

# Protecting open space at multiple scales along Utah's Wasatch Front

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## Abstract

Utah ranks among the nation's fastest growing states, fueled by high rates of natural population increase and in-migration. During the 1990s, as the loss of open space accelerated, communities enacted policies to control growth and protect open space. In Davis County, a Shorelands Plan was adopted in 2001 to protect important wetlands along the Great Salt Lake (GSL). A year later, a 5-county Wasatch Open Space Plan was developed covering 2.7 million hectares (6.7 million acres). This later Plan identified regionally-significant open space, as well as areas important for the protection of public health, safety, and welfare. Although the Shorelands Plan provided specific land use recommendations and implementation strategies, its limited geographic scope lacked the larger contextual perspective embodied in the Wasatch Plan. Conversely, the spatial detail of the Shorelands Plan provided levels of resolution not possible in the 5-county Wasatch Plan. This paper demonstrates how the specific land use designations of the Shorelands Plan (1:24,000 scale) can be integrated within the larger scale regional connectivity of the Wasatch Plan (1:100,000 scale) in order to arrive at a spatially explicit, county-wide model for open space protection.

*Keywords:* ecosystem services, environmental planning, development, sprawl, urbanization, wetlands protection.

## 1 Introduction

Mormon settlers entered Utah's Great Salt Lake (GSL) Valley in 1846 and quickly began transforming the arid, high-desert basin into an ordered agrarian landscape. An elaborate system of reservoirs and irrigation canals fed by



abundant snowmelt from the Wasatch Mountains gave life to fields, orchards, and a rapidly growing human population. Over the next 150 years, the Basin's population grew to over 2 million, and the Valley became a highly-fragmented matrix of urban and suburban development with remnant patches of agricultural lands and natural areas.

Today, Utah has one of the nation's fastest growing populations, with its population of 2.4 million expected to increase 44% by 2030 (U.S. Census Bureau [1]). Such rapid growth has fueled efforts to control growth and protect open space. In Davis County, located north of Salt Lake City, municipalities were concerned about the pace of growth and potential loss of GSL wetlands. In 2001, the County adopted a Shorelands Plan to guide development and protection efforts for the wetlands (Davis County Council of Governments [2]).

A year later, a 5-county Wasatch Open Space Plan was prepared for the Wasatch Front Regional Council (WFRC). The Wasatch Plan covered 2.7 million ha (6.7 million ac) and identified regions of future conflict by comparing areas of likely future development with regionally-significant open space, including landscape features important for maintaining public health, safety, and welfare (Toth *et al.* [3]). The landscape patterns identified in the Wasatch Plan suggested a generalized pattern of open space that, if preserved, enhanced, or restored, could provide ecological and social benefits to residents.

Although the Shorelands Plan provides specific land use recommendations and implementation strategies, its limited geographic scope lacked the larger contextual perspective embodied in the Wasatch Plan. Conversely, the spatial detail of the Shorelands Plan provided levels of resolution not possible at the 5-county level. To bridge the gap, this paper demonstrates how the specific land use designations of the Shorelands Plan (1:24,000 scale) can be integrated within the larger scale regional connectivity of the Wasatch Plan (1:100,000 scale) in order to arrive at a spatially explicit open space protection strategy.

The objectives of this paper are to: (1) identify important open spaces in Davis County, with special reference to riparian corridors as linear features that provide landscape connectivity for both human and ecological systems; (2) characterize current development patterns and identify where pattern changes could be made to preserve and enhance quality of life and ecological function; and (3) estimate the amount of land available for future development under alternative housing densities and levels of open space protection.

## 2 Study area

Davis County covers a land area of 68,635 ha (169,600 ac) within the GSL Valley (Figure 1). The County is bounded on the east by the Wasatch Mountains and on the west by the GSL. Major protected areas include Antelope Island State Park within the GSL, and the Wasatch National Forest along the County's eastern edge (Figure 1).

As shown in Figure 1, rapid population growth and residential development have altered much of the GSL Valley's landscape, leaving a sliver of wetlands along the shores of the Lake. Indeed, between 1990 and 2000, the County added



51,106 new residents – an increase of nearly 30% (U.S. Census Bureau [1]). As a result, the many forested riparian corridors that once linked higher elevation flora and faunal communities with lower elevation wetlands are largely absent in Figure 1. Also at risk are the County's remaining agricultural soils – some of the most productive in the state. Indeed, Busch *et al.* [4] estimated that across the broader Wasatch region nearly 44,515 ha (110,000 ac) of prime agricultural soils had been lost to development by the year 2000 – roughly one-third of the region's total. Based on population projections and settlement patterns, the region was predicted to lose an additional 32,375 ha (80,000 ac) by 2030.

