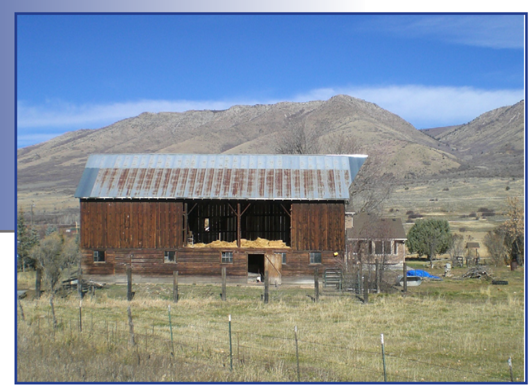
Alternative Futures 2030: Ogden Valley



Plan B Project

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2008-2009

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Ogden Valley

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Preface

Planning is a unique, diverse discipline, often caught between science and art. This discipline has a variety of different techniques, sub-disciplines, ideologies, and theoretical approaches. Each one of these different components asks unique questions which result in unique answers.

This study originated out of discussions between Utah State University, GEM, and Weber County in the Spring of 2008. The study's focus was regional and spatial in nature. Described below are some of the foundational portions of this study that hereafter are not mentioned, but which are still critically important. The theoretical approach driving this study is "Bounded Rationality" as described by Herbert Simon in his book, *Administrative Behavior*. The primary analysis is spatial in nature and conducted with Geographic Information Systems (GIS) software developed by ESRI. Given the focus on spatial analysis, this study would classify as physical or spatial planning.

This project is explicitly future-based and is rightly described as an "Alternative Future" study. This means that multiple spatially explicit futures (end points) are created and each "end point" is later analyzed and evaluated. By analyzing the effects of each future, the landscape will be better understood and make appropriate decisions can then be made concerning land-uses and development.

Finally, some might ask the question, "what justifies planning?" or "why not leave actions solely to market or economic forces?" Both of these questions, although related, are very important to answer and ultimately vitally important to understanding the justification for planning. I hope that this brief response can answer these questions.

The basic principles of market economics assume that individual freedoms, competitive markets, and complete situational knowledge will produce logical actions (Klosterman, 2003). However, quite often, none of these assumptions are met, thus producing a flawed economic situation for dealing with problems.

Additionally, aside from the violation of these assumptions, the typical market has four basic failures, which ultimately help to justify planning: public goods and free rider situations, externalities, prisoners' dilemma conditions, and imperfect distributional forces.

The combination of the failure to meet market assumptions and these market failures are the major justifications for planning (Campbell & Fainstein, 2003). Therefore, planning needs to supplement the economic system in specific situations and vice versa.

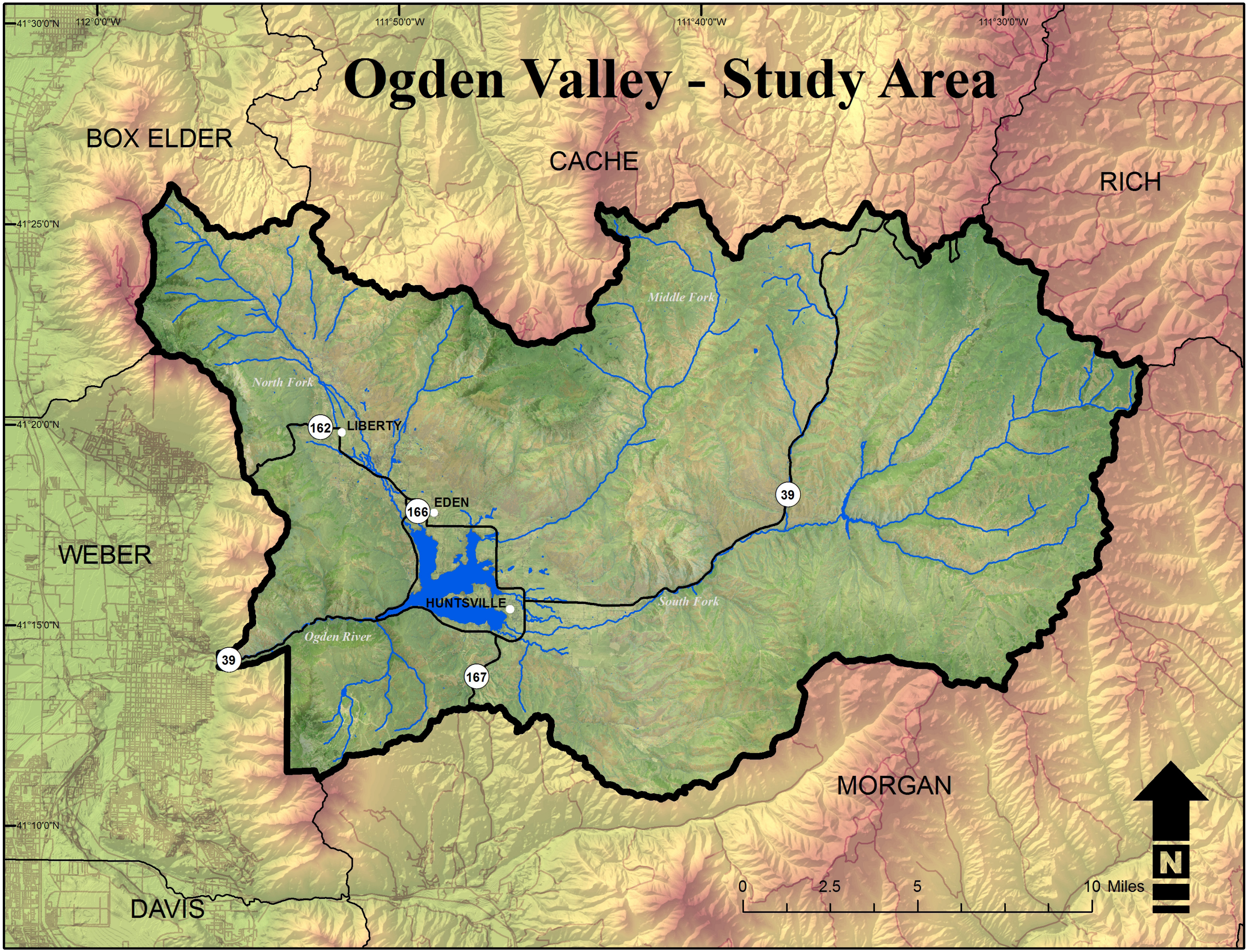


Figure 1: Context Map

Introduction

Ogden Valley is a high mountain community located in the northern Wasatch Mountain Range (Figure 1), and is located entirely within Weber County, Utah. Three communities sit within the valley: Huntsville, Eden, and Liberty. Early Mormon settlers established these communities in the mid-1800s; however, only the town of Huntsville is incorporated.

The rural valley is in close proximity to the densely populated Wasatch Front, in particular, Ogden City. Ogden Valley is approximately 331 square miles and has an elevation that ranges between 4400 and 9700 feet. This wide range in elevation provides a diverse environment for humans, wildlife, and vegetation.

Figure 2: View from North Ogden Divide, overlooking Liberty, Utah.

Ogden Valley contains a mixture of development intensity and types. Aside from the three towns, there are several recreation destinations such as ski areas, resorts, and recreation areas. In recent years, both summer and winter recreation has increased within the area. Historically, much of Ogden Valley was in agricultural production, both farming and ranching. Currently, both agriculture and recreation-based land-uses extend throughout much of the landscape.

The natural features of the area provide excellent resources for residents and visitors. The valley bottom is excellent for development, agriculture, and wildlife habitat. Comparatively, the mountains that encircle the valley provide scenic beauty, outdoor recreation, and natural amenities. In contrast to these features, at the heart of Ogden Valley is Pineview Reservoir and the North, Middle, and South Forks of the Ogden River. This network of streams crisscrosses the valley to form distinct areas and feeds the reservoir system. Furthermore, this network of streams and lakes gives life to the valley's wildlife and human populations.

Ogden Valley is a semi-contained area and needs planning at a regional level. The management of appropriate residential growth, while preserving the valley's character is a problem, and is thus the primary focus of this alternative future study.

Ogden Valley Methodology

Several key components within this approach originate from earlier planning methodologies. It is important to acknowledge the past work of these planners and their influences upon the methodology used for this study.

Despite differences in context and field of study, these approaches contain similar components. The three approaches that influenced this methodology developed and used here are:

- A Planning and Design Methodology (Toth, 1974)
- Ideal-Typical Decision Model (Friedmann, 1996)
- Political Feedback Strategy (Brooks, 1996)

Figure 3: Aerial view of Huntsville, Ogden Valley, Utah.

Six general phases compose the methodology for this alternative futures study (Figure 5). These phases group general tasks together and help guide the planning process.

Planning Methodology
1. Problem Formulation
2. Background Research
3. Development of Evaluations
4. Development of Alternative Futures
5. Evaluation of Alternatives
6. Conclusions

The process begins with the formulation of a problem. First, a problem is tentatively defined and outlined for a specific area. Next, issues are identified and discussed within a regional context, and last, a preliminary study area is defined.

The second phase includes background research and data collection. At this point, a regional inventory is outlined for the study area, which helps redefine the pertinent issues. Additionally, a database of information is collected, which includes both spatial and analytical data.

In the third phase, evaluation creation, the planner creates evaluators that incorporate the issues previously defined and that address the original problem. Critically, the third phase needs to occur before the creation of alternatives so that the planner avoids evaluation bias.

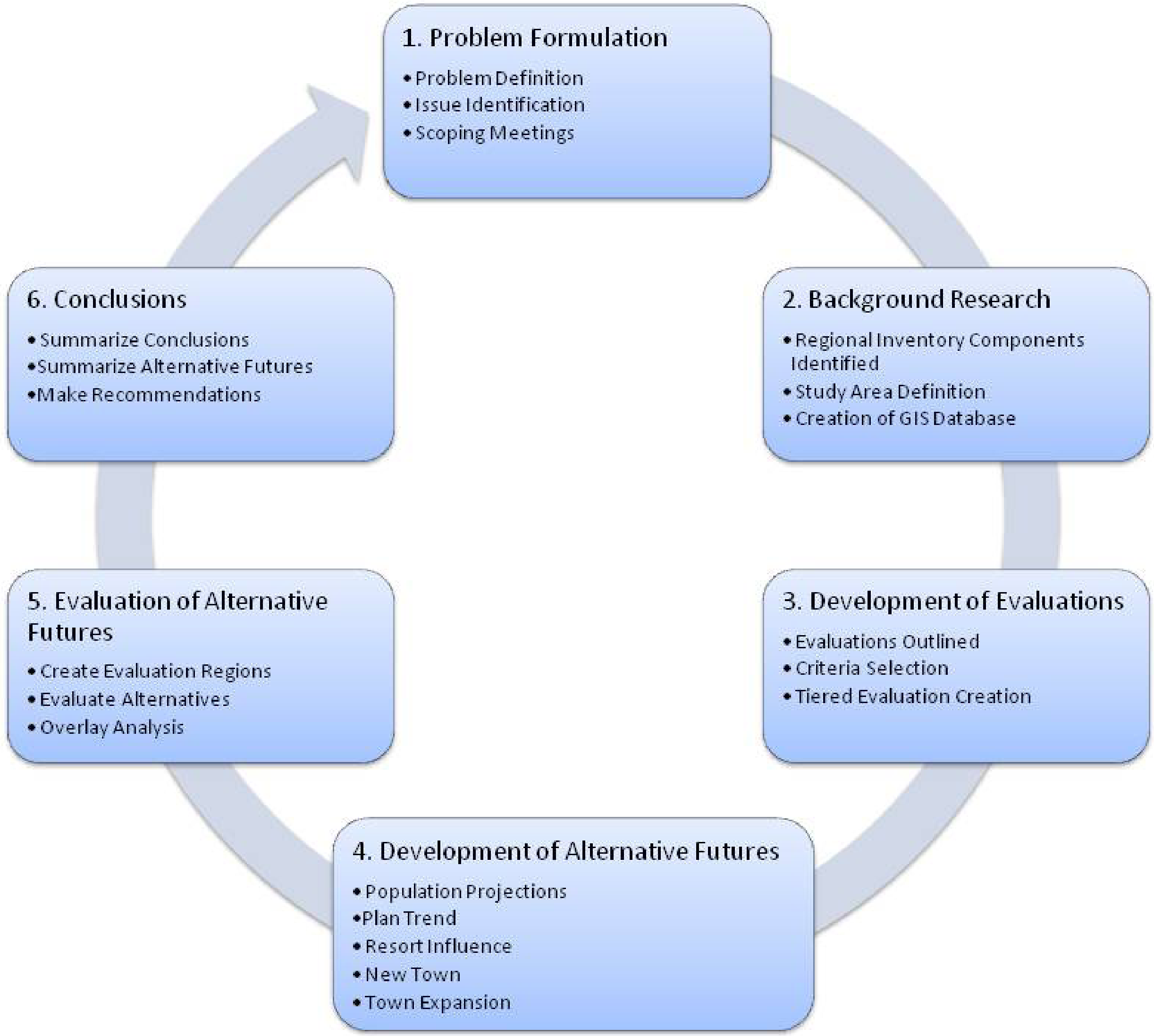


Figure 4: Planning methodology diagram. This is a six-phase process adapted to fit the needs of Ogden Valley and the project horizon.

The fourth phase within the methodology is the creation of alternative futures. This is an extrapolation process by which some change agent is projected over a specified time. This study uses growth in residential developments as the change agent, and the temporal component is approximately 20 years in the future.

The fifth phase is the evaluation of the different alternatives by the evaluations developed in phase three. The evaluation process is critical within any planning method because, without evaluations, there is no way to tell the level of impacts in the future.

The last and sixth phase is a summary of alternative futures and recommendations in the conclusion section.

Ideally, this methodology should extend two additional steps with implementation and monitoring phases. However, given the scope of this study and the constraints upon it, adding these steps would not be realistic or feasible; therefore, their inclusion within this planning methodology was not appropriate.

Identification of Issues

The issues identified within this study describe some of the basic concerns of the stakeholder group (Table 1). By no means are they to be viewed as all-inclusive but rather, they are to highlight some of the major concerns facing the valley.

The issues were tabulated through document research, scoping meetings, and stakeholder comments. The primary documents used were the *Ogden Valley General Plan* and *Ogden Valley General Plan: Recreation Element.* These documents contain guidance and objectives for Ogden Valley, and several of the issues originate from them. Next, scoping meetings to discuss potential valley issues occurred on May 30, June 24, and July 2, 2008. Following these meetings and research, a preliminary description of identified issues was developed and sent to the stakeholders for comment on July 24. After receiving responses from stakeholders, the issues were finalized but not prioritized. The issues include:

- Preserving a rural atmosphere and lifestyle
- Wildlife and wildlife habitat conservation
- Preservation of scenic beauty
- Protection of water resources
- Protection of air quality
- Ensuring appropriate development
- Developing the social service infrastructure

Rural Atmosphere and Lifestyle

Ogden Valley residents often view their valley as rural and enjoy a lifestyle associated with living close to the land. They have a heritage of agricultural activity and production that extends back to the 1850's. Although not a large industry in the valley, residents hold agriculture and ranching in high regard.

Wildlife and Habitat

The protection of wildlife and wildlife habitat is a very important issue to many residents in Ogden Valley. The residents' proximity to wildlands allows them a personal view of wildlife in their natural setting. Mentioned frequently throughout their documents and in stakeholder meetings as their concern, attention, and devotion for local wildlife and habitat.

Scenic Beauty

At the heart of the valley is Pineview Reservoir, whose waters stretch in three distinct directions and come together at the head of Ogden Canyon. Additionally, mountain ranges which climb to 9,000 feet surround the valley floor. Ogden Valley has both natural and rural beauty. Preservation of this beautiful area is a concern of residents and visitors alike.

Water Resources

Like most communities, water resources are a vital component of both the natural and human environment. It is important to remember both surface and groundwater sources are critical to overall water quality. The surface waters include the reservoirs, lakes, streams, wetlands, and springs. Groundwater resources include aquifers and recharge zones. These water resources provide drinking water for both Ogden Valley and Wasatch Front residents. Additionally, these water resources help to nourish farms and wildlife, and serve as a natural form of pollution control. All of these important and vital uses of water contribute to its inclusion within the range of issues.

Air Quality

Similar to the issue of water resources, air quality is a major concern for valley residents living in the intermountain west. The combination of climate, topography, and pollution can create serious health problems. Currently, the air quality in Ogden Valley is very healthy; however, future growth and development can influence these standards and degrade the quality of air. Additionally, poor air quality threatens the scenic beauty and rural atmosphere of the valley, which is why protection of this resource is important to consider at an early stage of development.

Residential Development

Development within Ogden Valley has occurred at a rapid pace, and has primarily been for residential homes, both seasonal and full-time. The location of the development includes the valley floor and extends into the mountains. In certain places, this can potentially put people and property at risk. Additionally, unplanned growth can threaten many other landscape features that residents value. As new growth continues, many external issues such as increases in traffic, limited resources, and competition between resources need attention. Growth is a critical issue currently and will continue to be in the future.

Social Service Infrastructure

The term “social service infrastructure” refers to specific services that any community needs to provide for its citizens. Some of these services include schools, hospitals, fire stations, and commercial areas. As growth continues, access to these services will increase at a dramatic rate. At some point in the future, traveling from Ogden Valley down to the Wasatch Front will no longer be a quick and easy trip as traffic increases and cheap fuel is no longer available. In order to maintain a high quality of life for valley residents, these services and others such as public transportation will need further attention.

Familiarization Period

Establishing a comprehensive familiarity with a landscape is a very difficult process. In this study, several activities helped to develop this familiarity with Ogden Valley. These activities included project meetings, personal communications, site visits, and literature research. The combination of these activities allowed for a basic understanding, which led to the regional inventory research and documentation.

Stakeholder Meetings

The activities that went into stakeholder meetings generally consisted of presentations, review of project items, and discussions about concerns and issues. A variety of people attended these meetings, including GEM members, landowners, ski industry representatives, Weber County officials, and others. Stakeholders were selected as advised by the GEM committee. Given the scope of the study, having public meetings or valley-wide participation was not an option. Meetings were held either at the Huntsville Library or Weber County Office Building.

Meeting Dates:

- Initial Meeting – May 1, 2008
- Stakeholder Meeting – May 30, 2008
- County Officials Presentation – June 24, 2008 (x2)
- County Officials Presentation – July 2, 2008
- Stakeholder Progress – January 14, 2009

Personal Communications

Personal communications consisted of e-mail, telephone conversations, pre- and post- meeting discussions, and other informal communications. These opportunities allowed stakeholders and county officials to express concerns, recommendations, or praise.

Site Visits

In combination with the other familiarization activities, site visits provided a personal experience with the valley itself. These visits consisted of two guided tours, four self-guided tours, and an aerial flight over the Ogden Valley. All of the visits provided a new and unique perspective of the area. The tour dates ranged between June 2008 and March 2009. The guided tours coincided with the county presentations and stakeholder meetings. The self-guided tours were taken to visit some areas with limited exposure during the guided visits. Additionally, the informal tours allowed for necessary data collection. Finally, the aerial flight over the valley provided an overview of the landscape. Furthermore, this view of Ogden Valley allowed for a better understanding of the development pattern undetectable from ground level.

Stakeholder Group

The formation of the stakeholder group was an important component within the study. This group of individuals served in a multitude of fashions and provided a variety of roles and responsibilities.

First, the stakeholders acted as clientele for the study (Table 1). They helped to define the issues and to what extent the issues needed addressing. They also helped to define evaluations and alternatives for the area, suggesting areas of interest, focus, and ideas for moving the study in a productive and helpful direction.

Second, this group acted as a quality control source for decision made within the study. Also, they provided refinement and criticism pertaining to the progress and development of the study.

Finally, the stakeholder group verified or double-checked the information going into and coming out of the study. All of these different stakeholder responsibilities helped the study progress with accuracy and reliability for Ogden Valley.

Table 1: Ogden Valley: Alternative Futures 2030 Stakeholder Group

Stakeholder Group		
Name	**Organization**	**Status Affiliation**
Steve Clarke	Ogden Valley Growth with Excellence Mandate (GEM)	Chairman
Robert Scott	Weber County	Planning Director
Scott Mendoza	Weber County	Planner
A.J. Roscoe	GEM	GEM Vice Chair
Kirk Langford	GEM	Ski Industry
Sharon Holmstrom	GEM	Former County Planning Comm.
Paul De Long	GEM	Consultant
Denzel Rowland	Snow Basin, GEM	General Manager
Steven Roberts	Wolf Creek Utah, GEM	Managing Partner
Rick Vallejos	USFS	Rec. Manager
Pam Kramer	UDWR	Habitat Biologist
Joan Blanchard	Large Landowner, GEM	(Self)
Jeff Burton	Large Landowner, GEM	(Self)
Richard Toth	Utah State Univ.	Professor/Advisor
Kim Wheatley	Ogden Valley Pathways, GEM	Chairman

Regional Inventory

Every landscape has different components which come together to form a complete environment. An example of this would be the way geology, soils, and climate help to determine vegetation and wildlife for an area. Separating the landscape into general categories or components helps to identify the relationships within an environment. The analysis within this study looks to uncover the relationships between these landscape components and then incorporate them into various decision-making strategies.

This study highlights a unique list of components that serve to best describe the area. The level of detail and extent of research behind each component varies given the context and role of that specific component within the environment. The information covered here serves to supplement the background knowledge gained as part of the site familiarization phase.

The following list details the components identified as important for this project. The information on each item was obtained through a literature search. Aside from gathering information which can later influence assessment models, alternative futures, and decision-making, this regional inventory acts as an overview for information, past and present, about the various landscape components within Ogden Valley.

Regional Inventory:

- Geology
- Soils
- Climate
- Hydrology
  - Groundwater
  - Surface Water
- Vegetation
- Wildlife
- History and Culture

The information provided in the following sections are only summaries of the larger research efforts in the regional inventory. These descriptions of landscape components are not intended to be encyclopedic, and only the most pertinent information is presented in these sections.

Geology

The geology of an area contains valuable information about that environment. Information can range from timelines and histories to descriptions about limiting or controlling factors of a landscape (Chronic, 1990). Within the context of this study, the geology directly references the lithosphere, or the upper layer (40-60 miles) of rock on the surface of the earth. The lithosphere contains three common rock types: sedimentary, igneous, and metamorphic rocks (Keller, 2002).

Extending throughout the middle of the Utah is the Wasatch Mountain Range. This mountain range is part of the larger Rocky Mountain Range that extends from Canada to Mexico in the western United States. The Wasatch Range acts as the backbone of Utah (Stokes, 1986). Areas of the Wasatch Mountain Range fall into three categories: Uinta Mountains, Wasatch Range, and Wasatch Plateau. Ogden Valley is located in the Wasatch Range, and this section is defined by complex formations and a steep western slope (Chronic, 1990).

Ogden Valley contains five physiographic sub-provinces from within the Rocky Mountain Range (Figure 5). The most substantial sub-province in the area is the Wasatch Hinterland. The following table lists the five physiographic sub-provinces and lists their square mileage and percentage area (Table 2).

Table 2: List of the physiographic provinces and areas within Ogden Valley, Utah.

Physiographic Provinces		
Physiographic Sub-provinces	**Sq. Mileage (Approx.)**	**Percent Area (Approx.)**
Wasatch Hinterlands	249	75%
Wasatch Range	78	23%
Bear River Plateau	3	1%
Wasatch Front Valley	.5	.5%
Bear River	.5	.5%
Total	331	100%

Rocks

The rocks in the Wasatch Range date between the Precambrian gneiss 2.6 b.y.a to Tertiary 35-45 m.y.a. (Chronic, 1990; Parry, 2005). These oldest Precambrian rocks extend throughout the western boundary of Ogden Valley. Beginning at Ogden Canyon, these rocks form the Farmington Complex Rock outcrop, which make up the cliffs in Ogden Canyon. They are thrust over younger Mississippian rocks around Pineview Reservoir. Precambrian rocks are also exposed at the Brigham Group outcrop along State Highway 39. Next, middle-aged rocks extend through Ogden Valley and Ogden Canyon. Some

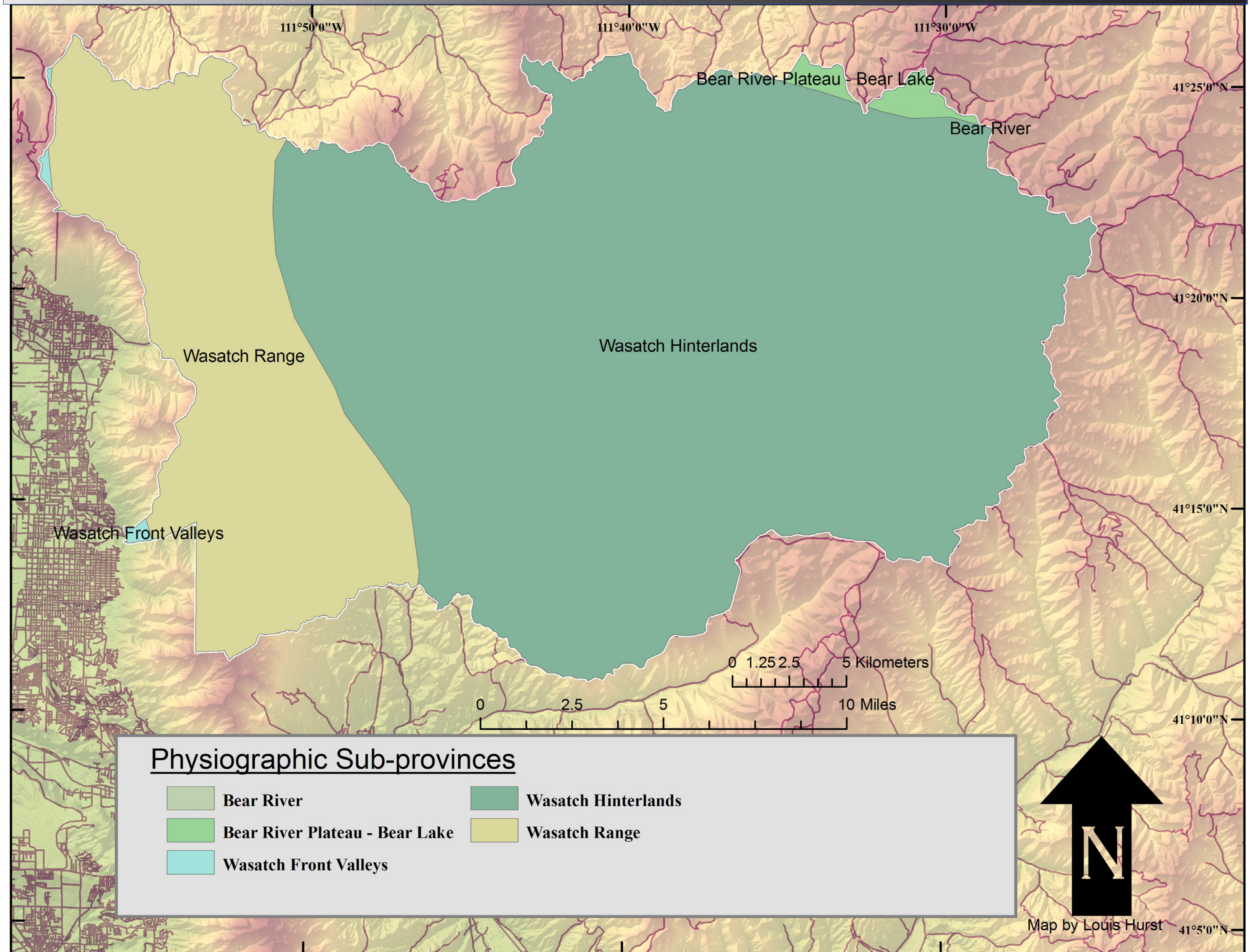


Figure 5: Physiographic provinces within Ogden Valley, Utah.

of these rocks include: Mississippian limestone, Devonian sandstone, Ordovician limestone, and Cambrian dolostone and limestone. Finally, the youngest Tertiary rocks are found in eastern Ogden Valley, such as Causey Reservoir and Hardware Ranch Junction Road. These rocks include quartzite, limestone, fossiliferous, and dolostone (Morgan, 1992).

Figure 6: Aerial view of Wasatch Mountain Range.

Formation

Formation of the Wasatch Range occurred due to a variety of events such as folding, faulting, igneous intrusions, glaciations, erosion from both inland seas and surface waters, and thrusting (Parry, 2005; Stokes, 1986; Utah Geological Survey, 2005). However, the Wasatch Range's Hinterland of Ogden Valley was formed due to normal faulting (Lowe & Wallace, 1999a). Normal faulting is ground subsidence, sinking, relative to the surrounding areas. Therefore, the valley's floor has dropped drown relative to the surrounding mountains. This ground movement occurs along fault edges and has resulted in up to 2,000 feet of vertical displacement over the past 11.2 million years (Lowe & Wallace, 1999a).

In terms of geologic units, Ogden Valley divides into three categories based upon age and degree of consolidation. The first division includes the mountains of the west, north, and east. They are steeply dipping rocks of the Proterozoic and Paleozoic. The second division lies along the eastern, western, and southern edges of Ogden Valley with rocks of sandstone and conglomerate materials. Lastly, the third division lies along the valley floor and margins. The valley floor has a mixture of Precambrian, Paleozoic, Tertiary, and Quaternary unconsolidated deposits. These unconsolidated deposits are primarily stream, alluvial fan, landslide, and lacustrine deposits (Lowe & Wallace, 1999a).

Soils

Although no agreed upon definition exists for soils, generally, soils make up the materials covering the earth's surface. Soils can vary in depth between a few millimeters to hundreds of feet thick (Gerrard, 2000). This resource provides the medium for plant growth and subsistence (Foth, 1990). Furthermore, soils perform critical ecosystem functions such as a conduction of the water cycle (Keller, 2002), carbon cycle, and nitrogen cycle (Gerrard, 2000). These cycles perform life-sustaining activities, and soils play a foundational role in each one. Additionally, soils help determine specific land-uses, costs of activities, and productivity. Given the integral nature of soils within the landscape, they are often looked at as a vital component to be understood.

There are ten total soil taxonomic orders in the world (Foth & Schafer, 1980). Of these ten soil orders, three soil taxonomic orders, Alfisols, Mollisols, and Vertisols, are found within Ogden Valley (Figure 8). These three groups cover approximately 97-percent of Ogden Valley, and the uncovered three percent is either water or exposed rock formations (Table 3). Soils are created through a combination of powers between the lithosphere, biosphere, atmosphere, and hydrosphere (Gerrard, 2000).

Table 3: Soil taxonomic orders and areas of coverage within Ogden Valley.

Soil Taxonomic Orders		
Soil Orders	**Sq. Milage (Approx.)**	**Percent Area (Approx.)**
Mollisols	305	92%
Alfisols	13	4%
Vertisols	3	1%
No Soils	10	3%
Total	331	100%

Figure 7: Southern end of Ogden Valley near Trappers Loop (Hwy. 167), an area with large amounts of Mollisols, or grassland soils.

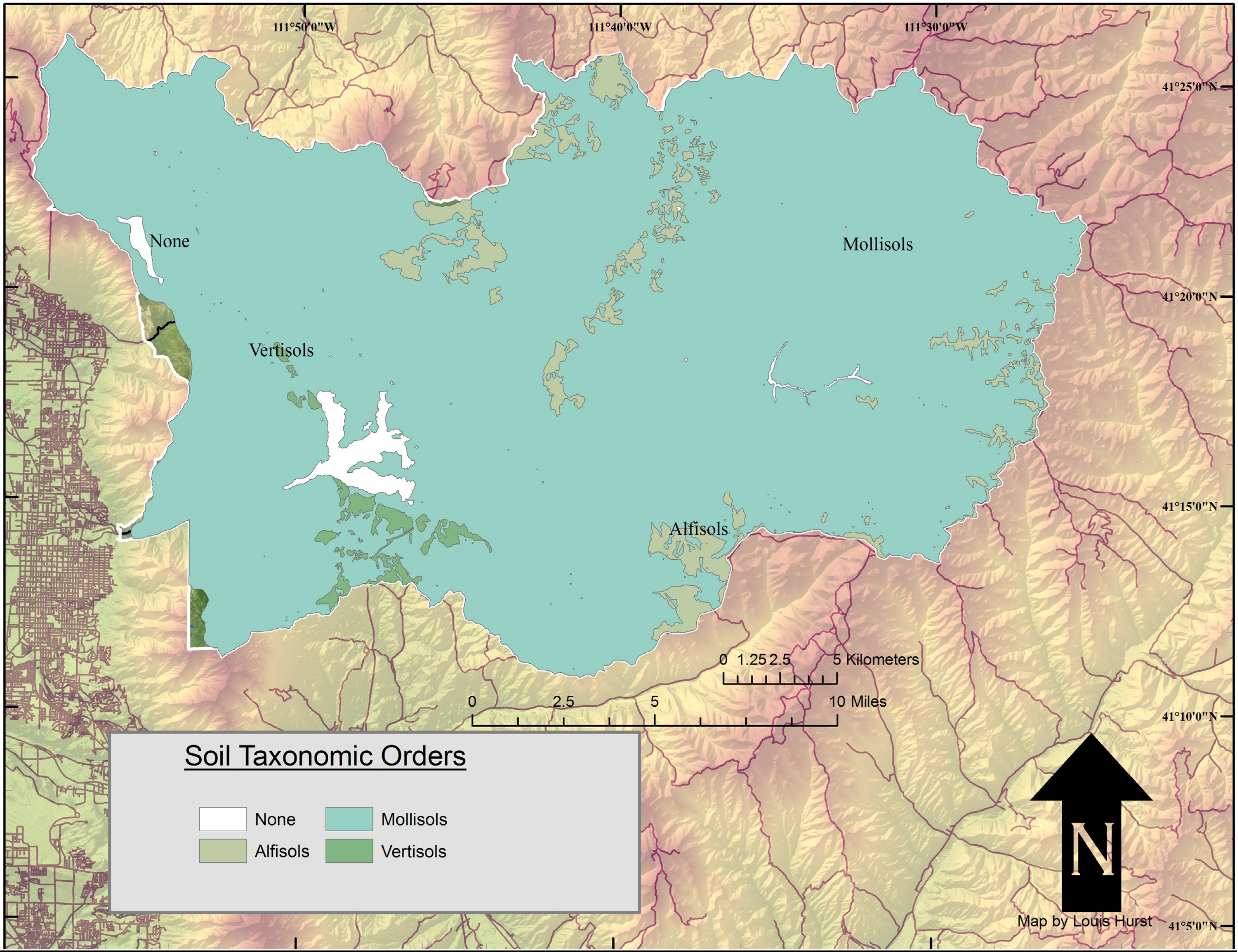


Figure 8: Soil taxonomic orders within Ogden Valley, Utah.

Mollisols

Mollisols have the meaning "soft soils" and they dominate grassland and steppe regions. Typically, drier desert soils and wetter forest soils border these Mollisols (Foth & Schafer, 1980). They are dark-colored, rich soils and they occur at high latitudes and altitudes (Gerrard, 2000). Mollisols are considered some of the most naturally fertile soils for agriculture when specific temperature and precipitation requirements are met, they can produce high yields of grains or other crops (Foth & Schafer, 1980). Mollisols are one reason for the agricultural heritage in Ogden Valley. Finally, these soils extend over 90-percent of Ogden Valley.

Alfisols

Alfisols are the second largest order within Ogden Valley, but make up only a small area, about 13 square miles. These soils are pedalfer in nature, meaning they have high concentrations of iron and alumina, with little carbonates (Foth & Schafer, 1980). Furthermore, these soils contain high quantities of water (Gerrard, 2000). Alfisols contain significant amounts of weatherable material. This material and water content allow for fertile soil (Foth & Schafer, 1980). Alfisols are quite similar to Mollisols, and typically, these soils appear near each other (Foth, 1990). The characteristics of high fertility and proximity to Mollisols are both confirmed within Ogden Valley.

Vertisols

The last soil order within Ogden Valley is the Vertisols, and they make up the smallest order found in the study area, taking up approximately 3 square miles. This soil order is not common within a regional or global context (Foth, 1990). Vertisols contain large amounts of clay that expand and contract under different moisture conditions (Gerrard, 2000). This expansion and contraction creates narrow ridges, basins, and cracks within the soils (Foth, 1990; Foth & Schafer, 1980; Gerrard, 2000). Generally, Vertisols contain very little organic matter and high levels of saturation (Gerrard, 2000). The characteristics of Vertisols such as high clay content, little organic material, and high saturation results in mixed results for agriculture production (Foth & Schafer, 1980).

Climate

Climate is the long-term effects of weather patterns within a specified area. Typically, temperature, precipitation, longitude/latitude, and evapotranspiration help determine climatic classification. The classification used within this study is a Modified Köppen Classification (Oliver & Hidore, 2002). Utah contains 3 climatic zones from this classification scheme, and Ogden Valley shows signs of all three within its boundaries (Greer et al., 1981; Lowe & Wallace, 1999b). These three climatic zones are Dry, Temperate, and Highland.

Figure 9: Area near Causey Reservoir that exhibits characteristics and vegetation of dry climates.

Dry Climates

The Dry Climate Zone classifies down to a level of semiarid mid-latitude (Greer et al., 1981). This sub-classification describes two things. First, the amount of precipitation within the semiarid climate is less than the total evapotranspiration, but more than half the evapotranspiration. Second, the mid-latitude location describes the climatic zone's location within a global context and gives information about temperature. This allows for quick deductions to be made, such as winters are cold and receive heavy precipitation, and summers are hot with little precipitation. These deductions are true for Ogden Valley. This type of semiarid climate is also referred to as Steppe. Lastly, this climatic zone lies within the valley floor and lowlands.

Temperate Climates

The Temperate Climate Zone classifies down further to a more specific level, the Humid Continental Hot Summer Zone (Greer et al., 1981). This zone receives more precipitation than evapotranspiration, but still has a cold winter season. Additionally, the Humid Continental Zone most likely goes into water deficit in the warmest summer months (Oliver & Hidore, 2002). This zone would likely be located on the benches of the valley where there is more precipitation and the temperature is slightly decreased compared to the valley floor. Lastly, this climatic zone acts as a transition zone from the Dry to Highland Climate.

