

## Exurban Land Use Planning Tools

Exurban and Land Use Planning Tools is a collection of tools designed to support land use decision making for conservation. The toolbox includes tools to assist conservationists and landuse planners with desiging landscapes that provide secure living habitat and/or allow movement habitat connectivity for wildlife.

Two general categories of tools are provided. Policy tools are designed to estimate the potential impact on wildlife resulting from specific land use policy decisions such as establishing density zoning regulations. Evaluation tools are designed to evaluate existing or proposed landscapes for impacts on wildlife. Evaluation tools are particularly helpful to allow developers, land use planners, and conservationists to explore the impacts of mulitple scenarios of structure and road placement on widllife.

### Toolsets

## Calculate Target Housing Density

Calculate Target Housing Density is designed for estimating an appropriate housing density that will meet specific wildlife conservation targets. The user specifies the minimum area requirement for core habitat and a disturbance distance.

The tool uses iterative Monte Carlo simulations of random patterns to simulate the influence of houses and roads on the size of habitat cores. After each simulation run, the mean percent area of "core habitat" is compared with the user specified target. The number of houses is adjusted for each subsequent simulation until a solution is reached. Processing stops when a solution within 5% of the target is reached.

When the final solution is reached, a message box displays the density of houses (in acres) that satisfied the target parameters. Outputs include a summary table of all simulation runs, and example shapefiles of cores and houses representing the final simulation that satisfied target parameters.

## Illustration

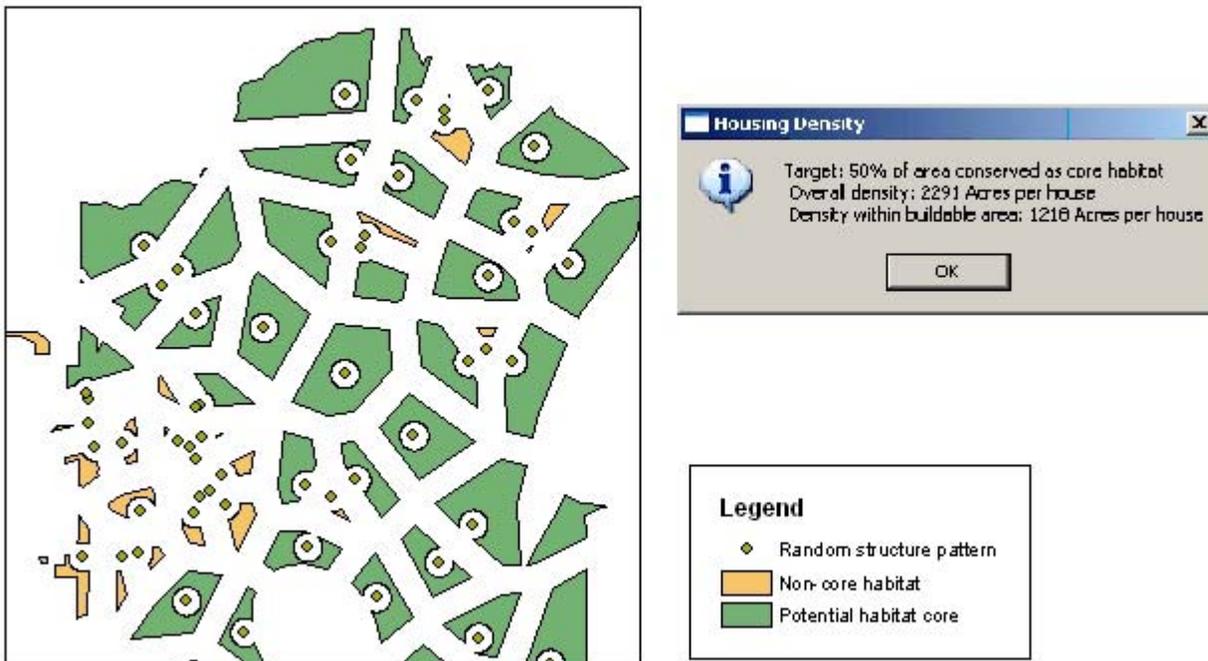


Figure 1 Example output of Calculate Target Density

## Usage Tips

HINT: Using 'multipart to singlepart' to convert a multipart analysis extent layer to a single part layer can dramatically improve processing speed.

