



GIS as a Planning Support System for Effective Growth Management

Identifying, Ranking, and Evaluating

Suitable Sites for Low-Density Residential Development

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Purpose of the study



Conducting suitability analysis for low-density residential development reflecting:

I. Developer's Preference:

First:

- Finding suitable residential locations with the least development cost
- Maximizing profits

Second:

- Obtaining approval from the City Planning Department

II. Environmentalist's Preference:

First:

- Preserving the integrity of the environment

Second:

- Protecting prime agricultural and forest land



Problem Statement



- ➔ **Establishing an attractiveness model for low-density residential development in Urbana-Champaign region, IL**

General attractiveness formula:

Low density residential land use sites =

F (built-up areas, schools, parks, 100-year floodplain areas, wetlands, minimum site size, accessibility, industrial areas, airport location)

Scope and study area



- ➔ **The study targets the Champaign-Urbana region, IL**
- ➔ **The study area consists of:**
 - The municipal boundary of the city of Champaign and the city of Urbana
 - Urban growth boundary: 1.5 miles around the municipal boundary of both cities
 - The University of Illinois campus town



1- Pass/fail screening:

Excluding land areas less than 30% slope

No degree of suitability

No weighting

2- Equivalent rating:

Five for 0-5% slopes; three for 5-15% slopes; one for 15-30 slopes; and zero for over 30% slopes

Total score = $R1 + R2 + R3 \dots Rn$

No weighting

3- Weighted rating:

Total score = $(W1 \times R1) + (W2 \times R2) + (W3 \times R3) \dots (Wn \times Rn)$

Weighting factors

4- Direct assignment rating:

Combinations of factors

e.g. high suitability: areas of slopes less than 5% and close to roads (less than 300 feet)

moderate suitability: areas of slopes 5-15% and close to roads (less than 300 feet)

not suitable: areas of slopes over 15%



A. Zones of Future Development and Annexation (suitable locations for growth)

- Vector analysis
- Using Geoprocessing tools

Criteria:

- I. Endogenous (features of the location)
- II- Exogenous (features of the surrounding locations)

B. Desired Future Development Zones (preferred growth areas)

- Raster analysis
- Using Geospatial Analyst

Criteria (different preferences and weighting factors)



A. Zones of Future Development and Annexation (suitable locations for growth):

Criteria:

I. Endogenous (features of the location)

Avoiding sites located within 100-year floodplain areas

Avoiding sites located within Wetlands

Minimum lot size : 200 units × 600 sq. ft. /DU
≥ 1200,000 sq. ft.

II- Exogenous (features of the surrounding locations)

Environmental legislations compliance:

avoiding conservation designated areas

Accessibility to roads and interchanges:

distance < 300 m from roads

Proximity to the existing built up areas:

distance < 1/2 mile

Proximity to industrial and airports sites:

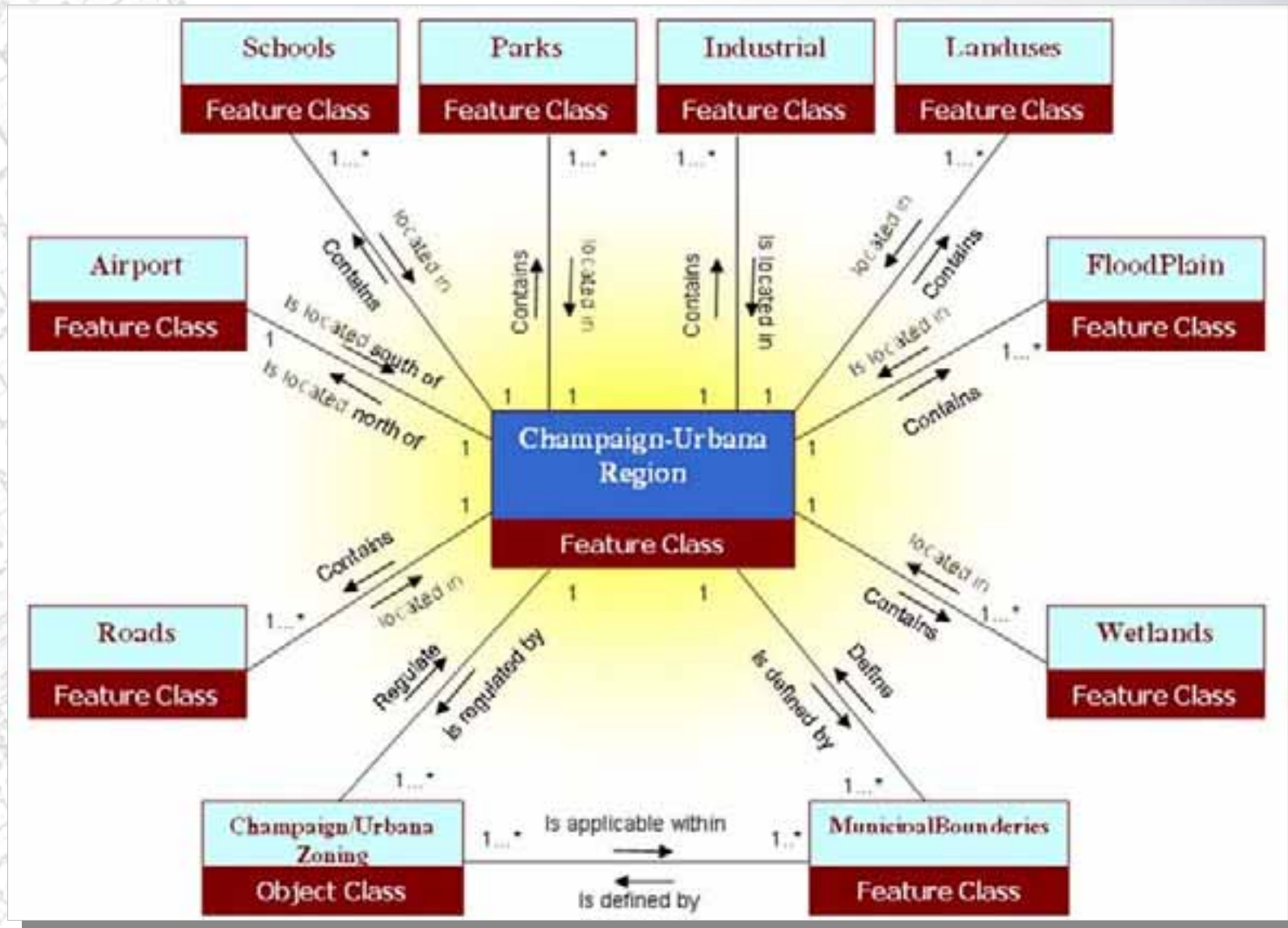
distance > one mile

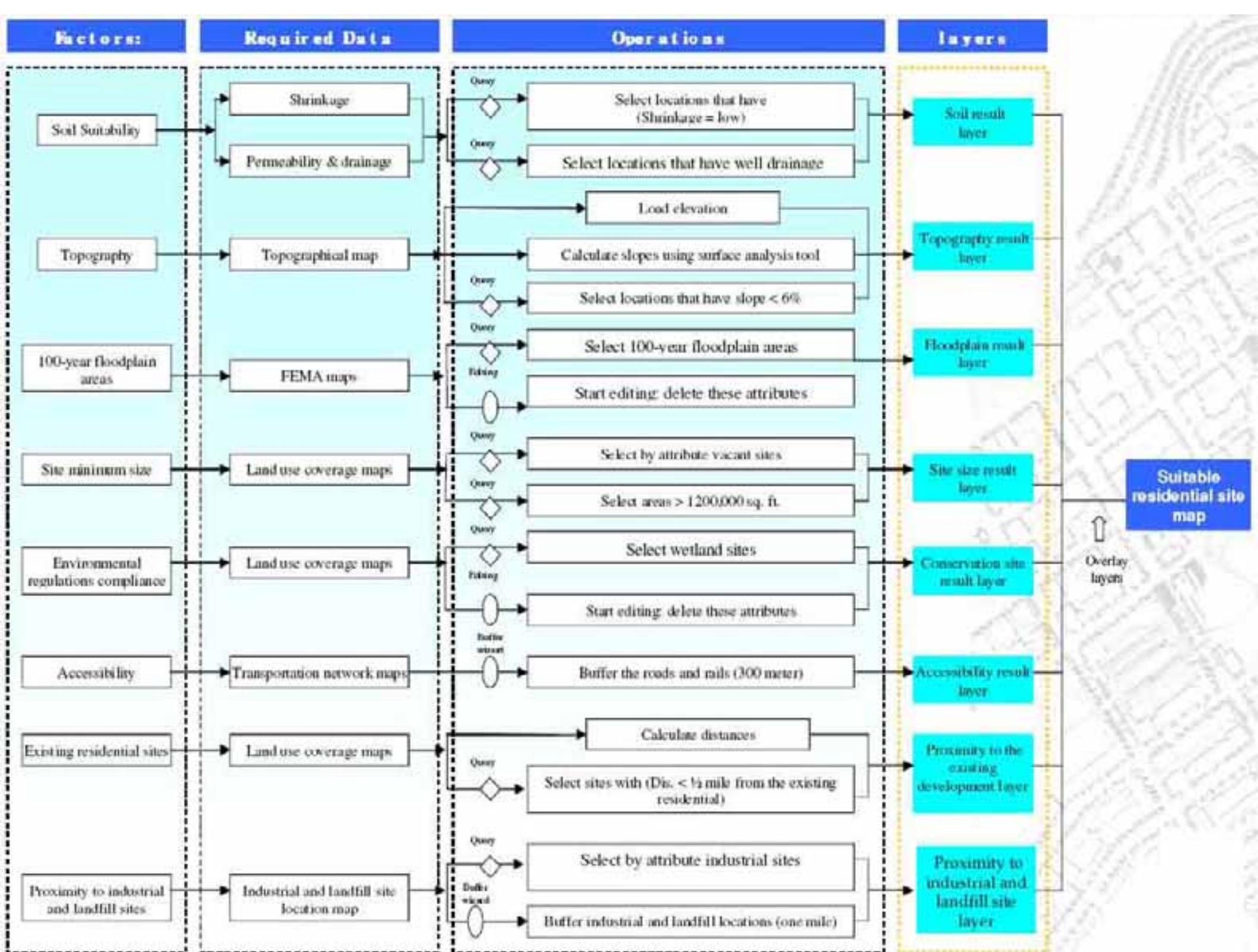
Data Acquisition



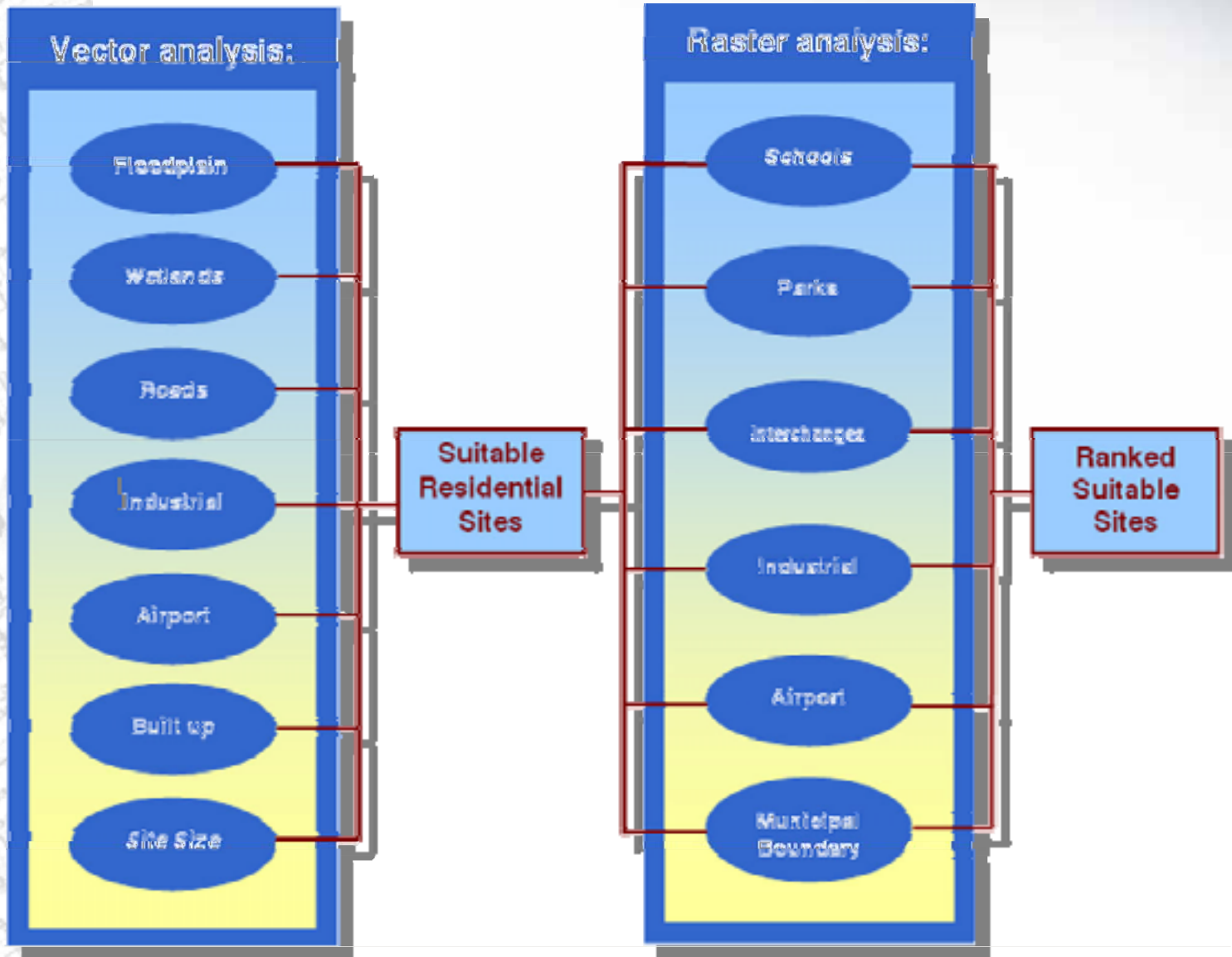
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Logical Model and Database Structure





Analytical Procedure





B. Desired Future Development Zones (preferred growth areas)

Step 1:
Input Datasets

Decide which datasets are needed as inputs, according to preference criteria.

Step 2:
Derive Datasets

Derive datasets. Create and extract data from existing data to generate new information.

Step 3:
Reclassify Datasets

Reclassify each dataset to a common scale – 1-10 giving higher values to more suitable attributes.

Step 4:
Weight and Combine Datasets

Weight datasets that should have more influence in the suitability model to reflect preference, then combine them to find suitable locations.

Analytical Procedure (Cont.)



➔ (Vector analysis)