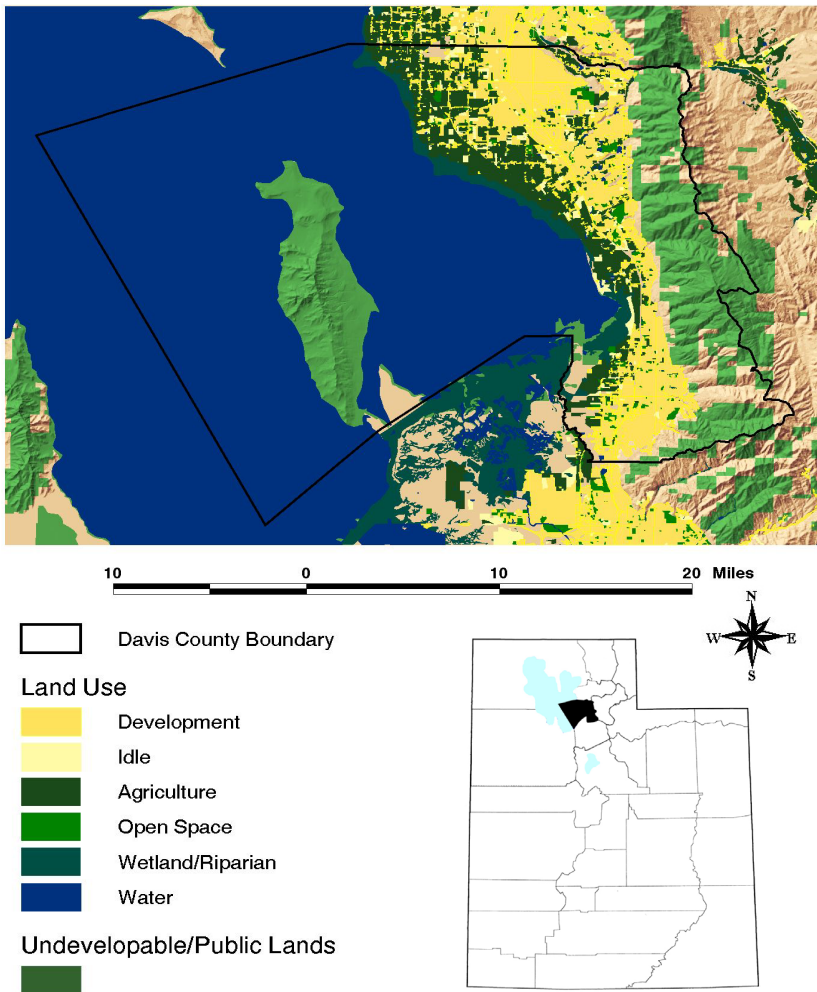


Figure 1: Developed lands and remaining open space, Davis County, Utah.

### 3 Methods

Integrating the Shorelands and Wasatch Plans to provide a consistent guide to open space protection required several steps. First, landscape features considered by each plan were described and evaluated in order to develop a comprehensive list of data layers important for open space protection. GIS layers of these land characteristics were then acquired at a 1:24,000 scale when possible. Most data were acquired from the Utah Automated Geographic Reference Center website (AGRC [5]). Some finer-grained soils data were obtained from the on-line National SSURGO database (USDA [6]).

Once these GIS data layers were gathered, they were used to spatially depict important open space concepts from both plans. For example, overlaying current development with the open space data layers revealed various patterns of open space across the study area. Depicting Davis County at this higher level of resolution allowed us to delineate streams, irrigation canals, and buffer zones that were indistinguishable at larger scales. The ability to integrate these smaller, linear features with larger patches of open space made it possible to examine open space connectivity in detail. Finally, by looking at future population projections and growth trends, future open space patterns and preservation options could be analyzed.

### 4 Results

Increasing the resolution of the Davis County portion of the Wasatch Plan to match the Shorelands Plan revealed the county-wide open space pattern depicted in Figure 2. In order to spatially display options for future development under different levels of protection, landscape features important for open space were sequentially removed from the current developable area to create a series of scenarios ranging from low to high open space protection (i.e., Scenarios 1 through 11 in Table 1, respectively).

A critical question for Davis County is to decide which, if any, open space layers are suited for protection. For example, the first six data layers that comprise Scenario 6 incorporate many natural landscape features considered critical to both human and natural systems. Scenarios 7 and 8 add the protection of existing agricultural lands – areas important for food security, quality-of-life, community character, economic stability, and wildlife habitat.