Constraint layer: A constraint layer can be used to constrain random structure placement to areas where actually development is most likely to occur. In most cases, public lands areas protected by conservation easement, or otherwise unsuitable building sites should be removed from the constraint layer to provide a more realistic simulation for analysis.

## Command line syntax

CalcTargetDensity <Output\_Table> {Number\_of\_Iterations} <Analysis\_Extent> {Constraint\_Layer} <Minimum\_Habitat\_Core> <Disturbance\_Distance> {Percent\_Area\_to\_Conserve}

### Parameters

Expression	Explanation
<Output_Table>	The name of a table where summary data will be stored.
{Number_of_Iterations}	The number of iterations to run each Monte Carlo simulation. Note: Execution time is multiplied by the number of iterations selected.
<Analysis_Extent>	Polygon layer to be used as boundary for analysis extent. This layer must have a projection with units in meters.
{Constraint_Layer}	Polygon layer used to confine the random placement of houses. This layer must be in same projection as, and overlap

	with, the Analysis Extent. Specifying a Constraint Layer is useful for masking out areas that cannot be developed. If no Constraint Layer is specified, houses will be placed randomly throughout polygons contained in the Analysis Extent.
<Minimum_Habitat_Core>	The minimum habitat core area requirements for the target species.
<Disturbance_Distance>	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded. This value must be specified in square meters.
{Percent_Area_to_Conserve}	The percentage of the analysis area you wish to conserve as core (undisturbed) habitat for the target species. This must be an integer value from 1 - 100.

**Command Line Example**

## Scripting syntax

CalcTargetDensity (Output\_Table, Number\_of\_Iterations, Analysis\_Extent, Constraint\_Layer, Minimum\_Habitat\_Core, Disturbance\_Distance, Percent\_Area\_to\_Conserve)

**Parameters**

Expression	Explanation
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Output Table (Required)	The name of a table where summary data will be stored.
Number of Iterations (Optional)	The number of iterations to run each Monte Carlo simulation. Note: Execution time is multiplied by the number of iterations selected.
Analysis Extent (Required)	Polygon layer to be used as boundary for analysis extent. This layer must have a projection with units in meters.
Constraint Layer (Optional)	Polygon layer used to confine the random placement of houses. This layer must be in same projection as, and overlap with, the Analysis Extent. Specifying a Constraint Layer is useful for masking out areas that cannot be developed. If no Constraint Layer is specified, houses will be placed randomly throughout polygons contained in the Analysis Extent.
Minimum Habitat Core (Required)	The minimum habitat core area requirements for the target species.
Disturbance Distance (Required)	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded. This value must be specified in square meters.

Percent Area to Conserve (Optional)

The percentage of the analysis area you wish to conserve as core (undisturbed) habitat for the target species. This must be an integer value from 1 - 100.

Script Example



ArcToolbox

## Calculate Corridor Housing Density

Calculate Target Housing Density is designed for estimating an appropriate housing density that will meet specific wildlife conservation targets. The user specifies the minimum area requirement for core habitat and a disturbance distance.

The tool uses iterative Monte Carlo simulations of random patterns to simulate the influence of houses and roads on the size of habitat cores. After each simulation run, the mean percent area of "core habitat" is compared with the user specified target. The number of houses is adjusted for each subsequent simulation until a solution is reached. Processing stops when a solution within 5% of the target is reached.

When the final solution is reached, a message box displays the density of houses (in acres) that satisfied the target parameters. Outputs include a summary table of all simulation runs, and example shapefiles of cores and houses representing the final simulation that satisfied target parameters.

