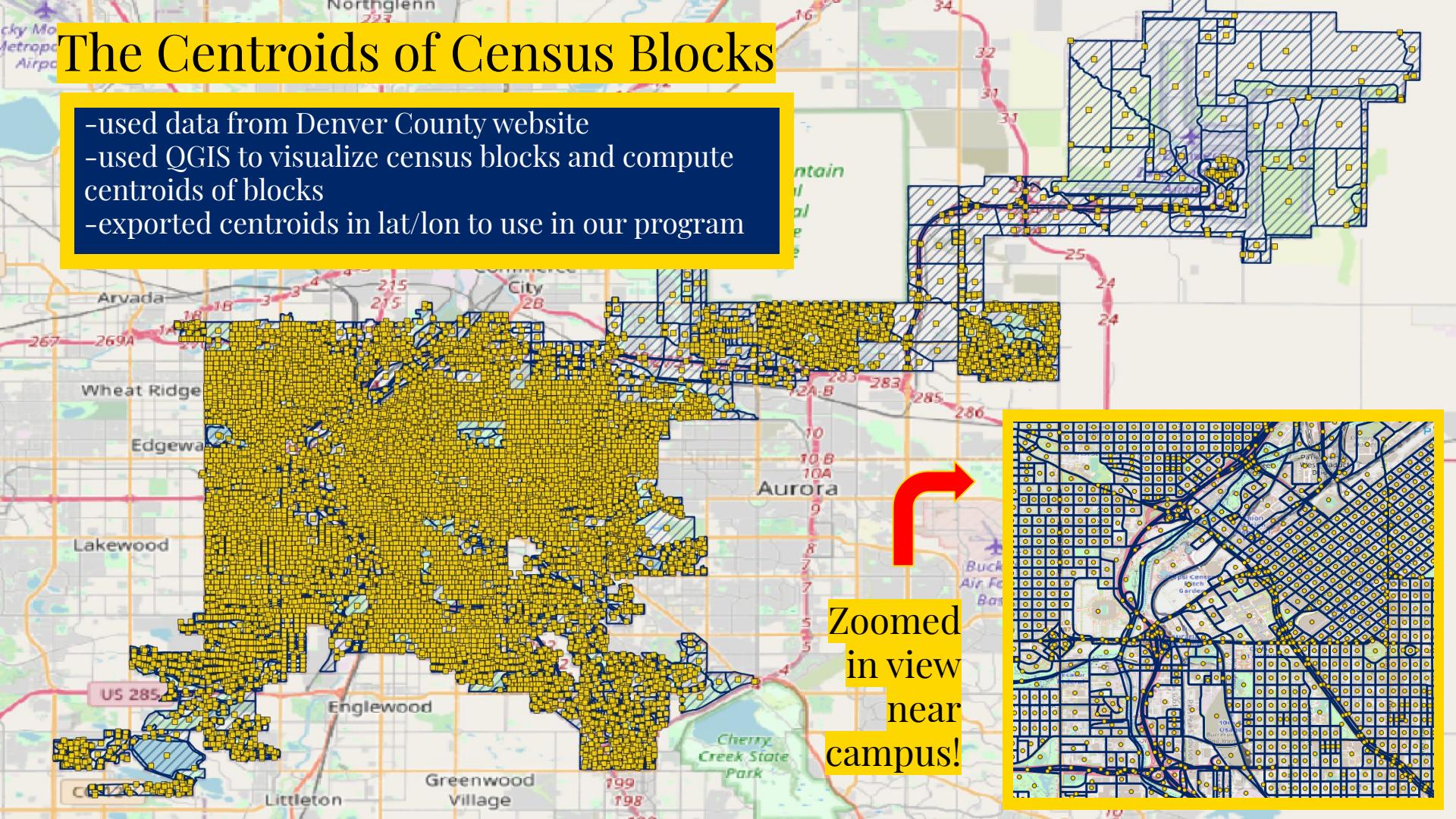
- Could be strengthened by being combined with other factors
 - redistricting/gerrymandering
- Can be easily adapted
 - Add more constraints
 - Can compute distance to bus stops or other public transportation options
 - Can change constraints
 - Based on population density
 - Based on availability to public transportation
 - Based on availability of poll volunteers
 - Intakes data, so can be kept relevant throughout the years