Suitable residential sites:

➔ (Raster analysis)

Factor weighting and rating:

Scenario (1):
Developer:

| Factor: | Weight: |
|------------------------|------------|
| Schools | 25 |
| Parks | 15 |
| Interchanges | 20 |
| Industrial sites | 10 |
| Airport | 10 |
| Municipal boundary | 20 |
| Agriculture and forest | 0 |
| Total: | 100 |

Preference

Scenario (2):
Environmentalist:

| Factor: | Weight: |
|------------------------|------------|
| Schools | 10 |
| Parks | 10 |
| Interchanges | 10 |
| Industrial sites | 15 |
| Airport | 15 |
| Municipal boundary | 10 |
| Agriculture and forest | 30 |
| Total: | 100 |

Preference

Analytical Procedure (Cont.)



☑ **Step1 Input datasets:** (Municipal Boundary, Interchanges, Schools, Parks, Industrial, and Airport)

☑ **Step 2 Find distance and Reclassify datasets:**



Municipal boundary:



Interchanges:



Schools:



Parks:



Industrial:

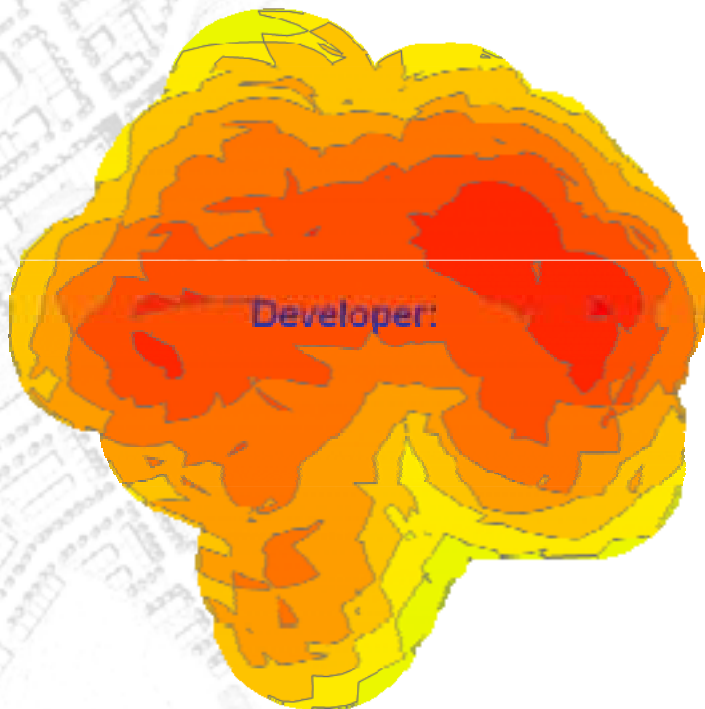


Airport:

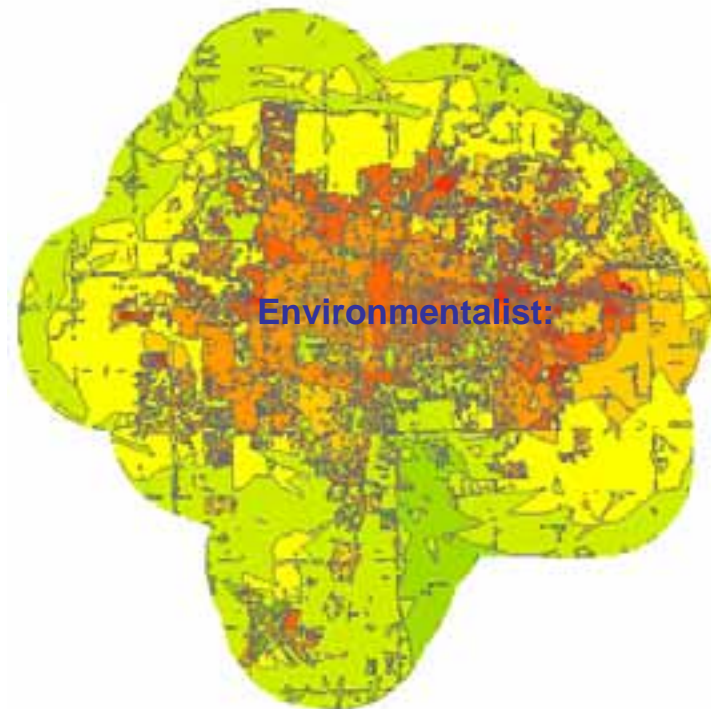


Agricultural & forest:

☑ **Step 3 Weight and combine datasets:**

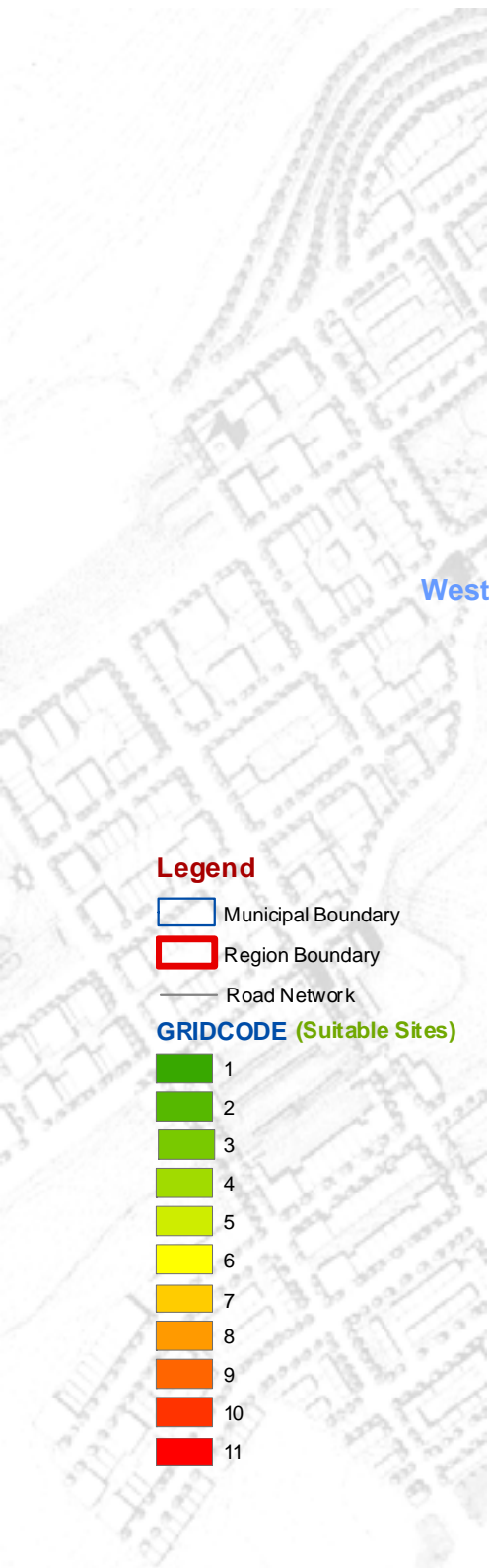


Developer:



Environmentalist:

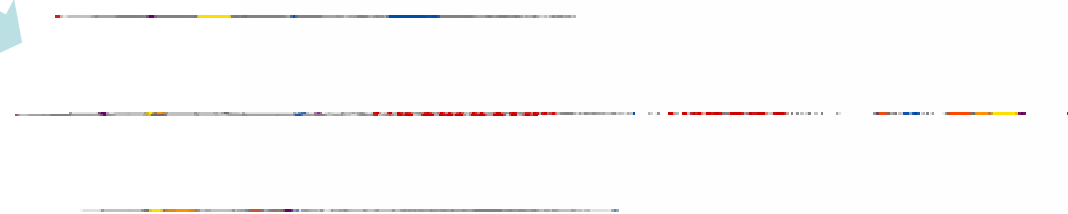
First Scenario Results/ Developer






West Champaign














North East Urbana



Legend

-  Municipal Boundary
-  Region Boundary
-  Road Network

GRIDCODE (Suitable Sites)

