

Urban Planner Analytical Tool for Land Suitability Evaluation

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Urban Planner

- Developed at Palacký University, Olomouc (Czech Republic), currently private company Urban Planner s.r.o.
- **Urban Planner enables to analyze land suitability for the further development**
 - Land suitability calculation
 - Land use allocation – detection of the most suitable areas for spatial development
 - Several scenarios of land suitability calculation
 - Multi-criteria analysis – weights of the input data
- **Add-In ArcGIS for Desktop 10.x**

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Urban Planner Development

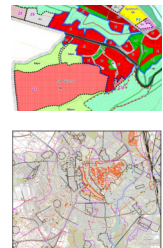


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INPUT DATA - Analytical Material for Planning

- **Content of „AMP“**
 - Data – more than 200 vector layers in unified databases
 - Analysis & Maps
- **Since 2006 – new Building Act**
- **Scale**
 - Regional level – **14 regions**
 - Local level – **210 districts**
- **Coverage – whole Czech Republic**



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Input data

- **Supported formats of input data**
 - File Geodatabase - *.gdb
 - Personal Geodatabase - *.mdb
 - Esri Shapefile - *.shp
- **Supported data models of „AMP“:**
 - DMG ÚAP 4.2 (Hydrossoft Veleslavín)
 - ÚAP 3.3, 3.2, 3.12, 3.0, 2.0 (T-MAPY)
 - Data model of Olomouc region
 - Data stored in any other data model
- **Supported formats of output data**
 - File Geodatabase - *.gdb

Automatical import of
paths to the data

Manual paths settings

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Input data

- Not necessary and not real to dispose by all input data
- Land suitability can be calculated by using limited number of input factors (at least 3 factors)

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Categories of Land Use

- 6 main categories with possible changes (delete, add, rename)

1. **Housing**
2. **Recreation**
3. **Commercial areas**
4. **Heavy industry**
5. **Light industry, storage**
6. **Transportation**

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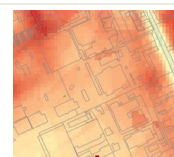


Urban Planner



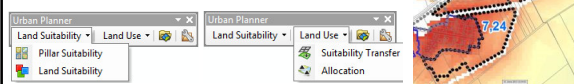
1. Land suitability

- Multi-criteria analysis
- Raster output



2. Land use

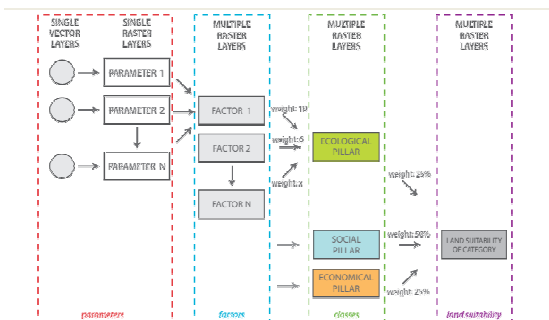
- Land suitability - allocation
- Vector output



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Land Suitability Calculation



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Factors' parametrization

Value	Suitability
X	Eliminated
0	Unsuitable
1	Very low
2	Low
3	Very low average
4	Low average
5	Average
6	High average
7	Very high average
8	High
9	Very high
10	Optimal

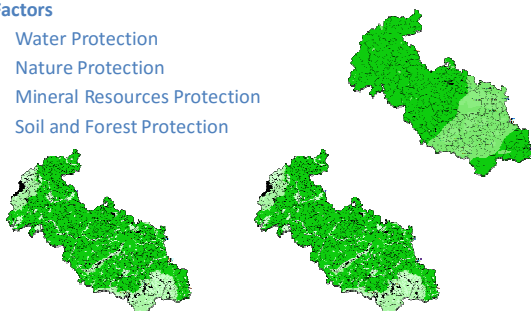
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Ecological Pillar

Factors

- Water Protection
- Nature Protection
- Mineral Resources Protection
- Soil and Forest Protection



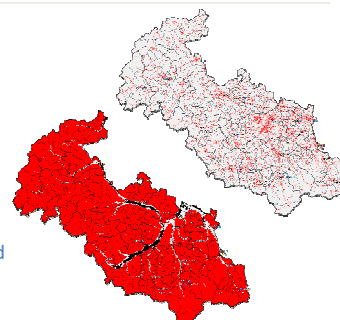
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Economic Pillar