Comparing Figures 1 and 2 reveals that many east/west corridors linking the Wasatch Mountains to the Valley floor have already been severed. As a result, many patches of remnant vegetation have been isolated, degraded, or destroyed. These connections are not only important in maintaining ecological processes in the County, but serve as well to ensure water quality and quantity (Rudd *et al.* [7]). Indeed, restoring riparian corridors as part of a larger effort to protect open space is particularly important in Utah, where despite the region's arid setting, residents use over 1100 liters (300 gallons) of culinary water/person/day – the second highest level of consumption in the U.S. (UDWR [8]). Current population projections of 380,000 County residents by 2020 (Davis County



Government [9]) and a limited water supply suggest that residents will need to reduce their consumption of culinary water. Indeed, according to the Utah Division of Water Resources [8], the Weber River Basin, which passes through Davis County, will be fully utilized for culinary use by 2040. By 2050, demand is estimated at 442 million m<sup>3</sup>/year (358,000 acre-feet/year), far surpassing the Weber River's annual supply of 324 million m<sup>3</sup>/year (263,000 acre-feet). Even under an assumed 25% reduction in use due to conservation measures, culinary water demand is expected to exceed supply by 27 million m<sup>3</sup>/year (22,000 acre-feet/year) in 2050.

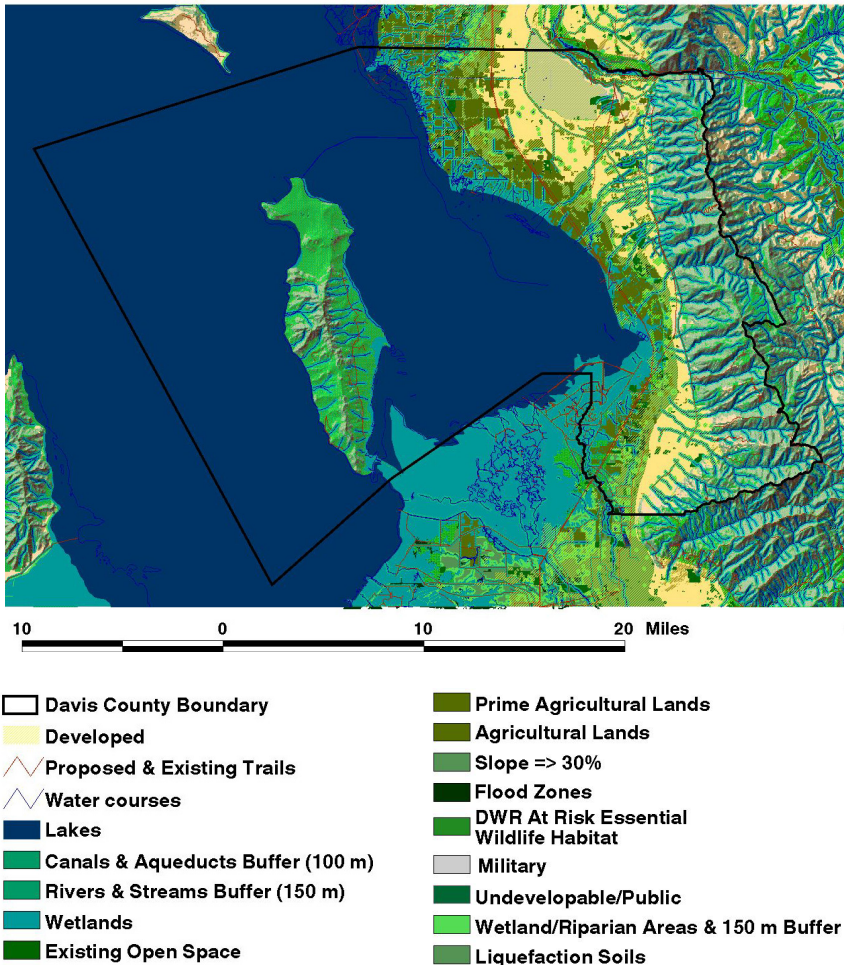


Figure 2: Current development and open space protected under Scenario 11 (maximum protection).

Table 1: Area available for development under different levels of open space protection.