The Data

1. Census data
2. Potential Polling Locations
3. Current Polling Locations

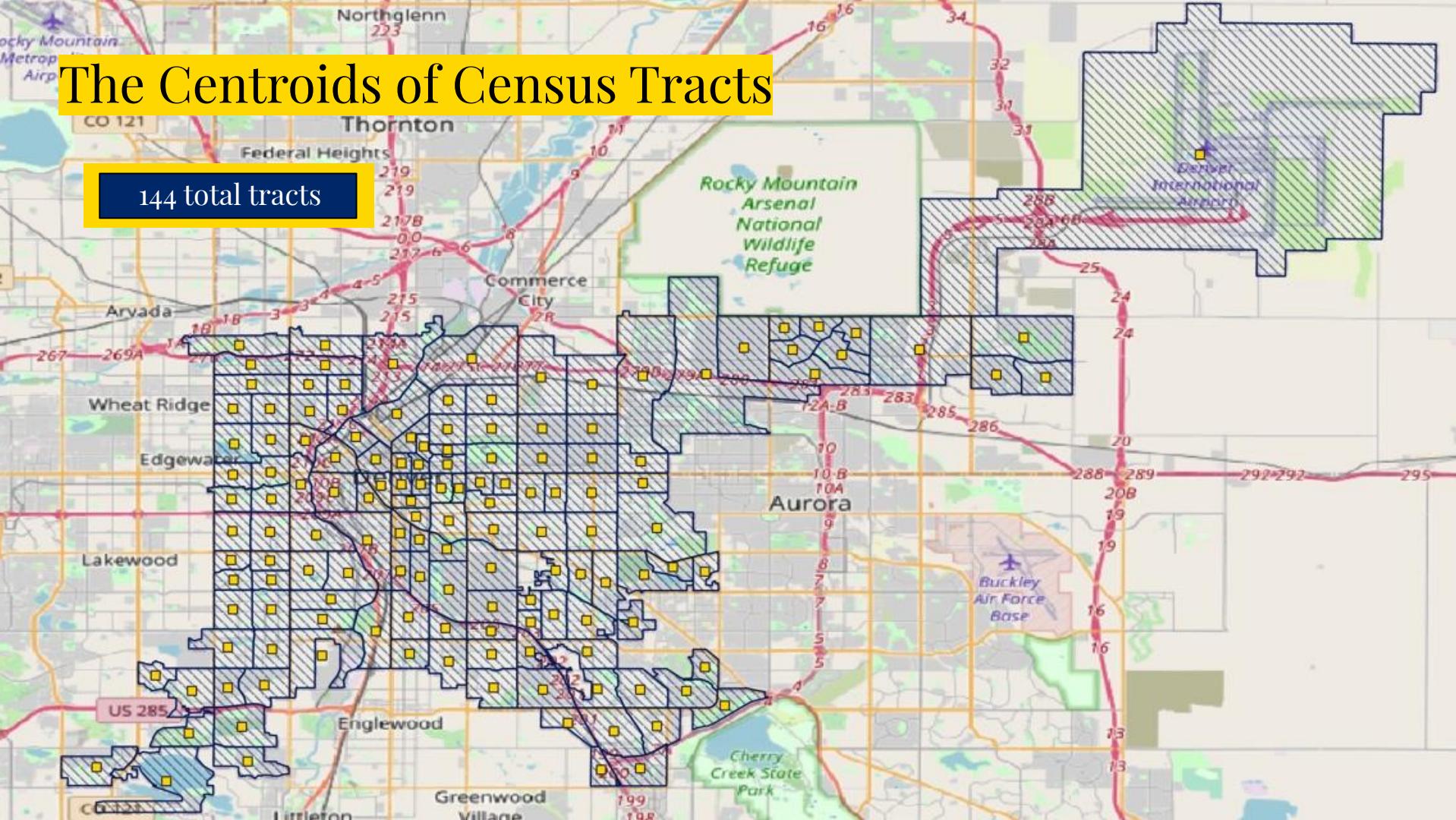
The Centroids of Census Blocks

- used data from Denver County website
- used QGIS to visualize census blocks and compute centroids of blocks
- exported centroids in lat/lon to use in our program

