

# 7: Analyzing Suitability

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## Overview

The **What if? | Suitability** component provides procedures for determining the relative suitability of different locations for different land uses. These procedures, which previously took weeks or months to complete have been implemented in a quick and easy computer-based process.

This chapter provides a detailed description of the suitability component of What if?. The first section defines the suitability analysis concepts and terms. The second section describes the suitability analysis process incorporated in What if?. The remaining sections describe the procedures for using What if? to conduct a suitability analysis, the forms used to conduct the analysis, and the suitability analysis outputs.

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## Suitability Analysis Terminology

The following terms can be defined to help clarify the discussion of the suitability analysis process.

### ***Suitability Factors***

***Suitability Factors*** are the characteristics of the land which will be considered in determining the relative suitability of different locations for a particular land use. The suitability factors to be considered are specified by the user and can include the full range of natural features including slopes, soils, flood plains, and landslide prone areas. They can also include other suitability factors such as the distance to amenities such roads and parks or to disamenities such as hazardous waste sites.

### ***Factor Types***

***Factor Types*** are the set of possible values for a particular suitability factor. Thus, for example, the What if? demonstration project considers five different slope types: (1) <6%, (2) 6% to <12%, (3) 12% to <18%, (4) 18% to <25%, and (5) 25% and above.

**Importance Weights**

**Importance Weights** are numerical scores indicating the relative importance of different suitability factors for determining the suitability of different locations for a particular land use. Thus, for example, the Slope factor could be given a importance weight of 100 and the Soils factor could be given a importance weight of 50 to indicate that slope is twice as important as soils in determining a site's suitability for a particular land use. An importance weight of 0 can be used to indicate that a suitability factor should not be considered in determining the suitability of different locations for locating a particular land use.

**Suitability Ratings**

**Suitability Ratings** are numerical values indicating the relative suitability of locations with a particular factor type for locating a specified land use. Thus, for example, suitability ratings can be specified for each of the five slope types listed above to indicate the relative suitability of each slope type for locating a particular land use. In this case low slopes could be given a high suitability rating; moderate slopes could be given an intermediate suitability rating; and high slopes could be given a rating of 0, indicating that new development should be excluded from areas with high slopes.

**Suitability Score**

The **Suitability Score** is a numerical value indicating a location's overall suitability for a given land use when all of the suitability factors are considered. The suitability score for a particular UAZ is determined by: (1) multiplying the UAZ's suitability rating for each factor by the corresponding importance weight; and (2) summing these products. Suitability scores are computed for all UAZs and all land uses.

**Conversion**

**Conversion** refers to changes in an area's land use which occur during the development process. Thus, for example, an area which is currently is devoted to agricultural uses may be converted to residential or other non-agricultural uses during the projection period

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## Suitability Analysis Process

Given this terminology, the What if? suitability analysis process involves the following four steps:

1. Specifying importance weights;
2. Specifying suitability ratings;
3. Specifying land use conversions; and
4. Computing suitability scores

These steps are described briefly below and in detail in the following section on conducting a land suitability analysis.

### 1. Specifying Importance Weights

**Specifying Importance Weights**

You must first specify the **importance weights** indicating the relative importance of the different factors for determining the relative suitability of different locations for a particular land use.

For example, the What if? demonstration project includes the following suitability factors: (1) Slopes; (2) Ag. Soils; (3) Septic Soils; (4) 100-Year Floodplain; (5) Historic Sites; (6) Stream Buffer, and (7) Accessibility.

Given these factors, the Slope factor could be given an importance weight of 100; Ag. Soils factor could be given an importance weight of 50; and the Septic Soils factor could be given an importance weight of 0 for locating new residential developments. These weights would indicate that: (1) slope is considered to be twice as important as agricultural soils in determining a site's suitability for residential development; and (2) Septic Soils should not be considered in locating new residential development.

### ***Specifying Suitability Ratings***

## **2. Specifying Suitability Ratings**

You must then specify suitability ratings for each factor type, e.g., for each slope type, each soil type, and so on. The factor types are rated on a scale from high to low. An "Excluded" rating of zero, can be used to identify area from which development is to be excluded, regardless of its rating on other factors. Thus, for example, a suitability rating of zero could be used to exclude new residential development from areas with high slopes.