Scenario	Landscape features removed for protection	Area remaining for new development (1000 ha)	
1	Public lands, water bodies, existing development	22.2	100%
2	All above + river and stream buffers	15.4	70%
3	All above + flood zones	14.2	64%
4	All above + wetland/riparian areas and buffers	8.6	39%
5	All above + slopes greater than 30%	6.1	28%
6	All above + prime agricultural lands	2.6	12%
7	All above + all existing agricultural lands	2.2	10%
8	All above + essential wildlife habitat	2.1	10%
9	All above + canals, aqueducts, and buffers	1.9	8%
10	All above + high liquefaction soils	1.5	7%
11	All above + proposed and existing trails	1.5	7%

5 Discussion

The open space protection scenarios described above provide a starting point for assessing the impacts of growth on open space. These scenarios can be combined with population forecasts and assumptions of household size and housing density to estimate the area likely to be developed over the next 20 years.

For example, Scenario 1 reveals that there are 22,200 ha (54,857 ac) of developable land currently available in Davis County – an area more than twice the 8,640 ha (21,350 ac) currently developed. Based on existing housing densities and population forecasts, these remaining open spaces will be converted to development by 2055.

Davis County has a number of options to control growth and protect open space. For example, between 2000 and 2020, an additional 47,900 households are expected to locate in the County (ECONorthwest [10]). Under the current housing density of 0.12 ha/household (0.30 ac/household) (Table 2), Scenario 5 in Table 1 would meet projected housing needs. If, however, housing densities were to increase and policies favoring community reuse and infill were implemented, additional lands could be protected. For example, increased housing options (e.g., apartments, multiplexes, townhomes, etc.) combined with a moderate increase in single family housing density (i.e., from 0.12 ha to 0.07 ha, or 0.30 ac to 0.17 ac) would save an additional 2,520 ha (6,228 ac) of open space by 2020. Table 2 shows various housing densities and the additional land needed for development by 2020. Taking a longer view, if average lot size was reduced to 0.20 acres/household, the County would have an additional 10,234 ha (25,293 ac) of open space in 2055. The range of housing mixes and lot sizes depicted in Table 2 were developed by Envision Utah [11] based on extensive public input and study. In this paper, we demonstrate the benefit of simply increasing the density of single family housing while keeping the housing mix



the same as the determined future trend. It is important to note, however, that it would be simple to calculate the additional land area that could be saved for open space under scenarios with higher percentages of apartments and/or townhomes/duplex style housing.

Table 2: Area needed to accommodate 47,900 new households under various housing densities (ECONorthwest [10], Envision Utah [11,12]).

Housing type	Housing mix (%)	Average lot size by housing type	Weighted average lot size	Additional land developed 2000-2020
Current density	na	0.12 ha (0.30 ac)	0.12 ha (0.30 ac)	5,815 ha (14,368 ac)
Current zoning				
Single family	77%	0.15 ha (0.37 ac)	0.11 ha (0.26 ac)	5,039 ha (12,452 ac)
Apartments	14%	0.02 ha (0.06 ac)		
Townhomes/duplexes	9%	0.01 ha (0.03 ac)		
Likely future trend				
Single family	60%	0.15 ha (0.37 ac)	0.10 ha (0.24 ac)	4,652 ha (11,495 ac)
Apartments	26%	0.02 ha (0.06 ac)		
Town Townhomes/duplexes	14%	0.01 ha (0.03 ac)		
Low increase in single family density				
Single family	60%	0.12 ha (0.30 ac)	0.08 ha (0.20 ac)	3,876 ha (9,579 ac)
Apartments	26%	0.02 ha (0.06 ac)		
Townhomes/duplexes	14%	0.01 ha (0.03 ac)		
Moderate increase in single family density				
Single family	60%	0.10 ha (0.25 ac)	0.07 ha (0.17 ac)	3,295 ha (8,142 ac)
Apartments	26%	0.02 ha (0.06 ac)		
Townhomes/duplexes	14%	0.01 ha (0.03 ac)		



Encouraging higher housing densities to protect open space would allow Davis County to protect and “re-connect” vital east/west corridors linking the Wasatch Mountains to the GSL. Depending on community needs and resources, it may be necessary in some cases to acquire land, day-light streams, or restore riparian areas to re-establish connectivity. Johnson [13] notes the importance of corridors as parts of a larger system of open space patches, explaining that “the long-term value of corridors is highly dependent on the health of the adjacent landscape and large patches of native vegetation.” Johnson continues: “the puzzle can be completed through public and private landowner partnerships, passing on to future generations the rich wildlife and scenic heritage our nation has come to cherish” (Johnson [13]).

