APPENDIX F: TRAVERSABILITY ANALYSIS

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A detailed analysis was conducted using ArcInfo GIS software (ESRI, Redlands, CA 92373) to solve the following equation for traversability index (McGarigal, K., SA Cushman, MC Neel, and E Ene. 2002; Table L123.)

$$\text{TRAVERSE}=\left[\frac{\left(\frac{\sum_{r=1}^{z} t_r}{z}\right)}{t_{max}}\right]100$$

t_r=least cost hull area around the rth cell in the landscape
Z=total number of cells in the landscape
t_{max} = maximum least cost hull area around a focal cell of any type given minimum resistance

Description	TRAVERSE equals the sum of the least cost hull area across all cells in the landscape, divided by the number of cells in the landscape (i.e., the mean least cost hull area for the landscape), divided by the maximum least cost hull area; multiplied by 100 to convert to a percentage.
Units	Percent
Range	0 ≤ TRAVERSE ≤ 100 TRAVERSE equals 0 when every cell is a separate patch and is surrounded by hostile patch types that prevent any movement (i.e., function as barriers). This is achieved when the resistance coefficients for all patch type(s) are greater than the user-specified bank account. TRAVERSE equals 100 when every cell is surrounded by minimally resistant patch types (i.e., resistance weight = 1). This can occur when the landscape consists of a single patch type or when all resistance coefficients are set to the minimum value. However, in the latter case, the use of this metric would be pointless.

The equation requires the following user-based inputs:

- Resistance coefficients
- Maximum least cost hull area

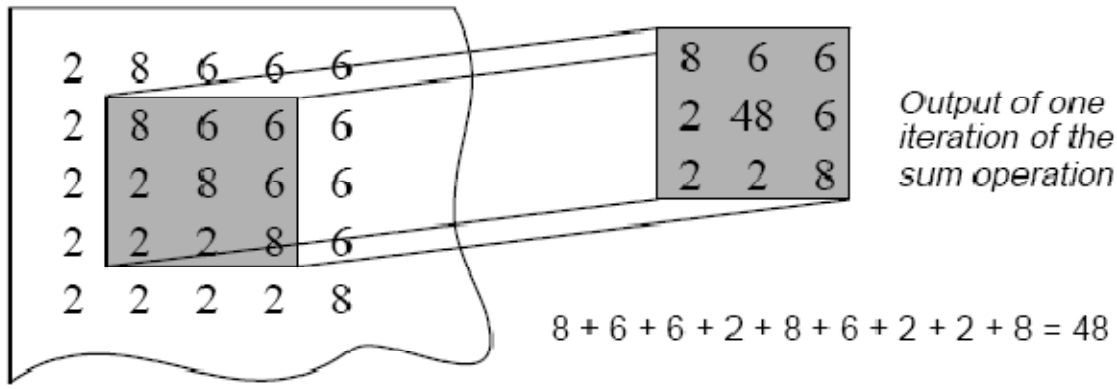
The first input is the resistance matrix containing coefficients for each combination of patch types. Using the 30m resolution 1995-2000 Kansas GAP Land Cover database, resistance values were assigned and recorded in the table below. It was assumed that some primary aspects of grassland bird movement include habitat acceptable for:

- Foraging,
- Breeding, and
- Nesting.

Resistance	Cover Type Name	Cover Type Code
1	Tallgrass Prairie	17
1	Sand Prairie	18
1	Western Wheatgrass Prairie	20
1	Mixed Prairie	22
2	Shortgrass Prairie	25
2	Non-Native Grassland	40
2	CRP (Conservation Reserve Program)	41
3	Alkali Sacaton Prairie	24
3	Grass Playa Lake	26
3	Weedy Upland	71
4	Sandstone Glade/Prairie	21
4	Salt Marsh/Prairie	27
4	Spikerush Playa Lake	28
4	Low or Wet Prairie	30
4	Mixed Prairie - Disturbed	60
5	Forb Playa Lake	38
5	Cultivated Land	44
5	Weedy Marsh	70
6	Playa Lake	29
7	Freshwater Marsh	31
7	Bulrush Marsh	32
7	Cattail Marsh	33

Resistance	Cover Type Name	Cover Type Code
8	Sandsage Shrubland	12
8	Willow Shrubland	14
8	Buttonbush (Swamp) Shrubland	15
8	Salt Cedar or Tamarisk Shrubland	42
9	Urban Areas	81
10	Maple - Basswood Forest	1
10	Oak - Hickory Forest	2
10	Post Oak - Blackjack Oak Forest	3
10	Pecan Floodplain Forest	4
10	Ash - Elm - Hackberry Floodplain Forest	5
10	Cottonwood Floodplain Forest	6
10	Mixed Oak Floodplain Forest	7
10	Bur Oak Floodplain Woodland	8
10	Mixed Oak Ravine Woodland	9
10	Post Oak - Blackjack Oak Woodland	10
10	Cottonwood Floodplain Woodland	11
10	Deciduous Forest - Mined Land	50
10	Maple Floodplain Forest	51
10	Evergreen Forest - Disturbed Land	52
10	Deciduous Woodland	55
10	Water	82

A neighborhood operation was performed on each cell to examine the surrounding resistance values and return the mean value to the focal cell.



**Example of neighborhood operation using sum instead of mean for the focal output.*

All resistance values within the band were averaged, resulting in a mean resistance value for the entire landscape.

A linear relationship was assumed between the mean resistance(R) value and least cost hull area.

y = m(x) + b

y = least cost hull area

m = $\frac{t_{\min} - t_{max}}{R_{min} - R_{max}}$

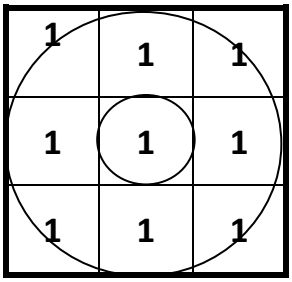
x = R

b = R_{max}(y)

The following equation was used for this analysis:

least cost hull area = 628.319(R) + 6283.186

The maximum least cost hull area is the other user defined input. It determines the maximum area that can be traversed if all surrounding cells have the minimum resistance value. This can be thought of as the area of a circle contained in the 8-cell neighborhood, as shown below.



The mean least cost hull area will vary by species, but for the purposes of calculations, it was assumed that grassland birds could move one cell(30m) in any direction.

The results for this detailed analysis show that the impact of the Project to traversability in the region is equal to 0.38 percent, a value consistent with the more simple method and providing a similar basis for conclusions.