## Illustration

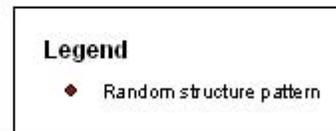
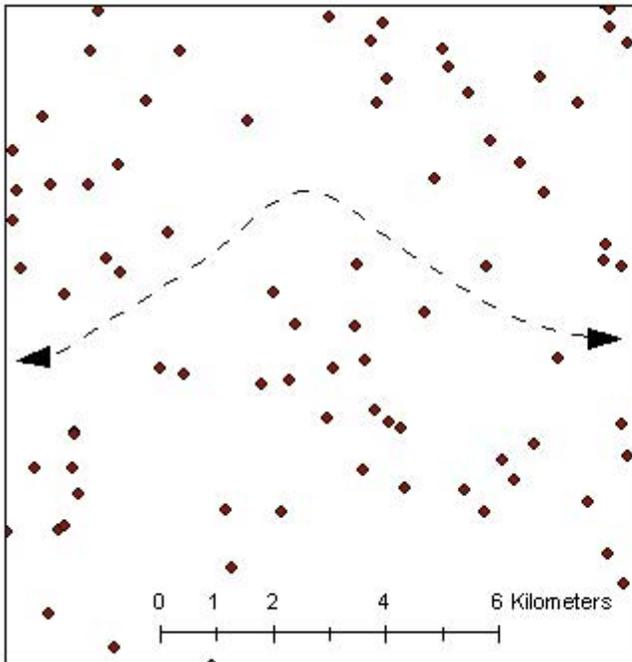


Figure 1. Example output. A random pattern of structures at a density that produces an average distance between structures equal to the target value provides high probability that the landscape matrix is permeable for the target species. One of many possible movement routes is indicated by the dashed arrow.

## Usage Tips

HINT: Using 'multipart to singlepart' to convert a multipart analysis extent layer to a single part layer can dramatically improve processing speed.

## Command line syntax

CalcTargetDensity2 <Output\_Table> {Number\_of\_Iterations} <Analysis\_Extent> {Constraint\_Layer} <Minimum\_Corridor\_Width> <Disturbance\_Distance> {Acres | Hectares | Square Kilometers | Square Meters | Square Miles}

**Parameters**

<b>Expression</b>	<b>Explanation</b>
<Output_Table>	The name of a table where summary data will be stored.
{Number_of_Iterations}	The number of iterations to run each Monte Carlo simulation. Note: Execution time is multiplied by the number of iterations selected.
<Analysis_Extent>	Polygon layer to be used as boundary for analysis extent. This layer must have a projection with units in meters.
{Constraint_Layer}	Polygon layer used to confine the random placement of houses. This layer must be in same projection as, and overlap with, the Analysis Extent. Specifying a Constraint Layer is useful for masking out areas that cannot be developed. If no Constraint Layer is specified, houses will be placed randomly throughout polygons contained in the Analysis Extent.
<Minimum_Corridor_Width>	The minimum width of undisturbed habitat the target species requires for movement security.
<Disturbance_Distance>	The distance from roads and houses the target species is likely

	to avoid or where habitat quality is degraded. This value must be specified in square meters.
{Acres   Hectares   Square Kilometers   Square Meters   Square Miles}	Select the units for reporting output densities.

**Command Line Example**

## Scripting syntax

CalcTargetDensity2 (Output\_Table, Number\_of\_Iterations, Analysis\_Extent, Constraint\_Layer, Minimum\_Corridor\_Width, Disturbance\_Distance, Output\_Units)

### Parameters

Expression	Explanation
Output Table (Required)	The name of a table where summary data will be stored.
Number of Iterations (Optional)	The number of iterations to run each Monte Carlo simulation. Note: Execution time is multiplied by the number of iterations selected.
Analysis Extent (Required)	Polygon layer to be used as boundary for analysis extent. This layer must have a projection with units in meters.
Constraint Layer (Optional)	Polygon layer used to confine the random placement of

	houses. This layer must be in same projection as, and overlap with, the Analysis Extent. Specifying a Constraint Layer is useful for masking out areas that cannot be developed. If no Constraint Layer is specified, houses will be placed randomly throughout polygons contained in the Analysis Extent.
Minimum Corridor Width (Required)	The minimum width of undisturbed habitat the target species requires for movement security.
Disturbance Distance (Required)	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded. This value must be specified in square meters.
Output Units (Optional)	Select the units for reporting output densities.

Script Example



ArcToolbox

## Evaluate Habitat Patches

Evaluate Habitat Patches measures the percent area of landscape within the analysis area remaining and generates a shapefile of the results.