### ***Specifying Land Use Conversions***

## **3. Specifying Land Use Conversions**

Next, you must specify the permitted land use *conversions*, i.e., the land uses that may be converted from their current use (e.g., agriculture) to another use (e.g., residential) during the land use allocation process.

### ***Computing Suitability Scores***

## **4. Computing Suitability Scores**

The model then computes the factor scores for each UAZ by multiplying the importance weights by the corresponding suitability rating and summing these values. The resulting suitability scores are then used to prepare suitability maps and to allocate projected demand to alternative sites in the What if? Allocation component, described in Chapter 9.

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## **Analyzing Land Suitability**

The following process can be used to analyze land suitability:

1. Selecting a suitability scenario;
2. Specifying importance weights;
3. Specifying suitability ratings;
4. Specifying land use conversions;
5. Computing suitability analysis scores; and
6. Viewing suitability analysis outputs.

The procedures for using What if? to conduct each of these steps are described below.

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## 7.1 Selecting a Suitability Scenario

The What if? **Suitability** option has the following sub-options

- **S**cenarios;
- **M**aps;
- **R**eports; and
- **A**ssumptions.

The procedures for using the **Scenarios** option to open an existing suitability scenario, create a new suitability scenario, copy, or delete a suitability scenario are described briefly below.

### 7.1.1 Opening an Existing Scenario

#### *Opening an Existing Scenario*

You can open an existing suitability scenario to review or modify by:

1. Selecting the **Suitability** option from the main What if? form;
2. Selecting the **Scenarios** option; and
3. Selecting the desired scenario from the list of previously defined scenarios that is displayed on the screen.

### 7.1.3 Creating a New Scenario

#### *Creating a New Scenario*

You can create a new suitability scenario by:

1. Selecting the **Suitability** option from the main What if? form;
2. Selecting the **Scenarios** option;
3. Selecting the **New...** option;
4. Entering the new scenario name and an optional scenario description on the **Create New Scenario** form; and
5. Clicking **OK**.

### 7.1.2 Copying a Scenario

#### *Copying a Scenario*

You can create a copy of an existing suitability scenario by:

1. Selecting the **Suitability** option from the main What if? form;
2. Selecting the **Scenarios** option;
3. Selecting the **Copy...** option;
4. Selecting the scenario to be copied from the **Source Scenario** drop-down list;
5. Specifying the new scenario name in the **New Scenario** text box;

6. Specifying a scenario description, if desired, in the **Description** box; and
7. Clicking on the **OK** button.

### 7.1.4 Deleting a Scenario

#### **Deleting a Scenario**

You can delete a previously defined suitability scenario by:

1. Selecting the **Suitability** option from the main What if? form;
2. Selecting the **Scenarios** option;
3. Selecting the **Delete...** option;
4. Selecting the scenario to be deleted the **Scenario** drop-down list;
5. Clicking on the **Delete** button; and
6. Clicking on **OK**, on the confirmation form.

You can click on the **Cancel** button at any point to return to the main What if? form without deleting a scenario.

**NOTE!**

**NOTE: Scenarios cannot be recovered after they have been deleted.**

**NOTE!**

**NOTE: Scenarios that have a check displayed in the Read Only Scenario box on the Suitability Scenario Assumptions form cannot be deleted.**

## Suitability Scenario Assumptions Form

### Suitability Scenario Assumptions Form

After opening a suitability scenario, creating a new scenario, or copying an existing scenario, you are presented with the **Suitability Scenario Assumptions** form, shown below

Suitability Factor	None/Low 0	Factor Importance Medium 50	High 100
Slopes			100.00
Prime Ag Soils			75.00
Septic Soils			50.00
100-year Flood			100.00
Historic Sites			75.00
Streams			75.00
Accessibility			25.00

Read Only

Weight factor importance from 0 (not considered) to high (5, 9, or 100)

**What if? Project  
and Scenario  
Name**

**What if? Project and Scenario Name**

The label at the top of the form identifies the Suitability Scenario Assumptions form and your What if? project, in this case, the Demonstration project. The **Scenario:** label at the upper left of the form identifies the scenario for which the assumptions are being defined, in this case the Conservation scenario.