-  1
-  2
-  3
-  4
-  5
-  6
-  7
-  8
-  9
-  10
-  11

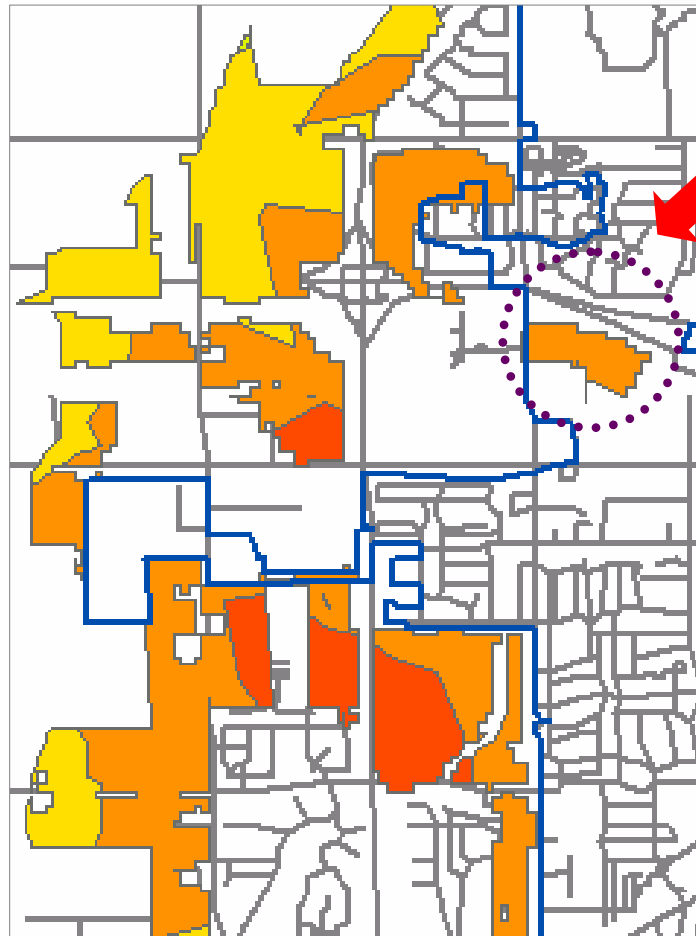


Rated suitable low-density residential development :

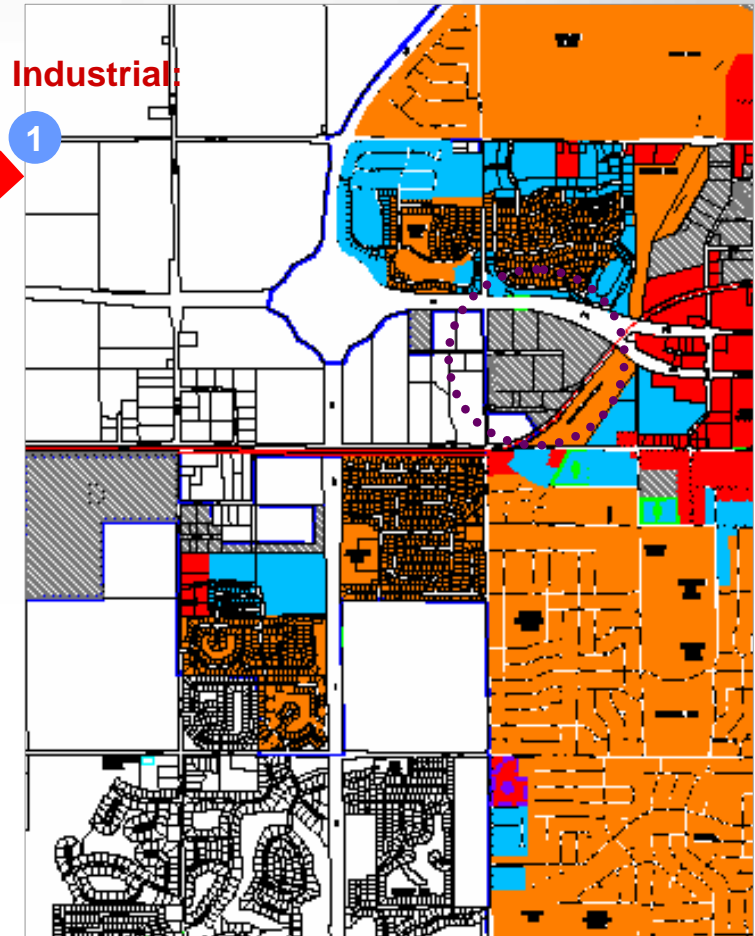
Results Compared to Zoning






Results for west Champaign area:














Zoning map for west Champaign area:



Legend

-  Municipal Boundary
-  Region Boundary
-  Road Network

GRIDCODE (Suitable Sites)

-  1
-  2
-  3
-  4
-  5
-  6
-  7
-  8
-  9
-  10
-  11

Zoning map legend:

- | | | | |
|---|---|--|--|
|  MHP MANUFACTURED HOUSING PARK |  SF1 SINGLE FAMILY |  IT-MF IN-TOWN MULTIFAMILY |  CB CENTRAL BUSINESS |
|  MHG MANUFACTURED HOUSING SUBDIVISION |  SF2 TWO FAMILY |  IT-MX IN-TOWN MIXED USE DISTRICT |  CI COMMERCIAL INDUSTRIAL |
|  IT-SF1 IN-TOWN SINGLE FAMILY |  MF1 MULTIFAMILY LOW DENSITY |  CO COMMERCIAL OFFICE |  IBP INTERSTATE BUSINESS PARK |
|  IT-SF2 IN-TOWN SINGLE AND TWO FAMILY |  MF2 MULTIFAMILY MEDIUM DENSITY |  CN COMMERCIAL NEIGHBORHOOD |  LI LIGHT INDUSTRIAL |
|  IT-NC IN-TOWN NEIGHBORHOOD CONSORTION |  MF3 MULTIFAMILY HIGH DENSITY/LIMITED BUSINESS |  CG COMMERCIAL GENERAL |  HI HEAVY INDUSTRIAL |















Results Compared to Zoning (Cont.)