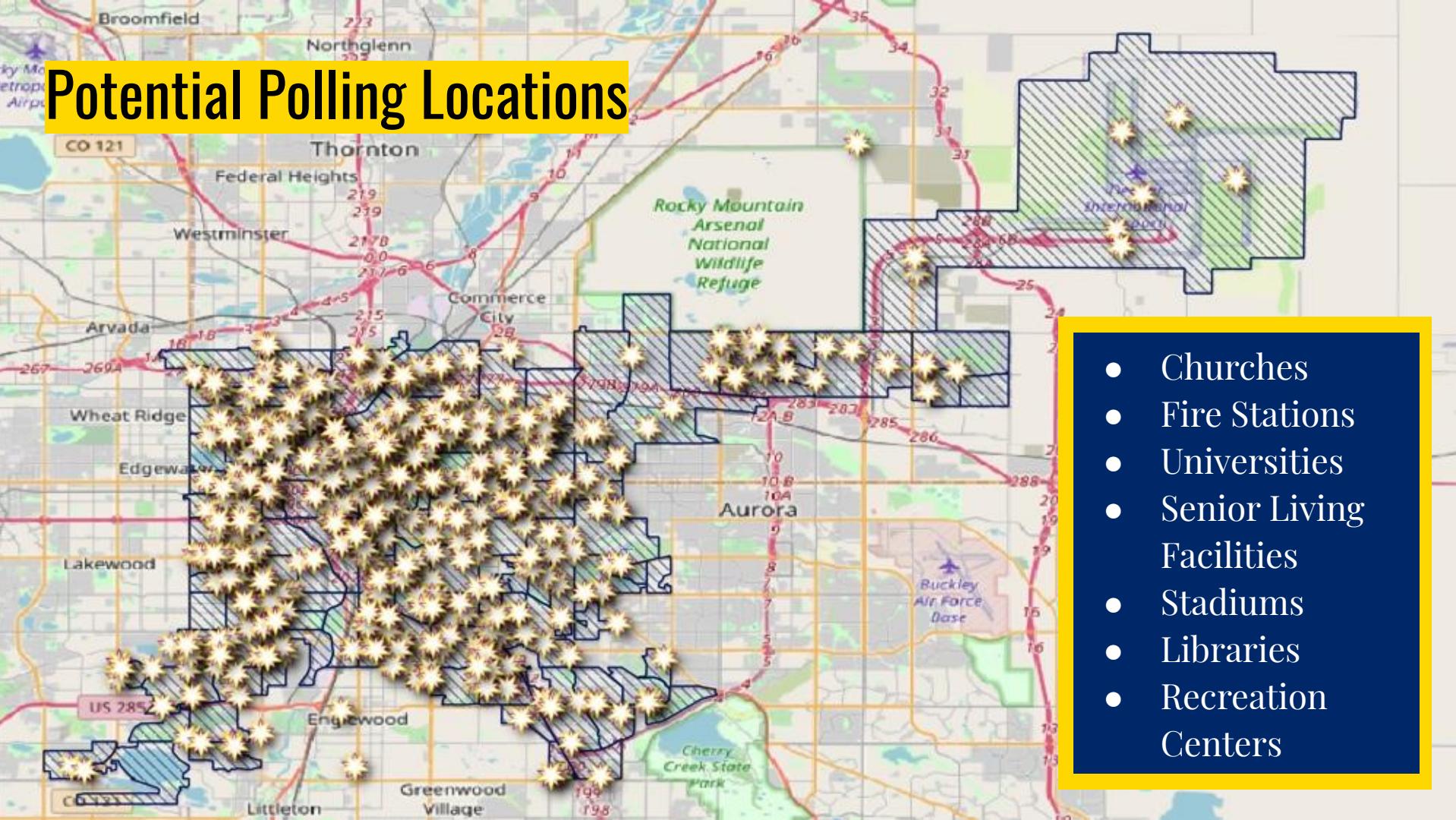


The Centroids of Census Tracts

144 total tracts

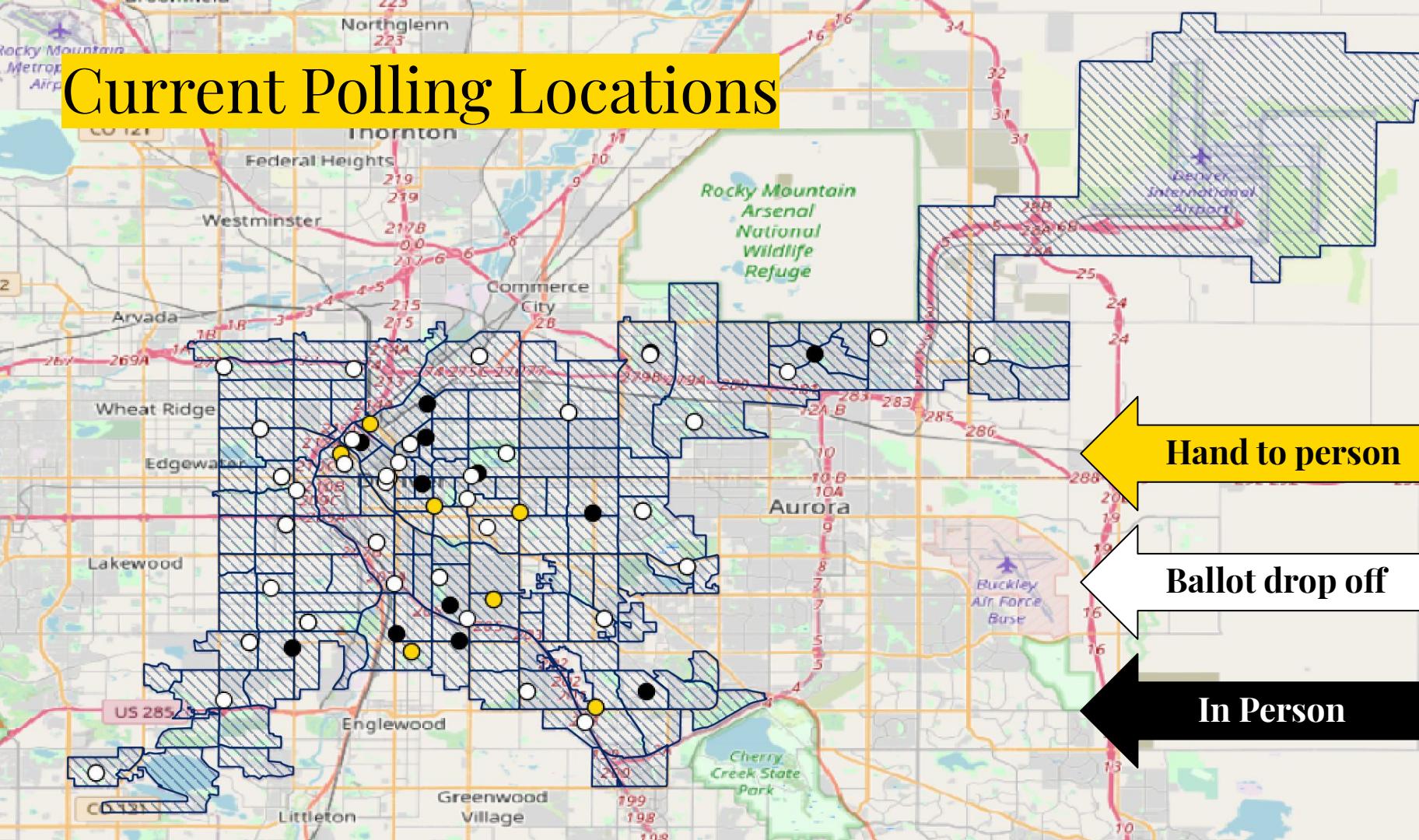


Potential Polling Locations



- Churches
- Fire Stations
- Universities
- Senior Living Facilities
- Stadiums
- Libraries
- Recreation Centers

Current Polling Locations



The Program

An Assignment Model

What does the program do?

- Assignment Problem: Given census tracts and possible polling locations, assign each tract to a location in some optimum way.
- Coverage formula for the voting rights act.

The Variables

- Binary Matrix, loc_used (location used)
 - 515 rows for 515 possible polling locations
 - 144 columns for 144 census tracts
 - The $(i, j)^{th}$ entry is 1 if the i^{th} tract is assigned to the j^{th} location and 0 otherwise.

Objective Function:

$$\min : \sum_i^{515} \sum_j^{114} (p_j * l_{ij} * ((a_i - a_j)^2 + (b_i - b_j)^2)));$$

p_j := population

b_i := longitude

l_{ij} := assignment variable

i := polling location index

a_i := latitude

j := census tract location index

```
minimize Total_Distance: sum {i in PPL} (sum {j in CB} (pop[j]*loc_used[i,j]*  
((latp[i] - latc[j])^2 + (lonp[i] - lonc[j])^2)));
```



Sneak peak of the code!

Constraints:

- Assignment: Each tract gets assigned to a polling location

```
subject to Assignment {j in CB}: sum {i in PPL} loc_used[i,j] = 1;
```

- Max people at a polling location: Each location can handle up to 15,000 voters. We have 600,000 voters in Denver over 50 polling locations. There will be an average of 12,000 voters per location and we set the max at 25% more than the average.

```
subject to Max_People {i in PPL}: sum {j in CB} loc_used[i,j]*pop[j] <= 15000;
```

- Max amount of polling locations: There is an upper bound of 50 (approximately the number of actual locations in Denver) locations our program can use. An unused location corresponds to a row of all zeros in our matrix. This will count the number of such rows and ensure they count high enough so that only 50 places are used.