Highland Climates

The Highland Climatic Zone is most unique of the three zones in Ogden Valley. This zone is not defined by temperature or precipitation; rather, elevation is the primary determinant for this zone (Figure 10). This is due to the dramatic shifts in weather patterns and climate around areas with large vertical elevation gains over short horizontal distances (Oliver & Hidore, 2002). Temperature and precipitation varies dramatically in these spaces and creates a unique climate zone. Ogden Valley contains several areas with rapid vertical elevation gain. These Highland climate areas flank the other two climatic zones encircling them.

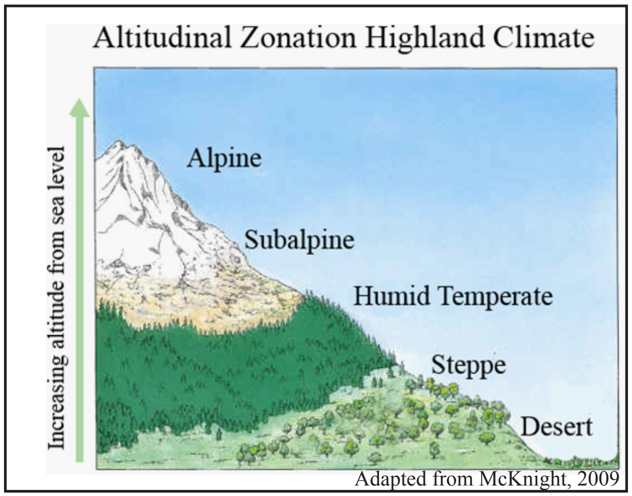


Figure 10: Highland climates are based upon rapid elevational gains and, as a result, they exhibit unique climatic characteristics.

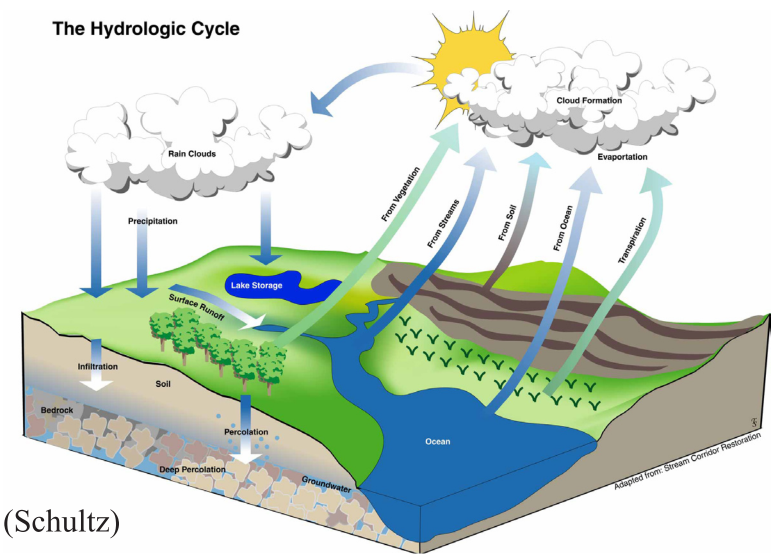
Observed Weather Patterns

The following provides more tangible information about weather and climate. These are direct weather observations and help to highlight some of the above-mentioned climatic descriptions. This weather data comes from Utah's cooperative weather stations, one of which is located at the Huntsville Monastery, elevation 4150 feet. The annual average temperature is 44.7° Fahrenheit. The hottest month of the year is typically July, with temperatures reaching the upper 80s. The coolest month of the year is typically January, with temperatures dropping into the single digits. This weather station has average annual precipitation around 21 inches and annual snowfall near 56 inches (Ashcroft, Jensen, & Brown, 1992).

Finally, as a way to compare the valley floor's weather and climate (dry and temperate) with the surrounding mountains (highland), the three ski resorts snow reports contrast the annual valley snowfall of 56 inches. The lowest annual estimate of snowfall for the resorts is that of Wolf Mountain with 249 inches, then Snowbasin with 392, and Powder Mountain with 479 inches (Pope & Brough, 1996). The sites are less than 15 miles as the crow flies from the Huntsville Monastery. This simple comparison illustrates the dramatic difference between climatic zones.

Hydrology

The hydrologic system (Figure 11) within Ogden Valley is divided into two sections. First are the surface water resources, such as the lakes, reservoirs, streams, and springs. Second are the groundwater resources like aquifers, recharge zones, and wells. Both of these water resources act in unison to create the Ogden Valley hydrologic system. However, to address each of these systems more accurately, they will be presented independently of each other.



(Schultz)

Figure 11: Diagram showing the hydrologic system and the interaction between different phases. Of importance are the surface water and groundwater interactions.

Both surface water and groundwater systems in Ogden Valley are functioning and free from major pollutants (Division of Water Quality, 2006). However, future concerns may develop primarily from increases in population growth. The potential risk to these water resources stem from activities such as septic systems, stream degradation, and water loss within streams and aquifers.

Surface Waters

Surface waters are those water resources that flow and rest upon the earth's surface (Keller, 2002). These resources are some of the most recognizable and defining characteristics within Ogden Valley, and are primarily the result of runoff from snowfall and waters that come from natural springs.

Reservoirs and Lakes

Ogden Valley does not contain any sizeable natural lakes within its boundary. However, there are several man-made reservoirs of noticeable size. Pineview Reservoir is the most visible and largest body of water within the valley, and is located at the top of Ogden Canyon. The dam was built to store drinking water for the Wasatch Front. The primary uses of Pineview Reservoir are storage of drinking water, swimming, boating, and fishing. This reservoir has a capacity of approximately 100,000 acre-feet (Division of

Water Quality, 1992a).

Similar to Pineview, the Bureau of Reclamation built Causey Reservoir and dam. However, this reservoir is much smaller with a capacity of only 8,700 acre-feet. Additionally, the water from this reservoir is primarily directed to agricultural processes, but recreation and culinary uses are still important. Causey Reservoir is located upon the South Fork of the Ogden River and its waters extend into three distinct canyons, all marked by vertical cliffs (Division of Water Quality, 1992b).

Rivers and Streams

The Ogden River is the major tributary within Ogden Valley and continues below Pineview Dam, and down Ogden Canyon. Above Pineview Reservoir there are three forks of the Ogden River: North, Middle, and South Forks and they are all perennial streams that feed Pineview. The North Fork of the Ogden River originates from ancient glacial deposits north of Liberty, and it follows a straight path with little meandering through the valley. This river passes the towns of Liberty and Eden and flows into Pineview Reservoir (Parry, 2008).

The Middle Fork of the Ogden River begins within the Bear River Range (Parry, 2008), and flows southwest to the reservoir. The Middle Fork flows to the east of the community of Eden and north of Huntsville, and empties into the middle section of Pineview Reservoir. The Middle Fork flows through wildlife management areas, and equestrian/walking trails flank this stream.

The South Fork of the Ogden River originates out of the Monte Cristo Range in the eastern-most areas of Ogden Valley (Parry, 2008). The Left and Right Forks of the South Fork feed Causey Reservoir. Below the dam is where they join and form the South Fork. Below Causey Dam, Highway 39 follows along the river bottom for nearly five miles. However, once the river reaches the valley floor, the South Fork runs further south and meets Pineview Reservoir south of Huntsville.

Figure 12: South Fork of the Ogden River running through U.S. Forest Service campgrounds.

There are also many tributary streams within Ogden Valley. Ultimately, all of these smaller streams feed the Ogden River and flow out of the valley. Many of the smaller streams in Ogden Valley are ephemeral, meaning they flow only during runoff periods or high water events.

Springs

Ogden Valley has close to 150 natural springs that can be attributed to several sources. In certain places, Ogden Valley has a shallow aquifer that allows underground water resources to surface as springs. Additionally, the area is geologically active with faults that allow these underground waters to break through to the surface. The springs within the area serve as a great way to measure the health of the aquifer and the water supply. If flow rates change, that can mean the aquifer feeding them is dropping or changing, so paying attention to these resources is important (Keller, 2002).

Groundwater Resources

In addition to the surface waters, Ogden Valley has a groundwater component that completes the hydrologic system. The groundwater system within Ogden Valley contains several parts including confined aquifers, unconfined aquifers, shallow aquifers, and recharge zones. Both valley and Wasatch Front residents depend upon these groundwater resources for culinary drinking water, so it is vitally important to preserve the quality and health of the groundwater resources in this area (Lowe & Wallace, 1999b).

Confined Aquifer

The confined aquifer is defined by a low permeable material that contains water. In Ogden Valley, this material is silt and clay left by a lacustrine deposit. This aquifer is beneath the western extent of the valley and at this point the confining layer is thickest. The confining layer decreases in thickness moving eastward, until it no longer exists near Eden. The flow of this aquifer is generally southward. The primary discharge from the confined aquifer is well water (Lowe & Wallace, 1999b).

Unconfined Aquifer – Valley-fill

The unconfined aquifer is also referred to as a "valley-fill" aquifer. The deposits within this aquifer are similar to the confined aquifer, such as clay and silt. These sediments were primarily from alluvial deposits. The depth of the water table fluctuates seasonally by as much as 30 feet, and the depth of the aquifer ranges from 50 to 100 feet below the surface. The flow direction of the groundwater is towards Ogden Canyon, near the dam at Pineview Reservoir. Most streams help replenish the unconfined aquifer as they enter the valley. Discharge from this aquifer also includes stream, springs, wells, and evapotranspiration (Lowe & Wallace, 1999b).

Shallow Unconfined Aquifer

The shallow unconfined aquifer is in a relatively thin layer above the unconfined aquifer at a depth of 10 to 60 feet. The deposits around this shallow aquifer were left by Lake Bonneville when Ogden Valley acted as a small bay. The deposits are highly permeable, as they consist of sand, silt, gravel, and cobbles. The direction of flow is toward Ogden Canyon, and discharge from this shallow aquifer is primarily into Pineview Reservoir (Lowe & Wallace, 1999b).

Figure 13: Wetland areas can serve as recharge areas and locate shallow aquifer areas.

Recharge Areas

Ogden Valley has both primary and secondary recharge zones within its boundaries. Primary recharge zones are typically found near fractured rocks or coarse-grained sediments with high infiltration rates. Recharge at these points allows water to move downward at a fast pace. The primary recharge areas take up much of the valley floor. The secondary recharge areas generally have fine-grained layers greater than 20 feet. Often they are located upon the valley benches. Movement of water at these points is still downward, but at a slower pace. Both of these primary and secondary recharge zones feed the three types of groundwater aquifers. These recharge zones are very important because of the relative ease of contaminant transmission at these points (Lowe & Wallace, 1999b).

Vegetation

Vegetation results from a variety of environmental factors, such as climate, geology, soils, and hydrology. Events like succession and disturbance, both natural and human caused, also add to these variations (Bailey, 1996). The vegetation in Ogden Valley is no different. The disturbance regime and environmental features determine the vegetation types found within the area.

The description of Ogden Valley's vegetation is based on ecoregions, the combination of vegetation communities, physiographic provinces, and climate (Bailey, 1980). The ecoregions used contain four levels of detail, ranging from the general (level 1) to specific (level 4). Ogden Valley was looked at using the most detailed level (Table 4) (Figure 15). The ecoregions used were taken from the U.S. Environmental Protection Agency (EPA).

Table 4: Ogden Valley Level 4 ecoregions and their approximate areas within the study area.

Level 4 Ecoregions		
Ecoregions	**Sq. Mileage (Approx.)**	**Percent Area (Approx.)**
Semiarid Foothills	165	50%
Wasatch Montane	114.5	34.5%
Mountain Valleys	51.5	15.5%
Total	331	100%

Figure 14: Semiarid vegetation areas near Causey Reservoir.

Semiarid Foothills

This vegetation zone is typically located on the lower mountain slopes and foothills between 5,000 and 8,000 feet. The underlying geology is often Precambrian, Cenozoic, Mesozoic, and Paleozoic. Additionally, bedrock outcrops are common within this zone. Soils within this area are typically Mollisols. The climate of the semiarid foothills is usually dry with long, cold winters. The vegetation of this community has the potential for mountain mahogany-oak scrub and juniper-pinyon woodlands communities. The present vegetation includes Gambel oak, maples, juniper, sagebrush, pinyon, serviceberry, mountain mahogany, snowberry, and associated grasses (Woods et al., 2001).

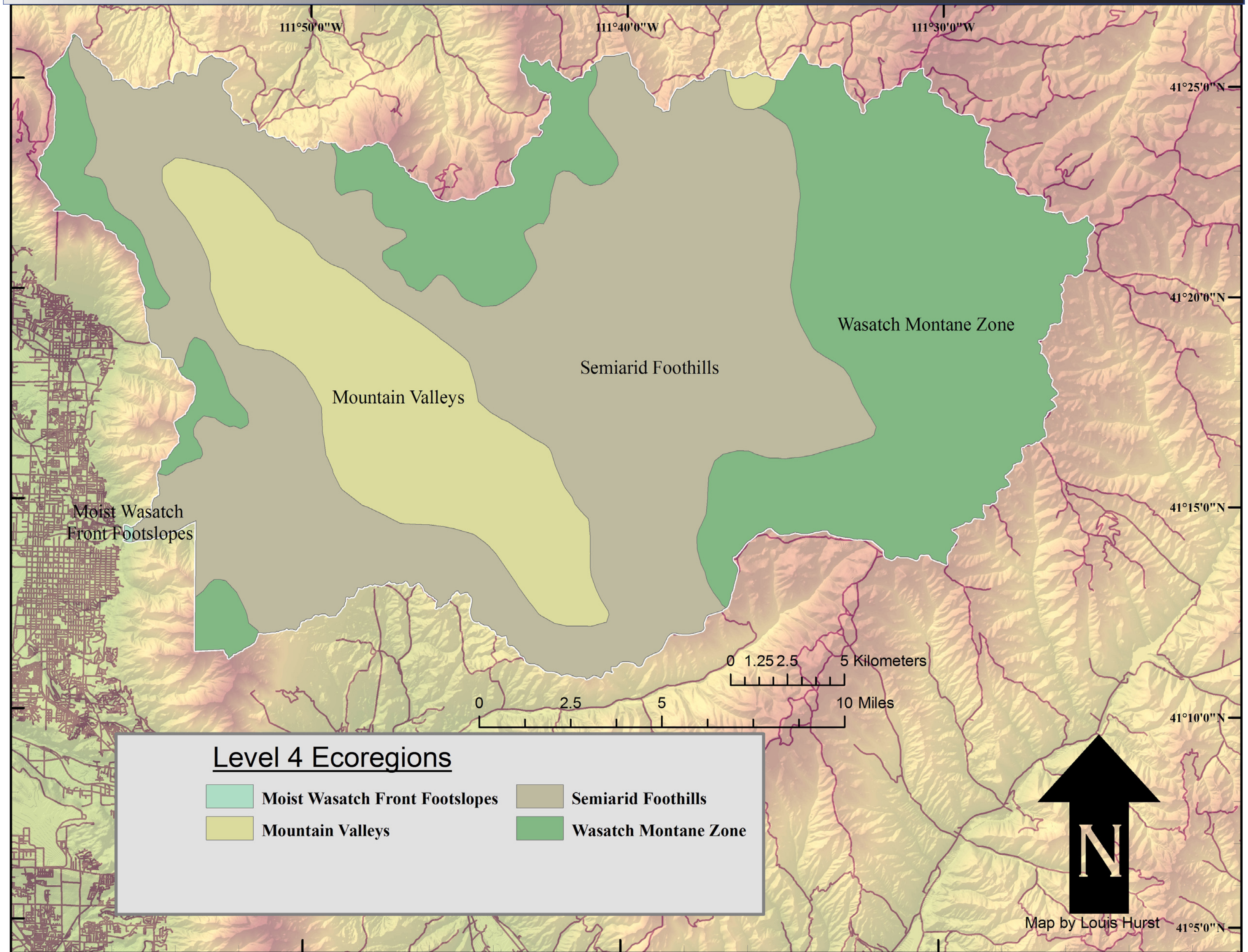


Figure 15: Ogden Valley Level 4 ecoregions.

Wasatch Montane Zone

This vegetation zone is typically located upon the slope of mountains, mountain tops, and ridges. The topography of this zone can range between steep and rolling hills. The rocks date between the Cenozoic to Proterozoic periods. The soils orders in this zone are usually Alfisols and Mollisols. The climate of the Wastach Montane Zone is wetter than the Semiarid Foothills, but still has long, cold winters. The vegetation community in this zone are usually Douglas fir and spruce fir forests. The vegetation includes: Aspen parkland, Douglas fir, big sagebrush understory, snowberry, elderberry, and mountain grasses. Upon the cirques and north-facing slopes there are subalpine fir and Engelmann spruce. Lastly, near streams there are willows and birch (Woods et al., 2001).

Figure 16: Mountain vegetation on the Wasatch Range, primarily fir and spruce.

Figure 17: Grass, shrub, and forest vegetation found near Hwy. 39.

Mountain Valleys

This vegetation zone is typically located in large non-forested valleys near the elevation of 4,800 feet. These valleys often separate mountains from the high plateaus, and the valleys are typically flat with rolling hills. The geology of Mountain Valleys is mostly quaternary with some tertiary igneous and sedimentary rocks. The soils often include Mollisols, but in Ogden Valley Vertisols and Alfisols are also present in small amounts. Mountain Valleys receive modest rainfall, between 8 to 24 inches, with temperatures ranging from cold winters to warm-hot summers. The potential vegetation types are Great Basin sagebrush and Juniper-Pinyon woodlands. The vegetation includes grasses, common sagebrush, pinyon, and Utah Juniper. Additionally, in riparian areas there are cottonwoods and introduced species (Wood et al., 2001).

Wildlife

Wildlife populations are an important part of the landscape within Ogden Valley. However, gaining accurate information about wildlife in an area is a very difficult task. As a way to learn about the local wildlife, Ogden Valley's natural habitat will be used to gain information about the local wildlife populations.

Habitat is the livable area needed for an animal to persist, usually consisting of appropriate climate, topography, food, and water (Benyus, 1989). In order to address habitat requirements, information from *Utah's Comprehensive Wildlife Strategy* was used. The state of Utah classifies into nine specific habitat categories (Gorrell et al., 2005); Ogden Valley contains seven of the nine (Table 5) (Figure 18). Looking at these habitats will facilitate drawing conclusions about wildlife species within Ogden Valley.

Table 5: Ogden Valley habitat types and areas. Habitat types serve as proxies for wildlife surveys or more detailed wildlife data.

Habitat Types		
Habitat Type	**Sq. Milage (Approx.)**	**Percent Area (Approx.)**
Mountain Shrub	100	30%
Aspen	64	19%
Shrubsteppe	59	18%
Lowland Riparian	4	1%
Montane Riparian	3	1%
Wet Meadow	2	1%
Grassland	1	1%
Non-Habitat	*98*	*29%*
Total	331	100%

Mountain Shrub

Mountain Shrub habitat forms in an elevation zone between 3,000 to 9,000 feet. This habitat serves as a critical transition zone between higher forested mountains and lowlands (Gorrell et al., 2005). This is the largest habitat within Ogden Valley, but rare within the regional context of Utah. Small trees dominate this landscape, providing rich food and abundant cover for a wide variety of wildlife. (Gorrell et al., 2005)

Many plants and berries help form this habitat type. Serviceberries, chokecherries, acorns, and a variety of other foods support bird populations. Deer and elk depend heavily upon this habit for food and forage and predators often lay in wait for prey in the thick cover. Wildlife in this area would include: Mule deer, elk, shrews, black-throated gray warbler, rubber boa, Townsend's big-eared Bat, Merriam's shrew, American pika, gray wolf (extirpated), and brown bear (extirpated) (Benyus, 1989; Bosworth, 2003; Gorrell et al., 2005).

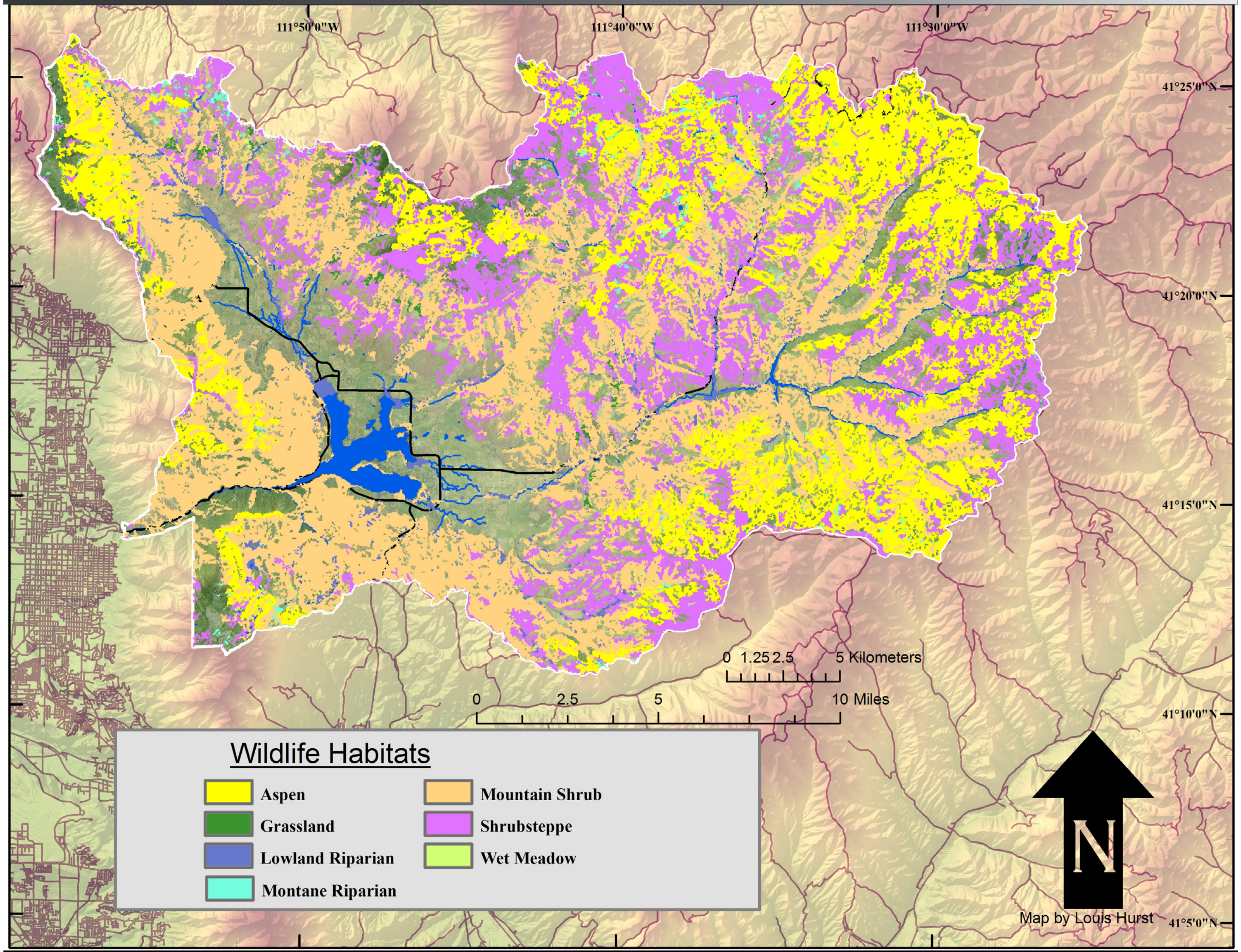


Figure 18: Ogden Valley habitat types and areas.

Aspen

Aspen habitat forms at an elevation above 5,300 feet in mountainous areas. This habitat name comes from the "Quaking Aspen;" each fall this tree changes colors to a bright yellow and has a distinct sound when the wind blows through its leaves. This change in color marks the coming season of autumn. Besides the Aspen, wildflowers and shrubs inhabit this area (Gorrell et al., 2005). The Aspen habitat is the second largest within Ogden Valley, covering close to 20% of the landscape. The combination of vegetation in this habitat supports a diverse array of wildlife, due to the relative thick understory, yet cool temperatures from the aspen tree cover (Benyus, 1989).

This habitat covers only 3% of the state of Utah, making it rare regionally. Additionally, Aspen habitat is increasingly becoming rare as changes to disturbance regimes affect the growth and productivity. The plant life in this habitat includes Aspens, shrubs, snowberries, and mountain bluebells. Wildlife that use this habitat for forage and cover include Northern goshawks, Williamson's sapsucker, western toad, woodpecker, vole, weasel, deer, elk, moose, yellow-billed cuckoo, bats, and many other birds (Benyus, 1989; Bosworth, 2003; Gorrell et al., 2005).

Figure 19: Moose eating vegetation from a pond in Ogden Valley foothills.

Shrubsteppe

The shrubsteppe habitat is a rugged and expansive habitat that exists at a variety of elevations. Dominating this habitat are plants like sagebrush and grasses. This is the most abundant habitat within the state of Utah, encompassing close to 13% of the landscape (Gorrell, et al., 2005). Within Ogden Valley, Shrubsteppe is the third most abundant habitat, roughly taking up 18% of the area. This habitat serves as a critical regional wintering ground for many animals (Gorrell et al., 2005). Often described as monotonous, this habitat forms a diverse ecological system (Benyus, 1989).

The health of this habitat is on the decline from a variety of activities. These include land development, changes in the disturbance regime, improper grazing, improper Off-Highway Vehicle (OHV) use, and invasive plants. The vegetation within this habitat includes a variety of sagebrush, bluebunch wheatgrass, needle grass, rabbit brush, juniper, pinyon, and mountain mahogany. The wildlife within the Shrubsteppe habitat includes greater sage-grouse, pygmy rabbits, sage thrasher, sage sparrow, mule deer, brown bear (extirpated), Preble's Shrew, spotted bat, Townsend's big-eared bat, white-tailed prairie dog, sage sparrow, desert kangaroo rat, Wyoming ground squirrel, and a variety of other birds (Benyus, 1989; Bosworth, 2003; Gorrell et al., 2005).

Lowland Riparian

Rivers and streams that have reached the valley floor make up the Lowland Riparian habitat. Generally, these areas are below the elevation of 5,500 feet and have waters that move slowly and calmly. This habitat is made up of vegetation along riverbanks and wetlands. Lowland Riparian habitat is very rare within the State of Utah, accounting for only 0.2% of the landscape (Gorrell et al., 2005). Within Ogden Valley, this habitat accounts for just under 1% of the landscape, or four square miles. Riparian habitats are some of the most diverse, productive, and critical for many wildlife species (Benyus, 1989).

Lowland Riparian habitat is defined by vegetation, terrestrial landform (topography), soils, and hydrology (DeBano & Schmidt, 2004). The vegetation within this habitat includes Fremont cottonwood, tamarisk, netleaf blackberry, velvet ash, desert willow, and squaw-bush. Wildlife within the Lowland Riparian includes mollusks, yellow-billed cuckoos, Columbia spotted frog, western toad, short-eared owl, American white pelican, Preble's shrew, Western red bat, Pacific treefrog, American avocet, Black-necked stilt, peregrine falcon, northern river otter, and a variety of other mammals, birds, and fish (Benyus, 1989; Bosworth, 2003; Gorrell, et al., 2005)

Figure 20: A small stream (riparian area) about to feed into the larger South Fork of the Ogden River.

Montane Riparian

Montane Riparian habitat refers to those streams and rivers above 5,500 feet with steep, fast moving water and riparian vegetation. This habitat is very rare within the state of Utah, only 0.2% of the landscape (Gorrell et al., 2005). Within Ogden Valley, the Montane Riparian habitat accounts for only approximately 1% of the landscape. The streams that make up this habitat are rocky and cold; however, they are highly productive and ecologically diverse areas (Benyus, 1989).

Despite the importance of this habitat, its area is currently declining from stream channelization, improper grazing, invasive plants, improper OHV use, and water development. Vegetation within this area includes willows, cottonwood, water birch, black hawthorn, and wild rose. These riparian areas serve as critical corridors for wildlife (DeBano et al., 2004). The wildlife using this habitat would include northern river otter, rubber boa, smooth greensnake, black-billed cuckoo, Bonneville cutthroat trout, western toad, sharp-tailed grouse, northern flying squirrel, Columbia spotted frog, southwestern willow flycatcher, northern leopard frog, and a variety of other mammals, birds, and fish (Benyus, 1989; Bosworth, 2003; Gorrell et al., 2005).

Wet Meadow

Wet Meadow habitat is made up of grasses, shrubs, and ground that is saturated with water throughout most of the year. This habitat generally ranges between the elevations of 3,000 to 9,000 feet. Wet Meadows are very rare within the state of Utah, accounting for only 0.1% of the landscape (Gorrell et al., 2005). In Ogden Valley, they account for approximately just less than 1%. These areas support a wide variety of plants and wildlife, despite their meager size (Benyus, 1989; Gorrell, et al., 2005).

Wet Meadow habitats are very sensitive to disturbances, and they are under threat from a variety of sources including drought, human disturbance, loss of nearby habitat, improper grazing, and water development. The vegetation common within this habitat includes sedges, rushes, reedgrasses, and willows (Benyus, 1989; Gorrell et al., 2005). The wildlife that use this area includes Columbia spotted frog, common gartersnake, bobolink, smooth greensnake, and a variety of other amphibians and birds (Benyus, 1989; Bosworth, 2003; Gorrell et al., 2005).

Grasslands

Grassland habitat is very similar to Wet Meadow habitat, except for a lack of water saturation in the surrounding soil. Utah's Grassland habitat is primarily short-grass prairies within the dry climate regions. This habitat is rare within Utah, covering about 3.5% of the landscape. In Ogden Valley, Grassland habitat covers less than 1% of the area.

Grasslands need a very specific mixture of precipitation, temperature (both hot and cold), and topography (Benyus, 1989). Grasslands are a balance between productivity and disturbance. The natural vegetation of these areas evolved with fire regimes, and changes to this system threaten this habitat type. The natural vegetation includes: wheatgrass, bluegrass, bluebunch, yarrow, Richardson's geranium, other grasses, and wildflowers. The wildlife that lives in these areas includes white-tailed prairie dogs, burrowing owl, short-eared owl, sharp-tailed grouse, long-billed curlew, grasshopper sparrow, black rosy-finch, Merriam's shrew, and a variety of other mammals and birds (Benyus, 1989; Bosworth, 2003; Gorrell et al., 2005)

Figure 21: Kit Fox running through a grassy area in the southern portion of Ogden Valley.

History and Culture

Human adapted to and adapted the environment to fit their needs, therefore, examining the influences of people and how they have shaped the environment is critical to understanding a landscape. This section of the regional inventory describes the history and culture of Ogden Valley, beginning with native cultures and moving to the more recent Euro-American influences.

Native Cultures

Native cultures inhabited this area much longer than the current Euro-American cultures. The first inhabitants followed big game through northern Utah in the Paleo-Indian period between 12,000 to 8,500 before present (B.P.). Between 8,500 to 2,500 B.P., in the Archaic period, hunters and gatherers were the dominant peoples living in the region. Characterized by their use of atlatls (spear-throwing weapons), food milling, and textiles, these nomadic people lived around a large inland sea. From 1,500 to 600 B.P., plains related cultures began to move into northern Utah and develop agriculture, bow and arrow hunting, pottery, and settlements (Greer et al., 1981).

Several historic Indian cultures more recently used and lived in Ogden Valley. These included the Utes, Shoshone, Blackfoot, and Cheyenne (Hedges, 2001), although the Shoshoni and Ute cultures were the primary inhabitants of this area (Greer et al., 1981; Roberts & Sadler, 1997; Stamm, 1999; Trenholm & Carley, 1964). The Shoshoni cultures typically lived in semi-"nuclear" bands of extended families (Stamm, 1999). Subsistence of the Shoshoni ranged from reliance upon meat to gathering seeds and vegetables (Roberts & Sadler, 1997; Stamm, 1999; Trenholm & Carley, 1964). The boundary of the Ute's territory was near Ogden Valley (Greer et al., 1981). Weber Utes, or "Cumumba", occupied the area near Ogden Valley. They were closely related to the Shoshoni and were possibly bilingual (Greer et al., 1981). Similar to the Shoshoni people, Weber Utes hunted and gathered native seeds and vegetables (Pettit, 1990).

Figure 22: Chief Little Soldier, a prominent Shoshoni leader from the 1800s.

Both of these cultures lived in the Ogden Valley area, and both were influenced by Euro-American settlement in the 17th and 18th centuries (Pettit, 1990; Roberts & Sadler, 1997). Early influence included trading goods and services; however, later, these Euro-American cultures came to dominate and persecute the native peoples. Conflicts between native cultures and pioneer settlers steadily increased, until pioneers removed native cultures from the area (Hedges, 2001; Hunter, 1945).

Explorers and Mountain Men

The first Euro-American men who visited Ogden Valley were led by Peter Skene Ogden in May 1825 (Roberts & Sadler, 1997). Ogden Valley was originally called “Ogden’s Hole,” however, this name faded away (Hunter, 1945). The valley was a bountiful fur trapping region, and many famous trappers frequented the area including Jim Bridger, Jedediah Smith, John Weber, and Peter Ogden. These trappers practiced a policy of scorched earth (Roberts & Sadler, 1997), a policy which originated from fur trapping companies competing directly against one another for furs, so they trapped as much as possible with no regard for anything else but profit. On one expedition in 1829, Peter Ogden’s outfit trapped 4,000 beavers from the Ogden Valley.

After the trappers, the next explorers were Mormon pioneers and U.S. government officials. Thomas Abbot led the first non-trapper expedition to explore Ogden Valley, descending into the valley via Weber Canyon (Hunter, 1945). They explored the area, ultimately crossing the Bear River Range and exploring Bear Lake. Next, Captain Howard Stansbury of the Corps of Topographical Engineers visited Ogden Valley on August 27, 1849 and said, “The valley is rich and level.” Later, he mentioned the inaccessibility of Ogden Canyon as “wild and almost impassable” (Roberts & Sadler, 1997).

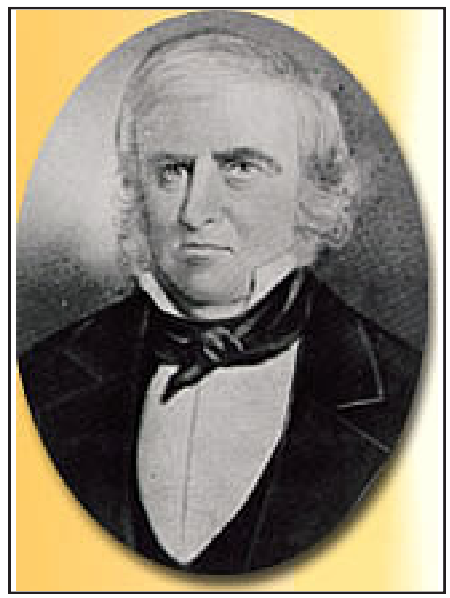


Figure 23: Peter Skene Ogden, mountain man and explorer, one of the first white men into Ogden Valley (Ogden’s Hole).

Four year later, Brigham Young sent another expedition into Ogden Valley under the direction of David Moore and Charles Middleton. They entered the valley via the North Divide above North Ogden, and they had to bring their wagons into the valley by hand and rope. Eventually, they left their wagons in the valley because of the inaccessibility of the area. In 1858, a second expedition from the U.S. government explored Ogden Valley. This second expedition was sponsored by the U.S. Army as they were searching for a better route into the Great Basin. This group camped at the future site of Huntsville and followed the earlier path of Captain Stansbury (Hunter, 1945).

Early Pioneers

The first Mormon pioneer activity within Ogden Valley was the grazing of cattle in 1856 (Hunter, 1945; Roberts & Sadler, 1997). At first, grazing activities were limited to summer months; however, this area soon became a year-round community. Pioneers began building cabins and grazing the area year-round. Settlers built the first cabin along the Middle Fork of the Ogden River in 1859. As more families arrived via the North Ogden Divide, surveyors worked on establishing towns. They were so impressed by the beauty of the landscape, they proclaimed, "We shall call it Eden after the famous Biblical Times." By 1860, Captain Jefferson Hunt and settlers established Hawkins' Grove, later renamed Huntsville (Hunter, 1945; Roberts & Sadler, 1997). Settlers established the town of Liberty on the south banks of Spring Creek. Originally, the settlers had a large problem with range cattle destroying fields, and one citizen proclaimed, "… this is sure one place where people take full liberty. Well, I guess it's where I got my liberty too, so that is the fitting name to call this place" (Hunter, 1945).

These first settlers established an agricultural way of life in Ogden Valley. The settlers engaged in farming, ranching, and dairy and poultry production. The first crops farmed in the valley consisted of alfalfa, grain, and vegetables. Additionally, the lumber business grew as an industry in these early years and was a source of pride for the valley (Roberts & Sadler, 1997).

Ogden Valley Settlers

After the completion of an adequate road through Ogden Canyon, the population of Ogden Valley grew tremendously. By 1870, Huntsville had a population exceeding 1,000 people, or 200 families (Hunter, 1945). Likewise, the other towns in Ogden Valley experienced rapid growth. Throughout the 1860s and 1870s these towns expanded in ways beyond mere population. These new residents built schools, churches, stores, gristmills, lumber mills, dairies, blacksmith shops, and roads (Hunter, 1945).

By the 1900s, each of the three towns had their own school and church buildings. In 1867, the Huntsville school was completed. This building served as a place for education, amusement, religious services, funerals, and public meetings. In 1877, Eden built their first schoolhouse and used that building for religious services as well. In 1887, Eden sold this structure to Liberty, and the building served to educate Liberty's children until 1892 when Liberty built their first school (Hunter, 1945).

The settlers began raising barley, oats, and potatoes within the valley in the late 1800s. As agricultural production increased, supportive industries began to appear within Ogden Valley. Jefferson Hunt, Jonathan Browning, and Samuel Ferrin opened the only gristmill within Ogden Valley. Blacksmith shops opened in Huntsville and Eden, which provided critical agricultural services to the valley (Hunter, 1945). During this same period in the late 1800's, many lumber mills began operating within Ogden Valley. The first was built near the town of Eden; however, several other mills quickly followed (Hunter, 1945).

Members of the Church of Jesus Christ of Latter-day Saints (LDS) (Mormon) were prominent residents as the valley was settled. Several church wards were set up within the first thirty years of valley settlement (Roberts & Sadler, 1997). In 1873, one of the most prominent valley residents was born. David O. McKay, future apostle and church president, was born to David McKay and Jennette Eveline Evans McKay in the town of Huntsville (Capase, 2001). The LDS faith was and is the prominent faith in the valley. The early history of Ogden Valley has close ties to this faith, and many of the first settlers and explorers were members of this church.