Factors

- Density of Population
- Radon Risk
- Slope
- Electric Power Supply
- Water Supply
- Gas Supply
- Heat Supply
- Distance from Roads
- Distance from Railroad
- Flood Hazard
- Geological Hazard



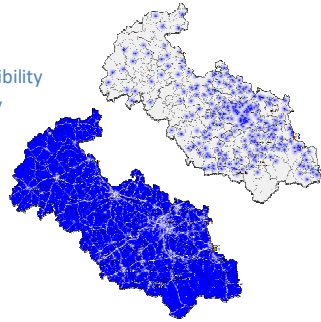
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Social Pillar

Factors

- Kindergarten Accessibility
- Elementary School Accessibility
- Grocery Store Accessibility
- Public Space Accessibility
- Bus Stops Accessibility
- Train Stops Accessibility
- Air and Noise Pollution
- Density of Population
- Radon Risk
- Cultural Protection

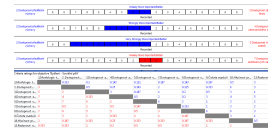


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Setting of Factors' Weights - Saaty Method

- Relative ratio between factors
- Information about relationship between all possible pairs of factors (subjective importance estimation by pair comparison)
- Calculation of factors' weights



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Scenario Settings

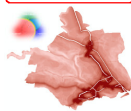
ecological pillar



social pillar



economic pillar

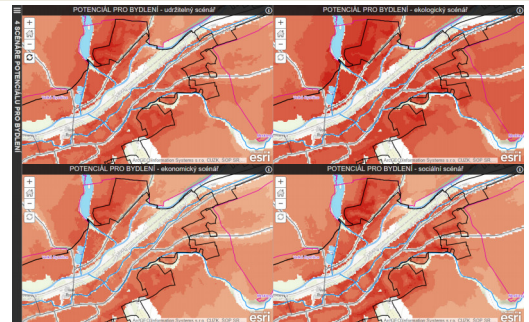


Scenario	Ecological	Social	Economic	Scenario	Ecological	Social	Economic
Sustainable	33 %	33 %	33 %	Ecological pillar priority	60 %	20 %	20 %
Acceptable	40 %	40 %	20 %	Social pillar priority	20 %	60 %	20 %
Viable	40 %	20 %	40 %	Economic pillar priority	20 %	20 %	60 %
Fair	20 %	40 %	40 %	Custom	7 %	7 %	7 %

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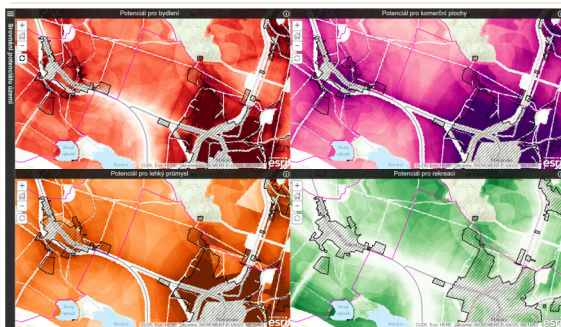
Scenarios of Development



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Land Suitability



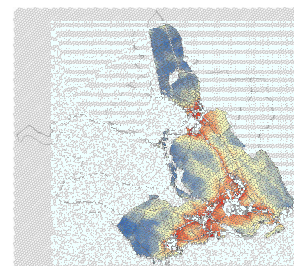
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Land Use Allocation

Basic allocation units

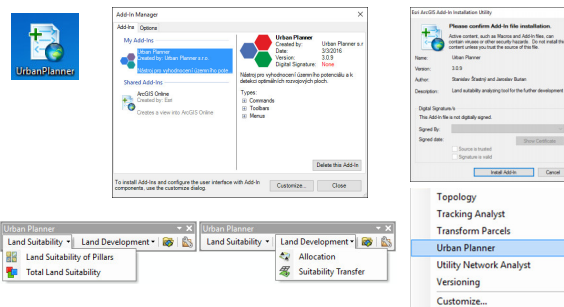
Hexagonal network + Land suitability transfer (zonal statistics)



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Installation



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Import and Export

- Possible to export and import data and settings to another computer
- Export to file *.up* (possible to rename to zip file), which includes:
 - Urban Planner Settings (.mdb)
 - Output Data (.gdb)