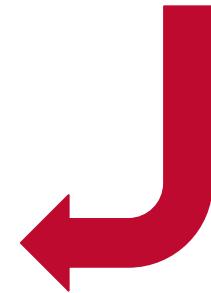
```
subject to Maximum_Number_of_Places_Used: sum {i in PPL} (prod {j in CB} (1-loc_used[i,j])) >= 465;
```

$$\sum_i^{515} \prod_j^{144} (1 - l_{ij}) \geq 515 - 50.$$

Results

```
ampl: display {i in PPL} sum {j in CB} loc_used[i,j];
sum{j in CB} loc_used[i,j] [*] :=
  1 2.82777    130 0      259 0      388 0
  2 3.08649    131 0      260 0      389 0
  3 3.18477    132 0      261 0      390 0
  4 3.58771    133 0      262 0      391 0
  5 4.2851     134 0      263 1      392 0
  6 3.79509    135 0      264 0      393 0
  7 4.7019     136 0      265 0      394 2
  8 3.70349    137 0      266 0      395 0
  9 4.33301    138 0      267 0      396 0
 10 2          139 0      268 0      397 0
 11 5.26155    140 0      269 0      398 0
 12 1.97086    141 0      270 0.714899 399 0
 13 2.82995    142 0      271 0      400 0
 14 3.3768     143 0      272 0      401 0
 15 2.86623    144 2.6232   273 0      402 0
 16 3.34226    145 0      274 0      403 0
 17 0          146 0      275 0      404 0
 18 3.73396    147 0      276 0      405 0
 19 0          148 0      277 0      406 0
 20 2.49885    149 0      278 0      407 0
 21 3.73191    150 0      279 0      408 0
 22 2.18289    151 0      280 0      409 0
 23 2.91636    152 1.96396  281 0      410 0
 24 5.03604    153 2.41229  282 0      411 0
 25 3.12371    154 0      283 0      412 0
 26 3.56685    155 0      284 0      413 0
 27 0          156 0      285 0      414 0
 28 0          157 0      286 0      415 0
 29 0          158 0      287 0      416 0
 30 3.47265    159 8.47636e-17 288 0      417 2.96728
 31 4          160 0      289 0      418 0
 32 1.06918    161 0      290 0      419 0
```