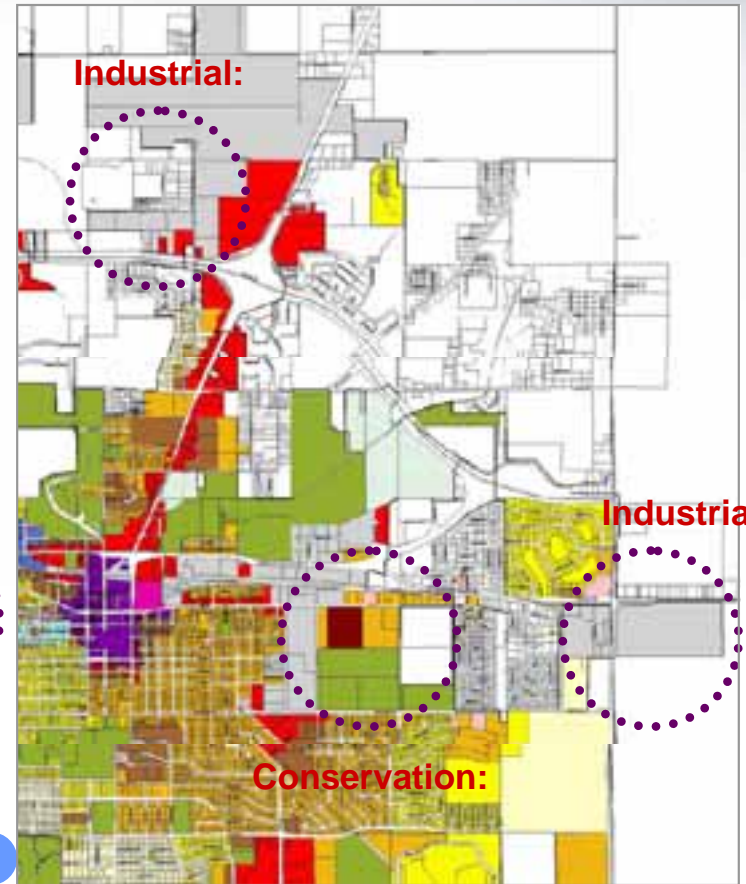
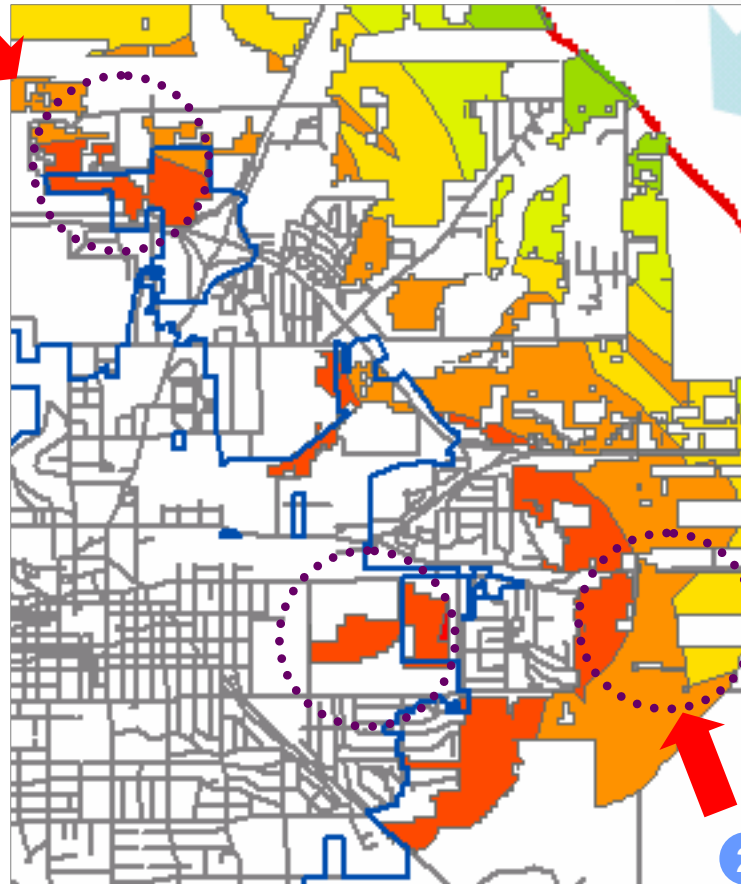


Results for North east Urbana Area:

Zoning map for North east Urbana area:

Legend

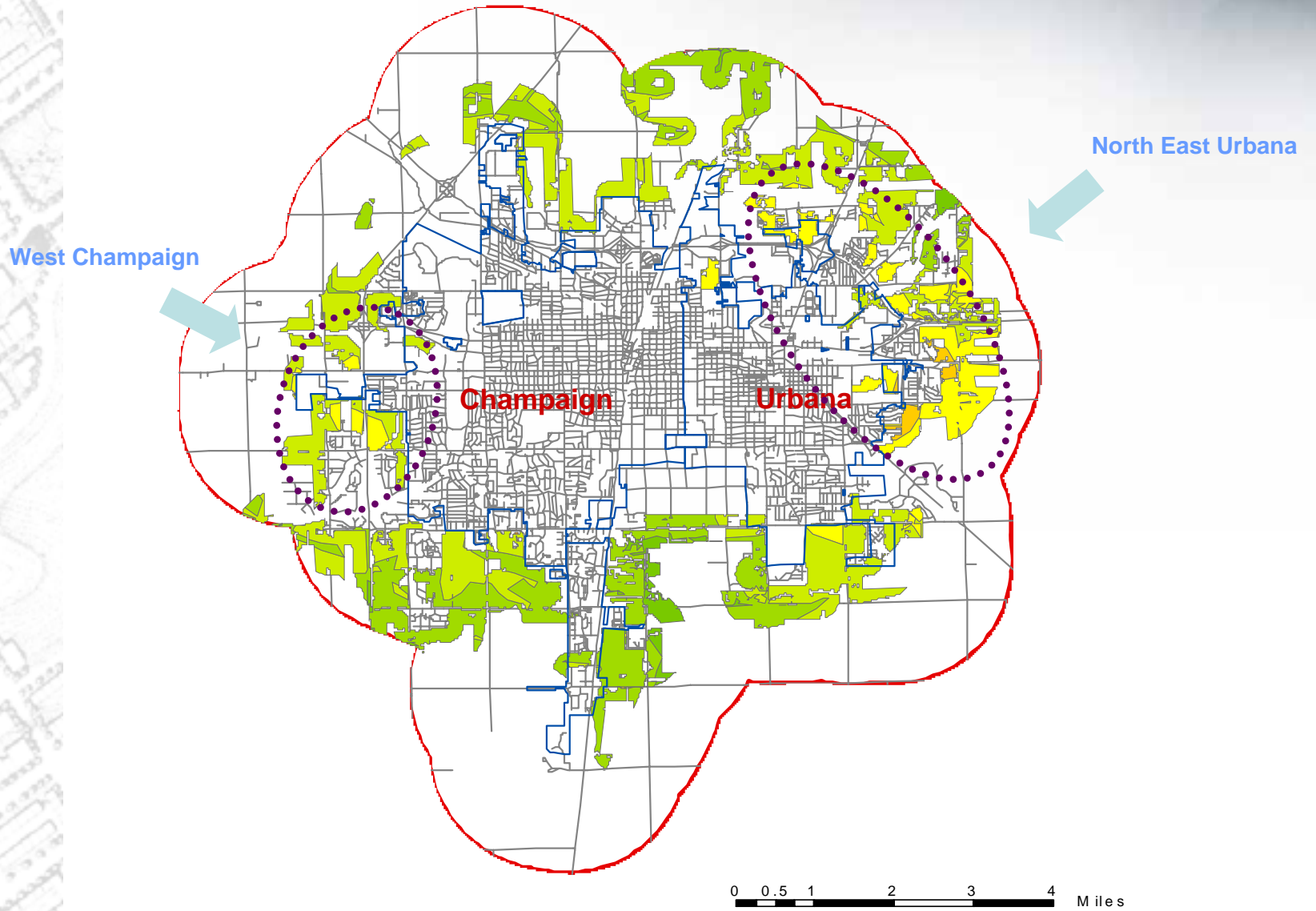
-  Municipal Boundary
-  Region Boundary
-  Road Network
- GRIDCODE (Suitable Sites)**
-  1
-  2
-  3
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-  6
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-  8
-  9
-  10
-  11