Figure 24: David O. McKay as a young boy posing with his parents and siblings. David O. McKay, Huntsville resident, would later become President of the Church of Jesus Christ of Latter-day Saints.

Valley Development

In the early and mid-1900s development began increasing at a rapid pace. The Ogden Valley of today was built during this time. In 1934, the Civilian Conservation Corps (CCC) began work on Pineview Reservoir and 51 artesian wells to provide water for Ogden City. In June of 1937 they completed Pineview dam, which sits at the head of Ogden Canyon just above Wheeler Canyon. The dam cost approximately $4 million dollars (Roberts & Sadler, 1997). Years later, in 1966, Causey Reservoir was completed, along with three other dams, at a cost of $97.5 million dollars (Division of Water Quality, 1992b; Roberts & Sadler, 1997).

Figure 25: Causey Reservoir at a low point in the late autumn of 2008.

In the early 1900's, the United States government decided to place their U.S. Forest Service Region 4 Headquarter in Ogden City (Roberts & Sadler, 1997). During this time, the government also established the Wasatch-Cache National Forest. Since these events, the U.S. Forest Service has managed these public landscapes including the shorelines and reservoirs, mountainous areas, and campgrounds around and in Ogden Valley (United States Forest Service, 2008).

As the federal government's presence increased in Ogden Valley, there was also an expansion in recreation activities within Ogden Valley. The reservoir system not only served to provide culinary and agricultural water, but served as a recreation resource. Activities such as swimming, fishing, boating, and camping are all very popular recreational activities (Division of Water Quality, 1992a). Increasingly popular throughout the mid-1900s, skiing developed into a major industry for Ogden Valley.

Currently, three ski resorts exist within the valley. The oldest, Snowbasin, was founded in 1938 on the advice of Forest Service recreation advisor Alf Engen (Snowbasin Resort Company, 2008). Next, the resort of Powder Mountain opened in the season of 1972 (Powder Mountain Resort LLC, 2009). The final resort opened under the name Nordic Valley, but is now called Wolf Mountain.

Another valley development was the addition of the monastery named Our Lady of the Holy Trinity, established in 1947 by a group of Trappist monks who moved to Ogden Valley. The monastery is located several miles east of Huntsville. Aside from their monastery duties, these monks also raise agricultural crops and sell honey (Curtis, 2004).

Present Day

More development has characterized the last 30 years of history for Ogden Valley. All three of the ski resorts were sold and bought. Resort influences have shaped development within the valley. Earl Holden bought a bankrupt Snowbasin in 1984 (Trimble, 2008), and Nordic Valley sold in 2005 to Wolf Creek Resorts changing its name to Wolf Mountain. Lastly, Western America Holdings bought Powder Mountain in 2006 (Powder Mountain Resort Management LLC, 2009).

In 2002, Ogden Valley hosted the world, along with the rest of Utah, as Salt Lake City held the 2002 Winter Olympic Games. Snowbasin was designated the site for men's and women's downhill, super G, and combine races (Hemphill, 2004). The attention surrounding the games allowed Ogden Valley to shift from a local playground to world class four-season recreation area.

Growth in Ogden Valley has been different from the rest of Weber County and the Wasatch Front region. Primarily, the valley has expanded by single home units, and the towns of Huntsville, Liberty, and Eden have seen the most growth (Roberts & Sadler, 1997). More recently, however, subdivision growth has occurred in the valley, and the ski resort industries are shifting from winter to four-season resorts (Powder Mountain Resort Management LLC, 2009; Snowbasin Resort Company, 2008; Wolf Creek Utah, 2008). All of these changes are still taking place in a pre-dominantly rural and residential community.

Figure 26: Earl's Lodge at Snowbasin Ski Resort.

Evaluations

Creating evaluations is the third phase within the study, and all of the evaluations are based upon spatially represented features. The primary objective for developing evaluations is to measure the impacts from a series of alternative futures. The information that is gained from evaluating the alternative futures should help improve the decision-making process.

The evaluation phase contains several important steps that will be reviewed. First, a list of evaluations were selected that represents issues for Ogden Valley. Next, each of these evaluations were researched, providing criteria or measurements that could then be modeled spatially. Lastly, the criteria for the evaluations were organized and combined to form each evaluation model.

Evaluation Selection

This phase began by selecting site specific evaluations for Ogden Valley. Selecting an appropriate set of evaluations relied heavily upon the issues outlined previously in the study. However, other factors such as data availability, time, and knowledge were also factors. Ultimately, eight evaluations were selected:

- Agricultural Analysis – Prime Farmland
- Air Quality Analysis – Inversion Susceptibility
- Biodiversity Analysis
- Groundwater Analysis
- Surface Water Analysis
- State Concern Wildlife Analysis
- Transportation – Infrastructure Analysis
- Viewshed Analysis

The above evaluations address specific issues related to Ogden Valley, referenced on page 5 of this study.

Developing Evaluations

After selecting a set of evaluations, each model's objecties and criteria were outlined. Importantly, the outlined criteria must be defined spatially. Simply stated, all of the criteria needs to be physically representable upon Ogden Valley's landscape. Background research plays a primary role in determining specific criteria, and previously developed standards and models are examined at this stage in the development process. Examples of evaluation criteria include slope, physical features, distances, number of occurrence, et cetera. Once specific criteria are selected from advice, research, and even speculation, the process moves forward to actually combining and forming the evaluation models.

Evaluation Criteria

Modeling Process

Once all the criteria were selected and the evaluation models were outlined, all of the models were developed with computer modeling hardware and geographic information systems (GIS) software. These models relied upon a variety of data sources (Appendix B). Additionally, a number of modeling techniques were used in the development of the evaluation models, including the use of raster (grid) data, vector (polygon) data, differing overlay and mathematical techniques. Figure 28 is a simplified presentation of one main overlay modeling technique used within this study.

Tiering Evaluation Models

Several of the evaluation models incorporated a modeling technique called "tiering." This technique is designed to add flexibility within criteria selection and later in the decision-making phases of a project. Tiering allows issues to be addressed in multiple ways. This technique also adds several layers to a model, making it more robust or practical.

This modeling technique was advanced specifically by planners at Utah State University in 2004 (Toth, Edwards, & Lilieholm, 2004), and several other planning projects have incorporated this technique, e.g., Covington, 2008; Toth et al., 2007; Toth et al., 2008 (Figure 27).

The organization of tiering within this study follows the framework of past projects. The tiered models are ordered in a three-level hierarchy (Figure 29). The tier 1 model describes the minimal, basic, or essential requirements for evaluation. The tier 2 model incorporates all of the criteria from the previous tier, and adds moderate criteria. The added criterion moves the model from essential to a more moderate evaluation. Finally, the tier 3 model incorporates both previous tiers' components and adds extensive criteria. The added criteria moves the model from moderate to an inclusive evaluation.

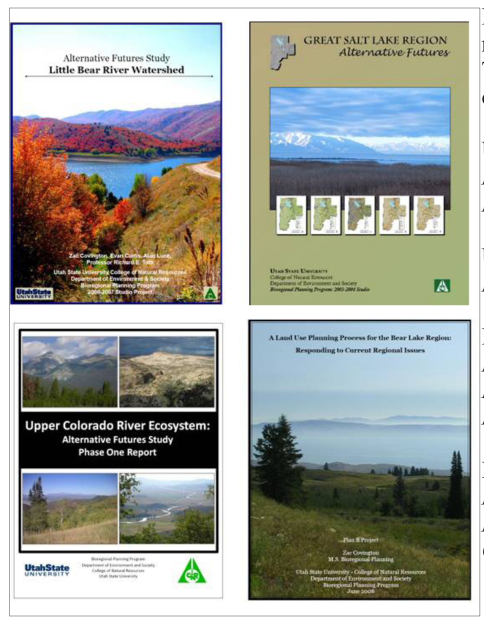


Figure 27: Four previous reports that incorporated Tiering into their development of evaluations.

Upper Left: *Alternative Futures Study: Little Bear River Watershed*

Upper Right: *Great Salt Lake Region: Alternative Futures*

Bottom Left: *Upper Colorado River Ecosystem: Alternative Future Study Phase One Report*

Bottom Right: *A Land Planning Process for the Bear Lake Region: Responding to Current Issues*

GIS Modeling Technique

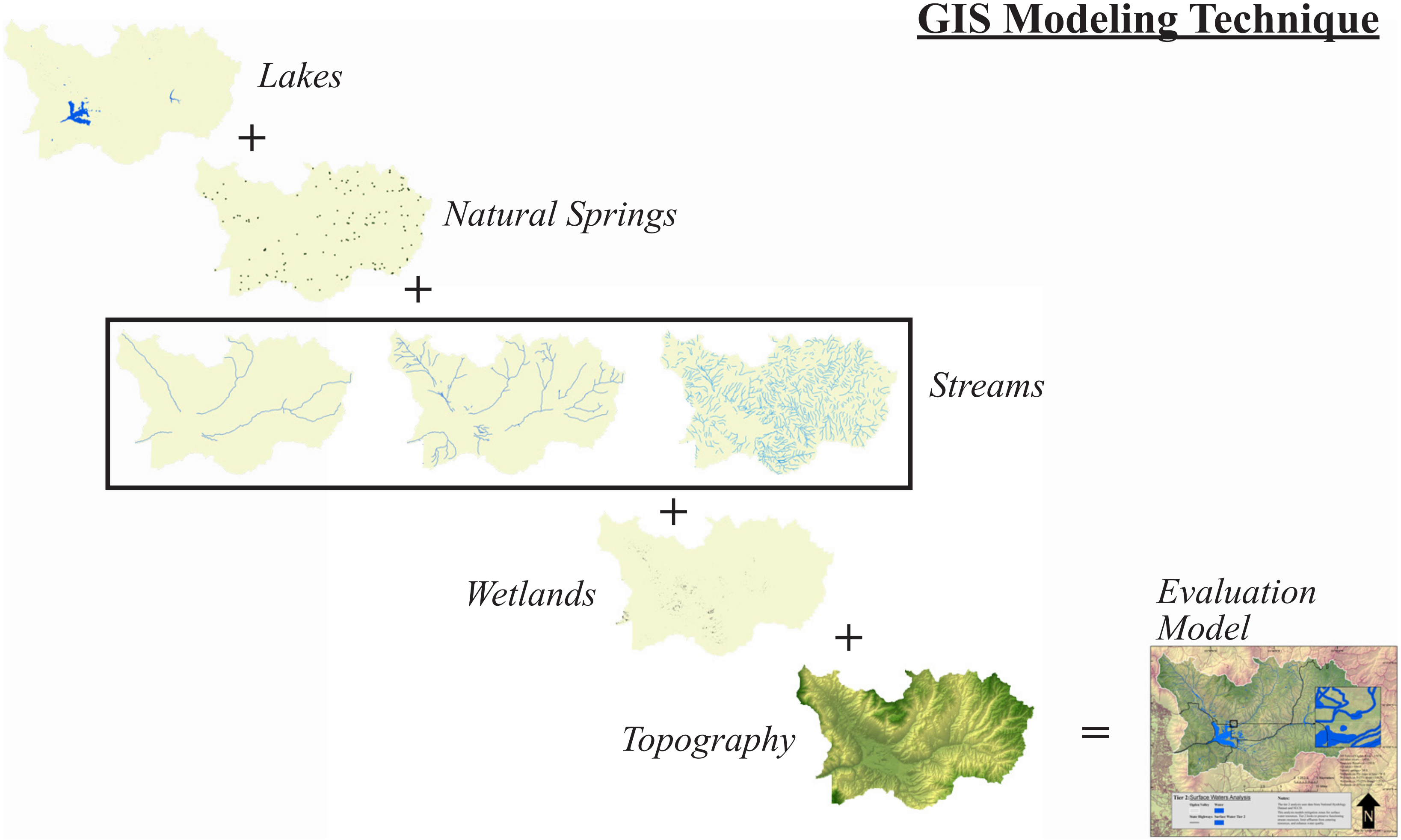


Figure 28: Visual Representation of the GIS modeling process used for surface water evaluation.

Overview of Tiering

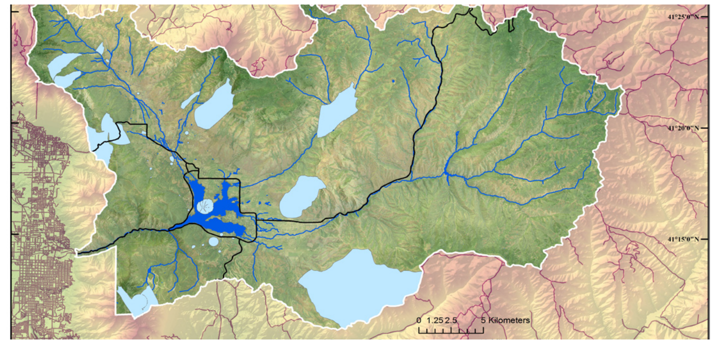
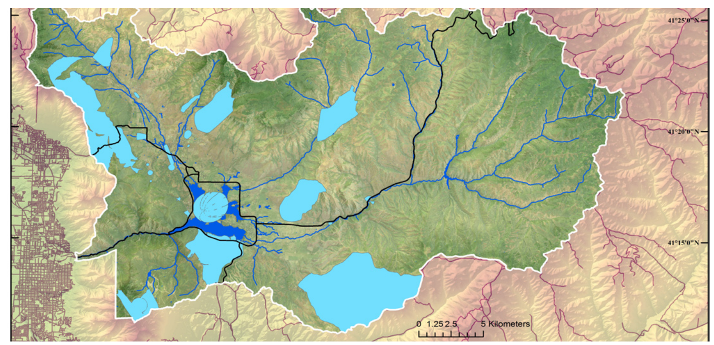
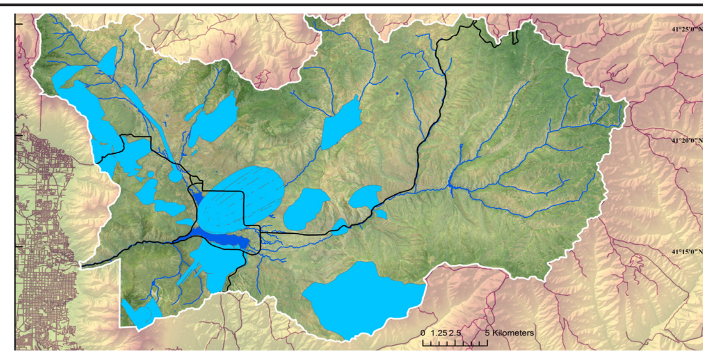
Level of Tiering	Description of Tiering Level	Tiered Maps
Tier 1 (Essential)	The tiering in level 1 models those landscape features most essential or critical for evaluation. These features would be baseline levels of critical features.	
Tier 2 (Moderate)	The tiering in level 2 models those landscape features moderately yet still highly valuable for evaluation. These features would expand upon the baseline levels to incorporate higher standards for the critical features.	
Tier 3 (Extensive)	The tiering in level 3 models extensively those landscape features that are valuable for evaluation. These features would extend much further than the baseline to incorporate a wide variety of critical and valuable features.	

Figure 29: Hierarchical organization and description of tiering technique with associated visual outputs.

Agricultural Analysis

Ogden Valley has a heritage of farming and ranching that extends back to its original settlement in the 1850s. The agricultural heritage of the valley is concurrent with the issue of maintaining a rural lifestyle. Typically, the farmland production in Ogden Valley consists of alfalfa, corn, grain, grass-hay, orchards, and pasture lands.

Farmland or agricultural land can be broken down in a variety of ways. For this study, farmland was analyzed for its suitability to produce food, feed, and forage crops (U.S. Department of Agriculture, Natural Resources Conservation Service, 2007).High resolution soil data provided the opportunity to analyze farmland based upon suitability.

The Natural Resources Conservation Service (NRCS) digitally mapped the Ogden Valley area and the resulting Soil Survey Geographic Database (Ssurgo) is their spatial output. Suitability was broken down into three levels (Table 6). Level 1 encompasses those areas that classify as "prime farmland." Level two encompasses those areas that classify as "prime farmland" and "farmland of unique or state importance." Finally, level three classifies as those areas of "prime farmland," "farmland of state importance," and actual farmland locations. These three levels make up the organization of the tiered agricultural evaluation model.

Figure 30: Agricultural operation at the southern end of Ogden Valley. This operation is visible from Trappers Loop and is one of the first seen upon entering the valley.

Prime Farmland (Tier 1)

This model is the combination of the best physical and chemical characteristics for producing food, feed, forage, and fiber crops. The physical classification includes soil quality, growing season, moisture supply, acceptable acidity and alkalinity, acceptable salt and sodium content, and few or no rocks (Soil Survey Division Staff, 1993; U.S. Department of Agriculture, Natural Resources Conservation Service, 2007). Additionally, the classification of prime farmland breaks down into 10 categories. Ogden Valley contains two types of prime farmland: prime farmland if irrigated and prime farmland if irrigated and drained (U.S. Department of Agriculture, Natural Resources Conservation Service, 2007).

Farmland of Statewide Importance (Tier 2)

The NRCS leaves the classification of farmland of statewide importance to the state's discretion. Typically, the qualifying state agency employs a wide range of criteria to classify these lands. These range between lands adjacent to prime farmland, areas with economically high yields of crops, mandated by state law, heritage areas, or unique farmlands (U.S. Department of Agriculture, Natural Resources Conservation Service, 2007).

Figure 32: A horse standing in a pasture as autumn ends and winter approaches.

Figure 31: A barn visible from Hwy. 166 between Huntsville and Eden.

Agricultural Lands (Tier 3)

The agricultural lands within this level were taken from the National Land Cover Dataset (NLCD). This last component within the agricultural model shows where current agriculture is taking place. This tier is a combination of suitability and practicality. The NLCD contains 16 land cover classifications, with two of those related to agriculture. Therefore, the land cover classes of Pasture/Hay and Cultivated Crops gained inclusion into the model. Pasture/Hay are those areas that support crops such as grasses, legumes, and grass-legumes with the intended purpose of livestock grazing. Typically, this is done on a perennial cycle. Cultivated crops are those areas with annual crops, such as corn, vegetables, and orchards (Homer et al., 2007).

Figure 33: Pasture land near Hwy. 162 in early autumn.

Table 6: Agricultural Analysis - Farmland model detailing intentions, components, and data sources.

Agricultural Analysis – Farmland			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Sources**
Tier 1 – Prime Farmland Analysis	The tier 1 model represents spatially those areas of Ogden Valley most suitable for agricultural activities, including cultivated crops, pasturelands, and ranching activities.	• Prime Farmland if Irrigated • Prime Farmland if Irrigated and Drained	• Ssurgo Soils Survey: Morgan and East Weber County
Tier 2 – Prime Farmland & State Importance Analysis	The tier 2 model represents spatially those areas of Ogden Valley most and moderately suitable for agricultural activities. This model includes all tier 1 areas, in addition to the Farmland of Statewide Importance.	• All Tier 1 Lands • Farmland of Statewide Importance	• Ssurgo Soils Survey: Morgan and East Weber County
Tier 3 – Prime Farmland, State Importance Analysis, & Agricultural Lands	The tier 3 model represents spatially those areas of Ogden Valley most and moderately suitable and under current production for agricultural activities. This model includes all tier 1 and tier 2 areas plus farmland areas from the NLCD.	• All Tier 1 Lands • All Tier 2 Lands • Cultivated Crops • Pasture/Hay Lands	• Ssurgo Soils Survey: Morgan and East Weber County • National Land Cover Dataset (NLCD)

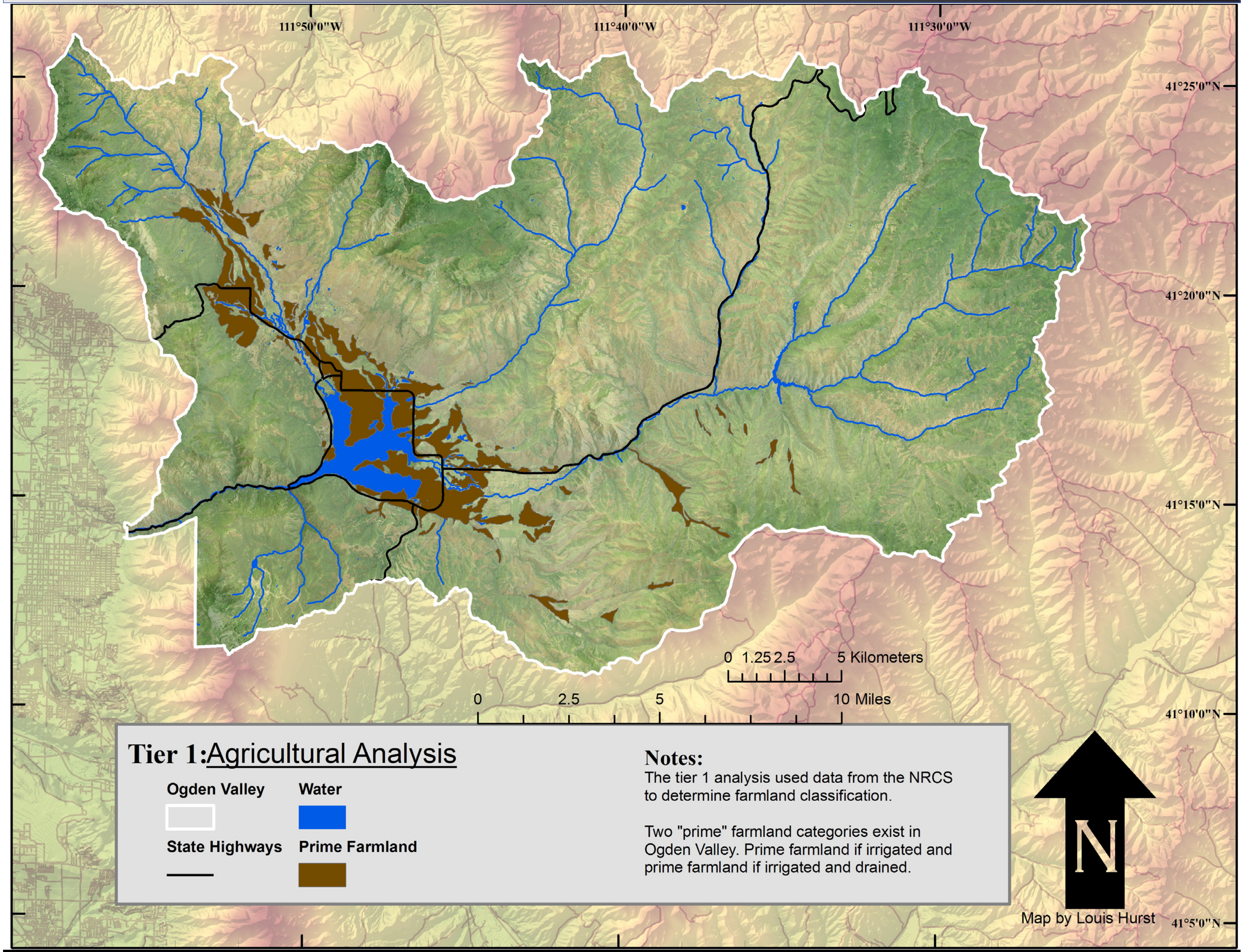


Figure 34: Tier 1 Evaluation Model - Agricultural - Prime Farmland

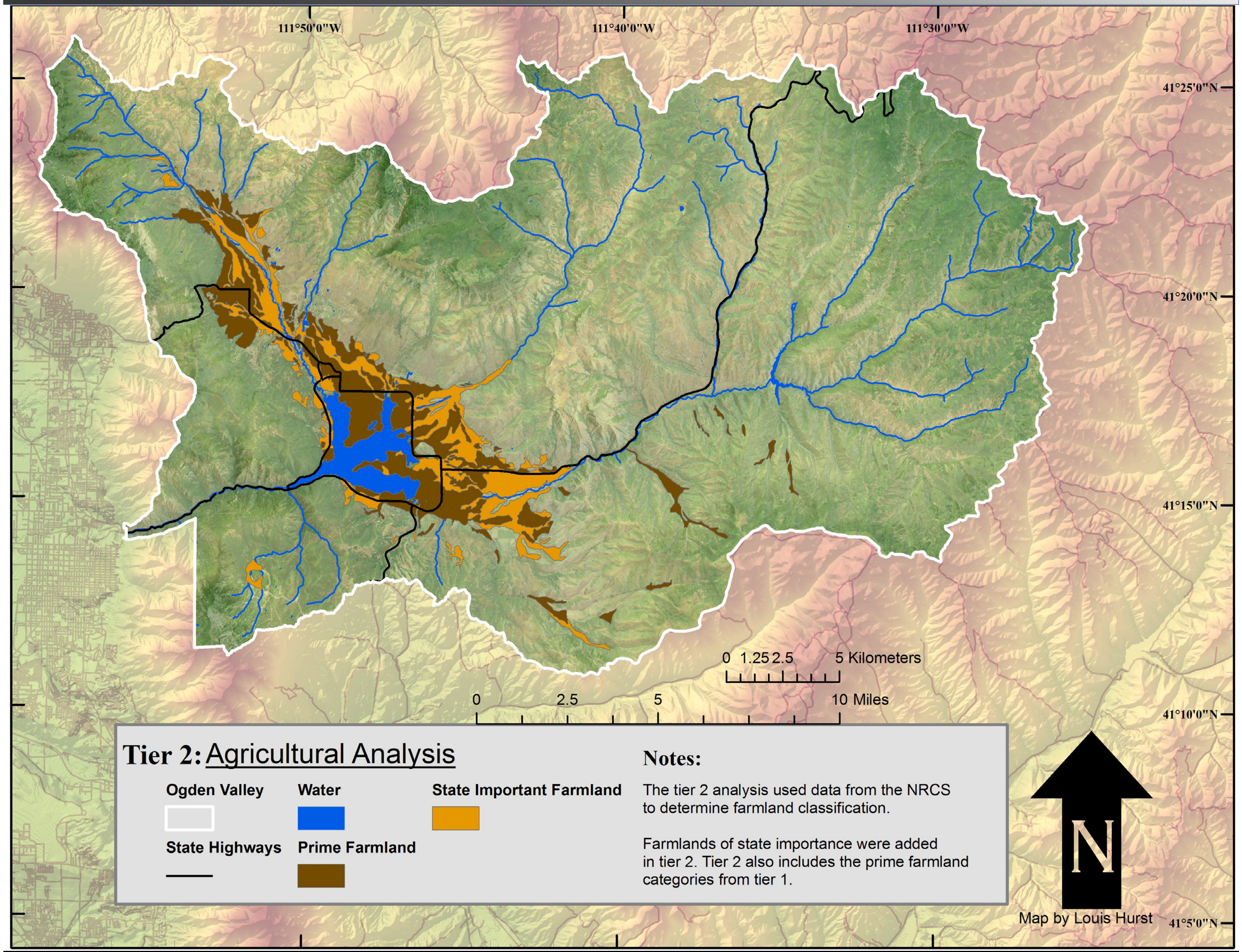


Figure 35: Tier 2 Evaluation Model - Agricultural - Prime Farmland

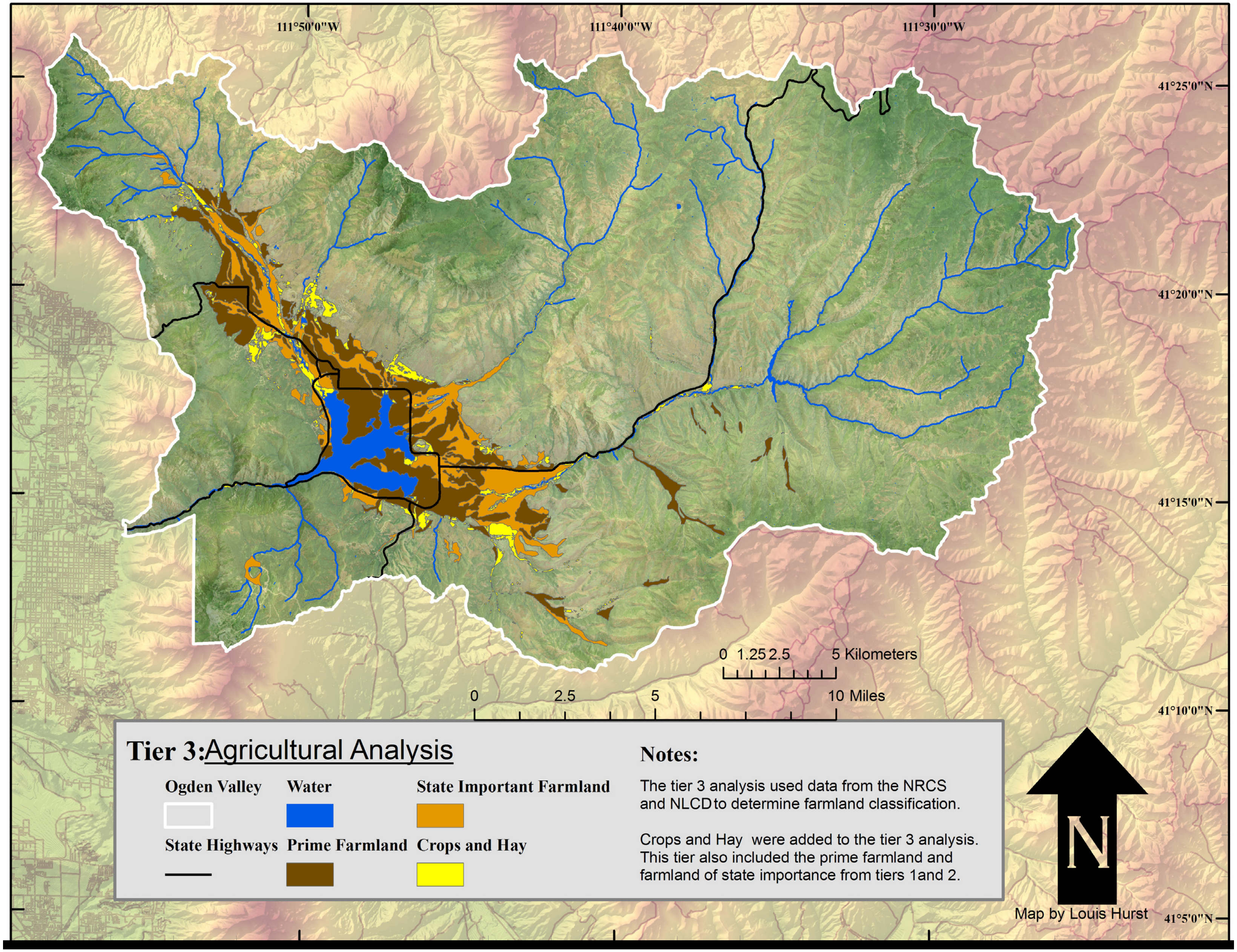


Figure 36: Tier 3 Evaluation Model - Agricultural - Prime Farmland

Air Quality Analysis – Inversion Susceptibility

Poor air quality is associated with health problems and a reduction of scenic beauty (Ferguson et al., 2003; Pope, Hill, & Villegas, 1999). Wasatch Front residents have an intimate knowledge of the effects from air pollution, as several cities within this region rank in the top 15 nationally with the worst short-term air pollution (American Lung Association, 2008). The air pollution in this region is a combination of land-use development, weather, and the topography (Department of Environmental Quality, 2009). Currently, Ogden Valley does not exhibit high levels of air pollution; however, the same features that multiply the effects of air pollution along the Wasatch Front are located in Ogden Valley. The serious health problems associated with air pollution requires its inclusion as an evaluation model.

Air Pollution Sources

Along the Wasatch Front, pollution comes from a variety of sources, including automobiles, industry, wood burning stoves, and agricultural by-products (Pope et al., 1999). These emissions include many different pollutants like carbon monoxide, carbon dioxide, ozone, particulate matter (pm 10 and pm 2.5), and sulfur oxides (Department of Environmental Quality, 2009).

Environmental Factors

Several environmental factors can compound the effects of pollution, including stable air masses, little or no wind, and topographical features (valleys). When these environmental factors occur simultaneously, they can often create temperature inversions, which trap air and pollutants in their source locations near ground levels (Figure 38). If these factors exist for prolonged amounts of time, the air quality can decrease significantly and adversely affect those within the area (Ferguson et al., 2003).

Inversion Susceptibility Model

This model combines the environmental factors that create temperature inversions to show the areas with the greatest risk for poor air quality. To represent spatially these at-risk areas, three components were combined (Ferguson, et al., 2003): 1) areas with little or no slope represent flat valley areas; 2) areas with a negative curvature, or those areas with concave characteristics; 3) areas with average low wind speeds to represent areas with stable air masses. The combination of these features replicates the conditions necessary to create inversion conditions. Given the simplicity of this model and the lack of data on pollution sources, no tiering was attempted.

Table 7: Air Quality Analysis - Inversion Susceptibility model detailing intentions, components, and data sources.

Air Quality Analysis – Inversion Susceptibility			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Sources**
Air Quality Analysis – Inversion Susceptibility	This model represents spatial areas most susceptible to inversion conditions. These at-risk areas have a high potential for poor air quality standards given emission increases.	• All lands less than 1% percent slope • All lands with negative curvature • Areas with wind speeds less than 5 meters/second	• Digital Elevation Model (10m) • National Research Energy Labartory (NREL)

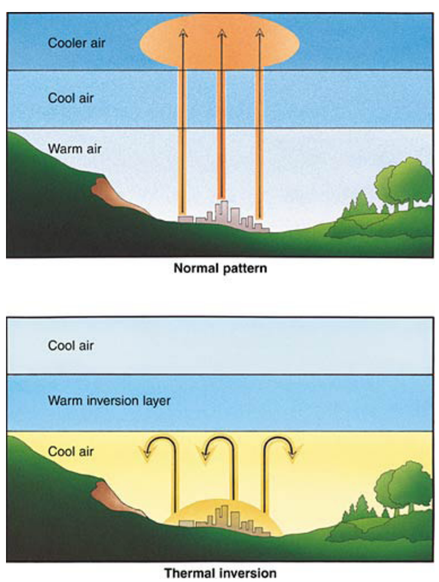


Figure 37: Diagram representing the normal movement of pollution and the effects of a temperature inversion upon pollution within the same area.

http://www.globalchange.umich.edu/gctext/Inquiries/Inquiries_by_Unit/Unit_9.htm

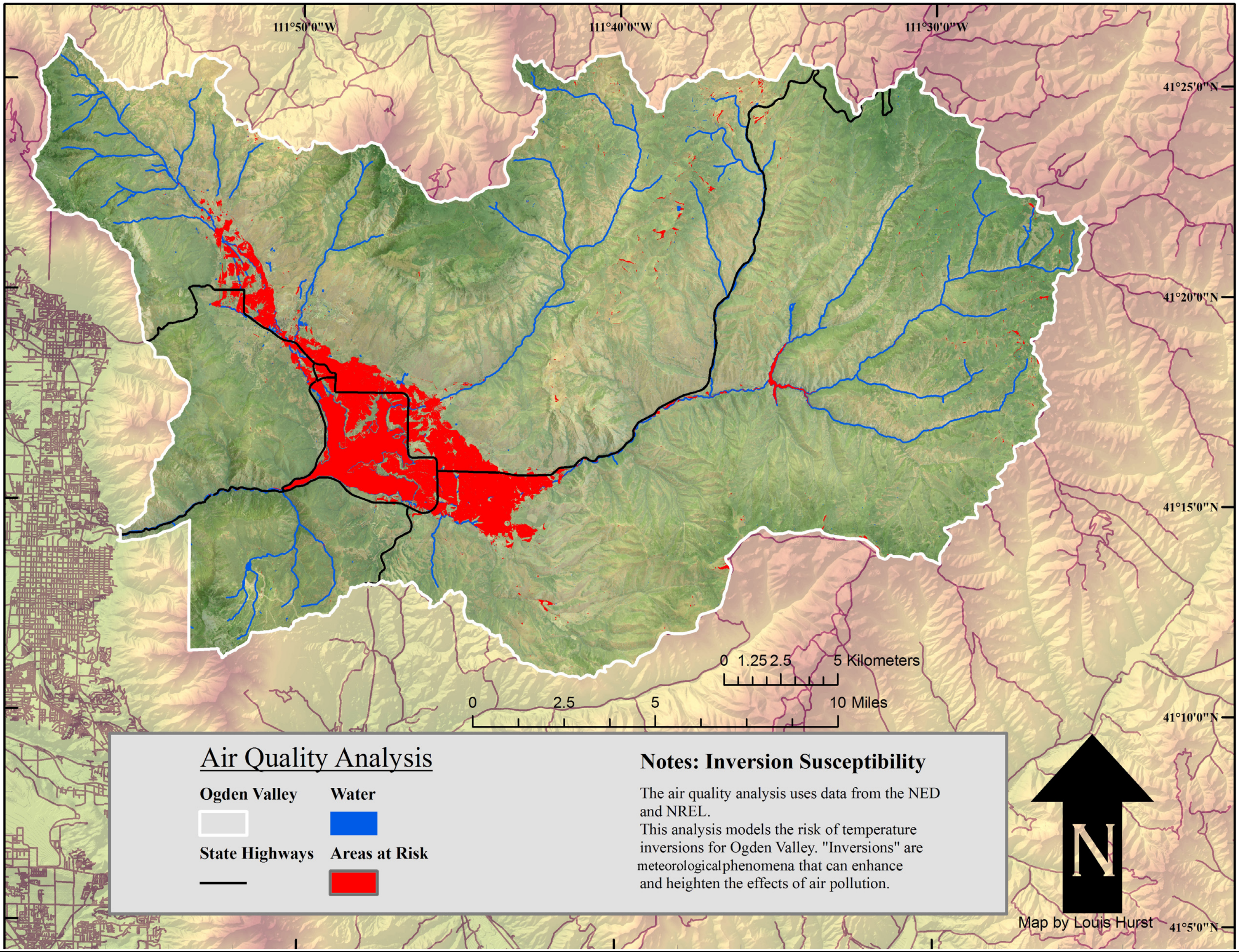


Figure 38: Air Quality Evaluation - Inversion Susceptibility

Biodiversity (Richness) Analysis

Wildlife is an important part of the environment for Ogden Valley residents. The same characteristics that allow farming to be productive in the valley also allow for wildlife diversity within the region. These characteristics include Ogden Valley's relative remoteness, large undeveloped areas, year-round water supplies, productive soils, and diversity in landscape types. Given how important wildlife is to Ogden Valley residents, two different evaluations were designed. The first uses biodiversity or species richness to model overall wildlife importance. The second evaluation uses state-selected species because they have been prioritized as important by the Utah Department of Wildlife Resources (UDWR).