Partial AMPL output!



Libraries
Central
Athmar Park Branch
Ross-Barnum Branch
Bear Valley Branch
Blair-Caldwell African American Research
Ross-Broadway Branch
Byers Branch
Ross-Cherry Creek Branch
Decker Branch
Eugene Field Branch
Ford-Warren Branch
Green Valley Ranch Branch
Hadley Branch
Hampden Branch
Montbello Branch
Park Hill Branch
Rodolfo "Corky" Gonzalez Branch
Schlessman Family Branch
Smiley Branch
Ross-University Hills Branch
Valdez-Perry Branch
Virginia Village Branch
Westwood Branch
Woodbury Branch

Churches
Christ Community
Church in Denver
Church in South Denver
Greater Harvest Church of God
Greater St John Baptist
Park Hill Congregational
Sacred Heart
St Barnabas Episcopal
St Patricks Catholic
True Light Baptist
Templo Emmanuel Centro Cristiano de Alabanza Asambleas de Dios
Denver North Park Foursquare
New Beginnings Congregation

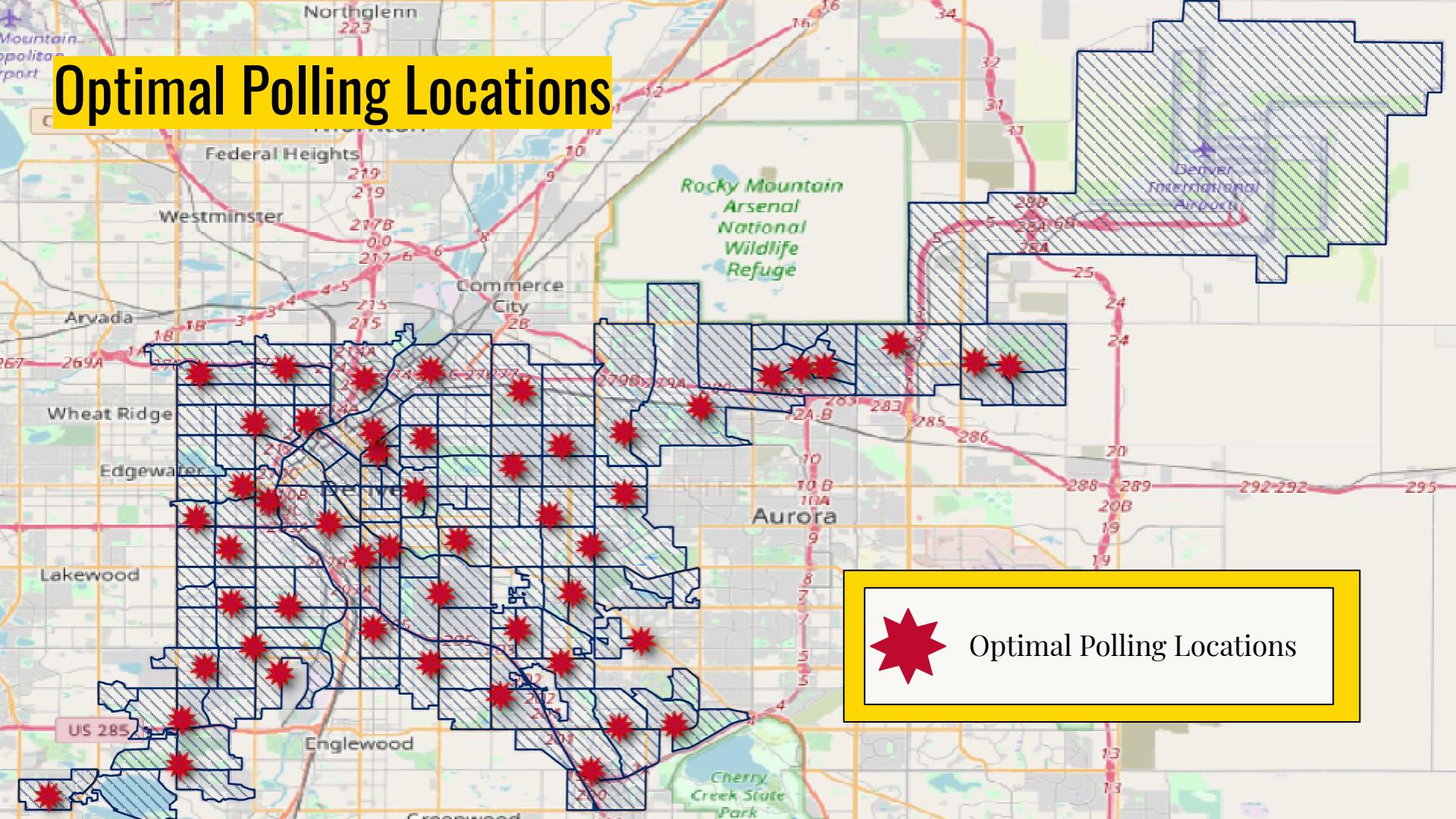
Senior Living Facilities
Springbrooke Retirement
Sunrise at Pinehurst
Balfour at Stapleton
Brookdale University Park
Broodale Parkplace
Rosemark at Mayfair Park
Modena Cherry Creek
Jerusalem
Our House II Inc
Volunteers of America Casa De Rosal
Quincy Place