Rudd *et al.*'s [7] analysis of connectivity in urban green spaces found that the best alternative for green space connectivity benefiting urban wildlife included a network covering the whole study region with a high degree of connectivity. Their research demonstrated that many links were created through backyard habitat and other urban spaces. These spaces contributed significantly to an overall connected network of open space. According to Rudd *et al.* [7], “it is important to remember that preserving parks is only part of the solution. Without connections between them, isolation and loss of genetic diversity is imminent.” These findings suggest that it will be important to create and preserve links from the mountains to the valleys, and between all existing open spaces in Davis County.

## 6 Conclusions

This study integrated large- and small-scale open space plans in order to capture the advantages afforded by each. The result demonstrated how a county-wide pattern of open space could be developed with sufficient detail to allow planners to begin to identify specific strategies and sites for protection.

A wide range of options are available to protect open spaces and areas important for public health, safety, and welfare (Fausold and Lilieholm [14]). These range from zoning strategies that reduce lot size and increase housing options, to residential infill and water conservation policies. By bringing different planning scales together and establishing a framework of open space patches and linked corridors, this study, which shows patterns where land use change or preservation is important, can lead to the planning decisions and lifestyle modifications that will have a positive effect on the future of Davis County.

In this regard, we identified waterways as vital east/west corridors connecting otherwise isolated patches of open space. Protecting remaining riparian corridors and restoring those lost under past development would provide a host of ecological benefits, including floral, faunal, and aquatic habitat. In addition, these networks of open space could provide recreational opportunities while enhancing water filtration, soil stability, visual aesthetics, and flood control.





## Acknowledgements

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## References

- [1] U.S. Census Bureau. State and County QuickFacts, Online. <http://quickfacts.census.gov/qfd/states/49000.html>
- [2] Davis County Council of Governments, *Davis County Shorelands Comprehensive Land Use Master Plan*, Davis County Council of Governments in Partnership with The Nature Conservancy of Utah and Envision Utah: Davis County, UT, 2001.
- [3] Toth, R.E., Edwards, Jr., T.C., Lilieholm, R.J., Bell, D.L. & Buteau, E.R., *Alternative Futures for Utah's Wasatch Front: Bioregional Planning for the Maintenance and Conservation of Open Space*, Final Project Report No. 2002-2, Utah Cooperative Fish and Wildlife Research Unit, Utah State University: Logan, 2002.
- [4] Busch, G., Lilieholm, R.J., Toth, R.E. & Edwards, Jr., T.C., *Alternative Future Growth Scenarios for Utah's Wasatch Front: Assessing the Impacts of Development on the Loss of Prime Agricultural Lands, Ecology and the Environment*, **81**, pp. 247-256, 2005.
- [5] Utah Automated Geographic Reference Center (AGRC). State of Utah – Division of Information Technology Services, Geographic Data, Online. <http://www.agrc.utah.gov>
- [6] U.S. Department of Agriculture (USDA), Soil Survey Geographic (SSURGO) Database, Natural Resource Conservation Service, National Cartography and Geospatial Center, Online. [http://www.ftw.nrcs.usda.gov/ssur\\_data.html](http://www.ftw.nrcs.usda.gov/ssur_data.html). 2002
- [7] Rudd, H., Vala, J. & Schaefer, V., Importance of Backyard Habitat in a Comprehensive Biodiversity Conservation Strategy: A Connectivity Analysis of Urban Green Spaces. *Restoration Ecology*, **10(2)**, pp. 368-375, 2002.
- [8] Utah Division of Water Resources (UDWR), The Utah Water Data Book, Online. <http://www.water.utah.gov/brochures/wrdatabk.pdf>
- [9] Davis County Government, Population, Online. <http://www.co.davis.ut.us/discoverdavis/demographics/population.cfm>
- [10] ECONorthwest, Greater Wasatch Area Housing Analysis, Prepared for Envision Utah by ECONorthwest with Free and Associates, Online. <http://www.envisionutah.org>
- [11] Envision Utah, *Urban Planning Tools for Quality Growth*, Envision Utah: A Partnership for Quality Growth: Salt Lake City, UT, 2000.
- [12] Envision Utah, *Model Codes and Analysis Tools for Quality Growth*, Envision Utah: A Partnership for Quality Growth: Salt Lake City, UT, 2000.



- [13] Johnson, C.W., Conservation Corridor Planning at the Landscape Level; Managing for Wildlife Habitat (Part 190). *National Biology Handbook*, United States Department of Agriculture, Natural Resources Conservation Service, 1999.
- [14] Fausold, C.F., & Lilieholm, R.J., The Economic Value of Open Space: A Review and Synthesis. *Environmental Management*, **23(3)**, pp. 307-320, 1999.