**Future Land Use**

**Future Land Use**

The **Future Land Use** drop-down list on the upper right of the form identifies the land use for which the suitability assumptions are being specified. That is, in this example, the suitability assumptions are being defined for locating future residential land uses. The **Future Land Use** drop down list contains all of the suitability land uses that were defined in the **Setup | Define Suitability Land Uses** option, described in Section 4.6.4 Defining Suitability Land Uses.

**Suitability  
Scenario Form  
Buttons**

**Suitability Scenario Form Buttons**

The **Suitability Scenario Assumptions** form contains the following buttons:

- **Compute.** This button is used to compute the suitability scores. This option does not save the suitability scenario assumptions or the analysis results. The **Save** option must be used to do that.
- **Save.** This button is used to save the suitability scenario assumptions and analysis results.
- **Cancel.** This button cancels the analysis process and returns you to the main What if? Form without computing the suitability scores or saving the scenario assumptions and results.

**Read Only  
Scenarios**

**Read Only Scenarios**

The **Read Only** check box in the lower right hand corner of the form can be used to lock the scenario so it cannot be changed or deleted. That is, if the **Read Only** check box is selected when the scenario is saved, the **Compute** and **Save** buttons will be disabled when the scenario is re-loaded and the scenario cannot be deleted with the **Suitability | Scenarios | Delete...** option.

**NOTE!**

**NOTE: Suitability scenarios that are included in an Allocation scenario cannot be deleted until the associated Allocation scenario is deleted.**

**Suitability  
Scenario  
Assumptions  
Form**

**Suitability Scenario Assumptions Form**

The Suitability Scenario Assumptions form contains three tabbed sheets which are used to specify the importance weights, suitability ratings, and permitted land use conversions which will be used in the suitability analysis. The procedures for doing this are described below.

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## 7.2 Specifying Importance Weights

The **Importance** sheet is used to specify the relative importance of different suitability factors for locating the land use selected in the **Future Land Use:** drop-down list.

As shown above, the **Importance** sheet contains a slider bar and a text box for each of the suitability factors defined in Section 4.8 Defining Suitability Factors. The values on the slider bar can range from a low value of 0 to a high value of 5, 9, or 100, depending on the option that was specified in the **Setup | Define Suitability Value Range** option described in Section 4.10 Defining Suitability Value Ranges. Importance values for each suitability factor can be specified by moving the slider bar or by entering a value in the text box to the right of each slider bar.

The values specified on the **Importance** sheet express your assumptions concerning the relative importance of each factor for locating a particular land use. Thus, an importance value of 100 for Slopes and a value of 50 for Septic Soils for the Residential land use indicate that slopes are assumed to be twice as important for locating residential development as septic soils.

Importance values of 0 can be used to designate factors that should not be considered in locating a particular land use. Thus, for example, the Septic Soils factor is given an importance weight of 0 for Mixed Use land use in the Demonstration project, indicating that septic soils should not be considered in locating mixed land uses.

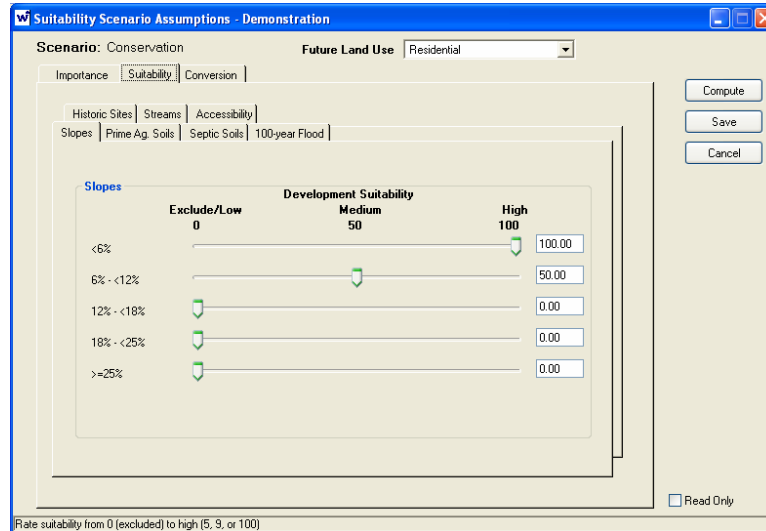
Importance weights must be specified for all future land uses and all of the suitability factors.