This tool buffers structures and roads input layers by the disturbance distance to simulate habitat fragmentation created by structures and roads. The resulting habitat patches are evaluated by applying the minimum core size threshold.

Evaluate Habitat Patches is suitable for testing existing landscapes or for scenario testing to help land use planners design landscapes that maximize wildlife conservation value.

## Illustration

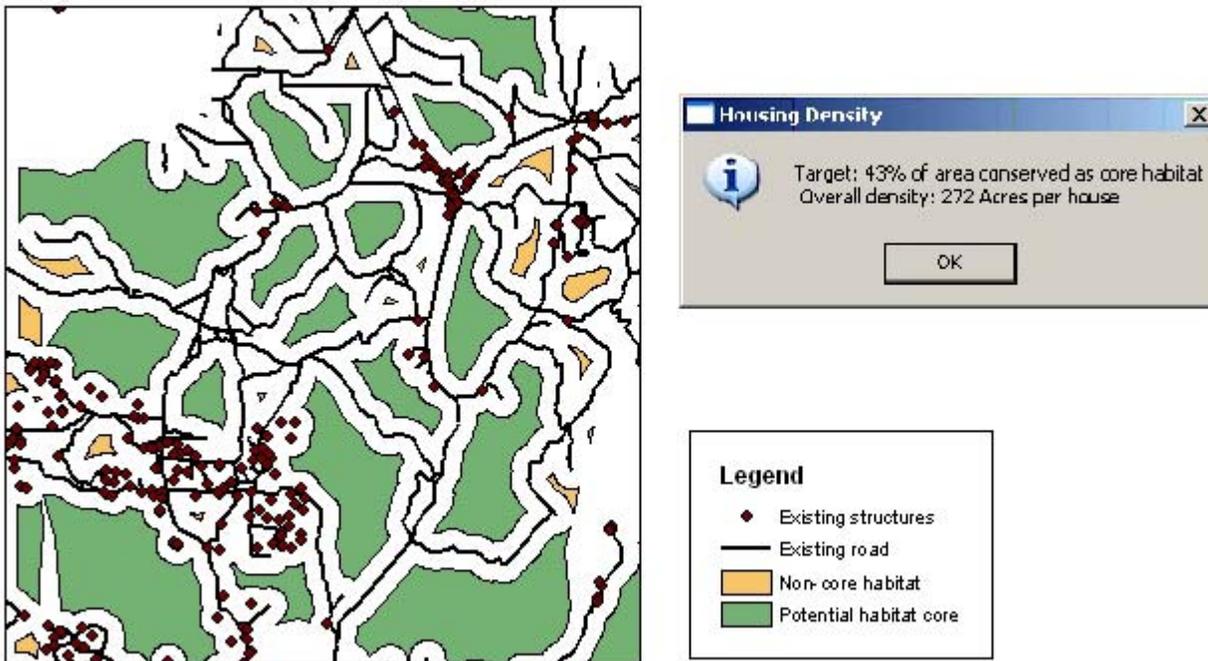


Figure 1. Example output showing habitat blocks that exceed specified minimum patch size.

## Usage Tips

Analysis Extent: Outputs are clipped to polygons contained in the analysis extent layer. For best results, the analysis extent should be limited to areas of suitable habitat for the target species.

Using 'multipart to singlepart' to convert a multipart analysis extent layer to a single part layer can dramatically improve processing speed.

## Command line syntax

EvaluateHabitatCores <Output\_Table> <Analysis\_Extent> <Structures\_Layer> <Roads\_Layer> <Minimum\_Habitat\_Core> <Disturbance\_Distance> {Hectares | Acres | Square Kilometers | Square Meters | Square Miles}

### Parameters

Expression	Explanation
<Output_Table>	The name of a table where summary data will be stored.
<Analysis_Extent>	<p>Polygon layer to be used as boundary for analysis area. This layer must have a projection with units in meters. Analysis outputs are clipped to the polygon(s) contained in this layer. For most accurate results, the analysis area should be limited to areas containing suitable habitat for the target species.</p> <p>HINT: Using dissolve to convert a multipart analysis extent layer to a single part layer can dramatically improve processing speed.</p>

<Structures_Layer>	A point layer representing the location of structures on the landscape.
<Roads_Layer>	A line layer representing the placement of roads on the landscape.
<Minimum_Habitat_Core>	The minimum habitat core area requirements for the target species.
<Disturbance_Distance>	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded.
{Hectares   Acres   Square Kilometers   Square Meters   Square Miles}	Select the units for reporting output densities.