Figure 39: Northern Goshawk

Species Richness

Typically, no single species defines or makes up an ecosystem. Rather, a multitude of interconnected species form a web of relationships that make up an ecosystem. Consumers, producers, and decomposers are necessary for this web of relationships to stay connected (Naumann, 2001). Given the complexity of ecosystems, one way to analyze them is holistically at a landscape level (Lovejoy, 1986). The species richness approach totals the number of species present in one geographic unit and is the aforementioned landscape level view of Ogden Valley (Begon, Townsend, & Harper, 2006).

Species Richness Model

In order to model species richness, a proxy of wildlife habitat had to substitute for actual species populations. This is necessary due to a lack of available data on wildlife populations in Ogden Valley. The data for this model comes from the Southwest Regional Gap Analysis Project (Prior-Magee et al., 2007) and only looks at vertebrates. Ogden Valley contains a wide array of species. In order to evaluate differing levels of richness, tiering was applied to this model. The breakdown of tiers is based upon three different levels of richness analysis (Table 8), i.e., high, moderate, and medium richness level.

Table 8: Wildlife Analysis - Species Richness model detailing intentions, components, and data sources.

Wildlife Analysis - Species Richness			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Source**
Tier 1 – High Richness Levels	The tier 1 model represents spatial areas in Ogden Valley with the highest numbers of overlapping wildlife habitats.	• Richness levels between 223 and 150	• Southwest Regional Gap Habitat Models
Tier 2 – Medium-High Richness Levels	The tier 2 model represents spatial areas of Ogden Valley with medium to high numbers of overlapping wildlife habitats. All tier 1 lands are included, plus an additional level of overlapping habitats.	• All Tier 1 Lands • Richness levels between 150 and 100	• Southwest Regional Gap Habitat Models
Tier 3 – Moderate Richness Levels	The tier 3 model represents spatial areas of Ogden Valley with moderate to high numbers of overlapping wildlife habitats. All tier 1 and 2 lands are included, plus an additional level of overlapping habitats.	• All Tier 1 Lands • All Tier 2 Lands • Richness levels between 100 and 75	• Southwest Regional Gap Habitat Models

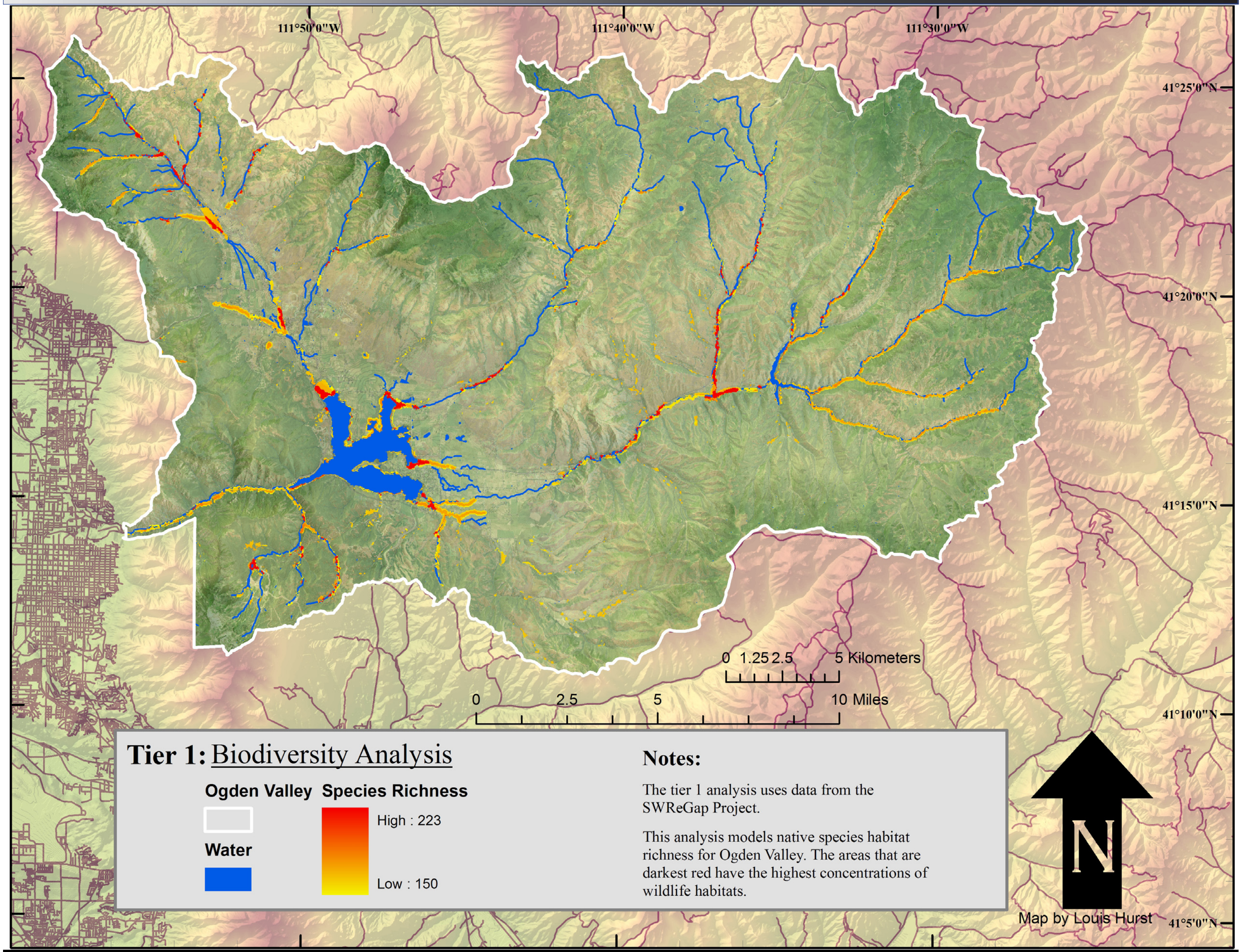


Figure 40: Tier 1 Evaluation Model - Biodiversity - Species Richness

Evaluation Criteria Biodiversity - Tier 2

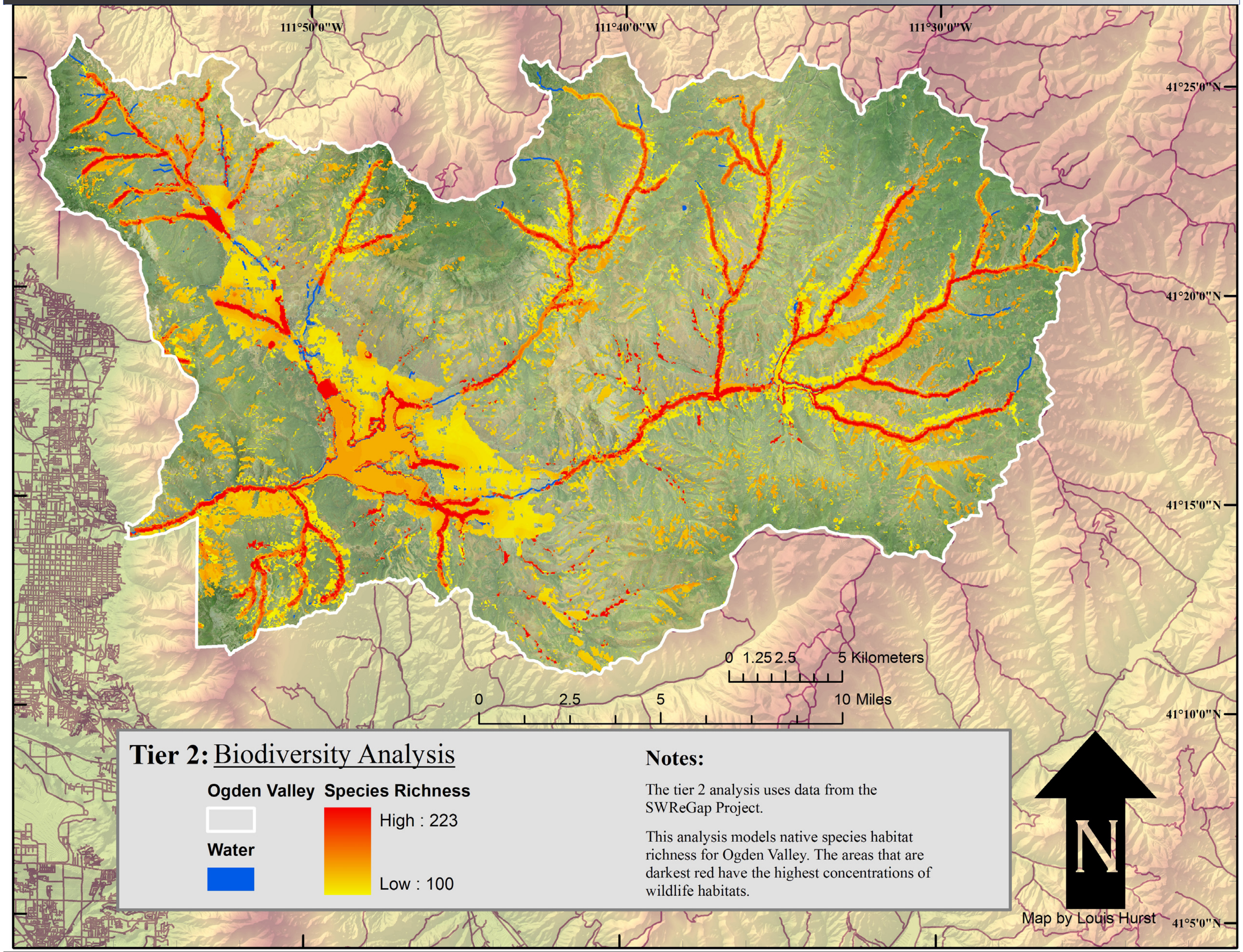


Figure 41: Tier 2 Evaluation Model - Biodiversity - Species Richness

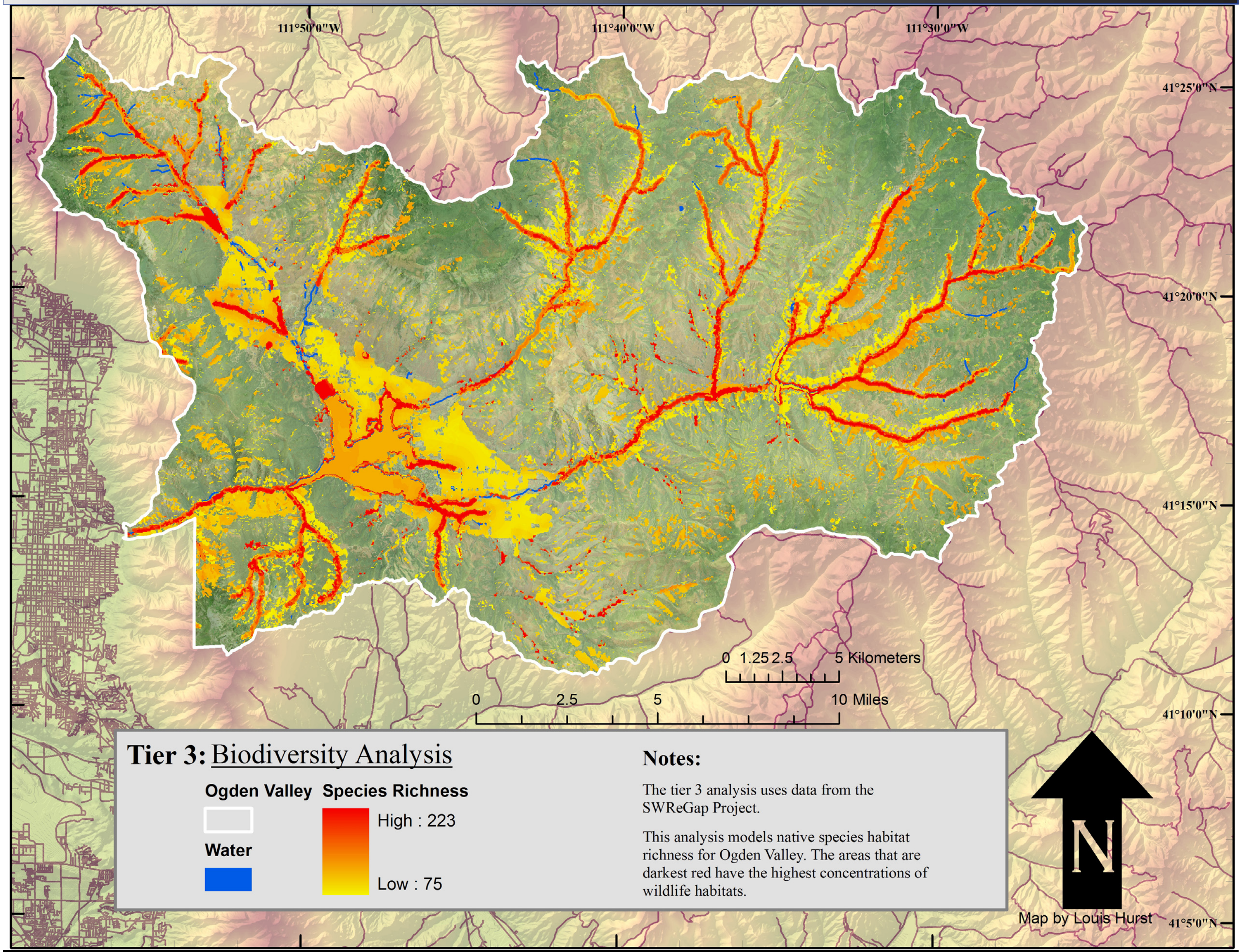


Figure 42: Tier 3 Evaluation Model - Biodiversity - Species Richness

State Prioritized Wildlife Analysis

In addition to viewing wildlife through an overall species richness perspective, wildlife can also be viewed via individual species of concern. Species of national and state importance often receive attention based upon need or threat. The Utah Department of Wildlife Resources (UDWR) developed a three-tiered system for species prioritization (Gorrell et al., 2005) based upon several factors, such as federal or state status, life history, conservation need, abundance, distribution, and threat.

State Prioritized Wildlife Model

This analysis consists of modeling the state tiering system. Again, no Ogden Valley wildlife population data exists, so wildlife habitat data served as a proxy. The data for this model came from the Southwest Regional Gap Analysis Project (Prior-Magee et al., 2007). Since the state of Utah previously categorized the species of concern into three categories, their categories were used to form this analysis which forms a hybrid of analysis between richness and individual species models (Table 12).

Tier 1

Under the state's prioritization system, tier 1 species generally consist of endangered, threatened, federal candidate species, and species with conservation agreements. Most of these species also have a recovery plan in place. Furthermore, in most cases these tier 1 species already have land managers taking actions for their best interest. Ogden Valley has six tier 1 species (Table 9)

Table 9: Tier 1 wildlife species from the Utah Comprehensive Wildlife Conservation Strategy

Tier 1 Wildlife Species		
Class	**Common Name**	**Scientific Name**
Amphibians	Columbia Spotted Frog	Rana luteiventris
Birds	Bald Eagle	Haliaeetus leucocephalus
	Northern Goshawk	Accipiter gentilis
	Southern Willow Flycatcher	Empidonax traillii extimus
	Yellow-billed Cuckoo	Coccyzus americanus
Mammals	Brown (Grizzly) Bear (Extirpated)	Ursus arctos

Tier 2

The tier 2 species are generally equivalent to Utah Species of Concern. A panel of expert biologists helped to choose the species at this level of prioritization, looking at several conditions when selecting species. These conditions included species biology, life history, population – abundance, population – conditions, distribution, and threats (Gorrell et al., 2005). Ogden Valley contains 21 tier 2 species (Table 10), plus all the tier 1 species.

Table 10: Tier 2 wildlife species from the Utah Comprehensive Wildlife Conservation Strategy

Tier 2 Wildlife Species		
Class	**Common Name**	**Scientific Name**
Amphibians	Western Toad	Bufo boreas
Birds	American White Pelican	Pelecanus erythrorhynchos
	Black Swift	Cypseloides niger
	Bobolink	Dolichonyx oryzivorus
	Burrowing Owl	Athene cunicularia
	Ferruginous Hawk	Buteo regalis
	Grasshopper Sparrow	Ammodramus Savannarum
	Greater Sage-grouse	Centrocercus urophansianus
	Lewis's Woodpecker	Melanerpes lewis
	Long-billed Grouse	Numenius americanus
	Sharp-tailed Grouse	Tympanuchus phasianellus
	Short-eared Owl	Asio flammeus
	Three-toed Woodpecker	Picoides triactylus
Mammals	Fringed Myotis	Myotis thysanodes
	Kit Fox	Vulpes macrotis
	Preble's Shrew	Sorex preblei
	Pygmy Rabbit	Brachylagus idahoensis
	Spotted Bat	Euderma maculatum
	Townsend's Big-eared Bat	Corynorhunus towsendii
	Western Red Bat	Lasiurus blossevillii
	White-tailed Prairie Dog	Cynomys leucurus

Tier 3

The tier 3 species were identified using the same process as within the tier 2 species selection. This tier also contains species with high habitat risks, substantial decreases in population size, or species with little or no information. Ogden Valley contains 23 tier 3 species (Table 11) and this model includes all tier 1 and tier 2 species.

Table 11: Tier 3 wildlife species from the Utah Comprehensive Wildlife Conservation Strategy

Tier 3 Wildlife Species		
Class	**Common Name**	**Scientific Name**
Amphibians	Pacific Treefrog	Pseudcaris regilla
Birds	American Avocet	Recurvirostra Americana
	Black Rosy-finch	Leucosticte atrata
	Black-necked Stilt	Himantopus mexicanus
	Black-throated Gray Warbler	Dendroica negrescens
	Boreal Owl	Aegolius funereus
	Caspian Tern	Sterna caspia
	Osprey	Pandion haliaetus
	Peregrine Falcon	Falco peregrines
	Sage Sparrow	Amphizpiza belli
	Sage Thrasher	Oreoscoptes montanus
	Virginia's Warbler	Vermivora virginiae
	Williamson's Sapsucker	Sphyrapicus thyroideus

Tier 3 Wildlife Species		
Class	**Common Name**	**Scientific Name**
(Continued from previous page)		
Mammals	American Pika	Ochotona princeps
	Desert Kangaroo Rat	Dipodomys deserti
	Merriam's Shrew	Sorex merriami
	Mule Deer	Odocoileus hemionus
	Northern Flying Squirrel	Glaucomys sabrinus
	Northern River Otter	Lontra Canadensis
	Northern Rock Mouse	Peromyscus nasutus
	Stephen's Woodrat	Neotoma stephensi
	Wolverine	Gulo gulo
	Wyoming Ground Squirrel	Spermophilus elegans

Figure 43: Mule Deer

Table 12: Wildlife Analysis - State Selected Species model detailing intentions, components, and data sources.

Wildlife Analysis - State Selected Species			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Source**
Tier 1 – State Prioritized Species Level 1	The tier 1 model represents spatially areas in Ogden Valley with level 1 state prioritized species.	• State Tier 1 Species (Six Species) (Table 9)	• Southwest Regional Gap Habitat Models
Tier 2 – State Prioritized Species Level 2	The tier 2 model represents spatially areas of Ogden Valley with level 1 and 2 state prioritized species. All tier 1 lands are included, plus additional level 2 species.	• All Tier 1 Lands • State Tier 2 Species (21 Species) (Table 10)	• Southwest Regional Gap Habitat Models
Tier 3 – State Prioritized Species Level 3	The tier 3 model represents spatially areas of Ogden Valley with level 1, 2, and 3 state prioritized species. All tier 1 and 2 lands are included, plus additional level 3 species.	• All Tier 1 Lands • All Tier 2 Lands • State Tier 3 Species (23 Species) (Table 11)	• Southwest Regional Gap Habitat Models

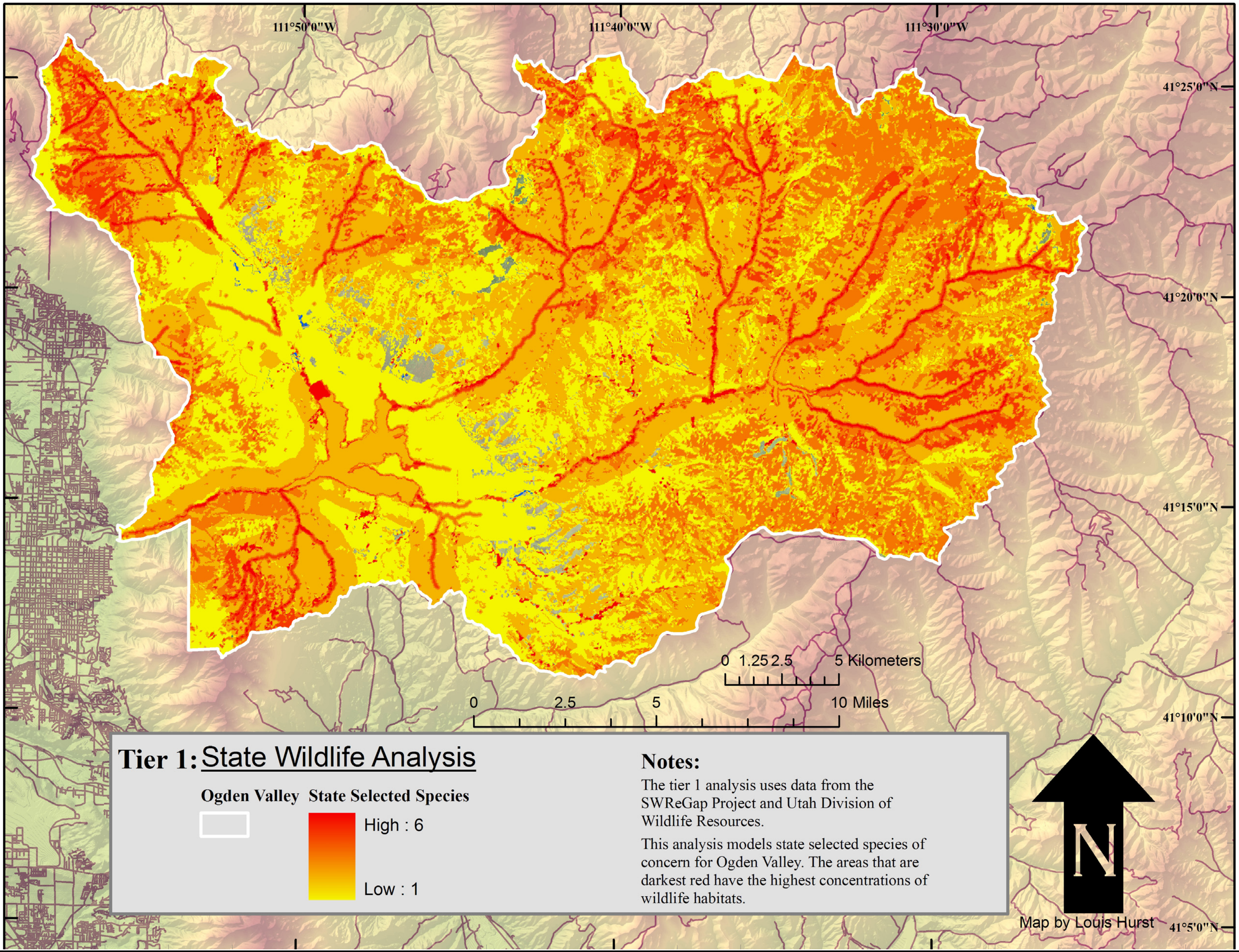


Figure 44: Tier 1 Evaluation Model - State Selected Wildlife Analysis

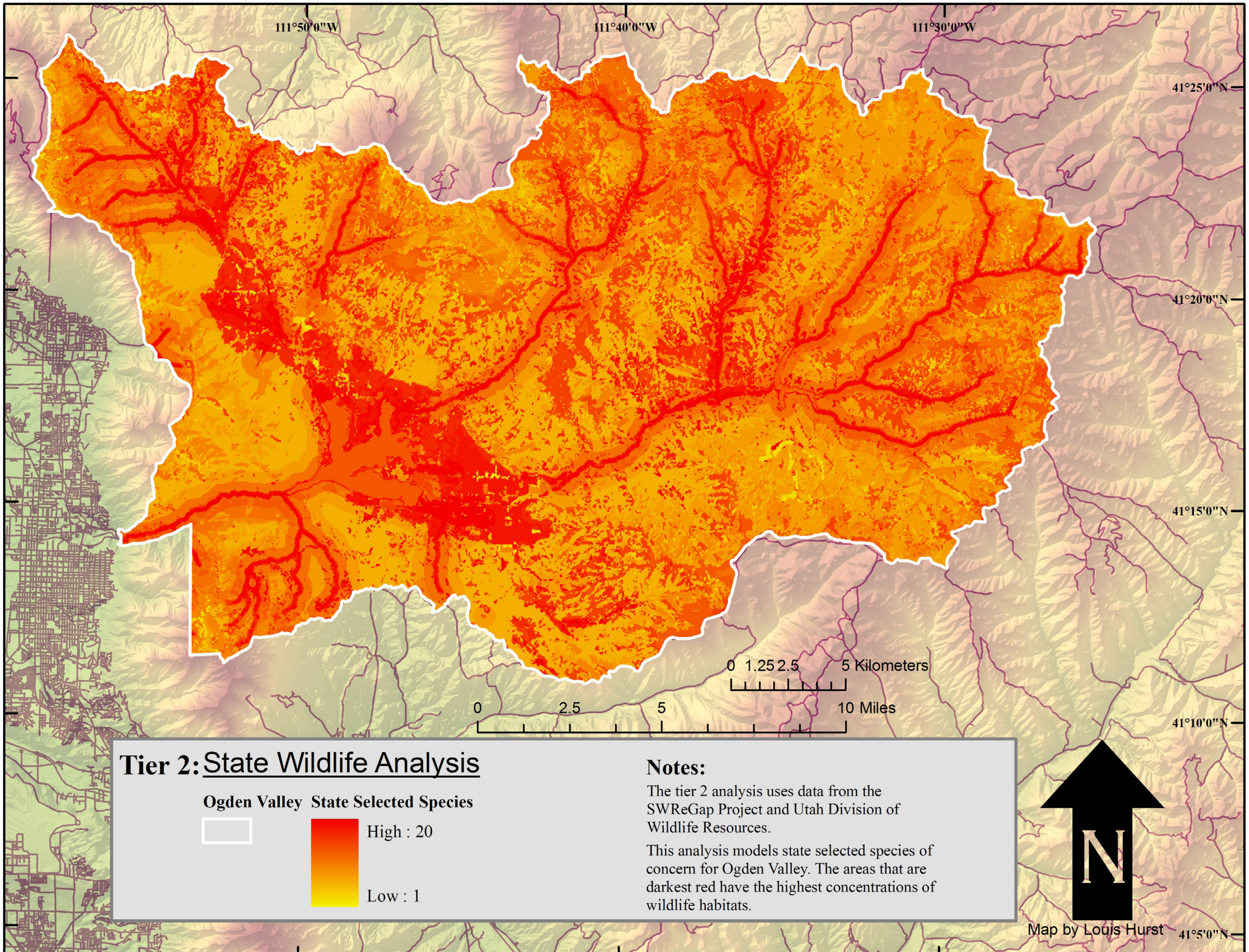


Figure 45: Tier 2 Evaluation Model - State Selected Wildlife Analysis

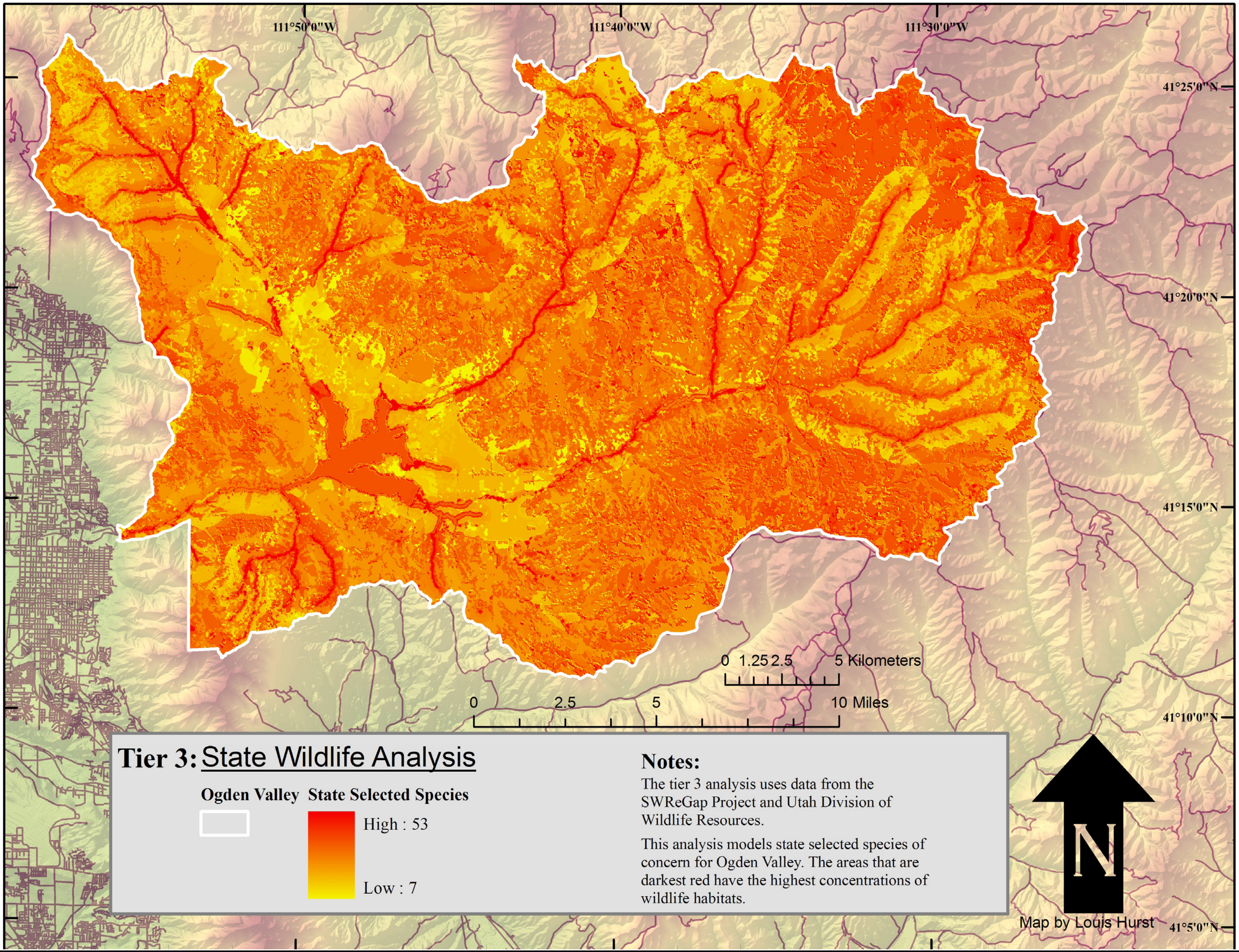


Figure 46: Tier 3 Evaluation Model - State Selected Wildlife Analysis

Hydrology

The hydrologic system within Ogden Valley is very important both locally and regionally, and consists of both groundwater and surface water systems. These water systems serve to provide water for Ogden Valley and the greater Wasatch Front region. These two hydrologic systems will be looked at independently from one another, even though they are interdependent systems.

Groundwater Analysis

Keeping high water quality is a top concern for Ogden Valley residents (Division of Drinking Water, 2008). Since they rely upon groundwater sources for their culinary water and for agricultural purposes, residents understand that keeping water quality high is in their best interest. Furthermore, Wasatch Front residents also rely upon both groundwater and surface water from the valley for culinary use.

Currently, Ogden Valley's water quality and aquifer system is in excellent, as assessed by the Utah Geological Survey. Ogden Valley also has some ordinances for groundwater sources such as protections for wellheads and source waters (Ordinance 41). However, the aquifer system is still vulnerable to threats, which include pathogens, household and industrial chemicals, phosphates, and nitrates (Lowe & Wallace, 1999b). Given these threats and the importance of groundwater, a tiered evaluation model was developed.

Groundwater Model

The groundwater evaluation incorporates data from Utah's Department of Environmental Quality and Division of Drinking Water. The basis for this assessment is the groundwater source protection zones (Table 13) (Division of Drinking Water, 2008). For modeling purposes, the four categories were regrouped to form a three-tiered hierarchy (Table 14). The intention of this evaluation is to find those areas of susceptibility to groundwater contamination based upon the delineation of protection zones.

Table 13: Water source protection zones delineated and defined by state of

Water Source Protection Zones	
Category	Description (Division of Drinking Water, 2008)
Zone One	Delineates areas within a 100-foot radius of a well-head or the margin of a collection area
Zone Two	Delineates areas with a 250-day groundwater time of travel to wellheads or margins of collection areas, aquifer boundary, supply source, or groundwater divide
Zone Three	Delineates areas with a 3-year groundwater time of travel to wellheads or margins of collection areas, aquifer boundary, supply source, or groundwater divide
Zone Four	Delineates areas with a 15-year groundwater time of travel to wellheads or margins of collection areas, aquifer boundary, supply source, or groundwater divide

Table 14: Groundwater Analysis - Source Water Protection model detailing intentions, components, and data sources.