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## 7.3 Specifying Suitability Ratings

The **Suitability** sheet is used to specify the relative suitability of each factor type (e.g., the different slopes for the slope factor) for each land use.

For example, as shown below, the **Suitability** sheet for the What if? demonstration project contains a sub-sheet for each suitability factor. The first sheet is used to specify suitability ratings for the Slopes factor; the second sheet is used to specify suitability ratings for the Prime Ag. Soils suitability factor; and so on.



As was true for the **Importance** sheet, the **Suitability** sheet contains a slider bar and a text box for each factor type. The values on the slider bar can range from a low value of 0 to a high value of 5, 9, or 100, as specified in the **Setup | Define Suitability Value Range** option.

Suitability values of 0 can be used to identify areas from which development is to be excluded, regardless of its rating on other factors. Thus, for instance, specifying a value of zero for slopes greater than or equal to 12% for the Residential land uses means that residential development will be excluded from all areas that have slopes of 12% or more.

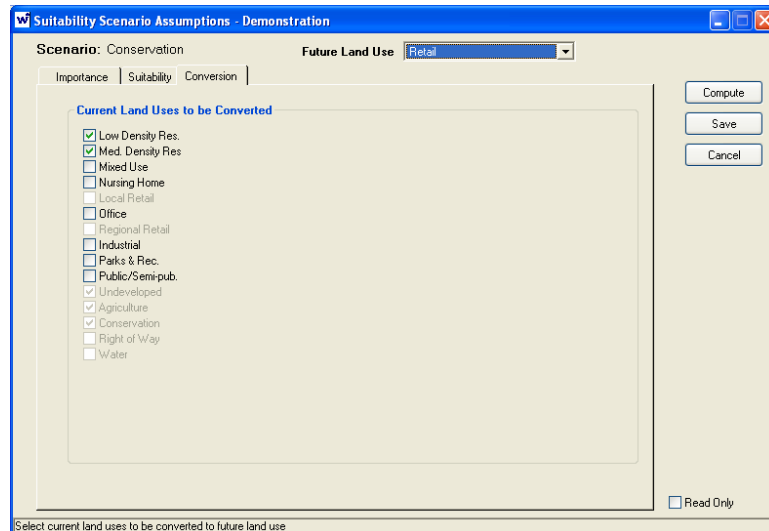
## 7.4 Specifying Land Use Conversions

The **Conversion** sheet, shown below, is used to specify land uses that are available for conversion from their current use (e.g., agriculture) to another use (e.g., residential) during the land use allocation process.

### 7.4.1 Convertible Land Uses

#### **Convertible Land Uses**

The check boxes in the body of the form indicate land uses that may be converted from their current land use (displayed on the body of the form) to the future land use displayed in the drop-down list at the top of the form. Thus, for example, as shown below, the check marks for the low density and medium density residential land uses indicate that areas that currently have these land uses are available for conversion to Retail uses.



## 7.4.2 Developable Land Uses

### *Developable Land Uses*

Land uses that are defined as developable on the **Setup | Define Land Uses** option (e.g., Undeveloped and Agriculture on the form shown above) are automatically checked, indicating that these areas are always available for development. If no other land uses are selected, only undeveloped land will be assumed to be available for accommodating future land use demands and considered in the suitability analysis.

## 7.4.3 Not Developable Land Uses

### *Not Developable Land Uses*

Land uses that are identified as not developable on the **Setup | Define Land Uses | Not Develop/Not Define** sheet (e.g., Water and Right of Way) are automatically unchecked, indicating that these areas are not available for conversion to other uses.

## 7.4.4 Not Convertible Land Uses

### *Not Convertible Land Uses*

Current land uses that are defined within the same suitability land use category on the **Setup | Associate Land Uses | Suitability** form (described in Section 4.7.1 Associating Allocation and Suitability Uses) cannot be selected on the Conversion form. For example, as shown above, the Local Retail and Regional Retail current uses are disabled when the Retail future land use is selected because these two uses were associated with the Retail suitability land use on the **Setup | Associate Land Uses | Suitability** form.

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## 7.5 Computing Suitability Scores

After specifying the importance weights, suitability ratings, and conversions for all of the suitability land uses listed in the drop down list at the top of the **Suitability Scenario Assumptions** form, you can click on the **Compute** button to compute the relative suitability of all the UAZs for each suitability land use.