Fire Stations
FS-29
FS-2

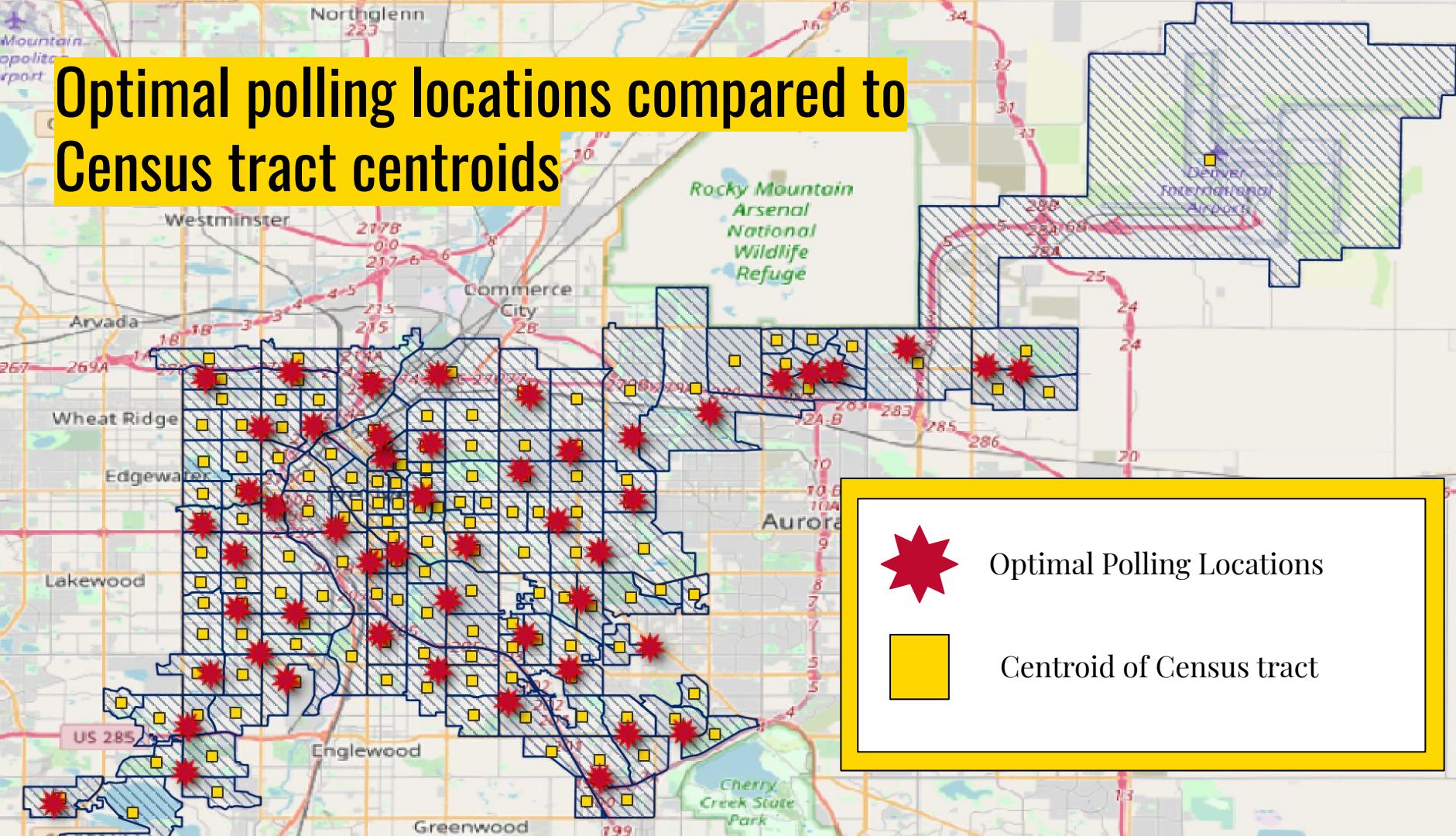
Recreation Centers
Southwest Recreation Center