GroundwaterAnalysis - Source Water Protection			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Source**
Tier 1 – Essential Groundwater Protection	The tier 1 model represents spatial areas in Ogden Valley needing essential protection to preserve excellent groundwater quality.	• Source Water Protection Zone 1 • Source Water Protection Zone 2	• Department of Environmental Quality
Tier 2 – Essential and Moderate Protection	The tier 2 model represents spatial areas of Ogden Valley needing essential and short-term protection for groundwater resources. The protection of these areas would preserve excellent groundwater quality in the short-term.	• All Tier 1 Lands • Source Water Protection Zone 3	• Department of Environmental Quality
Tier 3 – Extensive Groundwater Protection	The tier 3 model represents spatial areas of Ogden Valley needing essential and long-term protection for groundwater resources. The protection of these areas would preserve excellent groundwater quality in the long-term.	• All Tier 1 Lands • All Tier 2 Lands • Source Water Protection Zone 4	• Department of Environmental Quality

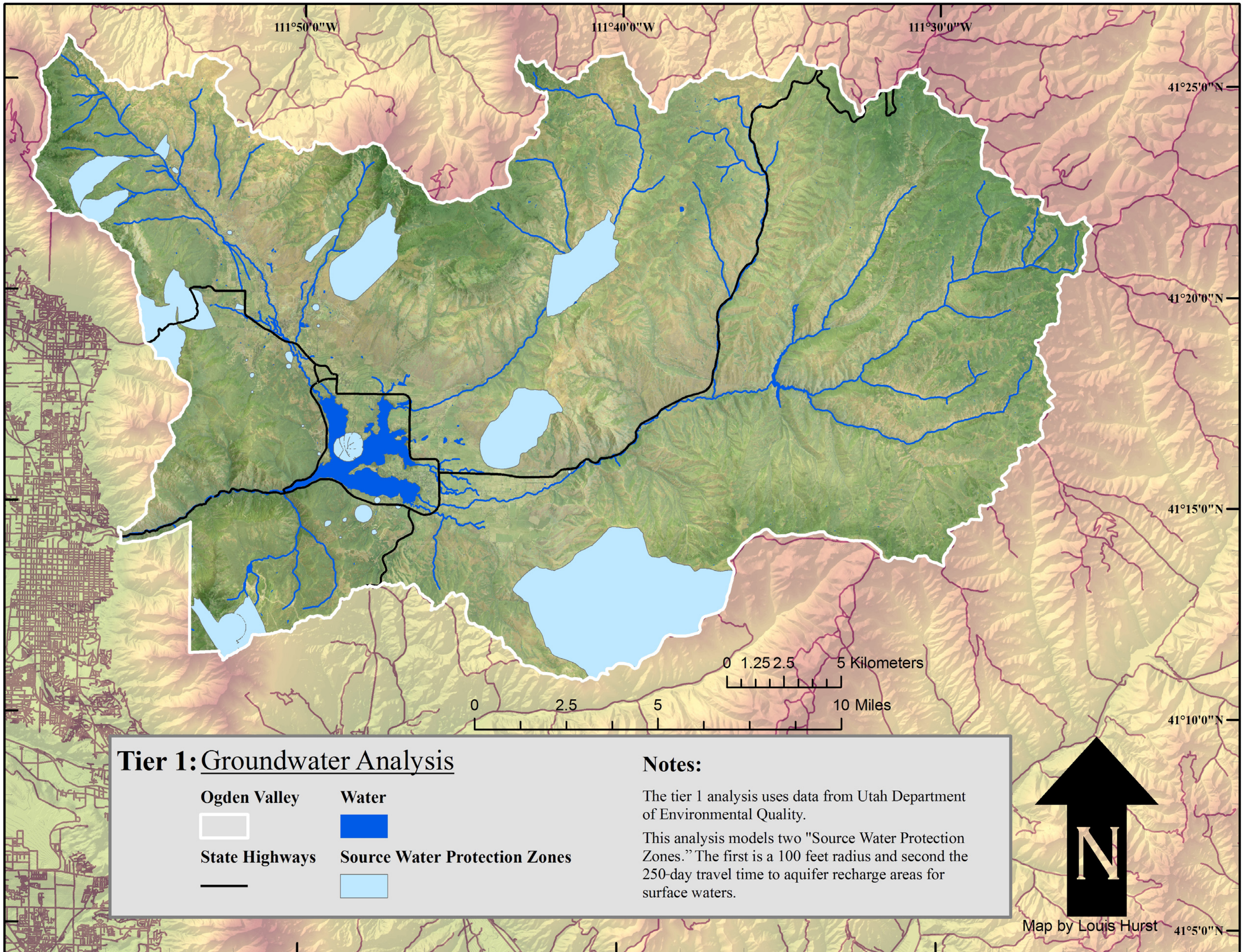


Figure 47: Tier 1 Evaluation Model - Groundwater

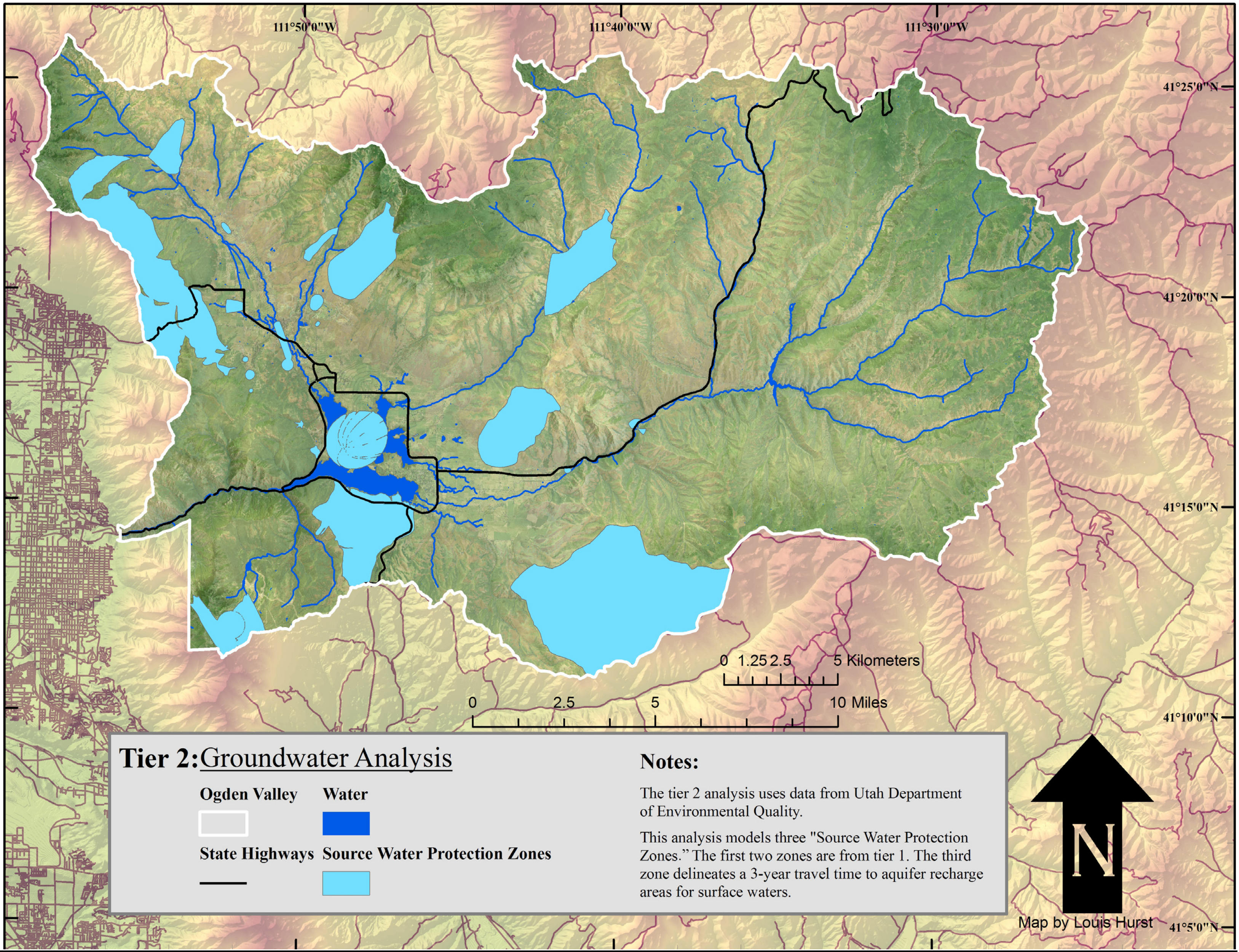


Figure 48: Tier 2 Evaluation Model - Groundwater

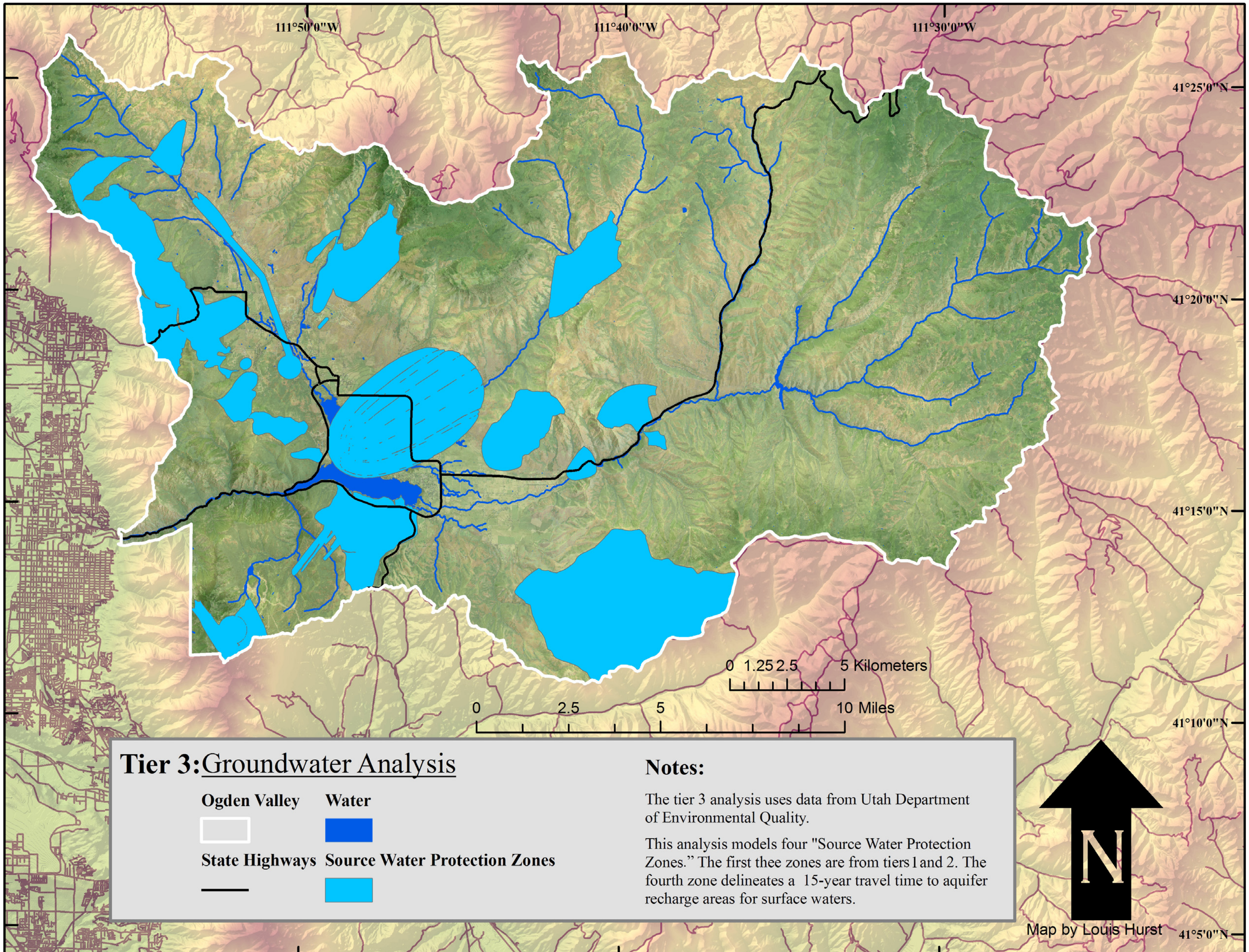


Figure 49: Tier 3 Evaluation Model - Groundwater

Surface Water Analysis

Maintaining high water quality depends on more than groundwater protection alone. This means that surface waters need adequate safeguards from degradation, in conjunction with the previously discussed groundwater protections. Surface waters consist of streams, rivers, lakes, wetlands, and springs, and each of these components come together to form a functional surface water system.

Currently, Ogden Valley is free of any major surface water degradation (Division of Water Quality, 2006). However, the state of Utah acknowledges that given the importance of recreation in Ogden Valley, increases in human activities could threaten portions of the surface water system. Ogden Valley currently has limited safeguards in place for surface water resources (Ordinance 43). Primarily, these protections extend to the Ogden River, Forks of the Ogden River, Pineview Reservoir, perennial rivers, and ephemeral rivers. Despite these surface water ordinances, lakes, reservoirs, and wetlands do not have any protections extended to them. Specifically, impacts to wetlands are a major concern for overall water quality (Cappiella et al., 2005).

Surface Water Assessment Model

The surface water assessment model attempts to increase the level of protection given to surface water and riparian areas. This model takes a proactive position by recommending differing levels of mitigation zones around surface waters and riparian areas. These zones provides floodwater control areas, protection for water quality and erosion control, protections for groundwater recharge areas, and preservation of ecological systems (Spano, 2007). These mitigation zones do not act exclusively as exclusionary restrictions but are designed to provide increasing protections based upon proximity to surface water resources (Figure 50). In addition, this model was tiered to provide greater flexibility within its creation (Table 15).

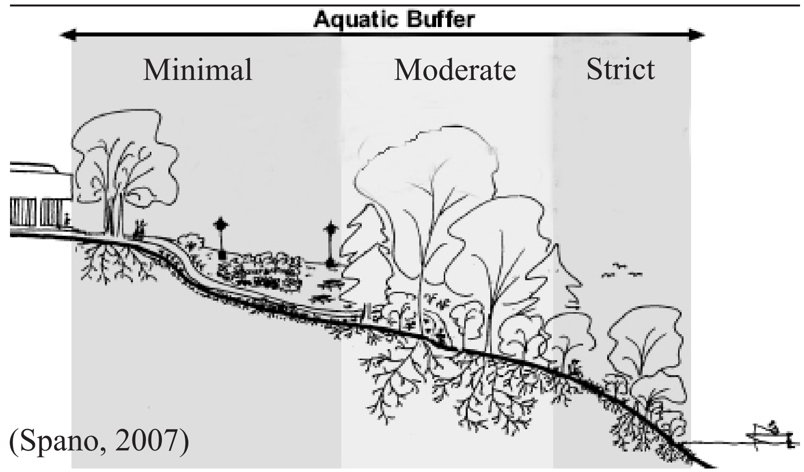


Figure 50: Explanation of the mitigation zones for surface water protection. Each shaded area represents a differing level of protection.

Tier 1

The tier 1 model (Table 15) tries to incorporate both the ordinances extended to surface waters previously by Weber County and add new protections to wetlands, lakes, and reservoirs. For rivers and streams, a strategy of mitigation zones was chosen to help preserve their ecological integrity by ensuring bank stabilization and stream shading. Lakes and reservoirs, other than Pineview Reservoir, also received new safeguards through the same tactic of applying mitigation zones. Finally, wetland mitigation zones were added to alleviate degradation from sediments, phosphorus, and nitrate contamination by reducing the speed of the water flowing into them. The mitigation zones for both surface waters and wetlands should help to improve and maintain water quality (Cappiella et al., 2005; Spano, 2007).

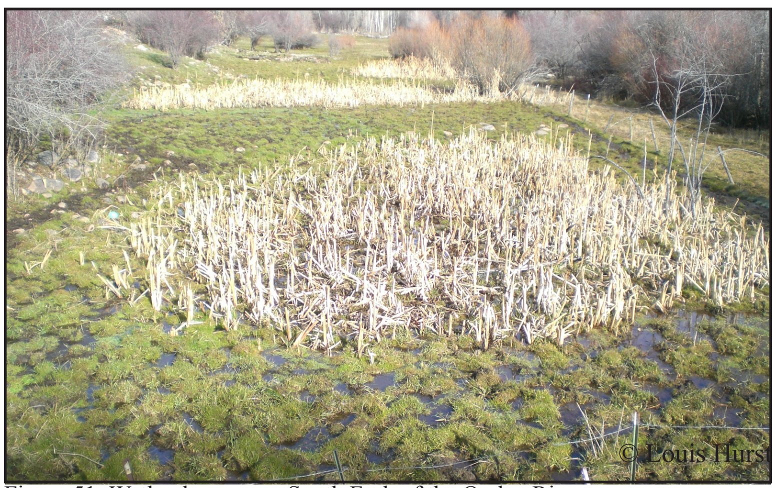


Figure 51: Wetland area near South Fork of the Ogden River.

Tier 2

The tier 2 model (Table 15) applies the same principle of applying mitigation zones from the tier 1 model. However, increased distances for the mitigation zones further improve water quality by reducing sediments, phosphorus, nitrogen, biological and chemical contaminants. These increased distances also improve wildlife habitat and help with flood control (Cappiella et al., 2005; Spano, 2007). All natural springs also receive protection in the tier 2 model.

Tier 3

The tier 3 model (Table 15) applies the same principle of mitigation zones to surface waters and riparian areas as the two previous models. However, this model makes the mitigation zones distances the same for lakes and reservoirs and streams and rivers. Wetlands within this model, as well as natural springs, receive their highest level of protection. The intention of this model is to provide excellent water quality by reducing sediments, phosphorus, nitrogen, biological, and chemical contaminants. The tier 3 model also improves wildlife habitat and serves as a flood control area (Cappiella et al., 2005; Spano, 2007).

Table 15: Surface Water Analysis - Mitigation Zones model detailing intentions, components, and data sources.

Surface Waters Analysis - Mitigation Zones			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Source**
Tier 1 – Essential Surface Water Protection	The tier 1 model represents spatial areas of protections to the most essential surface water resources. These protections ensure high water quality.	• Ogden River and Forks – 100 ft • Perennial Rivers – 75 ft • Intermittent Rivers – 50 ft • Pineview Reservoir – 100 ft • Lake and Reservoirs – 50 ft • Wetlands on 5% or less slope – 25 ft • Wetlands on 5-15% slope – 50 ft • Wetlands on 16-25% slope – 75 ft • Wetlands on 26% or greater slope – 100 ft	• Department of Environmental Quality
Tier 2 – Moderate Surface Water Protection	The tier 2 model represents spatial areas of protections to the most essential and moderate surface water areas. These protections ensure high water quality, wildlife habitat, and moderate flood control.	• Ogden River and Forks – 150 ft • Perennial & Intermittent Rivers – 100 ft • Pineview Reservoir – 150 ft • Lake and Reservoirs – 100 ft • Natural Springs – 50 ft • Wetlands on 5% or less slope – 50 ft • Wetlands on 5-15% slope – 100 ft • Wetlands on 16-25% slope – 125 ft • Wetlands on 26% or greater slope – 150 ft	• Department of Environmental Quality
Tier 3 – Extensive Surface Water Protection	The tier 3 model represents spatial areas of protections to the most essential, moderate, and low surface water areas. These protections ensure high water quality, wildlife habitat, and flood control.	• Surface Streams – 200 ft • Lake and Reservoirs – 200 ft • Natural Springs – 100 ft • Wetlands on 5% or less slope – 100 ft • Wetlands on 5-15% slope – 125 ft • Wetlands on 16-25% slope – 175 ft • Wetlands on 26% or greater slope – 200 ft	• Department of Environmental Quality

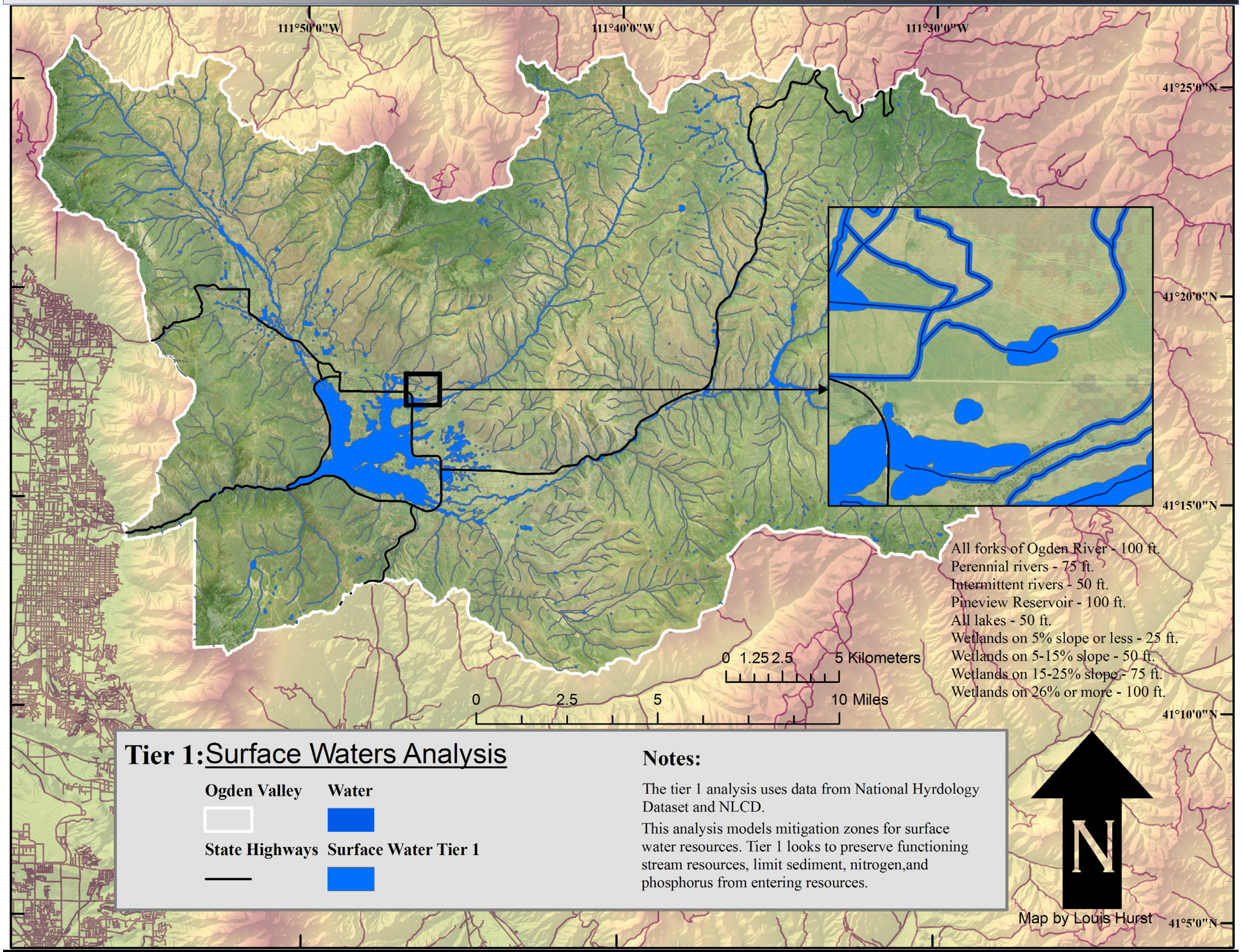


Figure 52: Tier 1 Evaluation Model - Surface Water

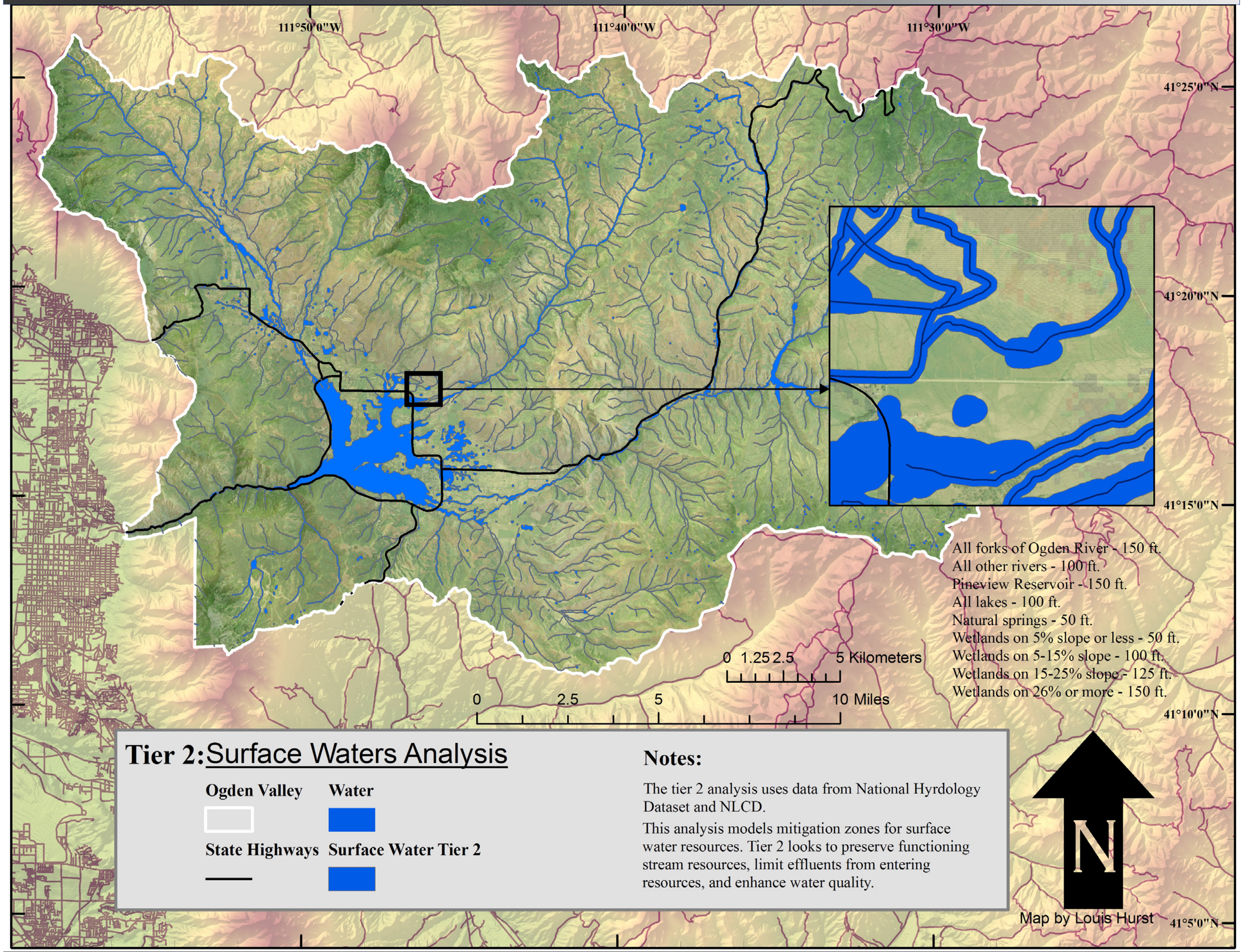


Figure 53: Tier 2 Evaluation Model - Surface Water

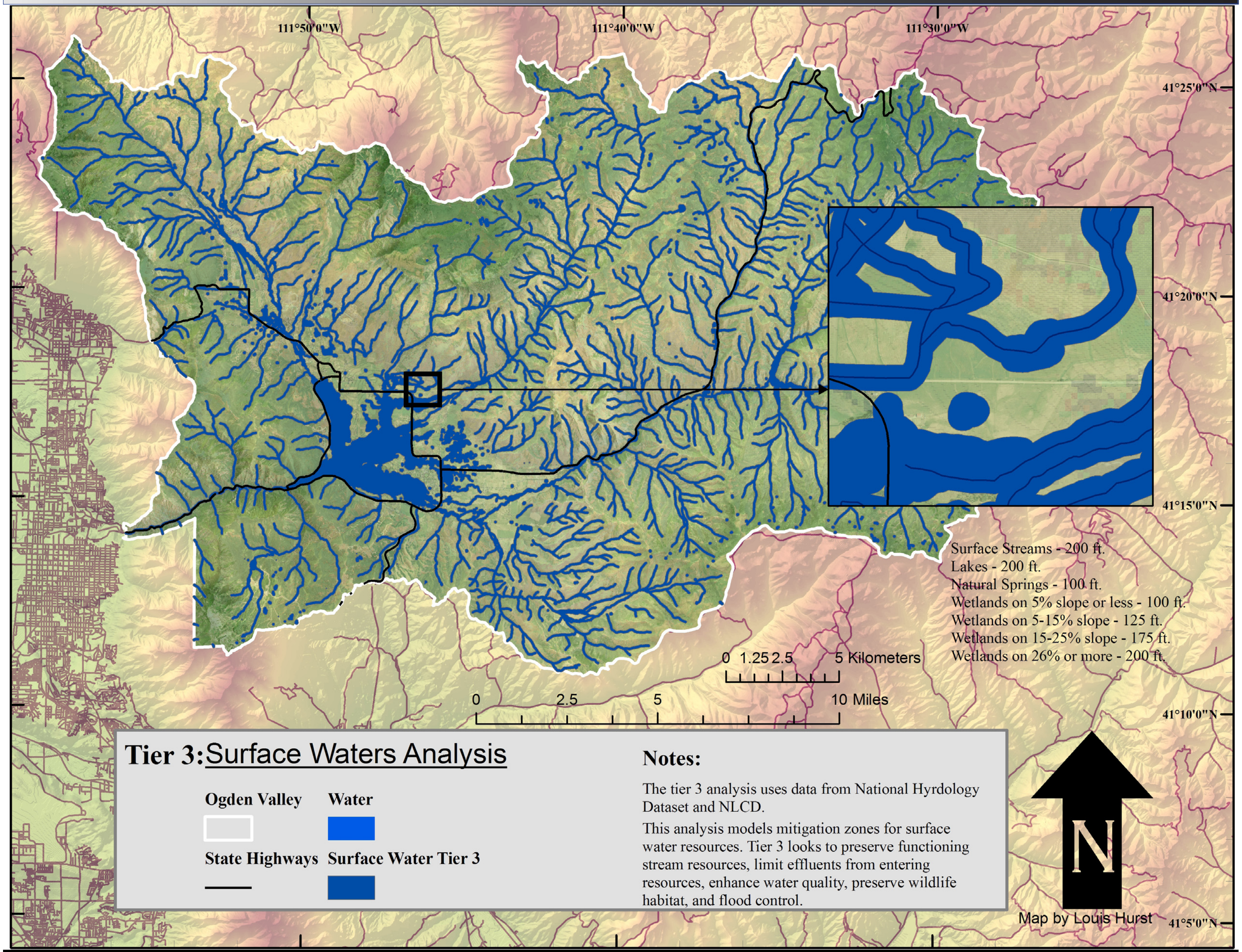


Figure 54: Tier 3 Evaluation Model - Surface Water

Transportation-Infrastructure Analysis

Today's society relies heavily upon surface transportation modes to deliver basic goods and services and to move people from place to place. Ogden Valley is no different, with residents often commuting out of the valley for work, everyday goods, and entertainment. Furthermore, Ogden Valley does not have any medical facilities to treat the injured or sick. In events of illness or emergency, resident shave to travel to McKay-Dee Hospital Center or instant care facilities in Ogden City, which can be over thirty miles from their homes. Other basic community services are limited, such as fire stations and schools. Finally, only one grocery store is located within Ogden Valley, and residents often must drive to the Wasatch Front for special goods and services.

As the population continues to grow, this rural community will have to respond to the lack of basic services and goods. Ogden Valley residents rely heavily upon their automobiles and the existing road network. This analysis shows the various distances from the local fire stations, hospitals, or grocery stores. By understanding these shortcomings to everyday services, residents may better allocate resources and push for greater transportation services, like public transportation, carpooling, et cetera.

Transportation – Infrastructure Model

This model calculates the distance from specific resources to areas within Ogden Valley. Specifically, some of the most vital services for everyday living and safety are modeled, including hospitals, fire stations, schools, and grocery stores (Table 16). Each of these services needed to be modeled individually, and the furthest distance modeled for all of these resources was limited to 30 miles. Because of the service types being modeled, tiering was not a viable option within this group of evaluations.

Figure 55: Trappers Loop (Hwy. 167) driving north into Ogden Valley.

Table 16: Transportation- Infrastructure Analysis model detailing intentions, components, and data sources.

Transportation Infrastructure Analysis			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Source**
Hospitals – McKay-Dee Hospital Center	This model shows the distances from Ogden Valley locations to the nearest hospital. The model calculates distances per mile.	• Ogden Valley Road Network • Hospitals	• Utah Automated Geographic Reference Center
Fire Stations – Huntsville, Eden, & Ogden City	This model shows the distances from Ogden Valley locations to the nearest fire stations, either Huntsville, Eden, or Ogden City. The model calculates distances per mile.	• Ogden Valley Road Network • Fire Stations	• Utah Automated Geographic Reference Center
High Schools – Weber High	This model shows the distances from Ogden Valley locations to Weber High School. The model calculates distances per mile.	• Ogden Valley Road Network • High Schools	• Utah Automated Geographic Reference Center
Ogden Valley Schools – Snowcrest Junior High School	This model shows the distances from Ogden Valley locations to Snowcrest Junior High. The model calculates distances per mile.	• Ogden Valley Road Network • Junior Schools	• Utah Automated Geographic Reference Center
Grocery Stores – Valley Market & Smith's Food & Drug	This model shows the distances from Ogden Valley locations to the nearest grocery store. The model calculates distances per mile.	• Ogden Valley Road Network • Grocery Stores	• Utah Automated Geographic Reference Center