The suitability score for a particular UAZ is determined by: (1) multiplying the UAZ's suitability rating for each factor by the corresponding importance weight; and (2) summing these products. Suitability scores are computed for all UAZs and all land uses.

Once the computations are complete, you can press the **Save** button to save the scenario assumptions and computational results. The **Cancel** button can also be pressed if you do not want to save the current scenario assumptions or analysis results.

After one of these buttons is pressed, you will be returned to the main What if? form to view the suitability analysis outputs.

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## 7.6 Viewing Suitability Outputs

The following options are available for viewing the suitability analysis results:

1. Viewing suitability maps;
2. Viewing suitability reports;
3. Comparing suitability reports; and
4. Viewing suitability assumptions reports.

These options are described briefly below.

### 7.6.1 Viewing Suitability Maps

#### Viewing Suitability Maps

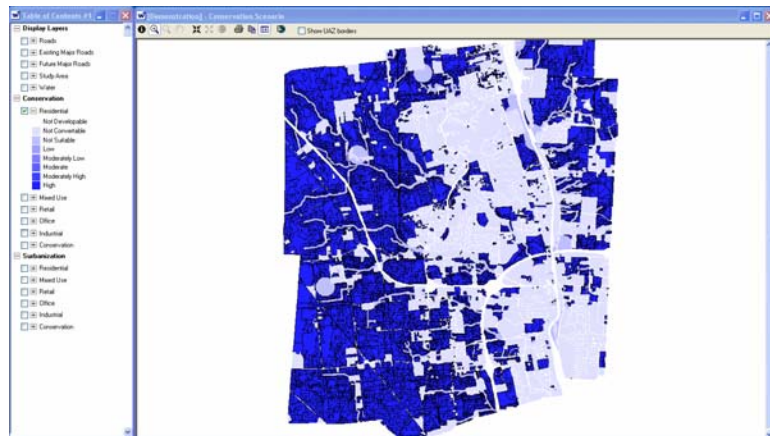
What if? can be used to generate a series of maps showing the relative suitability of different locations for each of the land uses considered in the suitability analysis. These maps can be viewed by

1. Selecting the **Suitability** option from the main What if? screen; and
2. Selecting the **Maps** option.

As shown below, the suitability maps contain a table of contents and a main map form, as described in Section 6.1 What if? Mapping Option. The table of contents contains a data frame for the display layers and a data frame for each suitability scenario. It also lists all of suitability land uses for each scenario, allowing you quickly and easily to view maps showing the relative suitability of different locations within the study area for the suitability scenarios you've created.

The map shows each location's suitability scaled from "Not Suitable" to "High" based on the user-defined importance weights and ratings for the

selected suitability scenario. The scenario classes are defined by computing the maximum suitability score for each land use and then dividing this maximum score into five equally broad class: Low, Moderately Low, and so on. The map also identifies areas that are not developable and not convertible from their current use.



## 7.6.2 Comparing Suitability Maps

### Comparing Suitability Maps

You can click on the **Open New Map** tool (the right-most tool on the main map form) to open up to four different map forms. This allows you to examine the suitability maps for more than one suitability scenario or land use at the same time.

## 7.6.3 Viewing Suitability Reports

### Viewing Suitability Analysis Reports

What if? also generates a report which identifies the number of acres (or hectares) within each suitability class for all land uses for a specified suitability scenario.

These reports can be viewed by:

1. Selecting the **Suitability** option from the main What if? screen;
2. Selecting the **Report** option; and
3. Selecting the desired suitability scenario from the list that is displayed on the screen; and
4. Clicking on the **OK** button.

As shown below, the Suitability Report provides the following information:

- The name of the project and the suitability scenario;
- The date on which the scenario was last computed and the date on which the report was printed; and

- The number of acres (or hectares) of land in each suitability class for each suitability land use and the range of scores which define each suitability class.

The scenario classes are defined by computing the maximum suitability score for each land use and then dividing this maximum score into five equally broad class: Low, Moderately Low, and so on.

The procedures for viewing the Suitability Report are described in Section 6.2 What if? Reports Option.