Optimal Polling Locations

Optimal Polling Locations



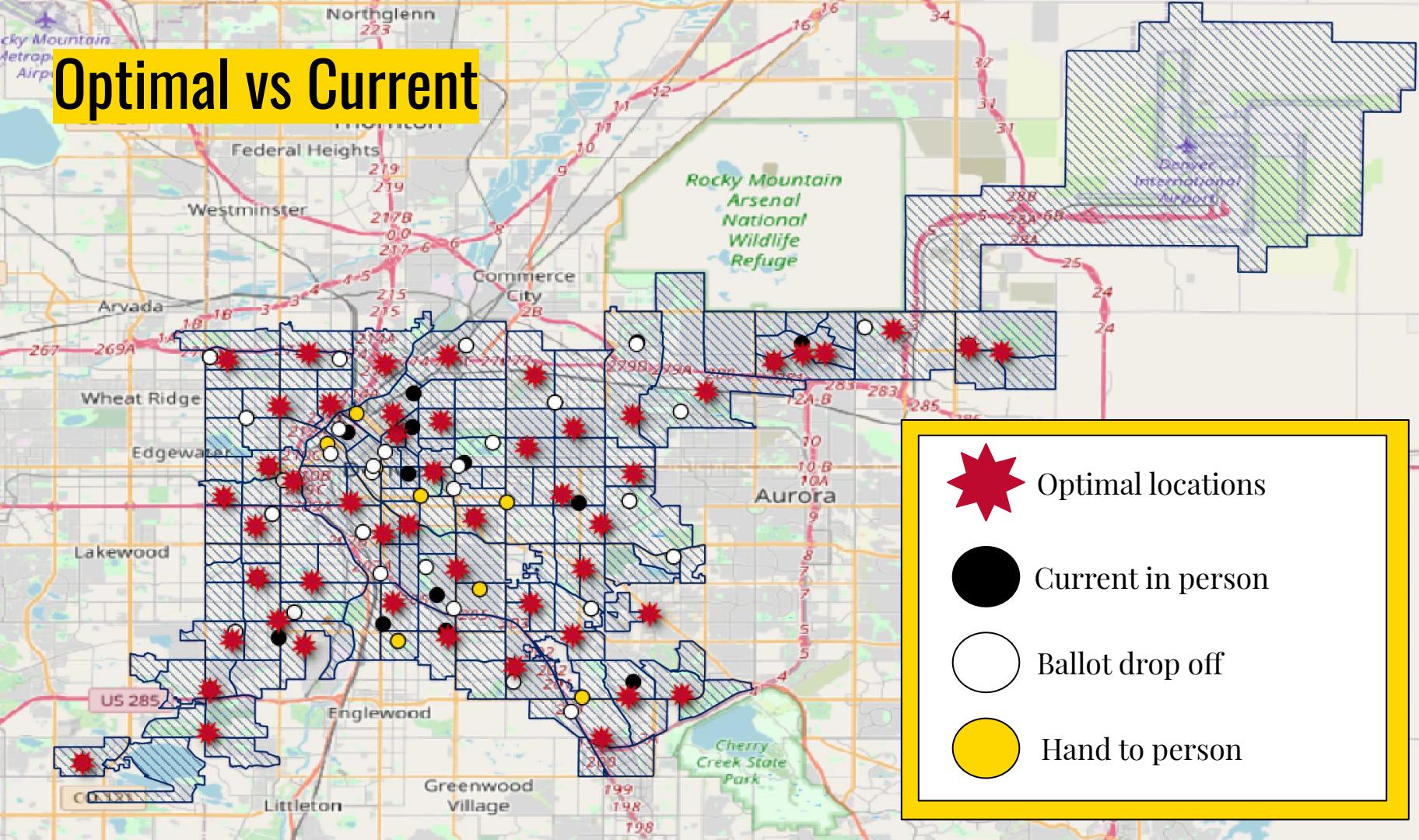
Optimal polling locations compared to Census tract centroids