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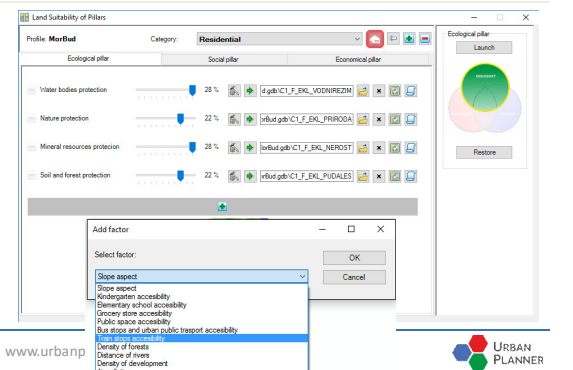
Category Selection/Modification

The screenshot displays the 'Land Suitability of Pillars' application window. The 'Profile' is set to 'Multiball'. The 'Category' dropdown menu is open, showing a list of categories: 'Residential', 'Recreational', 'Heavy Industry', 'Light Industry', and 'Transportation'. The 'Ecological pillar' section contains a list of factors with sliders and icons: 'Slope aspect' (slider at 50%), 'Kindergarten accessibility' (slider at 5%), 'Elementary school accessibility' (slider at 7%), 'Grocery store accessibility' (slider at 2%), 'Public space accessibility' (slider at 5%), 'Bus stops and other public transport accessibility' (slider at 4%), 'Train stops accessibility' (slider at 4%), and 'Distance of rivers' (slider at 4%). The 'Social pillar' section shows a 'Category rename' dialog box with 'Name' and 'New Category' fields, and a 'New category' dialog box with 'Name' and 'New Category' fields. The 'Copy of existing category' checkbox is checked, and the 'Recreation' category is selected.

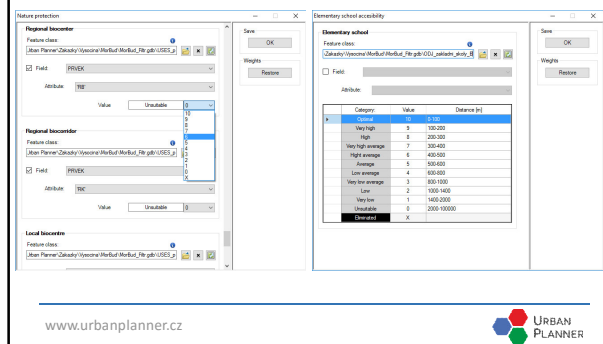
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Parameters' Settings/Modification



Parameter Settings

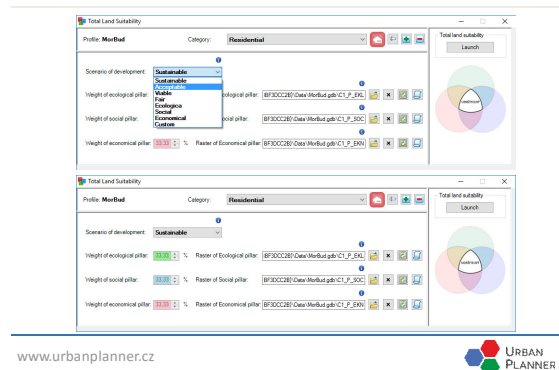


Summary of Results

Category	Pillar	Factor	Factor via Feature	Feature via Source
1	Ecological	Water bodies protection	10 1st degree protective zone of water source	X
2	Ecological	Water bodies protection	10 2nd degree protective zone of water source	X
3	Ecological	Water bodies protection	10 3rd degree protective zone of water source	X
4	Ecological	Water bodies protection	10 Water bodies	X
5	Ecological	Water bodies protection	10 Area designated for water flow management	X
6	Ecological	Water bodies protection	10 Vulnerable area	X
7	Ecological	Water bodies protection	10 Local bioecoregion	X
8	Ecological	Nature protection	10 Local bioecoregion	X
9	Ecological	Nature protection	10 Local bioecoregion	X
10	Ecological	Soil and forest protection	10 Local bioecoregion	X
11	Ecological	Soil and forest protection	10 Local bioecoregion	X
12	Ecological	Soil and forest protection	10 Local bioecoregion	X
13	Ecological	Soil and forest protection	10 Local bioecoregion	X
14	Ecological	Soil and forest protection	10 Local bioecoregion	X
15	Ecological	Soil and forest protection	10 Local bioecoregion	X
16	Ecological	Soil and forest protection	10 Local bioecoregion	X