Suitability Land Use	Suitability Category	Suitability Scores	Acres
Residential	Not Developable	NA	2,402.2
	Not Convertible	NA	9,402.6
	Not Suitable	NA	1,634.8
	Low	1.0 to 9,875.0	0.0
	Medium Low	9,876.0 to 19,750.0	0.0
	Medium	19,751.0 to 29,625.0	9.5
	Medium High	29,626.0 to 39,500.0	2,901.1
	High	39,501.0 to 49,375.0	12,575.6
<b>Total</b>			<b>29,879.5</b>

## 7.6.4 Comparing Suitability Reports

### Comparing Suitability Reports

What if? also prepares a report that allows you to directly compare the results for two different suitability scenarios.

These reports can be viewed by:

1. Selecting the **S**uitability option from the main What if? screen;
2. Selecting the **R**eports option;
3. Selecting the **C**ompare... option at the bottom of the form displayed on the screen; and
4. Selecting the two scenarios to be compare from the drop down lists in the Compare Scenario Results form; and
5. Clicking **OK**.

As shown below, the Suitability Scenario Comparison Report provides the following information:

- The name of the project and the suitability scenarios to be compared;
- The dates on which the report was printed and each scenario was last computed;

- The acres (or hectares) of land in each suitability score interval for each of the scenarios.

**What if? Suitability Scenario Comparison Report**

Project: Demonstration  
 Scenario #1: Conservation  
 Scenario Computed: Apr 25, 2005 4:05 PM  
 Scenario #2: Development  
 Scenario Computed: Apr 26, 2005 11:41 AM  
 Report Printed: Apr 26, 2005 11:42 AM

Suitability Land Use	Suitability Category	Suitability Scores	Scenario 1		Scenario 2	
			Acres	Suitability Scores	Acres	
<b>Residential</b>	Not Developable	NA	2,480.2	NA	2,480.2	
	Not Convertible	NA	79.8	NA	79.8	
	Not Suitable	NA	1,634.8	NA	1,501.8	
	Low	1.0 to 9,875.0	0.0	1.0 to 3,275.0	0.0	
	Moderately Low	9,876.0 to 18,750.0	0.0	3,276.0 to 6,750.0	0.0	
	Moderate	18,751.0 to 29,625.0	9.5	6,751.0 to 10,125.0	2,654.5	
	Moderately High	29,626.0 to 39,500.0	2,901.1	10,126.0 to 13,500.0	2,210.2	
	High	39,501.0 to 48,375.0	12,775.6	13,501.0 to 16,875.0	12,100.4	
<b>Total</b>			<b>29,879.5</b>		<b>29,879.5</b>	

### Viewing Suitability Assumptions Reports

#### 7.6.5 Viewing Suitability Assumptions Reports

The assumptions which underlay a given suitability analysis can be reviewed by viewing the **Suitability Assumptions Report**.

These reports can be viewed by:

1. Selecting the **Suitability** option from the main What if? screen;
2. Selecting the **Assumptions** option; and
3. Selecting the desired suitability scenario from the list displayed on the screen.

As shown below, the **Suitability Assumptions Report** provides all of the information that was specified for the selected suitability scenario including:

- The name of the project and the suitability scenario;
- The dates on which the report was printed and the scenario was last computed;
- The factors that were considered for each suitability land use;
- The user-specified weights for each suitability factor;
- The user-specified suitability ratings for each factor type; and
- The land uses that may—or may not—be converted from their current use to each suitability land use.

**What if? Suitability Assumptions Report**

**Scenario:** Conservation  
**Project:** Demonstration  
**Report Date:** Apr. 28, 2005 11:45 AM  
**Scenario:** Apr. 23, 2005 4:05 PM

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**Residential Suitability Assumptions**

**Factors Considered**

Factor	Considered	Weight
Slopes	Yes	10.00
Prime Agr. Soils	Yes	70.00
Septic Soils	Yes	50.00
100-year Flood	Yes	10.00
Historic Sites	Yes	70.00
Streams	Yes	70.00
Accessibility	Yes	20.00

**Factors Ratings**

Suitability Factor: Slopes		Suitability Factor: Streams	
Category	Rating	Category	Rating
<6%	100	<100'	0
6% - <12%	50	100' - <250'	33
12% - <18%	0	250' - <500'	67
18% - <25%	0	Outside Buffers	100
>=25%	0		