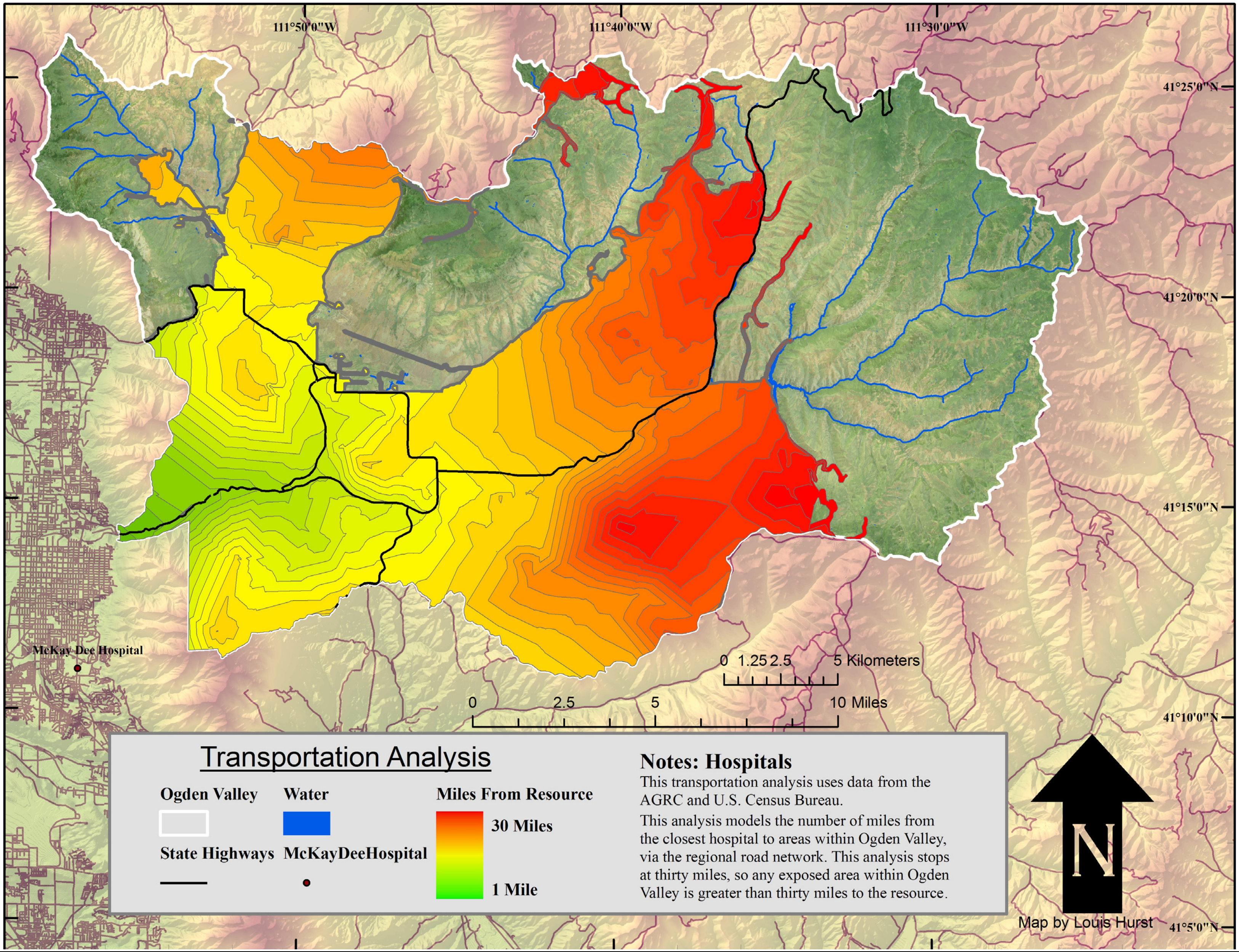


Figure 56: Transportation Infrastructure - Hospitals

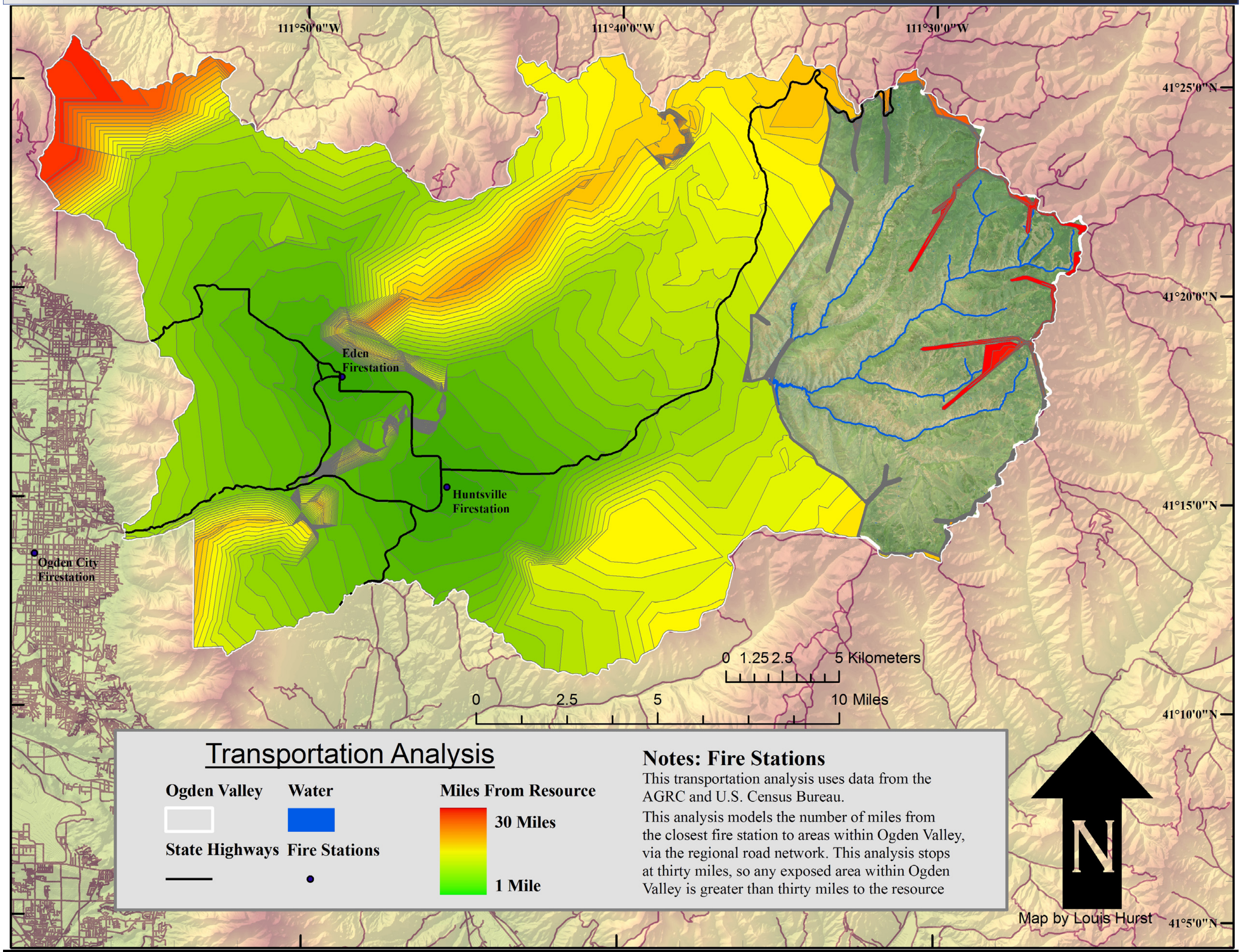


Figure 57: Transportation Infrastructure - Fire Stations

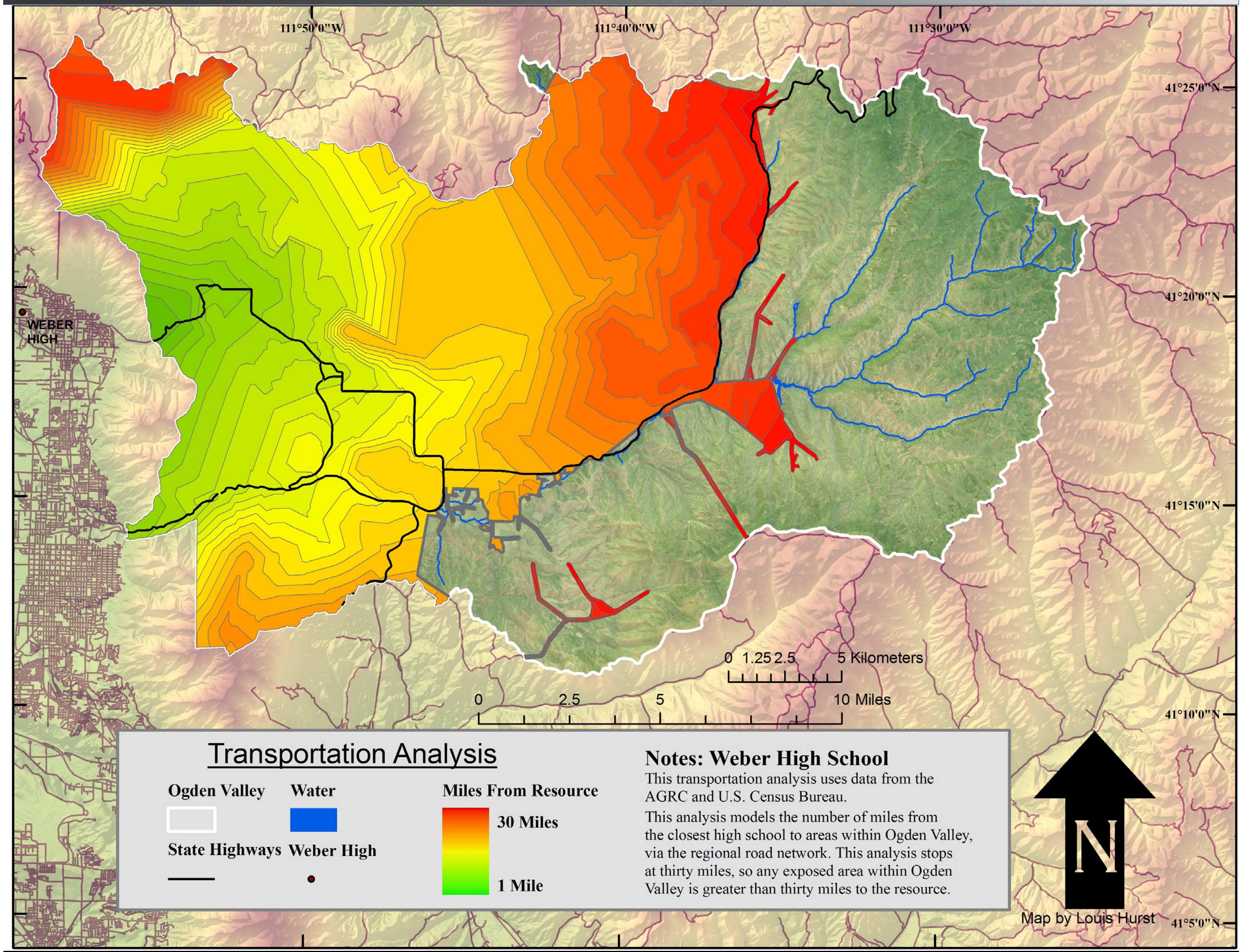


Figure 58: Transportation Infrastructure - Weber High School

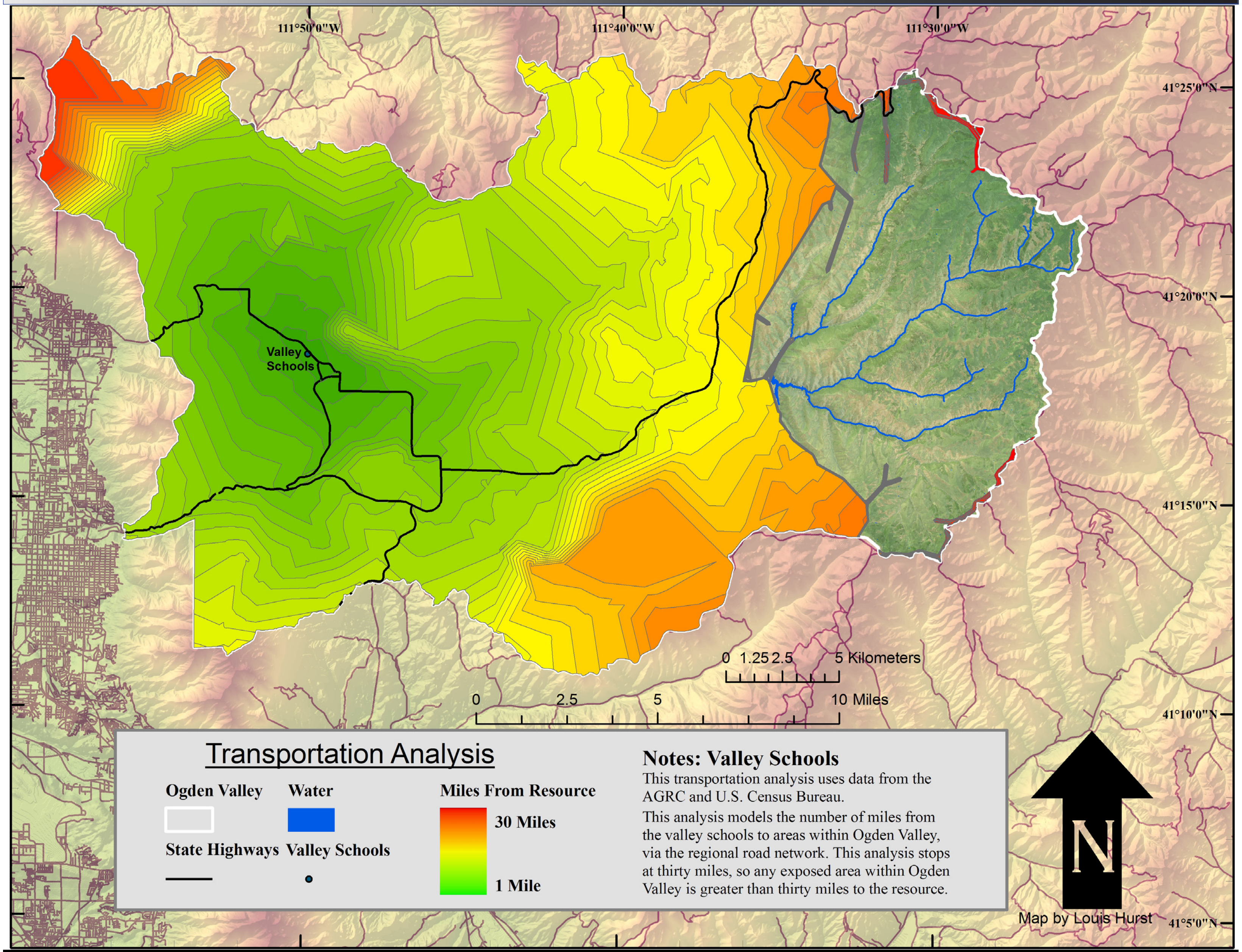


Figure 59: Transportation Infrastructure - Valley Junior High School

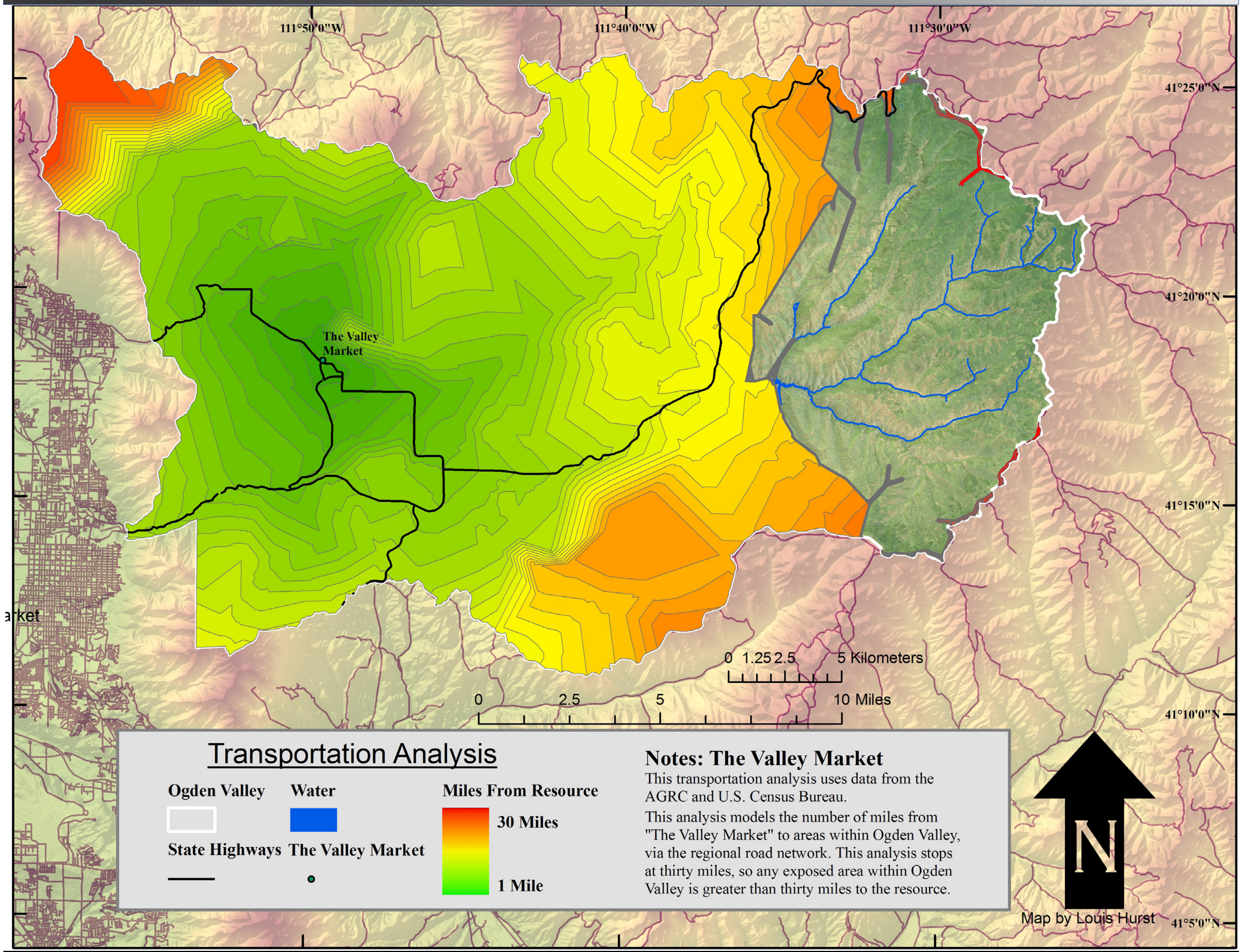


Figure 60: Transportation Infrastructure - Valley Market

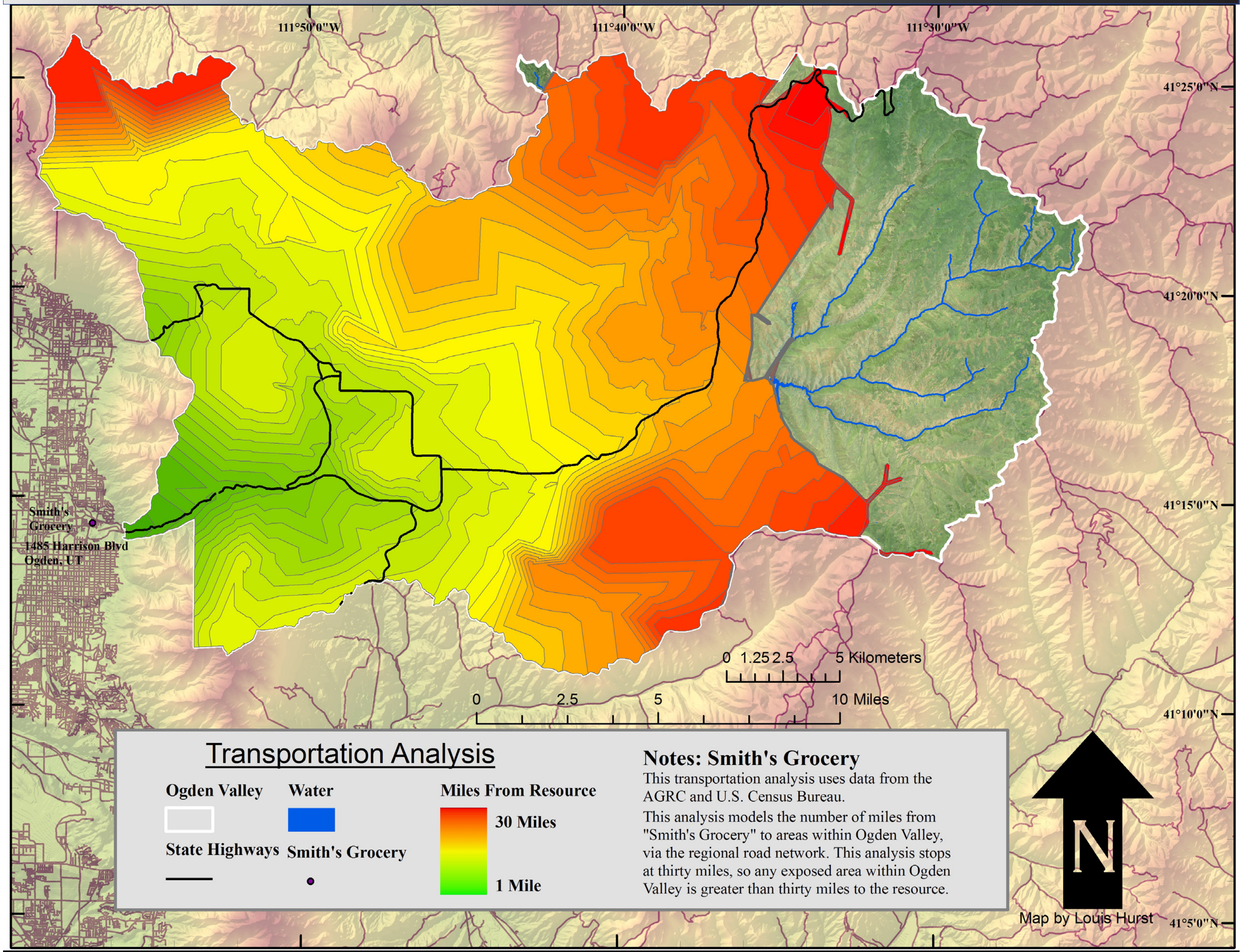


Figure 61: Transportation Infrastructure - Smith's Grocery

Viewshed Analysis

The landscape that surrounds an area often is a large determinant upon that area's "sense of place" (Stedman, 2005). Ogden Valley is no exception, and its rural character and proximity to natural environments help to define this community. As development continues to pressure the rural and natural setting of the valley, the character of the valley can change a great deal. Understanding that change is going to occur, Ogden Valley can begin to manage priorities between developers and residents (Seidl, 2005). Part of this will require managing the viewsheds within the valley and finding ways to maximize the goals of both developers and residents.

Ogden Valley has development pressures from both recreational influences and residential developers. The valley is an example of a rural community, yet it still has access to the amenities of a major city. It is important to understand where and how to accommodate growth without jeopardizing the sense of place which is attractive to development. Residents enjoy the long open views, natural landscape, and rural components. Analysis of the landscape needs to begin with first understanding what is visible and later discussing how to further manage sense of place and development (Lake et al., 1998).

Viewshed Model

This model analyzes areas that are visible from multiple viewpoints (Table 17), showing areas that are routinely visible throughout the valley. By understanding what is seen within the valley, residents and developers can both view the landscape on similar terms. Each will know where highly visible and less visible places exist.

Three sets of visibility points were selected. Town centers were the first points selected, and these included Huntsville, Liberty, and Eden. These sites were selected because residents view the valley from these areas most often. Next, entry points were selected including Ogden Canyon on Highway 39, North Ogden Divide, exiting Ogden Valley on Highway 39, and Trappers Loop Highway 167. These areas are important because they are the first views of the valley for both residents and visitors to the valley. Finally, as important as Pineview Reservoir is for Ogden Valley, eight points were selected from areas of the lake. The reservoir sites were selected because of the reservoir's importance to valley character, valley recreation, and tourism.

The viewshed evaluation model was tiered to show differing levels of visibility. Each model increasingly adds points as the tiering progresses, meaning that in tier 1, only 3 points were selected, but in tier 3 there were 15 points distributed across the landscape.

Table 17:Viewshed Analysis model detailing intentions, components, and data sources.

Viewshed Analysis			
Level of Tiering	**Model's Intention**	**Model Components**	**Data Source**
Tier 1 – Town Centers	The tier 1 model shows those areas of Ogden Valley that are visible from the town centers. Inversely, this model also shows areas that are not visible from town centers.	• Town of Huntsville • Town of Liberty • Town of Eden • 10 meter DEM	• Utah Automated Geographic Reference Center • Digital Elevation Model
Tier 2 – Town Centers & Entry Points	The tier 2 model shows those areas of Ogden Valley that are visible from entry points and town centers. Inversely, this model also shows areas that are not visible from entry points and town centers.	• Tier 1 Points • Valley Entry – Hwy. 39 • North Ogden Divide • Valley Exit – Hwy. 39 • Trappers Loop – Hwy. 167 • 10 meter DEM	• Utah Automated Geographic Reference Center • Digital Elevation Model
Tier 3 – Town Centers, Entry Points, & Lake Views	The tier 3 model shows those areas of Ogden Valley that are visible from Pineview Reservoir, entry points, and town centers. Inversely, this model also shows areas that are not visible from Pineview Reservoir, entry points, and town centers.	• Tier 1 Points • Tier 2 Points • Pineview Reservoir Points • 10 meter DEM	• Utah Automated Geographic Reference Center • Digital Elevation Model

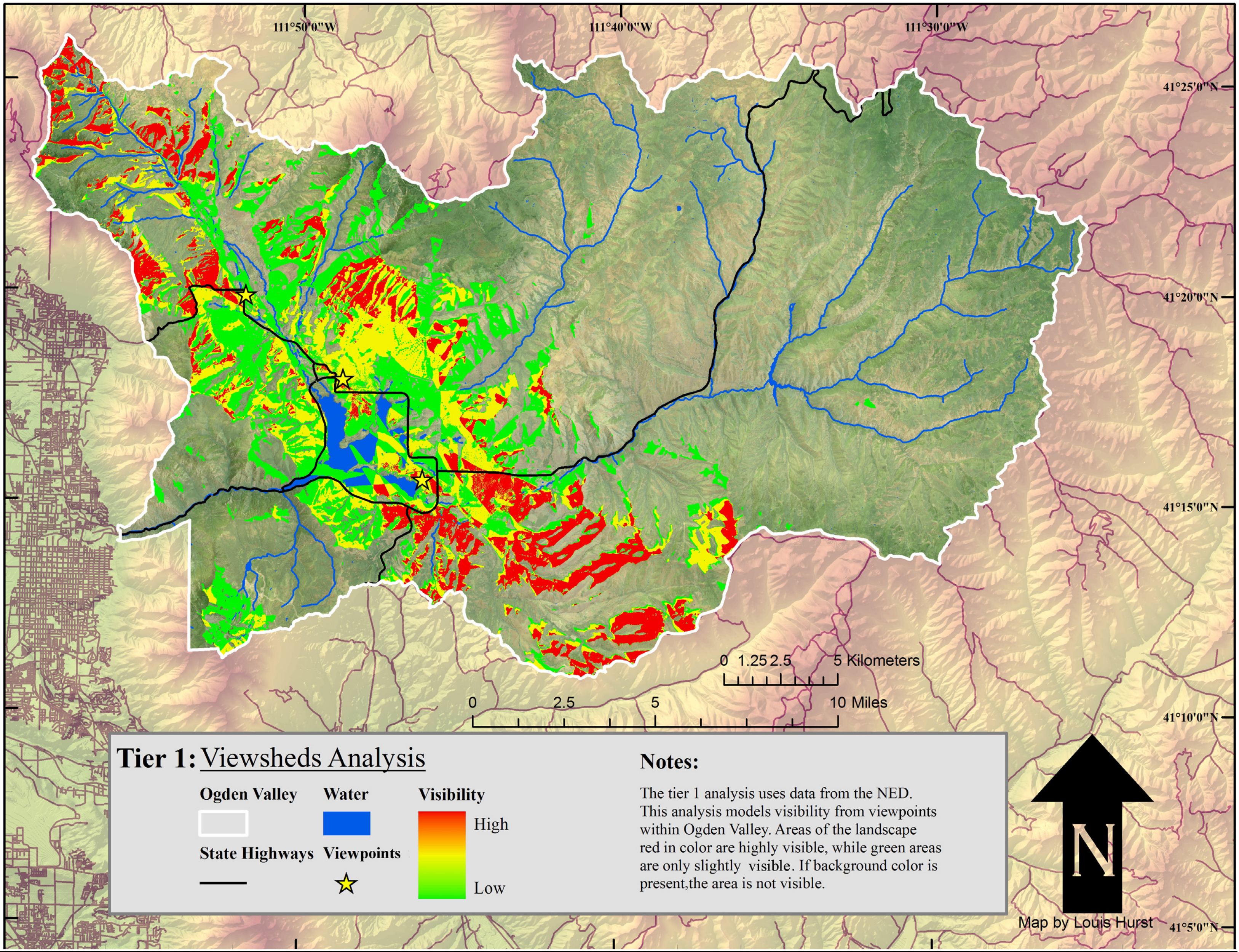


Figure 62: Tier 1 Evaluation Model - Viewshed

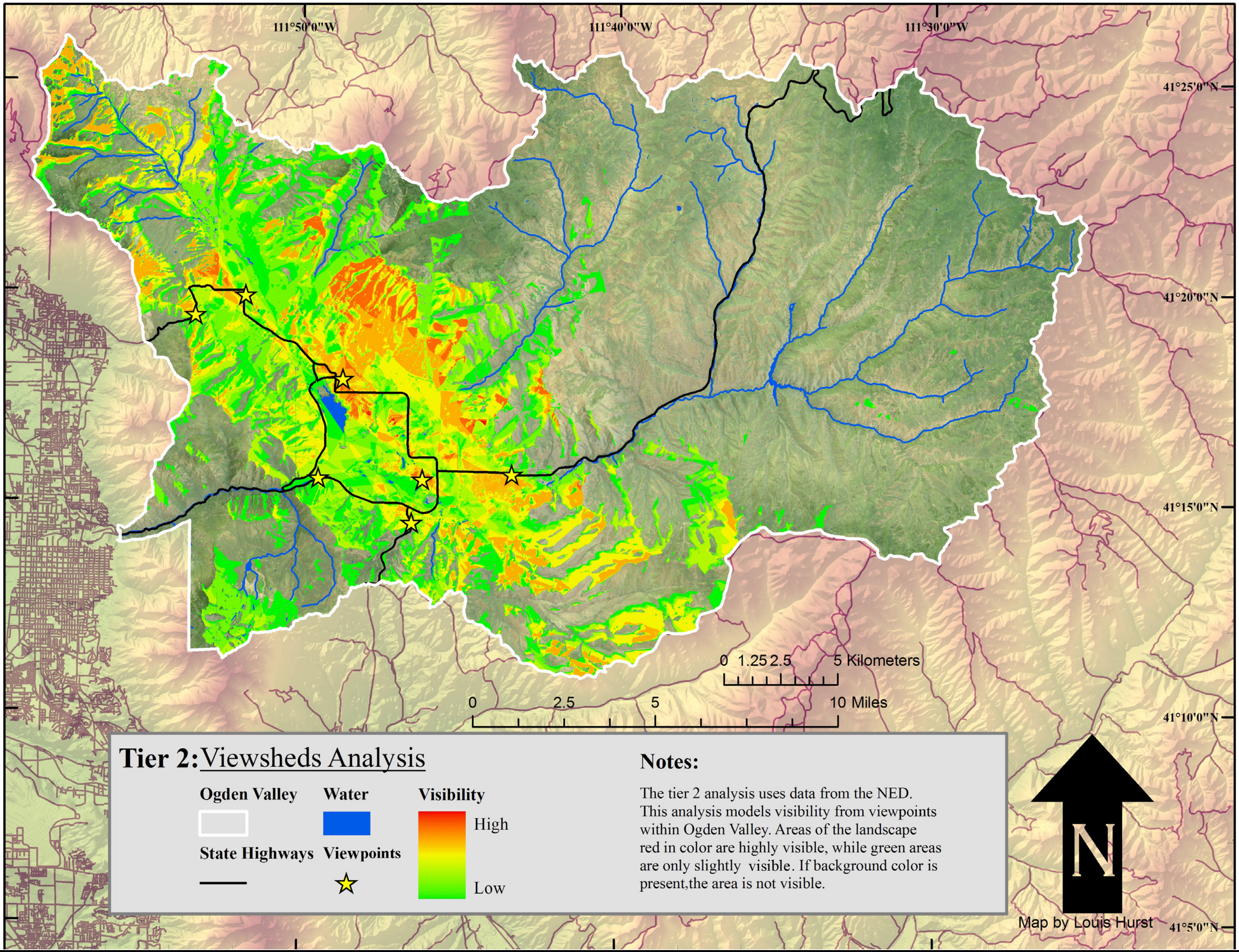


Figure 63: Tier 2 Evaluation Model - Viewshed

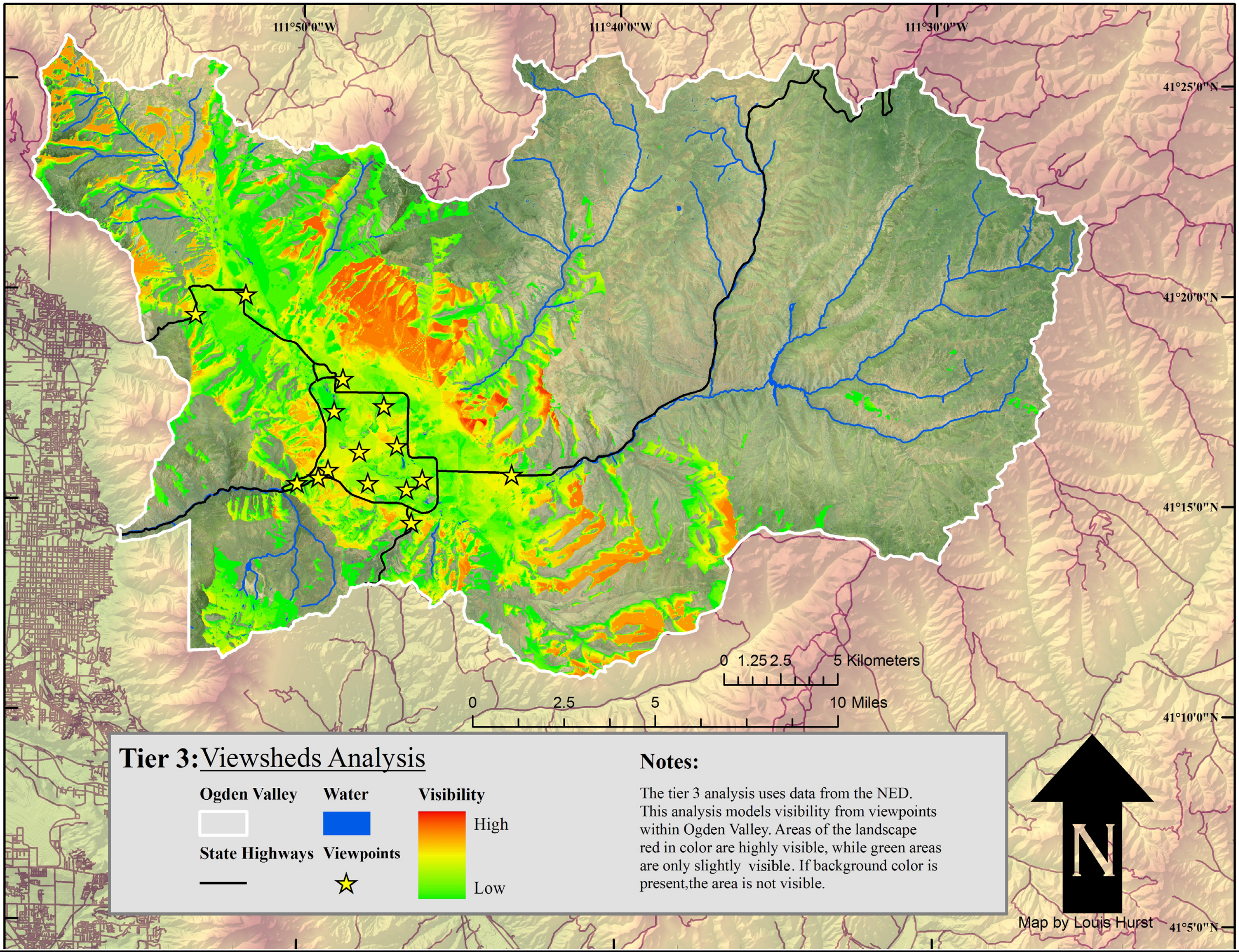


Figure 64: Tier 3 Evaluation Model - Viewshed

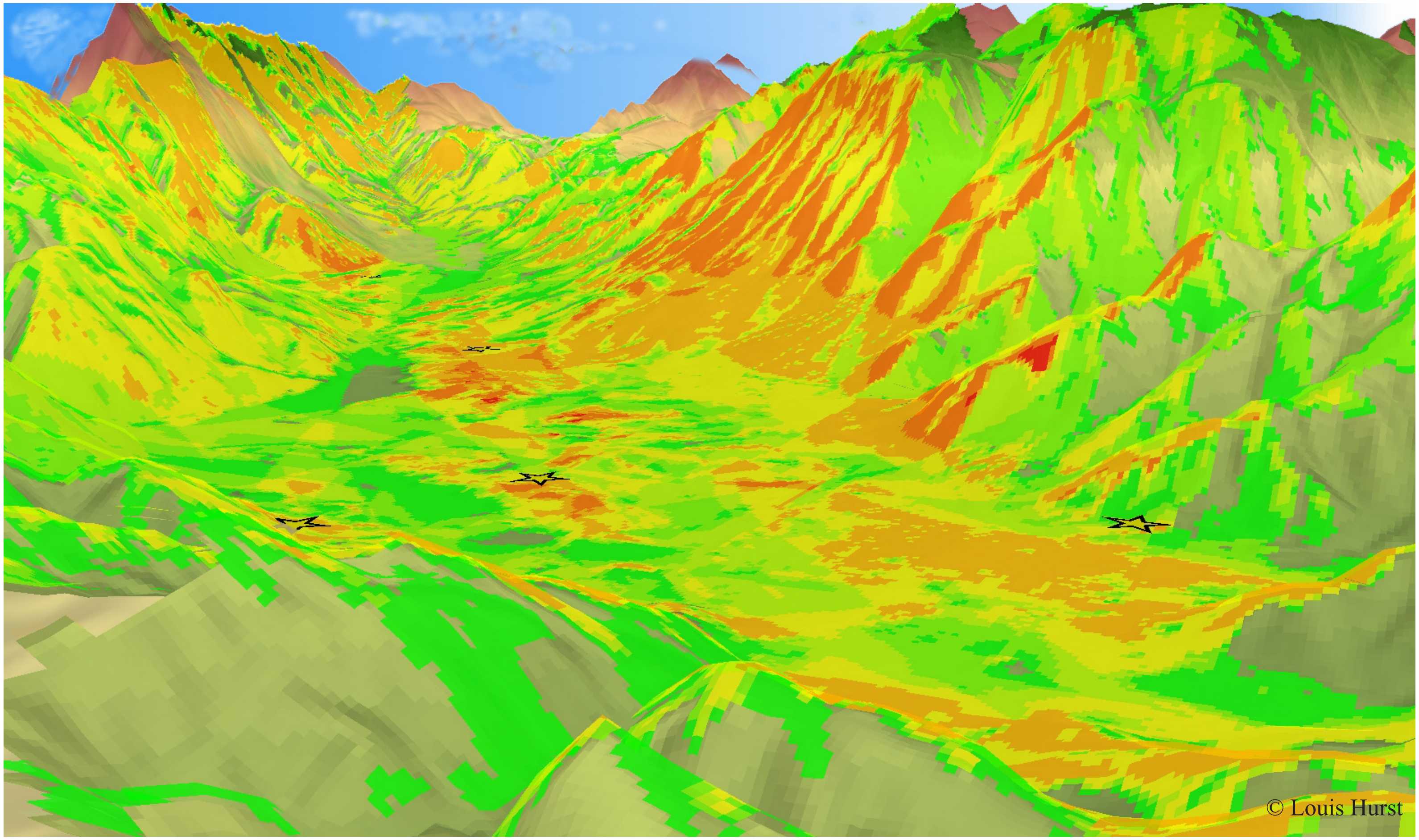


Figure 65: 3-D view of Ogden Valley's Tier 2 Viewshed Analysis. Viewpoint is from above Trappers Loop (Hwy. 167) looking northwest past Huntsville, Eden, and then Liberty. Areas of red on this analysis are highly visible from the seven analysis points (entry corridors and town centers).

Alternative Futures

Alternative futures are the spatial end points of a series of potential events or opportunities. Although predictive in nature, alternative futures do not prognosticate the "true" future. Therefore, instead of developing a single true future for Ogden Valley, a series of alternative futures were developed to simulate how different events could shape the future. These alternative futures are based upon changes in residential development over the next 20 years.

In order to create these different alternative futures, two factors for development had to be examined. First, population growth is one of the major drivers of development, and information on population growth is necessary. Several population projections were developed to look at this factor and each projection accounted for different amounts of growth over time. Second, the pattern and process of land-use development needed to be researched, analyzed, and then reconstructed. Finally, these two factors had to be assembled into a repeatable systematic model that could allocate new growth.

In order to develop, this process was slightly altered to produce a diverse array of alternative futures, using both scientific and speculative strategies in order to build each alternative future.

Lastly, the creation of the alternative futures ultimately leads to the evaluation phase. Although information can be taken from this phase, each alternative future needs to be evaluated for its overall fitness. Within this study, the evaluation of fitness is based upon the previously created evaluation models and appears in the next phase of the project.

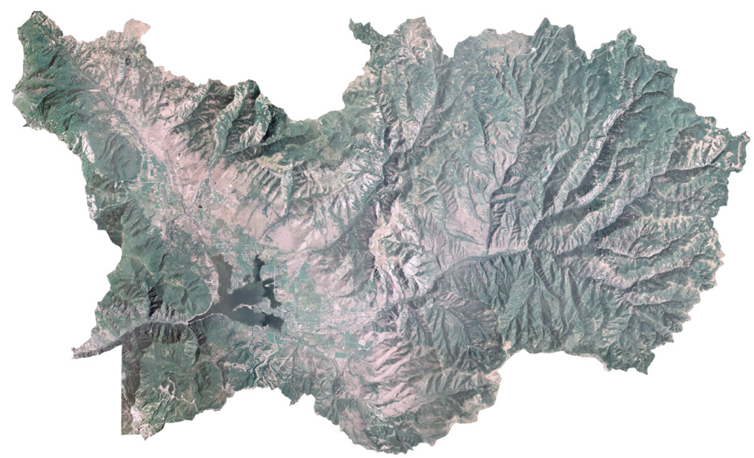


Figure 66: Aerial image of Ogden Valley.

Population Projections

As one of the major factors influencing development, population pressures within a region are important to understand. Population projections are generally calculated two ways (Pittenger, 1976). First, direct projections look at several statistical figures from the projection area. Typically, these statistical figures include birth, death, in-migration, and ex-migration rates (Barclay, 1958). This is a labor- and knowledge-intensive approach. The second technique, indirect population projections, uses overall population size to extrapolate a future population figure using mathematical techniques (Krueckeberg & Silvers, 1974; Shryock & Siegel, 1973). Indirect population projection techniques are used within this study.

When using population projections to predict future growth, both over or under estimates of the future population are a serious problem. For this reason, a variety of population projections were calculated for this study, and each calculation was slightly different from the next. This strategy bounds a large area of potential population growth for Ogden Valley.

The population projections for this study used four time steps to extrapolate into the future. These time intervals were 1970, 1980, 1990, and 2000. Over these four time intervals, Ogden Valley had the same census tract boundary within Weber County. This allowed for easy analysis of the population over the preceding 40 years. Beginning with 1970, Ogden Valley's population was 2,148, and by 2000, the population had almost tripled to 5,877. The annual growth rate for Ogden Valley was just above 5% over that time period. Between the years 1990 and 2000, the highest amount of growth occurred in Ogden Valley as the population grew by nearly 2,000 residents.

All of the data used for these population projections came from historical census tract figures. These data were obtained through the National Historic Geographic Information System. The projections themselves used a variety of equations to calculate different growth rates (Table 18). Within the study, four total population projections were developed, but only two of the four were used to develop the alternative futures (Table 19). The two projections used with the study were the percentage change and linear projections. Their inclusion in the study was the result of a comparison of all the projections and using the one moderate and faster projections.

<u>Population Projections</u>

1. Exponential - (Fastest Growth Rate)
2. Percent Change 5%/Year - (Fast Growth Rate)
3. Linear - (Slow Growth Rate)
4. Linear Regression - (Slowest Growth Rate)

Table 18: Population projection equations.

Population Projection Equations				
	Exponential	Percent Change	Linear	Linear Regression
Equations	$P_{t-n} = P_t (1+ r)^2$ $r = \frac{1}{m} \sum \frac{(P_t - P_{t-1})}{P_{t-1}}$	$P_{t+n} = P_t + (b[P_t][n])$ b= 4%	$P_{t+n} = P_t + b(n)$ $b = \frac{\sum^d_t (P_t - P_{t+1})}{m}$	Y=a+bX $b = \frac{N\sum XY-(\sum X)(\sum Y)}{N\sum X^2 -(\sum X)^2}$ $a = \frac{\sum Y - b\sum X}{N}$
Explanation	Pt+n = future population time Pt = last census taking Pt+1 = prior census taking m = number of intervals r = rate of change	Pt+n = future population time Pt = pop. at prior census b = growth rate n = number of units in time	Pt+n = future population time Pt = pop. at last census Pt-1 = prior census taking n = number of units in time b = growth rate d = data of last census m = number of intervals t = a time index (decade)	N = number of observations X = a year index (decade) Y = population size for a given census

Table 19: Ogden Valley past population figures and future projections based upon the four different growth equations. The two middle figures were used within the study.

Ogden Valley Population Projections								
1970	**1980**	**1990**	**2000**	**Projection Rate**	**Projection**	**2010**	**2020**	**2030**
2148	3294	3954	5877	**Fastest**	**Exponential**	8268	11631	16361
				Fast	**Percentage Change**	8228	10579	12930*
				Slow	**Linear**	7120	8363	9606*
				Slowest	**Linear Regression**	6780	7965	9150

* Indicates use in the study as part of creation of alternative futures.

Creating Alternative Futures

Alternative futures are the combination of several variables or scenarios resulting in a spatially explicit endpoint. This process began with researching several past techniques for developing growth models. This led to conceptualizing, designing, and implementing a growth model that could produce a variety of alternative futures. The model had to allocate individual homes based upon characteristics derived from housing trends in Ogden Valley. Additionally, the model had to be easily adaptable in order to make several additional and different alternative futures.

Model Background

Research for this model began in the early phases of the study. Three sources provided valuable information about how to begin developing this model. First, this process had to produce a final allocation of homes (Hopkins & Zapata, 2007). Second, the process had to use an approximate density for Ogden Valley, which ultimately helps determine the number of allocated housing units for each alternative future (Carr & Zwick, 2007). Finally, this model analyzed all of the existing homes in Ogden Valley based upon several variables. A series of histograms displayed this information visually and allowed for the assignment of values to different landscape types (Steinitz et al., 2003).