Feature class processing: Agricultural land - 2nd class of protection - Done
 Feature class processing: Agricultural land - 3rd class of protection - Done
 Feature class processing: Agricultural land - 4th class of protection - Done
 Feature class processing: Agricultural land - 5th class of protection - Done
 Factor calculation - Done
 Factor layer of factor was created
 FACTOR_LAYER_ECOLOGICAL_SULFORREST_1910_23141
 Factor calculation - Done
 Feature class processing: Agricultural land - 2nd class of protection - Done
 Feature class processing: Agricultural land - 3rd class of protection - Done
 Feature class processing: Agricultural land - 4th class of protection - Done
 Feature class processing: Agricultural land - 5th class of protection - Done
 Analysis was successful
 Duration: 4 minutes 6 seconds

Scenario Modelling



Land Use Allocation



Automatic Labeling of Outputs

- Pillars' abbreviations:**
 - EKL - ecological
 - EKN - economic
 - SOC - social
- Categories' Abbreviations:**
 - C1 - housing
 - C2 - recreation
 - C3 - commercial infrastructure
 - C4 - heavy industry
 - C5 - light industry and storage
 - C6 - transportation

Automatic Labeling of Outputs

- factor: C1_F_EKL_VODREZIM
 - category_F_pillar_factor
- pillar: C1_P_EKL
 - category_P_pillar
- suitability: C1_S_33_33_33
 - category_S_weights of pillars in ordering EKL_EKN_SOC
- hexagonal network: C1_H_100M
 - category_H_size of hexagonu
- allocation units: C1_U_30_30_30
 - category_U_weights of pillars
- allocation: C1_A_30_30_30
 - category_A_weights of pillars
- statistics: C1_X_33_33_33
 - category_X_weights of pillars

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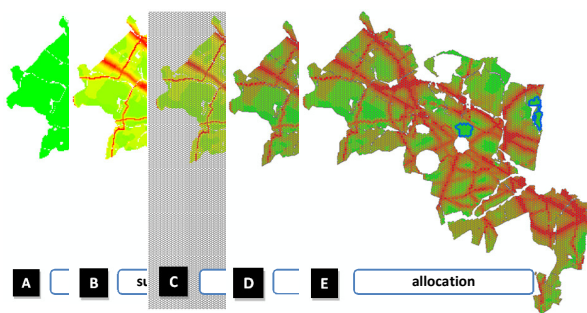
Video Preview



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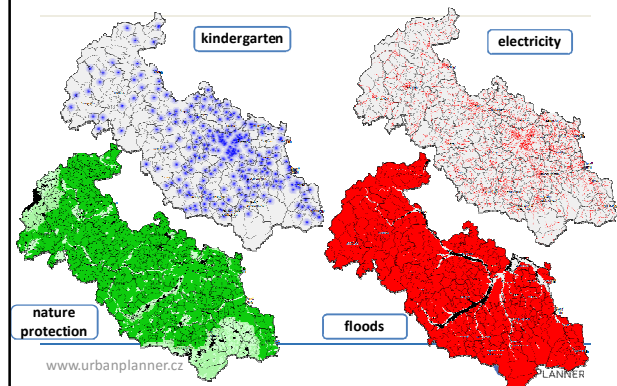
Results



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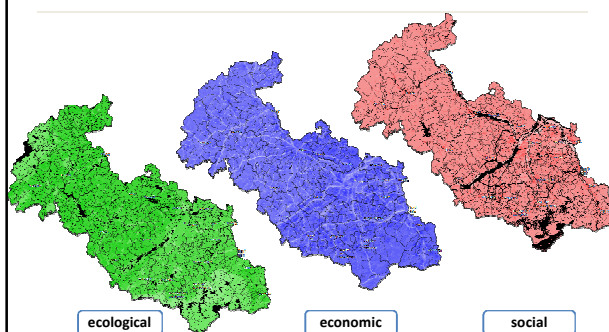
Partial Factors



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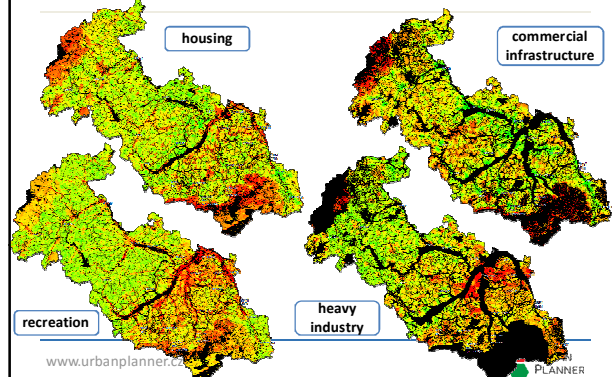
Pillars