Zoning map legend:

- | | | |
|---|---|---|
|  AG Agriculture |  I Industrial |  R5 Medium High Density Multiple Family Residential |
|  B1 Neighborhood Business |  MIC Medical Institutional Campus |  R6 High Density Multiple Family Residential |
|  B2 Neighborhood Business - Arterial |  MOR Mixed Office Residential |  R6B High Density Multiple Family Residential - Restricted |
|  B3 General Business |  R1 Single-Family Residential |  R7 University Residential |
|  B3U General Business - University |  R2 Single-Family Residential |  Business Development and Redevelopment (BDR) |
|  B4 Central Business |  R3 Single and Two-Family Residential |  BDR common boundary |
|  B4E Central Business - Expansion |  R4 Medium Density Multiple Family Residential |  Roseyard Creek District (BYC) |
|  CRE Conservation - Recreation - Education | |  Corporate Limits |

Second Scenario Results/ Environmentalist



Rated suitable low-density residential development:

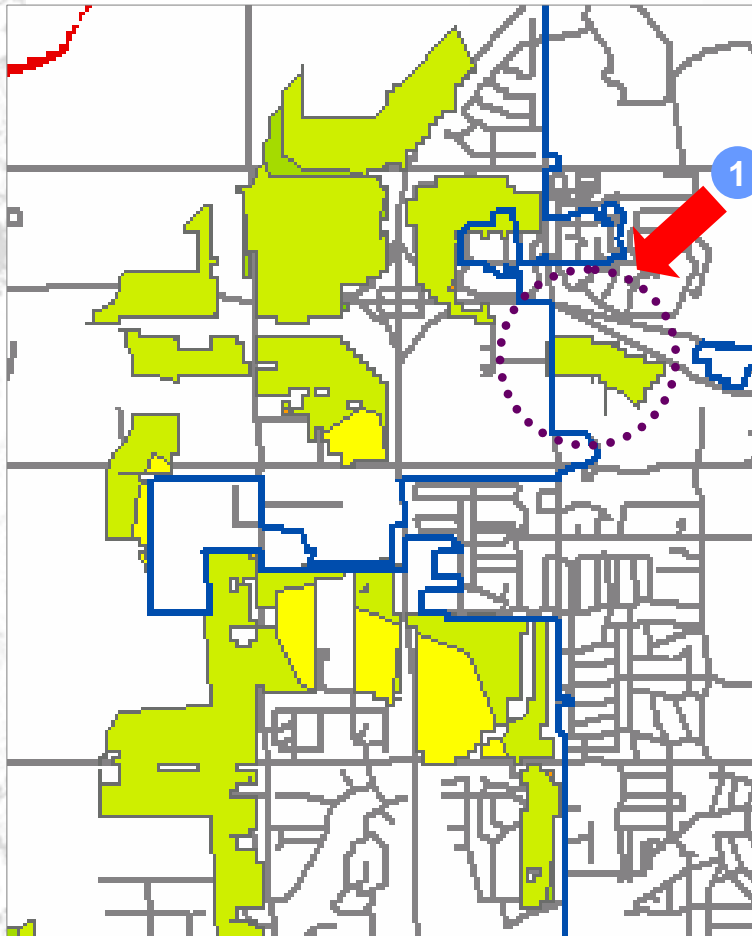
Results Compared to Zoning



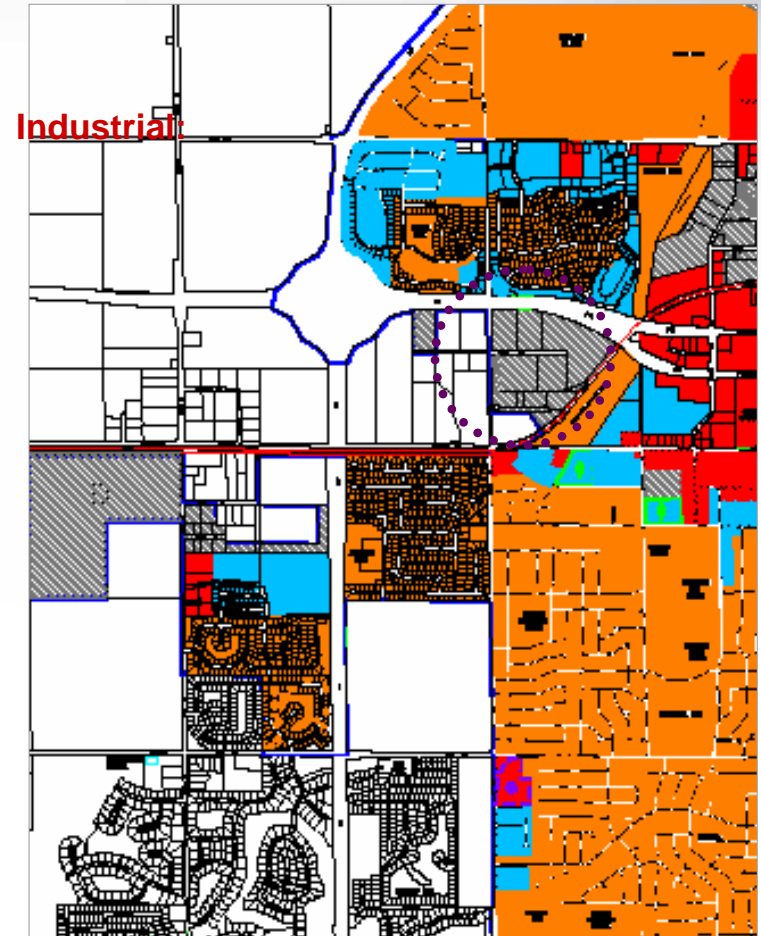
Results for west Champaign area:

Legend

- Municipal Boundary
- Region Boundary
- Road Network
- GRIDCODE (Suitable Sites)**
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Zoning map for west Champaign area:



Zoning map legend:

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Results Compared to Zoning (Cont.)













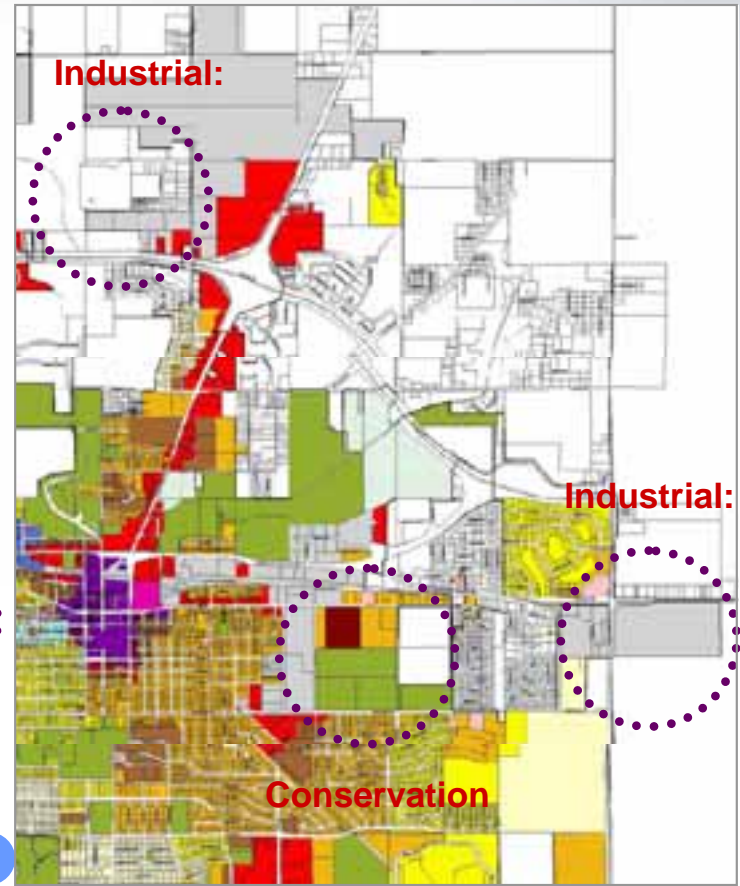
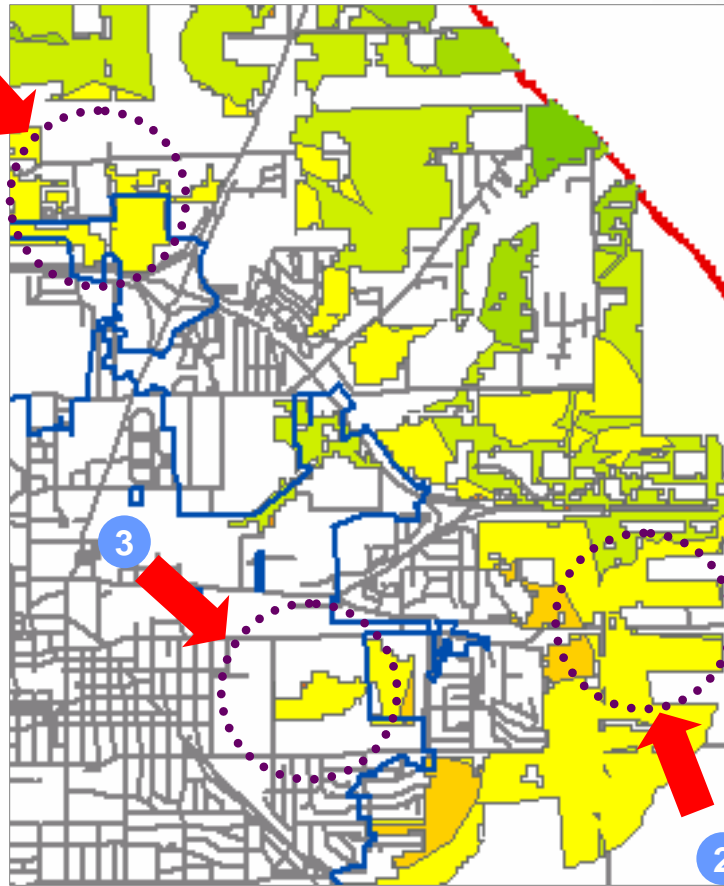
Results for North east Urbana Area:

Zoning map for North east Urbana area:

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|  B4E Central Business - Expansion |  R4 Medium Density Multiple Family Residential |  Roseyard Creek District (BYC) |
|  CRE Conservation - Recreation - Education | |  Corporate Limits |

Comparison of values > 5



—
Developers

Environmentalists



This application will provide guidance for:

- **Determining potential areas suitable for residential developments**
- **Deciding on amounts of tax benefit for residential development policies**
- **Future land use demand and allocation**
- **Future development scenarios (roads, infrastructure, ..., etc.)**
- **Population forecast and growth directions**
- **Determining future locations and capacities of different facilities and public services**

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Questions



Thank you ...

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