Growth Model

The major purpose of the growth model is to allocate housing units repeatedly and systematically. All the information going into the growth model comes from existing homes within Ogden Valley. From these existing units, information about five variables was obtained.

Base Variables

1. Slope
2. Distance from all roads
3. Distance from major roads (Hwys. 39, 167, and 162)
4. Distance from towns (Huntsville, Liberty, and Eden)
5. Housing unit density per ½ mile

For each existing home in Ogden Valley, data for these five variables was gathered. Each individual variable was separated and grouped into 32 categories based upon natural breaks within their range. Once the variables were grouped and categorized, each category was assigned a value relative to the total number of housing units. The value-assigned base variables were then combined to help predict future housing development. As appropriate, speculative variables or weighting assignments were added to shape the intention of the spatial output (alternative futures).

Once these base variables had been assigned values, the study area was subdivided based upon pre-existing or new zoning categories. Next, certain areas identified as inappropriate for growth were excluded. These areas include public lands, open water, slopes greater than 30%, and conservation easements. Following this analysis, the total number of new units was determined. Each zoning area then received a specific number of units based upon past trends or the objectives of the alternative future. Lastly, a random allocation of housing units was calculated in order to replicate the unpredictable nature of human development. Once the predicted and random allocations were completed, the alternative future based upon new housing units is completed.

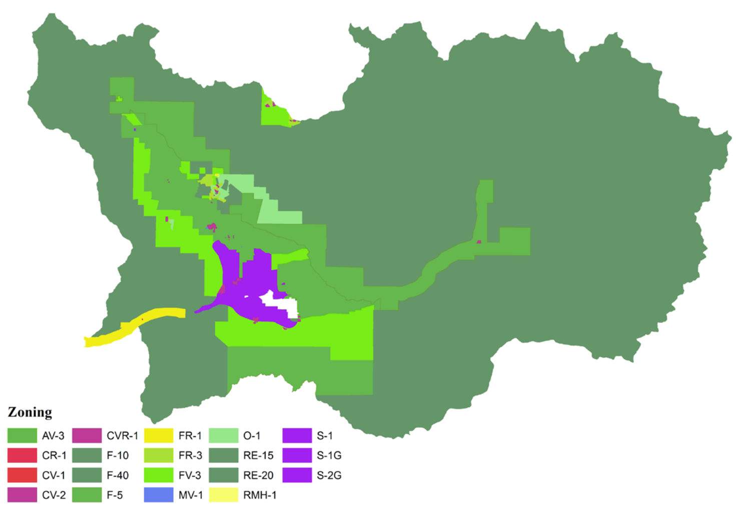


Figure 67: The current zoning for Ogden Valley.

Variable - Landscape Relationships

Each variable has a unique relationship between the existing housing units and the landscape in Ogden Valley. Some variables have very strong associations between housing units and the landscape, while others do not appear as strong. Furthermore, these variables have both negative and positive relationships between housing units and the landscape.

A negative relationship means that as the number of housing units decreases, the variable increases. A positive relationship means that as the number of housing units increases, the variable also increases.

In Ogden Valley, slope has a negative relationship with housing units. This means that as "slope" increases, the number of housing units decreases. This same relationship exists between the variables "distance from roads," "distance from major roads," and "housing unit density." The variable "distance from towns" is interesting, because it has a slight positive relationship. This means that as distance increases from one of the three towns in Ogden Valley, there is an increase in housing units.

Each of the five base variables had a histogram built for it. These descriptive statistics present the information described above in a visual format. Each of these histograms appear in Appendix C.

Trend

The Trend alternative future represents what Ogden Valley might look like in the year 2030, given the current policies and codes of Weber County. This future was created using only the five base variables. Although speculative, the trend alternative future extrapolates the existing patterns and processes of development into the future.

This future contains no major changes to zoning or other policy decisions. Additionally, this future uses the linear, slow, growth rate for its projection. By 2030, approximately 9,600 people will be living in Ogden Valley (Table 19), an addition of approximately 3,700 new residents. The difference between the current and future population determines the expected new homes based upon people per dwelling units, which is 1.93, which is Ogden Valley's current density. This future contains 1,911 new housing units. The Agricultural Valley zone is the most developed zone in this future. Once used for agricultural and ranching purposes, houses and lawns dominate this part of the landscape in 2030.

Importantly, each zoning type in this future has a basis in the current zoning of Ogden Valley. This means that if an area requires a specific lot size, each unit has the appropriately required land to accompany it.

Table 20 details the number of new homes and the different zoning types that accept new homes. Finally, this table also details the square mileage consumed by each new housing type

Table 20: Ogden Valley Trend Future housing units.

Ogden Valley Alternative Future – Trend Future			
Zoning Type	**Zoning Name**	**New Housing Units (Approx.)**	**Area Sq. Miles (Approx.)**
Existing Zoning	Agricultural Valley Zone (AV-3)	644	3.02
	Forest Residential Zone (FR-3)	330	1.55
	Forest Valley Zone (FV-3)	398	1.87
	Forest Zone 5 (F-5)	148	1.16
	Forest Zone 10 (F-10)	116	1.81
	Forest Zone 40 (F-40)	122	7.62
	Residential Estates (RE15 & 20)	153	.11
Total		1911	17.14

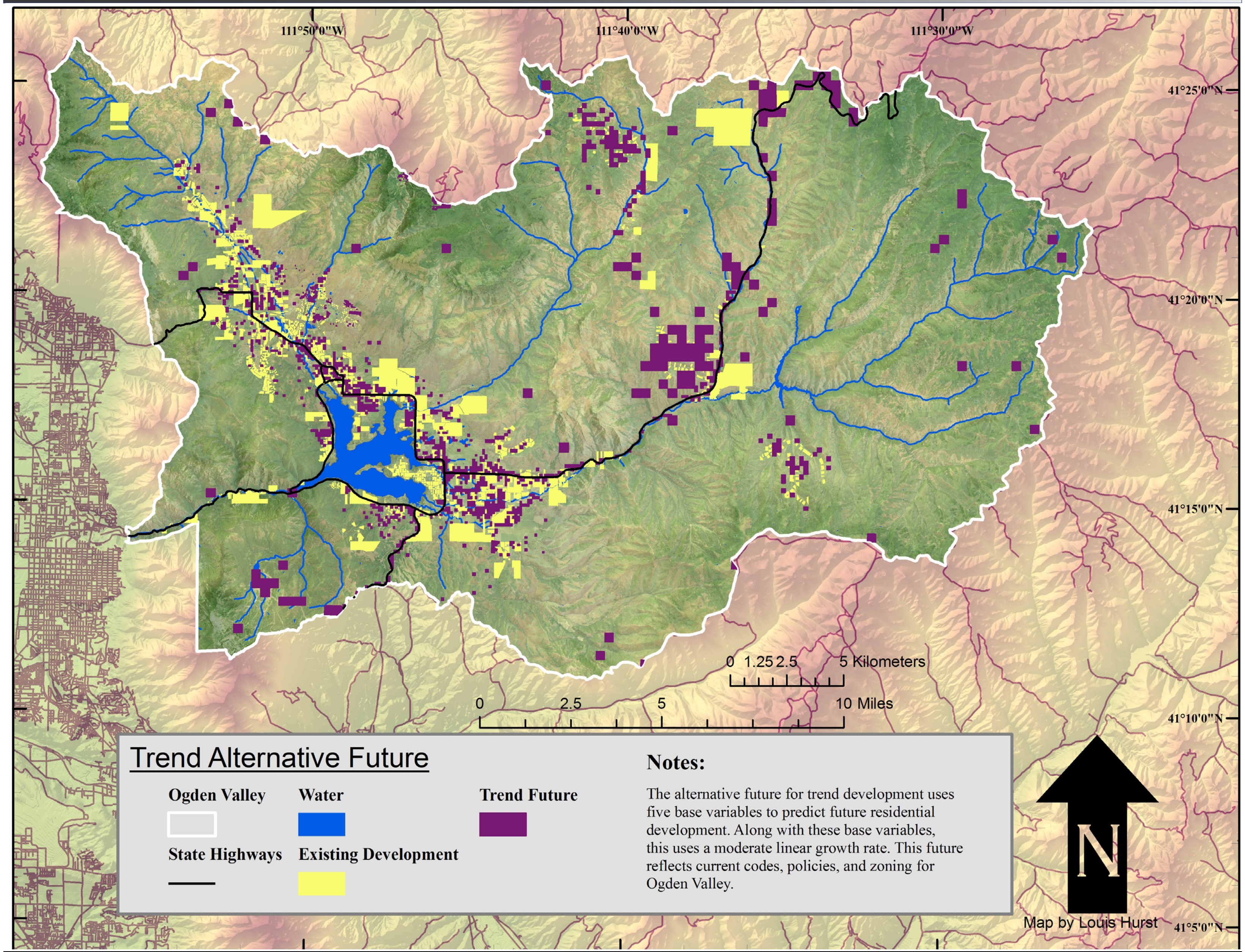


Figure 68: Alternative Futures - Trend

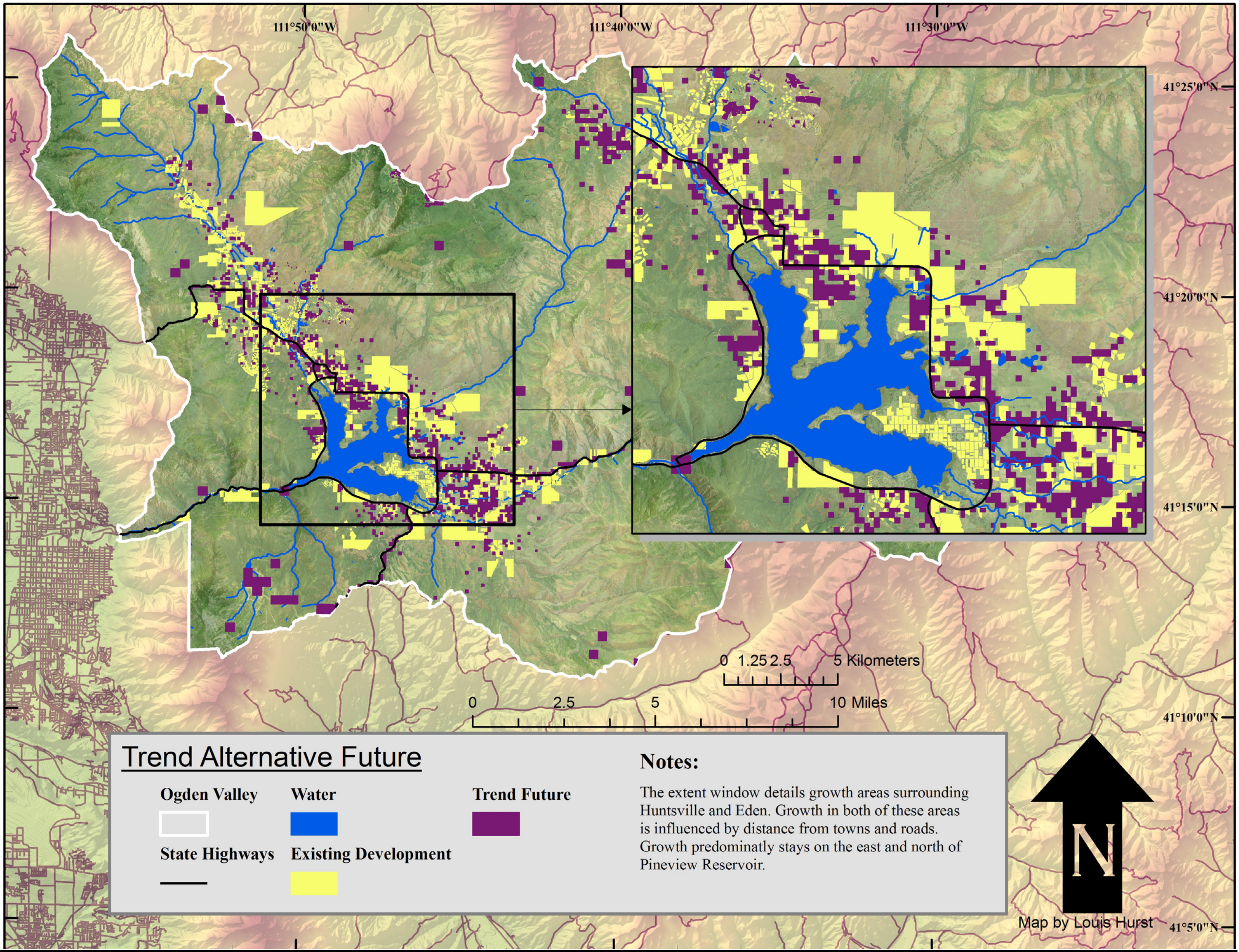


Figure 69: Alternative Futures - Trend - Window View

Town Expansion

The Town Expansion alternative future represents a change in jurisdiction within Ogden Valley. Currently, Huntsville is the only one incorporated town in Ogden Valley. This future expands both Huntsville's town boundary by annexation and incorporates areas around both Liberty and Eden. Within these new annexed and incorporated areas, there is a significant increase in zoning densities. Several new zones were created and they range between one unit per acre to four units per acre. The primary intention of this future is to show spatially what Ogden Valley would look like if these existing communities incorporated and development was concentrated near these towns.

This future uses more than just the base variables to allocate new housing units. The five base variables are applied, but the variable distance from towns is weighted to four times normal. Again, this variable had a negative relationship to housing units, meaning that the greater the distance from town centers, the less likely the area is to develop. This approach focuses development around the town centers. As mentioned above, several new zoning areas were created around the incorporated towns. These areas received approximately 55% of the new growth within this future. This allowed for consolidation of the total growth within the valley to three locations.

This future uses the same linear projection as the trend future. This means that there will be approximately 3,700 new residents in Ogden Valley by 2030. Given this population increase, a total of 1,939 new housing units are needed to accommodate the growth. This is approximately the same number as the trend alternative future. However, despite these similarities between alternative futures, this future uses about 3 square miles less than the trend alternative future due to the density increases in zoning.

Table 21 details the number of new homes and the different zoning types that accept new homes. Finally, this table also details the square mileage needed for each new housing type.

Figure 70: Huntsville Town Hall.

Table 21: Ogden Valley Town Expansion Future housing units.

Ogden Valley Alternative Future – Town Expansion Future			
Zoning Type	**Zoning Name**	**New Housing Units (Approx.)**	**Area Sq. Miles (Approx.)**
Existing Zoning	Agricultural Valley Zone (AV-3)	212	1.00
	Forest Residential Zone (FR-3)	77	.40
	Forest Valley Zone (FV-3)	202	.95
	Forest Zone 5 (F-5)	115	.90
	Forest Zone 10 (F-10)	113	1.80
	Forest Zone 40 (F-40)	96	6
	Residential Estates (RE15 & 20)	79	.06
New Zoning	Town Valley Zone (TV-1)	326	.51
	Town Valley Zone (TV-1/2)	382	.60
	Town Valley Zone (TV-1/4)	341	.26
Total		1943	12.48

Figure 71: Downtown Eden and the Eden General Store.

Figure 72: North Ogden Divide overlooking Liberty.

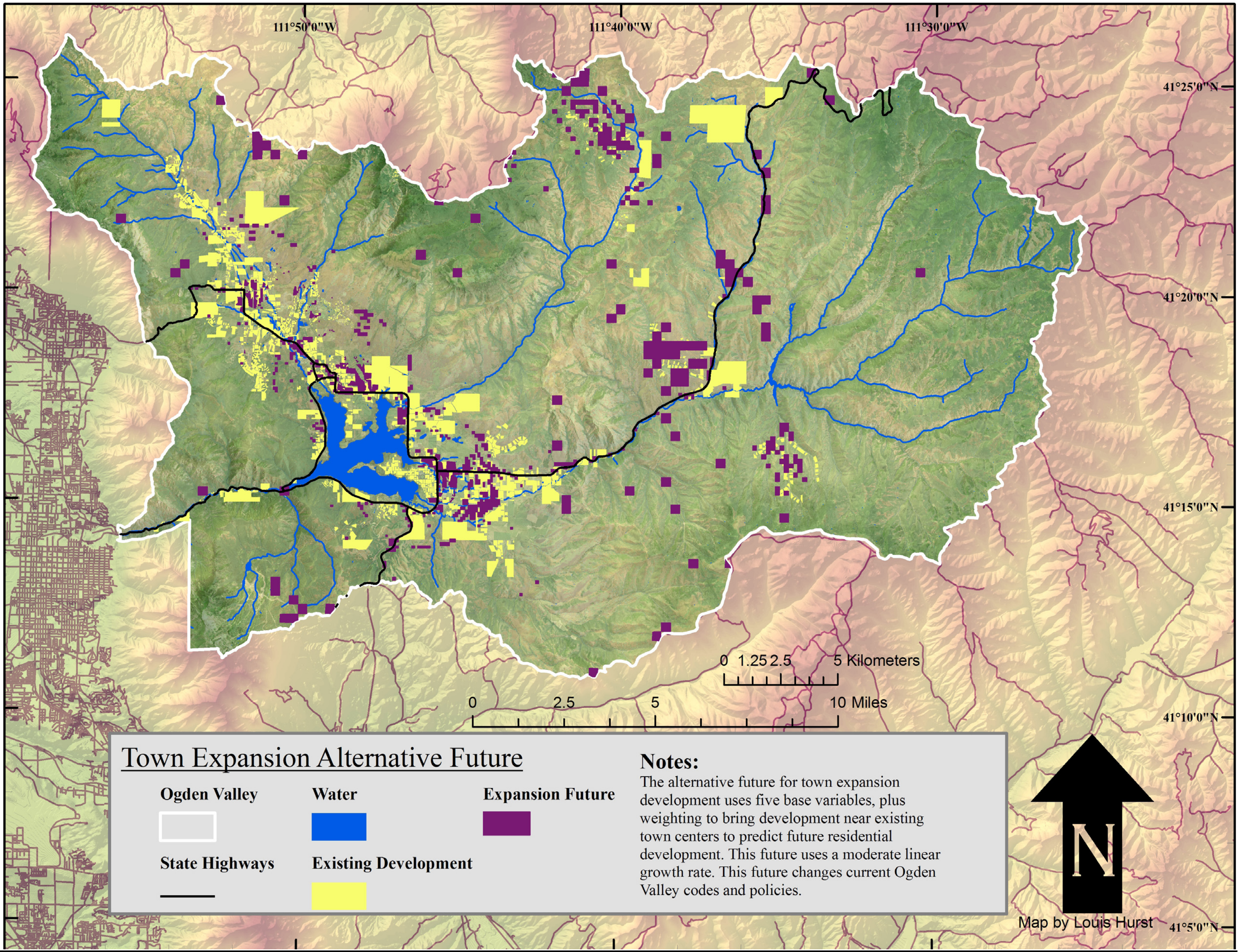


Figure 73: Alternative Futures - Town Expansion

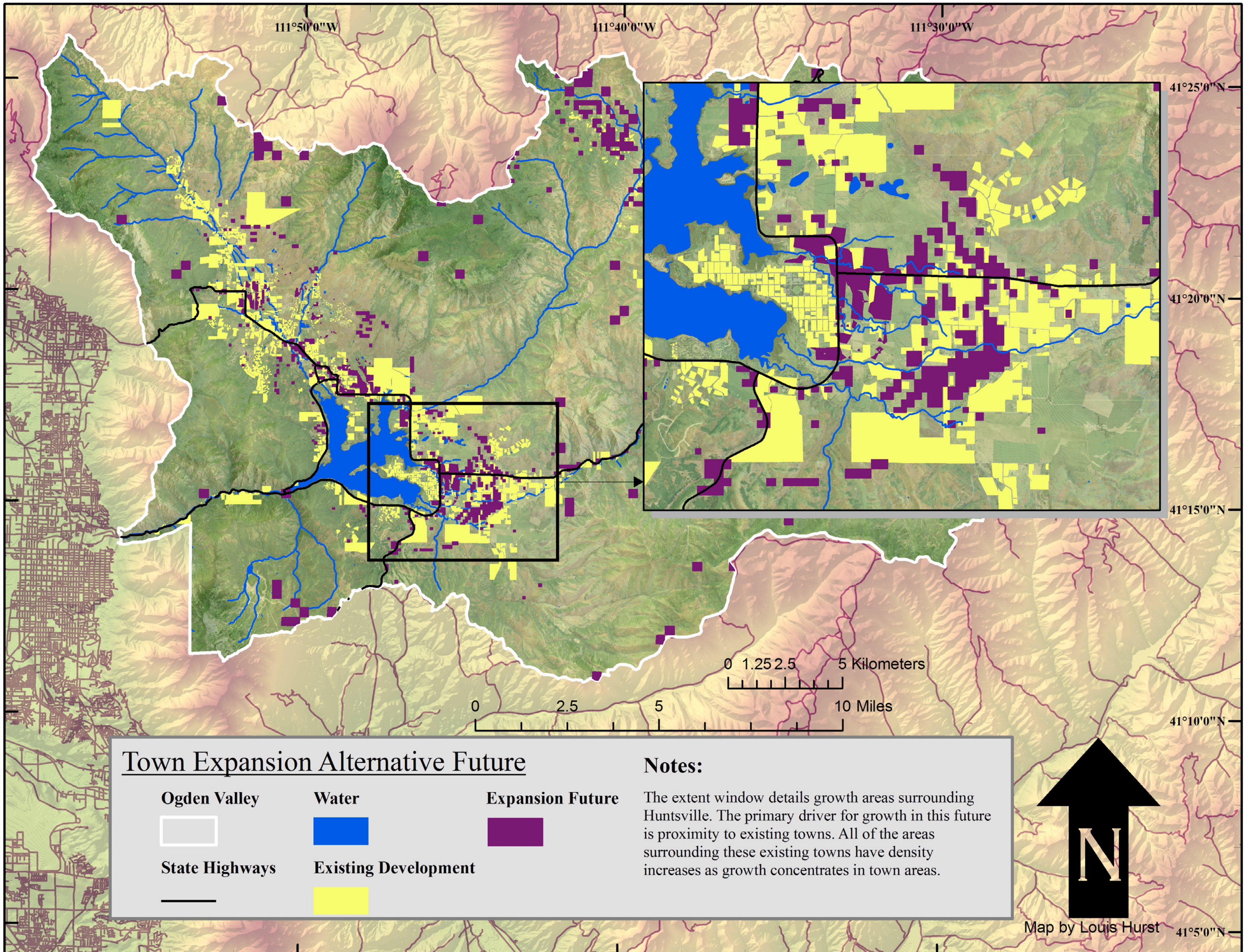


Figure 74: Alternative Futures - Town Expansion - Window View

Recreation Influence

The Recreation Influence alternative future shows increased development near the three resorts in Ogden Valley. This future uses a faster growth rate than the previous two futures. The intention of this future is to see what Ogden Valley looked like if development occurred near ski resorts and the density on resorts were increased.

The zoning of this future remains very similar to the current zoning in Ogden Valley except for the inclusion of a 1-acre lot zoning around the resorts. These areas include Snowbasin, Wolf Mountain, and Powder Mountain resorts. The expected new population for Ogden Valley in this future totals approximately 13,000 people. That figure is an increase of 7,000 new residents in the valley over the next 20 to 30 years. The growth rate for this future is 4% over a 30-year period.

The Ogden Valley that residents know today would be transformed by the new homes and shopping complexes found in other popular recreation and resort communities. There would be a significant decrease in the number of locally produced agricultural products and even a reduction in hobby farming activities. This future takes up close to 19 square miles more than the trend alternative future. The valley floor, benches, and mountain foothills would develop as close to 3,300 new houses would scatter throughout the landscape. In this future, new development accounts for approximately 36.35 square miles.

Table 22 details the number of new homes and the different zoning types that accept new homes. Finally, this table also details the square mileage consumed by each new housing type.

Table 22: Ogden Valley Recreation Influenced Future housing units.

Ogden Valley Alternative Future – Recreation Future			
Zoning Type	**Zoning Name**	**New Housing Units (Approx.)**	**Area Sq. Miles (Approx.)**
Existing Zoning	Agricultural Valley Zone (AV-3)	824	3.86
	Forest Residential Zone (FR-3)	413	1.93
	Forest Valley Zone (FV-3)	413	1.93
	Forest Zone 5 (F-5)	264	2.06
	Forest Zone 10 (F-10)	165	2.58
	Forest Zone 40 (F-40)	363	22.69
	Residential Estates (RE15 & 20)	33	.02
New Zoning	Town Valley Zone (TV-1)	824	1.28
Total		3299	36.35

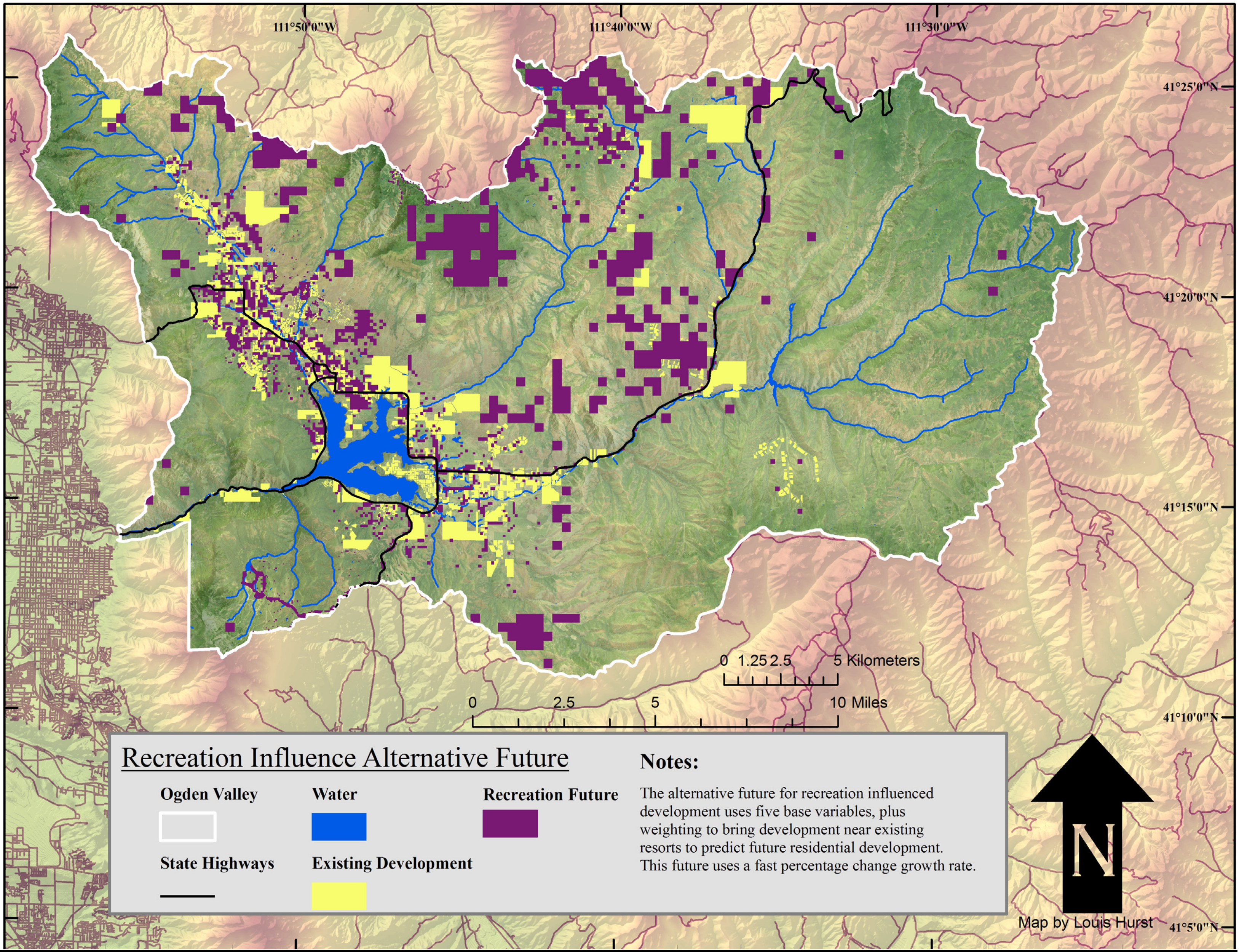


Figure 75: Alternative Futures - Recreation Influence

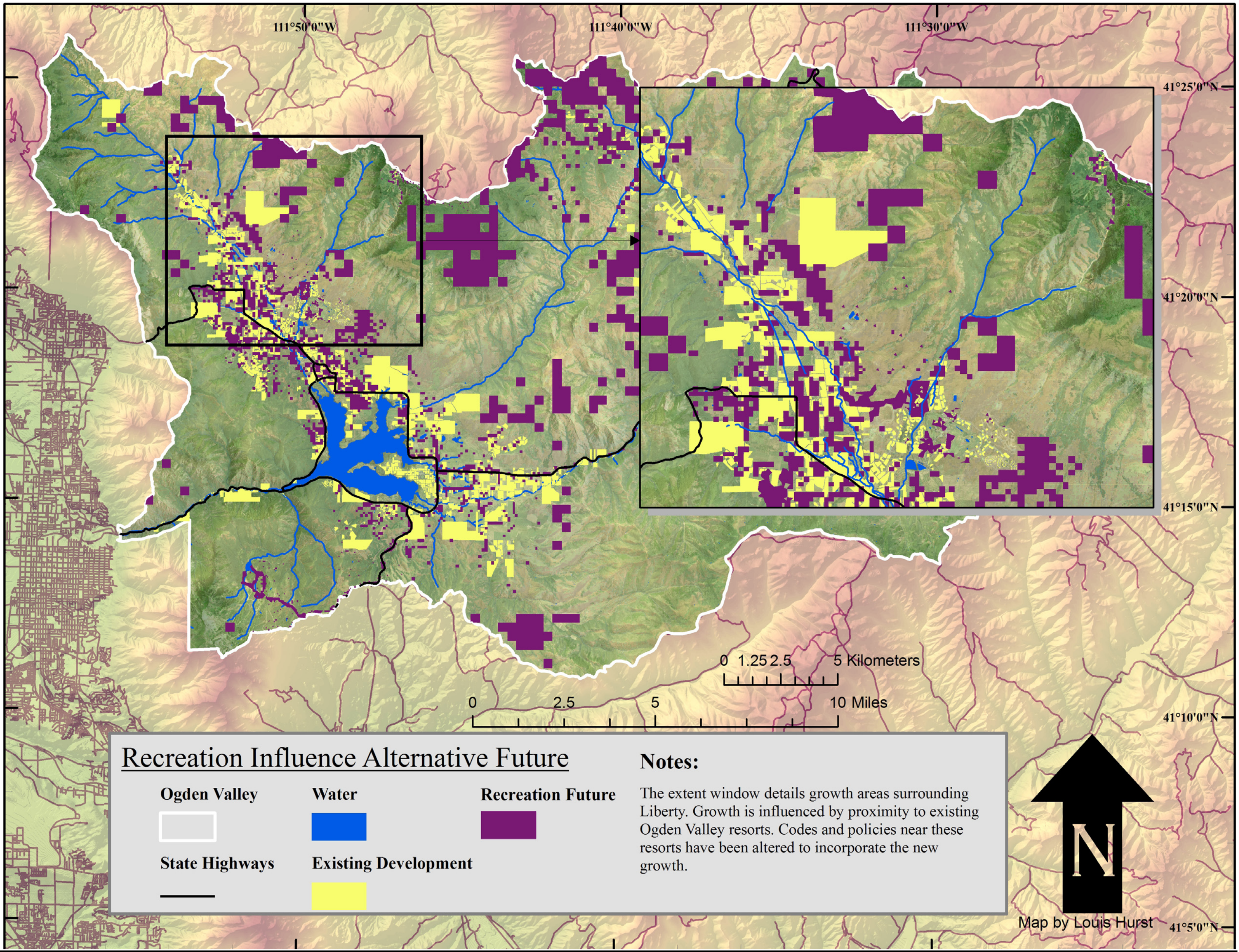


Figure 76: Alternative Futures - Recreation Influence - Window View

New Town

The new town alternative future shows Ogden Valley with two new towns or planned communities developing within the valley over the next 20 years. The first new community is located at the southern end of Ogden Valley. This town would rely upon its proximity to Highway 167 and is located south of the Abby of the Holy Trinity (Monastery). The second new community is located one mile northeast of the current town of Liberty. This new community is placed on the benches overlooking Ogden Valley.

Both of these new town locations were selected for their relatively undeveloped nature, proximity to water sources and roads, and no serious development limitations. It is important to remember that this future is speculative and only a basic representation of one possible new town future.

Current zoning in Ogden Valley will have to include a higher density for both of these new communities in order to accommodate the projected population. This future adds 3 new zoning types which range between 1 and 4 units per acre. The five base variables combine with an additional sixth variable that was weighted to form this future. This sixth variable favors development closer to the new town sites, i.e., as distance increases from these new towns, the number of new homes should decrease.

This future uses the percentage change population projection, a fast growth rate, which resulted in approximately 7,000 new residents living in Ogden Valley by 2030. This is the same population projection as the recreation influenced alternative future. Given this increase in new residents, there is also an increase of almost 3,300 new housing units. When this future is compared to the recreation influenced alternative future, the new town alternative consumes 29% less area, at 25.6 square miles. Given that these two futures have approximately the same number of new housing units, the difference in square mileage can be explained by the increase in density. This future still consumes more than 8 square miles compared to the trend alternative future. This finding shows the importance of population projections and densities.

Table 23 details the number of new homes and the different zoning types that accept new homes. Finally, this table also details the square mileage consumed by each new housing type.

Table 23: Ogden Valley New Town Future housing units.

Ogden Valley Alternative Future – New Town Future			
Zoning Type	**Zoning Name**	**New Housing Units (Approx.)**	**Area Sq. Miles (Approx.)**
Existing Zoning	Agricultural Valley Zone (AV-3)	426	2
	Forest Residential Zone (FR-3)	197	.92
	Forest Valley Zone (FV-3)	230	1.08
	Forest Zone (F-5)	230	1.8
	Forest Zone (F-10)	230	3.6
	Forest Zone (F-40)	230	14.38
	Residential Estates (RE15 & 20)	33	.02
New Zoning	Town Valley Zone (TV-1)	753	1.17
	Town Valley Zone (TV-1/2)	770	.60
	Town Valley Zone (TV-1/4)	181	.07
Total		3280	25.64

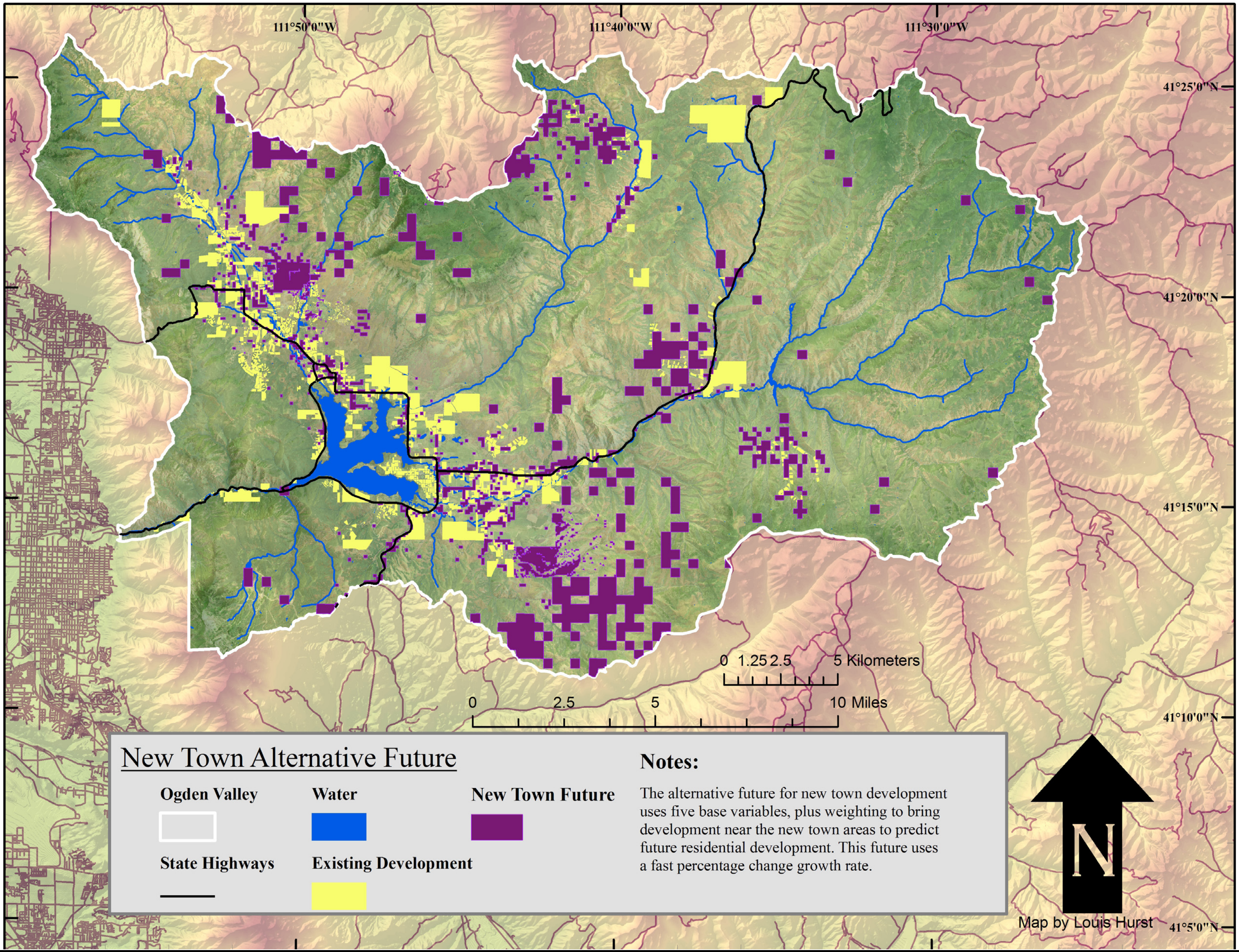


Figure 77: Alternative Futures - New Town

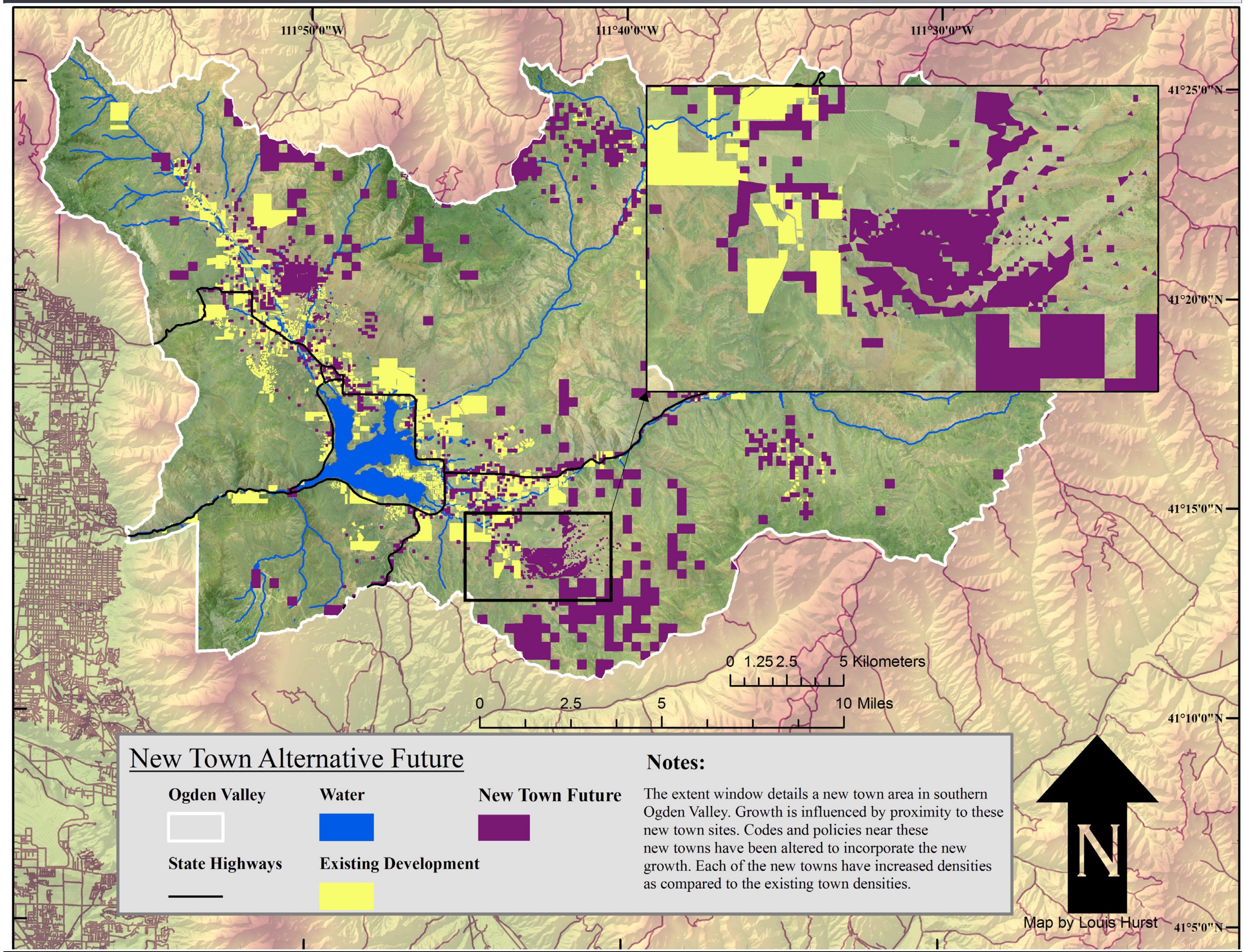


Figure 78: Alternative Futures - New Town - Window View

Evaluations

The future pattern and process of development in Ogden Valley is unpredictable, yet inevitable. Driving this new development is the projected increase in population from 6,000 residents to between 9,000 or 13,000 residents by 2030. The alternative futures utilized these increases in population and several hypothetical distributions of new development. However, to understand how these different patterns of development affect the landscape, each future must be evaluated individually. As was indicated in phase 3, evaluations were developed prior to creating the alternative futures. Having a set of evaluations will help the community of Ogden Valley promote responsible and community-based development. Ultimately, the evaluations should help the community prioritize development and identify critical lands.