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Land Suitability



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Suitability Evaluation

ID	Špeci	Štaci	Emi	Štaci	Emi	Vozovnice	Prírodn	Herost	Pútales	Orientac	Mizgala	Zigala	Potravný	Prostianstv	Bumidm	Vlak	Reka
1	Prigonen	65,8	84,4	48,6	54,5	100	100	100	30	100	0	0	0	0	20	30	0
2	Prigonen	65,3	83,6	50,6	52,7	100	100	100	30	100	0	0	0	0	30,3	40,8	0
3	Prigonen	66	82,2	60,1	56,7	100	100	100	20	100	0	0	0	0	40	61,9	0
4	Prigonen	66,7	82	62,8	58,9	100	100	100	20	100	0	0	0	0	40	61,9	0
5	Prigonen	66,7	82	62,8	58,9	100	100	100	20	100	0	0	0	0	40	61,9	0
6	Prigonen	66	80,9	52,8	52,2	100	100	100	60	100	0	0	0	0	30	30	0
7	Prigonen	66,1	82,5	58,5	57,9	100	100	100	20	100	0	0	0	0	40	61,9	0
8	Prigonen	66,1	82,5	58,5	57,9	100	100	100	20	73,3	0	0	0	0	44,3	59	13,7
9	Prigonen	66,9	82,8	53,2	52,2	100	100	100	60	65,1	0	0	0	0	21,9	30	0
10	Prigonen	66,9	82,8	53,2	52,2	100	100	100	20	27,4	0	0	0	0	21,9	30	0
11	Prigonen	67,5	84,2	61,1	61,2	100	100	100	287	72,4	0	0	0	0	30,1	51,5	18,2
12	Prigonen	65,9	84,4	64,1	61,9	100	100	100	287	72,4	0	0	0	0	30,1	51,5	18,2
13	Prigonen	66,2	84,4	54,3	60,2	100	100	100	20	100	0	0	0	0	20	30	0
14	Prigonen	66,5	79,3	55,2	51,5	100	100	100	60	84,2	0	0	0	0	20	30	0
15	Prigonen	67,2	82,4	57,8	51,5	100	100	100	60	84,2	0	0	0	0	20	30	0
16	Prigonen	67,2	82,4	57,8	51,5	100	100	100	60	84,2	0	0	0	0	30	40	0
17	Prigonen	67,2	82,4	57,8	51,5	100	100	100	60	84,2	0	0	0	0	30	40	0
18	Prigonen	67,9	79,8	59,8	60,5	82,3	100	100	30	100	0	0	0	0	20	39,2	0
19	Prigonen	67,3	79,1	56,1	61,8	80,8	100	100	30	100	0	0	0	0	20	39,2	0
20	Prigonen	66,8	80,8	47,8	53,8	100	100	100	497	100	0	0	0	0	35,1	7,7	0
21	Prigonen	66,8	80,8	48	56,5	83	100	100	50	93,2	0	0	0	0	19	20	0
22	Prigonen	66,2	83	48,2	56,7	100	100	100	50	93,2	0	0	0	0	19	20	0
23	Prigonen	66,8	80,8	49,5	51,4	100	100	100	50	93,2	0	0	0	0	6,3	22,2	11,9

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Statistical Results

Region	MIN	MAX	VARIANCE	AVERAGE	X [%]
Bilovec	3,9	7,9	4,0	6,1	22,2
Bruntál	3,0	7,1	4,1	5,4	35,2
Český Jiřín	3,5	7,4	3,9	5,7	14,7
Český Jiřín	3,5	7,3	3,7	5,7	27,3
Frenštát pod Radhoštěm	3,3	7,4	4,2	5,4	21,9
Frydek-Místek	3,7	7,7	4,5	5,5	23,3
Frydlant nad Ostravici	3,3	7,4	4,0	5,4	43,6
Hezlová	3,6	7,6	3,9	5,3	17,4
Hlučín	3,9	8,1	4,2	6,0	16,1
Jablunkov	3,7	7,7	4,0	5,7	16,2
Karviná	2,8	7,4	4,5	5,4	24,3
Kopřivnice	3,1	7,5	4,4	5,7	22,9
Kraňov	4,0	7,8	3,7	6,2	19,8
Krnov	3,7	7,7	4,0	5,9	14,1
Nový Jiřín	3,5	7,6	4,1	5,9	22,6
Odry	3,9	7,7	3,8	6,0	10,9
Opava	3,9	7,9	4,0	6,0	16,8
Orlová	3,7	7,3	3,6	5,7	15,7
Ostrava	3,0	8,0	5,0	5,8	22,3
Přemyslov	3,6	7,4	3,8	5,6	17,7
Tinec	3,8	7,8	4,1	5,7	15,7
Vítkov	3,8	7,7	3,8	5,9	13,8