Command Line Example

## Scripting syntax

EvaluateHabitatCores (Output\_Table, Analysis\_Extent, Structures\_Layer, Roads\_Layer, Minimum\_Habitat\_Core, Disturbance\_Distance, Output\_Units)

### Parameters

Expression	Explanation
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Output Table (Required)	The name of a table where summary data will be stored.
Analysis Extent (Required)	<p>Polygon layer to be used as boundary for analysis area. This layer must have a projection with units in meters. Analysis outputs are clipped to the polygon(s) contained in this layer. For most accurate results, the analysis area should be limited to areas containing suitable habitat for the target species.</p> <p>HINT: Using dissolve to convert a multipart analysis extent layer to a single part layer can dramatically improve processing speed.</p>
Structures Layer (Required)	A point layer representing the location of structures on the landscape.
Roads Layer (Required)	A line layer representing the placement of roads on the landscape.
Minimum Habitat Core (Required)	The minimum habitat core area requirements for the target species.
Disturbance Distance (Required)	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded.

Output Units (Optional)

Select the units for reporting output densities.

Script Example



ArcToolbox

## Evaluate Movement Landscape

Evaluate Movement Landscape identifies areas that may potential provide adequate wildlife movement habitat based on the location of structures and user specified input parameters. This tool is intended for fine-scale analysis within areas identified as potential wildlife corridors to identify areas important for maintaining habitat connectivity within an existing landscape, or to evaluate the potential impact of a proposed development on wildlife habitat connectivity.

This tool requires a spatial analyst license. Areas suitable for animal movement are first identified by calculating euclidian distance from each cell in the analysis area to the nearest structure. Areas beyond the specified disturbance distance are considered potential movement areas. Next areas within the potential movement landscape that are equal to, or greater than, the minimum corridor width specified are identified by calculating the euclidian distance from the nearest disturbed area boundary and calculating the focal maximum using a circular neighborhood with radius equal to one half the minimum corrdor width. Cells with a focal max greater than one half the minimum corridor width are coded as suitable for animal movement.