Optimal Polling Locations

Centroid of Census tract

Optimal vs Current



Optimal locations

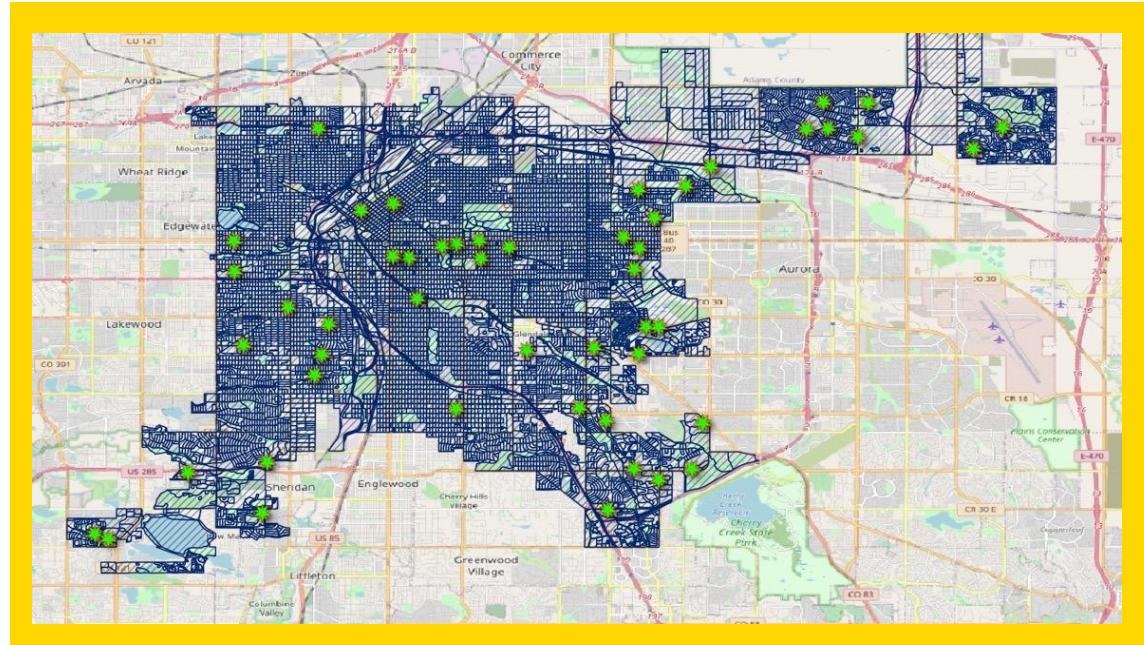
Current in person

Ballot drop off

Hand to person

Issues/Problems with our model

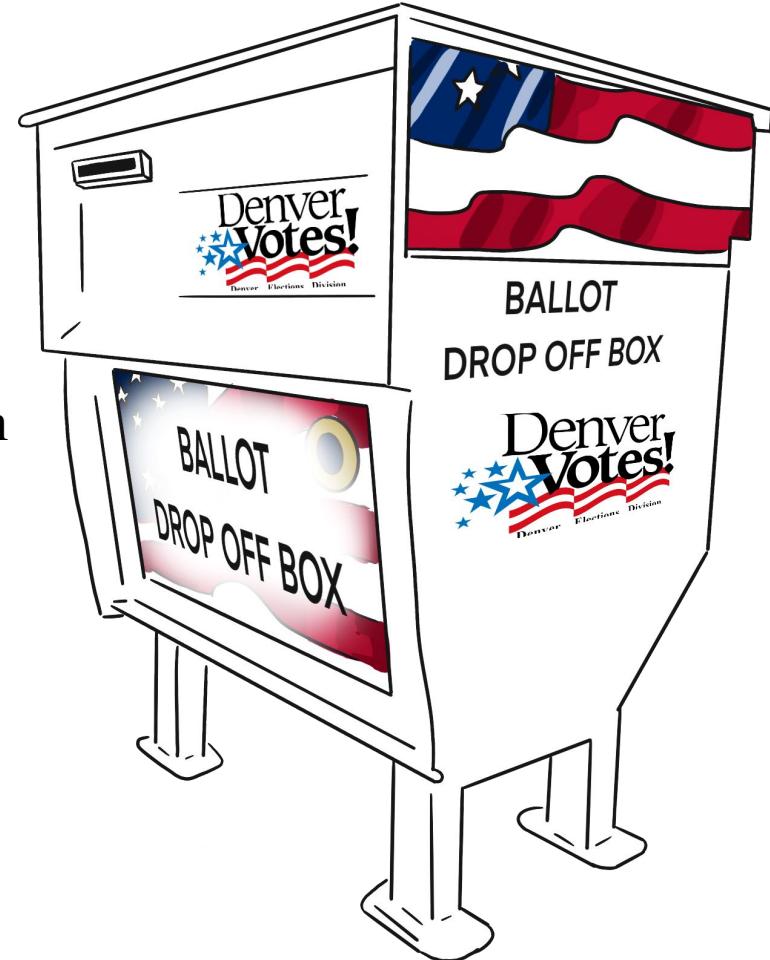
- With census blocks over 5 million variables
- Can't run an integer program with that many variables
- Adjusted program to run with 5 mil variables, but required some manual adjustments



The optimal locations with our adjusted program

Quick recap of Future plans

- Gather data from other states with more historical voter suppression issues
 - Georgia, Texas, Arizona, etc.
- Take into account location to bus stops/train
- Gather information on capacity of polling locations
- Get information on resources for polling locations
 - How many volunteers
 - How many voting machines
- Expand to include drop boxes and mobile voting stations





QUESTIONS?