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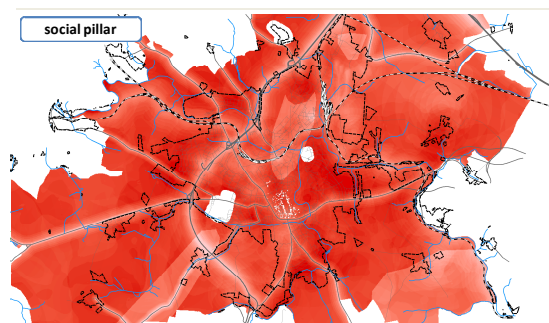


Example of the Results for the Jihlava Municipality

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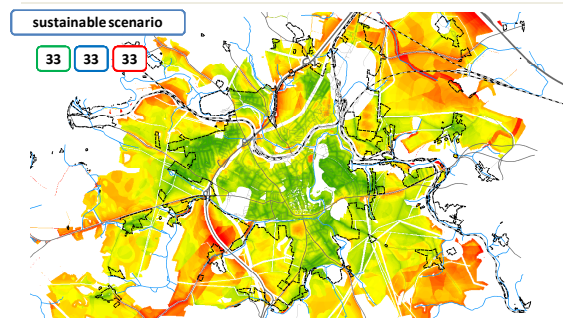
Housing



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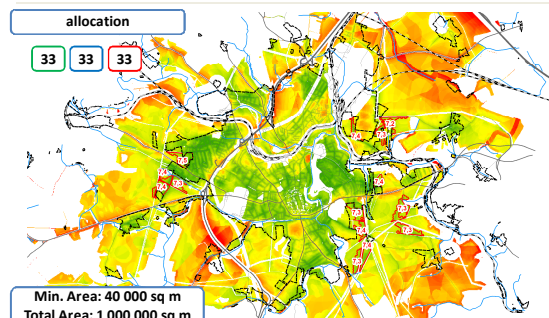
Scenarios for Housing



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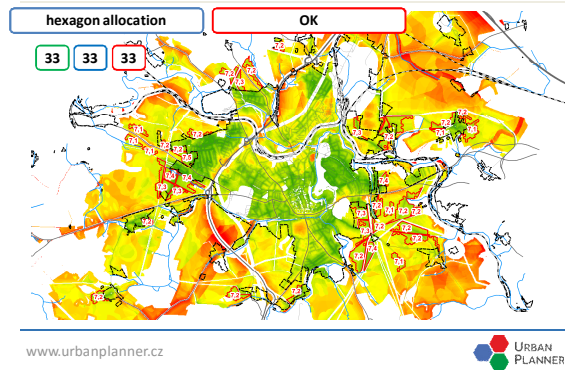
Allocation for Housing



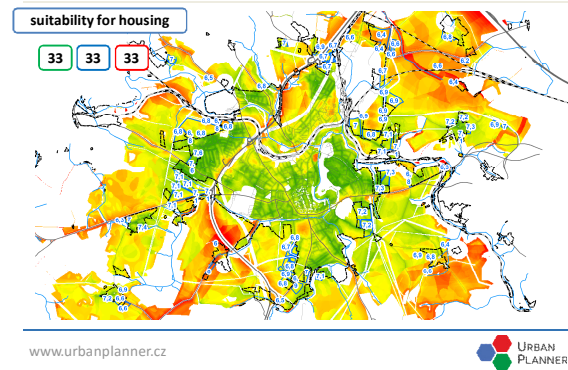
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Land Suitability for Housing



Land Suitability of Developable Areas



Application

- Analysis and interpretation of the land suitability
- Optimal development areas allocation
- Scenario calculations
- Comparison of possible variants of land development
- Verification of current or proposed activities
- Verification of principles of sustainability
- SWOT analysis

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Analysis for

- City & Regional Planning
 - Urban Plan
- Schools & Universities
- Urban & City Studies
- Geographical Studies

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Main Features

- Automatic retrieval of the data paths from the data model
- User profiles creation and transferability
- User profiles and calculation parameters are stored in the database
- Custom categories of the land use
- Custom factors' and pillars' weights setting
- Custom factors' selection

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