## Illustration

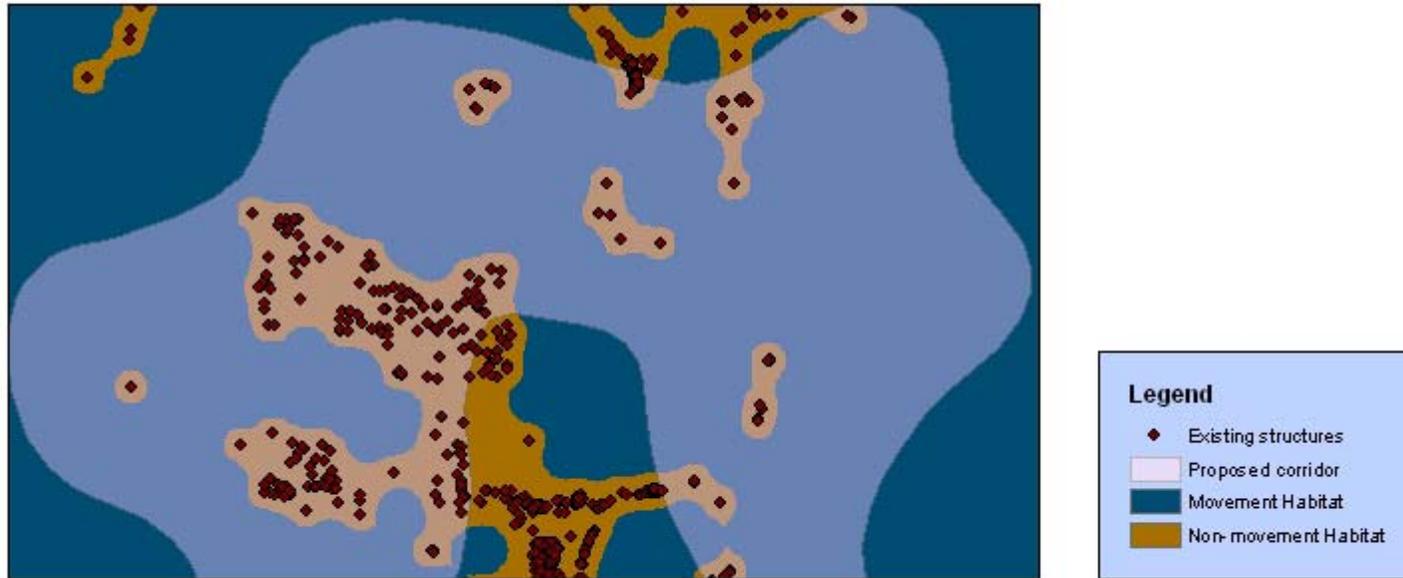


Figure 1. Example of final output raster showing potential movement areas.

## Usage Tips

Using a relatively small cell size produces the most accurate results but may significantly increase processing time and disk storage requirements for the final output. If no cell size is specified, the default cell size is  $\text{Minimum Corridor Width} \div 30$  which is usually sufficient to produce a good result. If large areas must be analyzed, we recommend dividing the analysis area into two or more overlapping analysis extents rather than increasing the cell size. Final results can be mosaiced into a single output raster by specifying 'maximum' as the mosaic type.

Specifying an analysis extent layer is optional. If no analysis extent is specified, it will be set to the extent of the input structures layer. In most cases an analysis extent should be specified that is larger than the extent of the structures layer and the extent should include all areas between source habitats between which habitat connectivity is desired for the target species.

## Command line syntax

EvaluateMovementLandscape <Structures\_Layer> <Minimum\_Corridor\_Width> <Disturbance\_Distance> <Output\_Raster> {<Analysis\_Cell\_Size>} {<Analysis\_Extent>}

### Parameters

Expression	Explanation
<Structures_Layer>	A point layer representing the location of structures on the landscape.
<Minimum_Corridor_Width>	The minimum width of undisturbed area required for the target species to move freely.
<Disturbance_Distance>	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded.
<Output_Raster>	The name and location of the output raster to store the results. Cell values of the output raster are 1 for areas suitable for animal movement and 0 for areas that are less likely to be used as movement habitat by the target species.

{Analysis_Cell_Size}	The cell size to use for analysis. Relatively small cell sizes produce more accurate results but may significantly increase processing times and disk storage requirements. See 'Usage Tips' under help for more information. If analysis cell size is not specified, it will be set to Minimum Corridor Width ÷ 30.
{Analysis_Extent}	Extent to be used as boundary for analysis area. For most accurate results, the analysis area should be large enough to include all area between source habitats where wildlife habitat connectivity is desired. If no extent is specified, the analysis area will be the extent of the input structures layer.

Command Line Example

## Scripting syntax

EvaluateMovementLandscape (Structures\_Layer, Minimum\_Corridor\_Width, Disturbance\_Distance, Output\_Raster, Analysis\_Cell\_Size, Analysis\_Extent)

### Parameters

Expression	Explanation
Structures Layer (Required)	A point layer representing the location of structures on the landscape.
Minimum Corridor Width (Required)	The minimum width of undisturbed area required for the

	target species to move freely.
Disturbance Distance (Required)	The distance from roads and houses the target species is likely to avoid or where habitat quality is degraded.
Output Raster (Required)	The name and location of the output raster to store the results. Cell values of the output raster are 1 for areas suitable for animal movement and 0 for areas that are less likely to be used as movement habitat by the target species.
Analysis Cell Size (Optional)	The cell size to use for analysis. Relatively small cell sizes produce more accurate results but may significantly increase processing times and disk storage requirements. See 'Usage Tips' under help for more information. If analysis cell size is not specified, it will be set to Minimum Corridor Width ÷ 30.
Analysis Extent (Optional)	Extent to be used as boundary for analysis area. For most accurate results, the analysis area should be large enough to include all area between source habitats where wildlife habitat connectivity is desired. If no extent is specified, the analysis area will be the extent of the input structures layer.

Script Example