A second evaluation process was conducted within this study, and it consisted of overlaying each alternative future to determine the number of times an area developed. Conversely, this analysis technique also identifies those areas that never developed or did so infrequently. This type of evaluation could lead to a critical lands plan or a development strategy for Ogden Valley.

Evaluation Models

Analyzing each alternative future with the evaluation models required separating the evaluations into different groups based upon the tiered models. All the tier 1 models and non-tiered models make up the first group. The non-tiered models include the air quality – inversion risk model and the transportation analyses. Next, the second group is made of tier 2 evaluation models, and finally, the tier 3 models make up the last group of evaluations.

Overlay Evaluation

The second evaluation examines the potential development pattern of Ogden Valley through the alternative futures by aggregating them into a single analysis. This evaluation details areas within Ogden Valley that either always, never, or sometimes developed via the alternative futures. This analysis breaks down into a scale of 0 to 4, with 0 Never developing and 4 Always developing and, as such, shows areas of potential high or low demand for development. The information from this evaluation could later be used to help create a critical lands plan or set priorities for development and conservation within Ogden Valley.

Evaluations Tier 1 and Transportation

The first group of evaluations includes the tier 1 analyses and the non-tiered air quality analysis (Table 24). The tier 1 evaluations are compared future versus future. This means that each future is evaluated and compared against one another in order to find the futures with the highest and lowest levels of impact.

A matrix was created to represent these comparisons, and was color coded with a scheme of Red (Highest Impact), Yellow (Moderate Impact), and Green (Lowest Impact). Within the matrix there should only be one green and red per column, as each column is a separate evaluation.

Following this evaluation is the transportation analysis (Table 25), which again compares future versus future. This evaluation compares each alternative future's average housing unit distance in miles to the resource being evaluated. For each evaluation, the future with the greatest distance performs the poorest, while the closest future performs the best. A similar matrix was created to represent the conclusions of this analysis.

Evaluations Tier 2 and 3

The last two evaluations were grouped solely by tiers. The tier 2 evaluations (Table 26) were grouped together and the tier 3 evaluations (Table 27) were grouped together. These evaluations consist only of tiered evaluation models, as all of the non-tiered models were included in the first group. As before, these evaluations consist of overall future versus future comparisons. Listed below are the descriptions of the matrices created for each level's evaluation.

The future versus future matrices uses a color coded scheme of Red (Highest Impact), Yellow (Moderate Impact), and Green (Lowest Impact). In these matrices, only one green and red space appear per column, as each column is a separate evaluation.

Appendix D contains the uncoded matrices for reference.

Table 24: Evaluation matrix. This matrix is a future versus future comparison that details which future performs best among a specific evaluation. Green squares represent the future that has the least amount of impacts in each evaluation, while red indicates the highest amount of impact.

Tier 1 Models Evaluation (Future vs. Future)

Alternative Futures	Agriculture	Biodiversity	Groundwater	Surface Water	State Selected Wildlife	Viewshed	Air Quality *Non-Tiered*
Trend	Yellow	Red	Yellow	Yellow	Yellow	Yellow	Yellow
Town Expansion	Green	Green	Green	Green	Red	Red	Red
Recreation Influence	Red	Yellow	Yellow	Red	Green	Green	Yellow
New Town	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Green

Table 25: Evaluation matrix. This matrix is a future versus future comparison that details which future performs best among a specific evaluation. Green squares represent the future that performed best in each evaluation, while red indicates poor performance.

Transportation Analysis (Future vs. Future)

Alternative Futures	Hospital	Fire Station	Weber High	Valley Schools	Valley Market	Smith's Grocery (Ogden City)
Trend	Red	Yellow	Yellow	Yellow	Yellow	Yellow
Town Expansion	Yellow	Green	Yellow	Green	Green	Green
Recreation Influence	Yellow	Yellow	Green	Yellow	Yellow	Yellow
New Town	Green	Red	Red	Red	Red	Red

Table 26: Evaluation matrix. This matrix is a future versus future comparison that details which future performs best among a specific evaluation. Green squares represent the future that has the least amount of impacts in each evaluation, while red indicates the highest amount of impact.

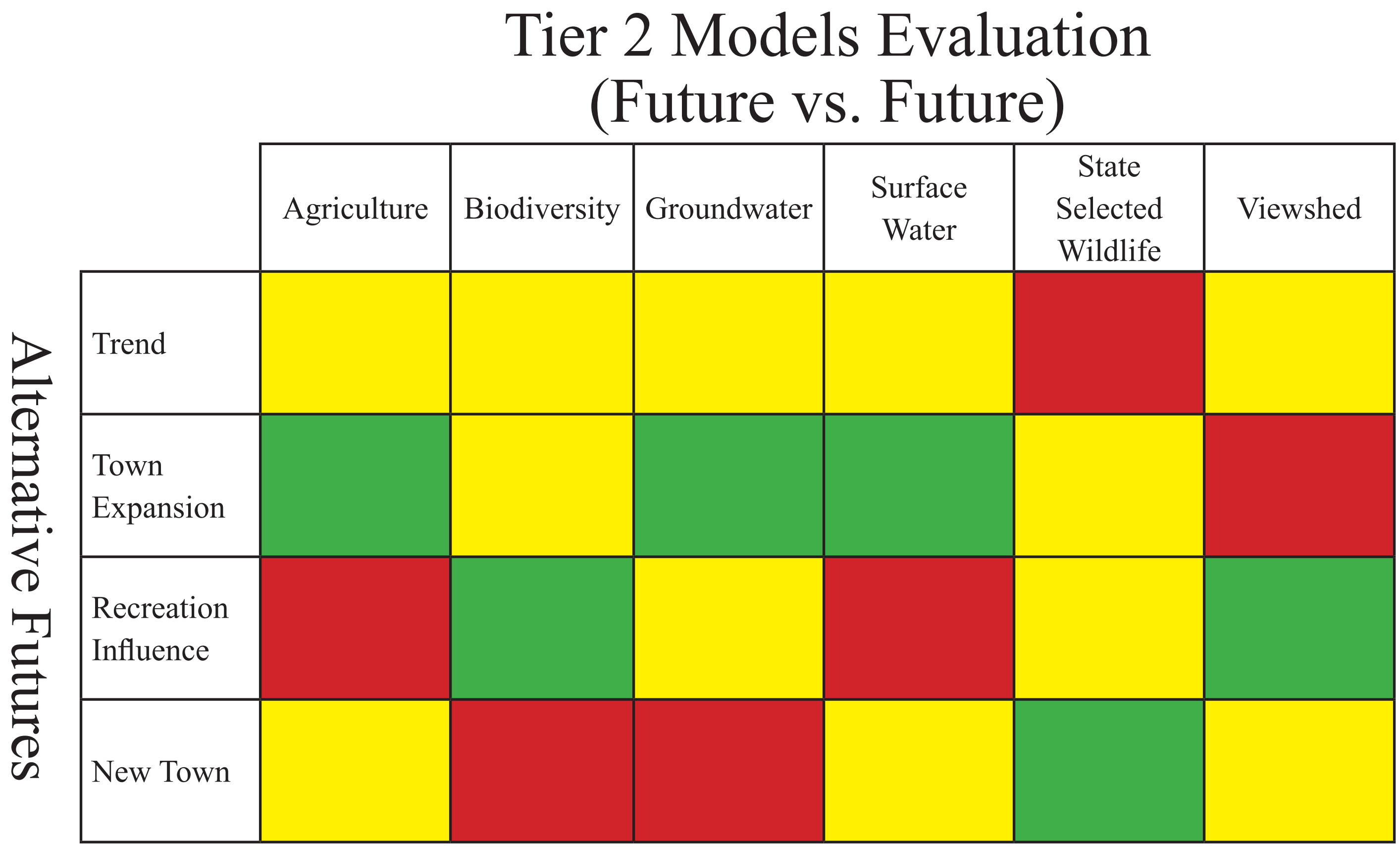
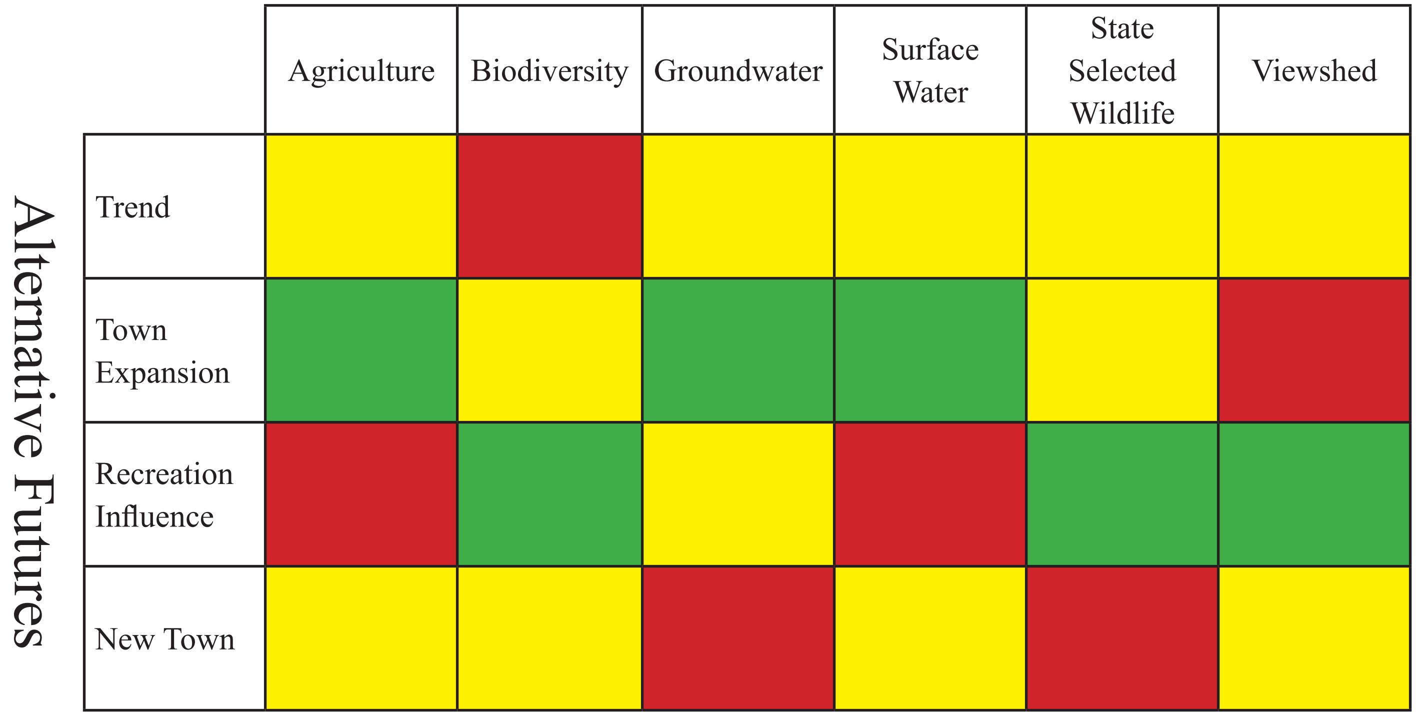


Table 27: Evaluation matrix. This matrix is a future versus future comparison that details which future performs best among a specific evaluation. Green squares represent the future that has the least amount of impacts in each evaluation, while red indicates the highest amount of impact.

Tier 3 Models Evaluation (Future vs. Future)



Overlay Evaluation

The overlay evaluation is a composite of the potential developmental patterns in Ogden Valley. Each alternative future creates a distinct pattern on the landscape. Although differences are quickly noticeable, the similarities are much more difficult to determine. This analysis attempts to find similarities and differences between the four alternative futures and make them visible.

This analysis uses the actual pattern of development within each alternative future. Each alternative future's development pattern is converted into a binary code with 1 representing development and 0 no development. The resulting binary futures are then combined and overlain with each other. This overlay analysis resulted in an output between 0 and 4 (Figures 80 and 81). If an area is scored 0, this means no development occurred in any of the four alternative futures. Conversely, if an area is scored 4, this means that predicted development occurred in all of the alternative futures.

Table 33 details the square mileage of each development overlay area. This table also reveals a trend that as the number of overlain alternative futures increases, the total area decreases. The most common area within Ogden Valley is the never developed category, and the least common is the always developed area.

Table 28: Overlay evaluation analysis description of type of development and approximate area.

Overlay Analysis Description		
Number	**Development Type**	**Area Sq. Miles (Approx.)**
0	Never Developed	280
1	Once Developed	31
2	Twice Developed	11
3	Thrice Developed	5
4	Always Developed	3

The information obtained from this evaluation of Ogden Valley's potential development pattern could be valuable towards developing a critical lands plan or conservation strategy. Conversely, this analysis could also help promote areas of high development within the valley and lead officials to promote development or higher densities in specific places. Either one of these approaches or strategies could help residents and officials with prioritization and decision-making when concerning development of critical lands.

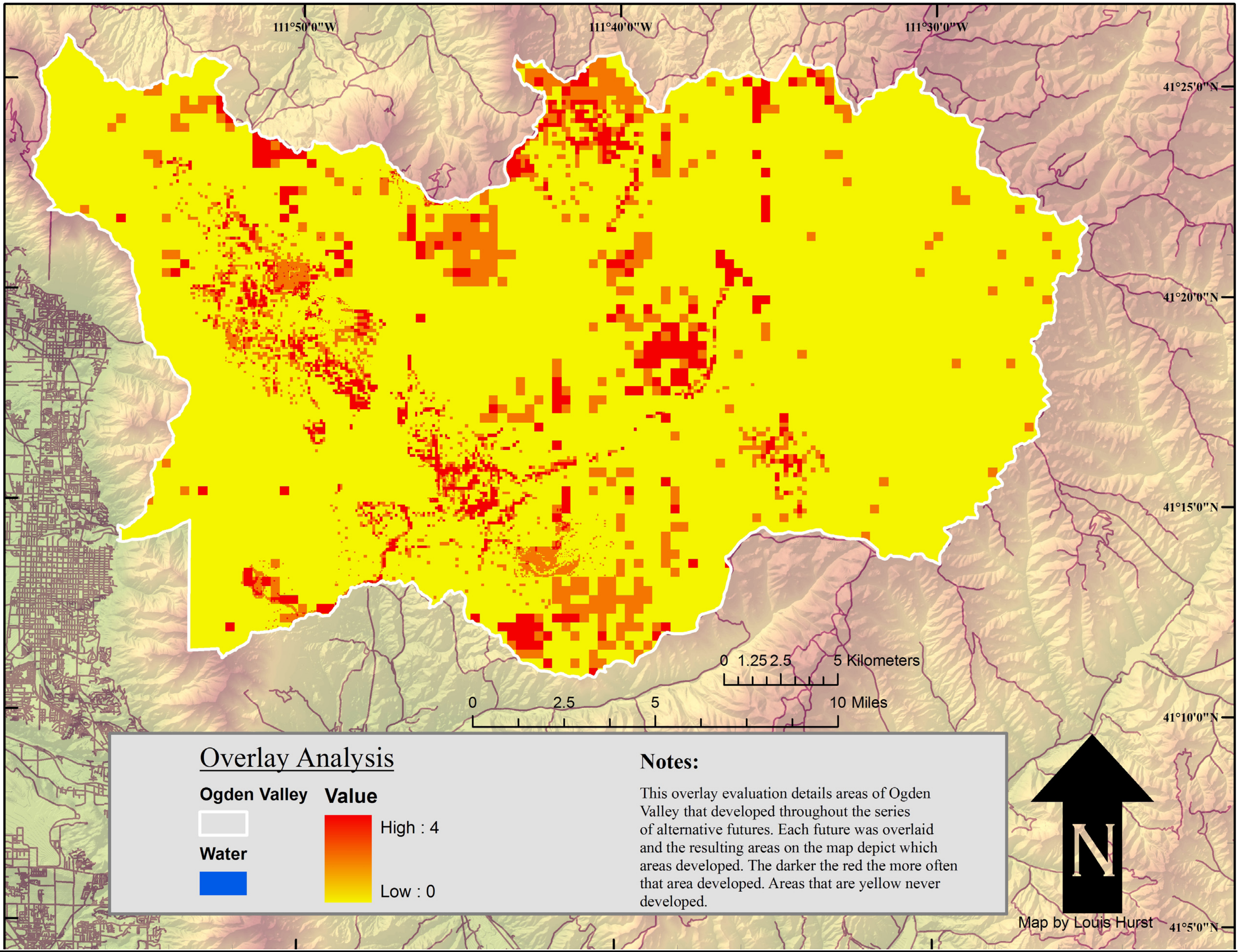


Figure 79: Overlay Evaluation

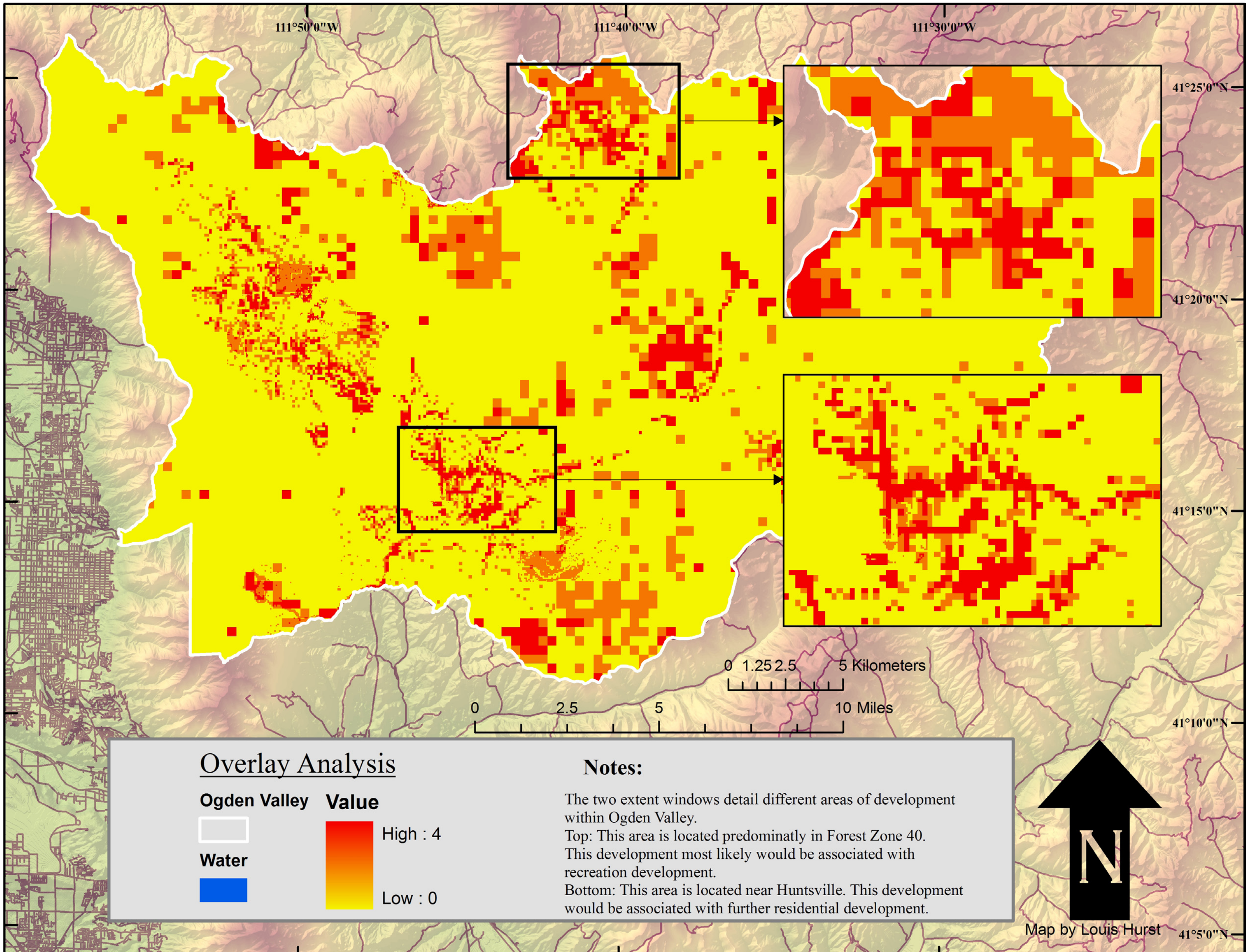


Figure 80: Overlay Evaluation - Window View

Conclusions

Ogden Valley is a beautiful mountain community located between the high-density urban environment of the Wasatch Front and the wildlands of the Wasatch and Bear River Ranges. Residents experience a wide range of other land uses including semi-natural environments like agricultural, pastoral, recreation environments, and fully developed residential areas. Residents also have small town centers and planned communities within their valley.

In this unique and beautiful environment, growth has steadily increased over the past forty years, and growth within the region will continue into the future. The proximity of Ogden Valley to population centers along the Wasatch Front and natural amenities makes the valley favorable to various types of development. This combination of resources is one of the reasons Ogden Valley helped host the 2002 Winter Olympics. Furthermore, several master-planned communities have begun to be built throughout Ogden Valley to take advantage of these natural amenities. Since growth is going to be a part of Ogden Valley's future, managing growth is a necessary task to ensure a high quality of life and to limit negative impacts to the valley's resources. Residents and decision-makers will have to make difficult choices about the valley's future.

Growth will come in a variety of forms such as residential, commercial, recreational, and industrial. This study focused on residential development. This process began by identifying a series of issues, which led to the development of evaluations that spanned a range of biophysical and cultural issues. These evaluations were used to assess each alternative future in a comparative fashion.

Finally, this study concludes with a simple ranking of the alternative futures. The pros and cons of each alternative future are briefly discussed. Lastly, a series of recommendations are made concerning both the direction of development and landscape protections for Ogden Valley. It is important to realize that these recommendations are at preliminary stages, and more research and public comment are needed.

Alternative Future Conclusions

After creating and evaluating the different alternative futures, it is apparent that no single solution can answer all of the questions for Ogden Valley. In order to achieve community goals, compromise and prioritization are necessary for valley residents.

To understand the benefits and shortcomings of the alternative futures discussed in this study, they are briefly summarized below. As can be expected, no future performed flawlessly throughout all of the analyses. The future that received the most green scores was the Town Expansion alternative. Development in this future was focused near the existing towns and increased the density near these areas. Conversely, the Trend alternative never received a single green score. This future did not change the existing valley zoning and allocated new development based upon past trends. The other two futures received a more even spread of negative and positive characteristics.

These futures were evaluated and scored, and are ranked below to show their benefits and shortcomings.

1. Town Expansion

Pros: This future is able to preserve the most area for groundwater, surface water, and agricultural protection. The new development would be closest to fire stations, valley schools, and grocery stores.

Cons: This future is the most visible, and many residents would live within an area susceptible to inversions and possible poor air quality.

2. Recreation Future

Pros: This future is able to preserve high levels of biodiversity and state selected wildlife species. The development in this future is also the least visible.

Cons: This future performs poorly in protecting agricultural and surface water resources.

3. Trend

Pros: This future performs moderately concerning all the evaluations, except biodiversity and state selected species.

Cons: The future never performs the best in any evaluation. Additionally, this future is the furthest from the local hospital and worst at protecting biodiversity and state selected species.

4. New Town

Pros: This future is close to the local hospital, has less risk of exposure to temperature inversions, and protects state wildlife selected species.

Cons: This future is poor at protecting groundwater and is furthest from every resource but the local hospital.

Recommendations

From the evaluations, several recommendations concerning future development within Ogden Valley arose. These recommendations look to promote the integrity, strength, and health of the entire Ogden Valley ecosystem and human environment. In addition, these are not final policies or codes, nor are they meant for immediate implementation. Their primary purpose is to start a dialogue between residents in order to improve and give direction to Ogden Valley's community and environmental concerns.

Increase Density

Currently, Ogden Valley contains low-density housing designed to spread development out across the landscape. In the past, this type of low-density zoning was assumed to preserve rural character and limit growth. This type of 3-5 acre density simply sprawls housing units across a landscape and diminishes much of the rural character. The futures that performed well increased density around the towns and resort areas. An increase in density would also allow for a multitude of housing types. Increasing density in appropriate places would change Ogden Valley demographics and support more sustainable development.

Town Incorporation

Huntsville is the only incorporated town within Ogden Valley. Liberty and Eden were established at similar times as Huntsville in the mid- to late-1800s; however, these communities have never incorporated. Undoubtedly, residents have a variety of feelings on the subject of town incorporation, but incorporating around the long-standing communities is likely to be the best course of action. Before action on this topic is taken, it is recommended that feasibility studies are conducted concerning economic concerns and land-use decisions. Many concerns would need more specific attention and public comment periods would need to be addressed in both the pre-planning, planning, and post-planning stages of any feasibility studies on this subject.

Hydrologic Protections

Several ordinances are already in place for valley residents that protect their surface water and groundwater resources. Nevertheless, these protections should be extended further to protect these valuable resources. The value of water is often understated and only considered when shortages are identified. Some people even go so far as to that say water is a human right (World Health Organization, 2003).

Conclusions

The protections currently in place should be extended to include all streams, wetlands, lakes, natural springs, and recharge zones. By protecting these areas, valley residents could ensure high water quality and quantity. Side benefits would include protection for natural habitat and biodiversity and reduction of future costs for water purification.

Specifically, the system of protections for the hydrologic resources would include several levels of mitigation zones (Figure 51) (Spano, 2007). These zones would allow different levels of protection depending upon their distance from the hydrologic resources. These levels of mitigation are one possibility for increasing the protection of water resources; however, public comment and further hydrologic studies may be necessary for determining the extent of the mitigation zones.

Figure 81: South Fork of the Ogden River.

Viewshed Protections

Ogden Valley's Sensitive Land Overlay ordinance and Ogden Valley's General Plan concerns are voiced over ridge top and hillside development visibility. These protections should be further developed with a list of prioritized and highly visible areas within Ogden Valley. Residents need to work with planners to select sensitive viewsheds within the Ogden Valley. Once areas are selected, planners and decision-makers can design appropriate regulations concerning development standards.

Figure 82: View of the highly visible back wall found in Ogden Valley.

Critical Lands Prioritization Scheme

Protecting valuable areas within Ogden Valley is a difficult task that residents should consider now. By looking at what is valuable to residents and planning to protect, acquire, or conserve these areas, Ogden Valley will be better able to manage their development. These areas may include agricultural areas, historical town centers, cultural resources, rare habitats, or other valuable landscape areas. For more help with this issue, refer to the Critical Lands Toolkit provided by the state of Utah (Utah Governor's Office of Planning and Budget, 2005) .

For any community-wide prioritization scheme of critical lands to succeed, the first step is defining critical lands. This definition must be systematic and have the ability to classify the entire landscape. Secondly, once defined, the community would need to have a clear goal of what to do with these critical lands. This, of course, would need extensive public and professional involvement. Once Ogden Valley's critical lands are defined and a clear direction for these lands is agreed upon, these specified areas could be protected in a variety of ways. These protections could include implementing a transfer of development rights ordinance, a taxation scheme, voluntary association, grant purchase, or a mixture of these protections.

Ogden Valley General Plan Update

Finally, the Ogden Valley General Plan is out of date and filled with many inconsistencies. This document must be updated to reflect the current values and needs of the people living within the valley. Since the general plan serves as a guiding document for development, it needs to be consistent with the other planning documents and ordinances for Ogden Valley. Updating this document, and including any new ordinances and goals for Ogden Valley's future, will help the residents be better served by the general plan.

Figure 83: Agricultural area near Liberty in northwestern Ogden Valley.

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GIS References

The GIS database that was developed for this study incorporated data from a variety of sources. These sources include local, regional, state, and federal organizations. The table that follows below lists a description of the data, source, scale, and format.

GIS Database			
Description	**Source**	**Scale**	**Format**
Boundary Data			
Counties - Weber, Rich, Box Elder, Morgan, and Davis	Utah Automated Geographic Reference Center	1:24,000	Vector
Conservation Easements - Weber County	Utah Automated Geographic Reference Center	1:24,000	Vector
Land Ownership - Utah	Utah Automated Geographic Reference Center	1:500,000	Vector
Land Ownership - Weber County	Utah Automated Geographic Reference Center	1:24,000	Vector
Forest Service Boundary - Utah	Utah Automated Geographic Reference Center	1:100,000	Vector
Ogden Valley Study Boundary	Bio-west via Geo-graphics	NA	Vector
Ogden Valley Study Boundary - Weber County	Weber County	NA	Vector
Weber County Unincorporated Zoning	Weber County	NA	Vector
Climate Data			
Utah Wind Data - High Resolution	National Renewable Energy Laboratory	NA	Vector

GIS Database

Description	Source	Scale	Format
Cultural			
Centerline -Road Network	Weber County	NA	Vector
Parcel Data - Ownership	Weber County	NA	Vector
Tigerline 2000 - Road Network - Utah	Utah Automated Geographic Reference Center	1:100,000	Vector
Elderly Care Facilities - Utah	Utah Automated Geographic Reference Center	1:24,000	Vector
Hospitals - Utah	Utah Automated Geographic Reference Center	1:24,000	Vector
Place Names - Weber County	Utah Automated Geographic Reference Center	1:24,000	Vector
Electrical Lines	Utah Automated Geographic Reference Center	1:24,000	Vector
Oil Gas Pipelines	Utah Automated Geographic Reference Center	1:24,000	Vector
Communication Towers	Utah Automated Geographic Reference Center	1:100,000	Vector
Ogden Valley Census Tract - Population 1970	National Historic Geographic Information Systems	NA	Vector
Ogden Valley Census Tract - Population 1980	National Historic Geographic Information Systems	NA	Vector
Ogden Valley Census Tract - Population 1990	National Historic Geographic Information Systems	NA	Vector

GIS Database

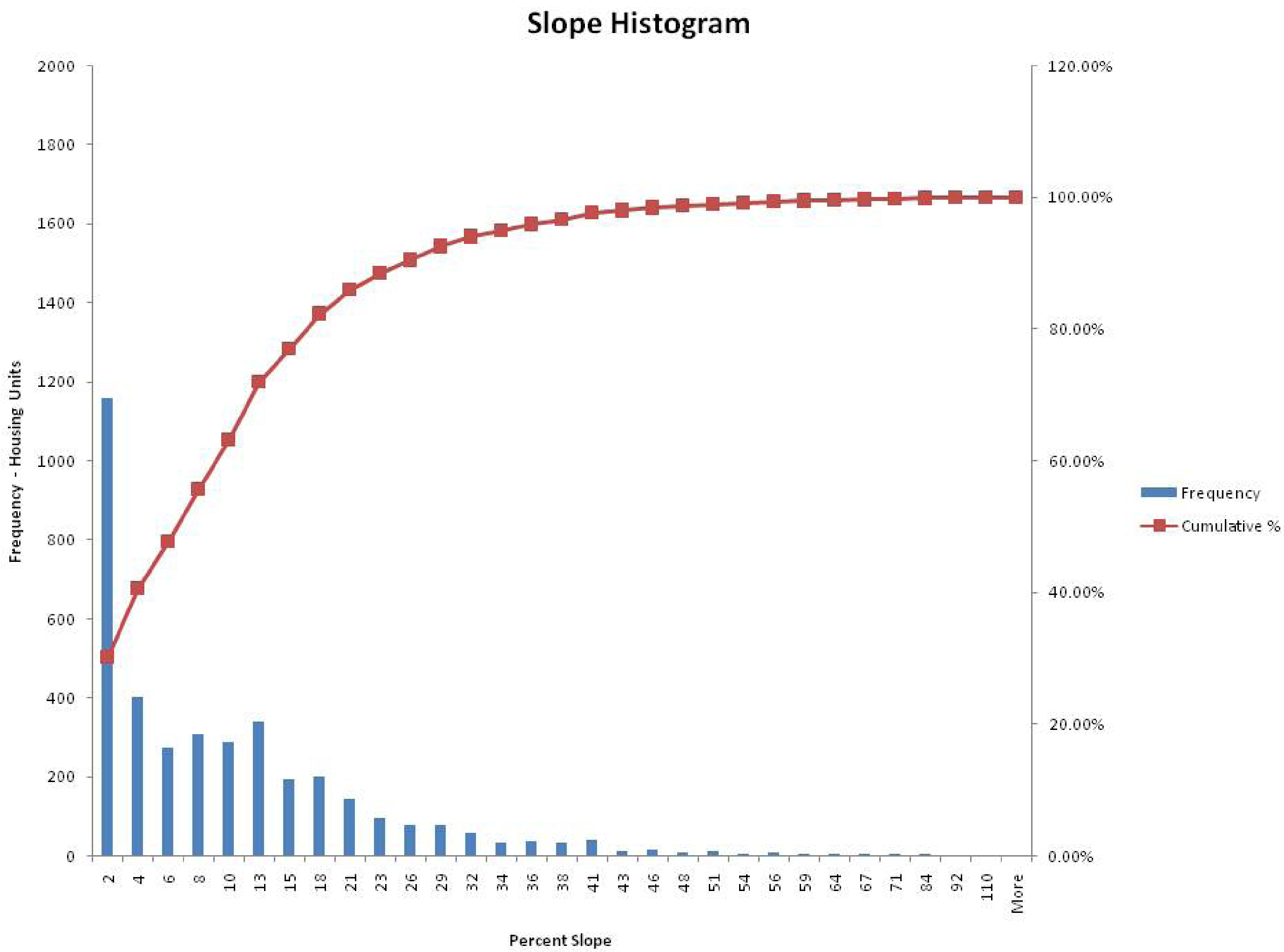
Description	Source	Scale	Format
Ogden Valley Census Tract - Population 2000	National Historic Geographic Information Systems	NA	Vector
Town Demographics	Utah Automated Geographic Reference Center	1:24,000	Vector
Municipalities	Utah Automated Geographic Reference Center	1:24,000	Vector
School Districts	Utah Automated Geographic Reference Center	1:24,000	Vector
Schools	Utah Automated Geographic Reference Center	1:24,000	Vector
Geology			
Landform - GNIS - Utah	Utah Automated Geographic Reference Center	1:24,000	Vector
Shallow GroundWater - Utah	Utah Automated Geographic Reference Center	1:500,000	Vector
Physiographic Provinces	Utah Automated Geographic Reference Center	1:500,000	Vector
Landslide Areas	Utah Automated Geographic Reference Center	1:100,000	Vector
Hydrology			
Lakes - Utah	Utah Automated Geographic Reference Center	1:24,000	Vector

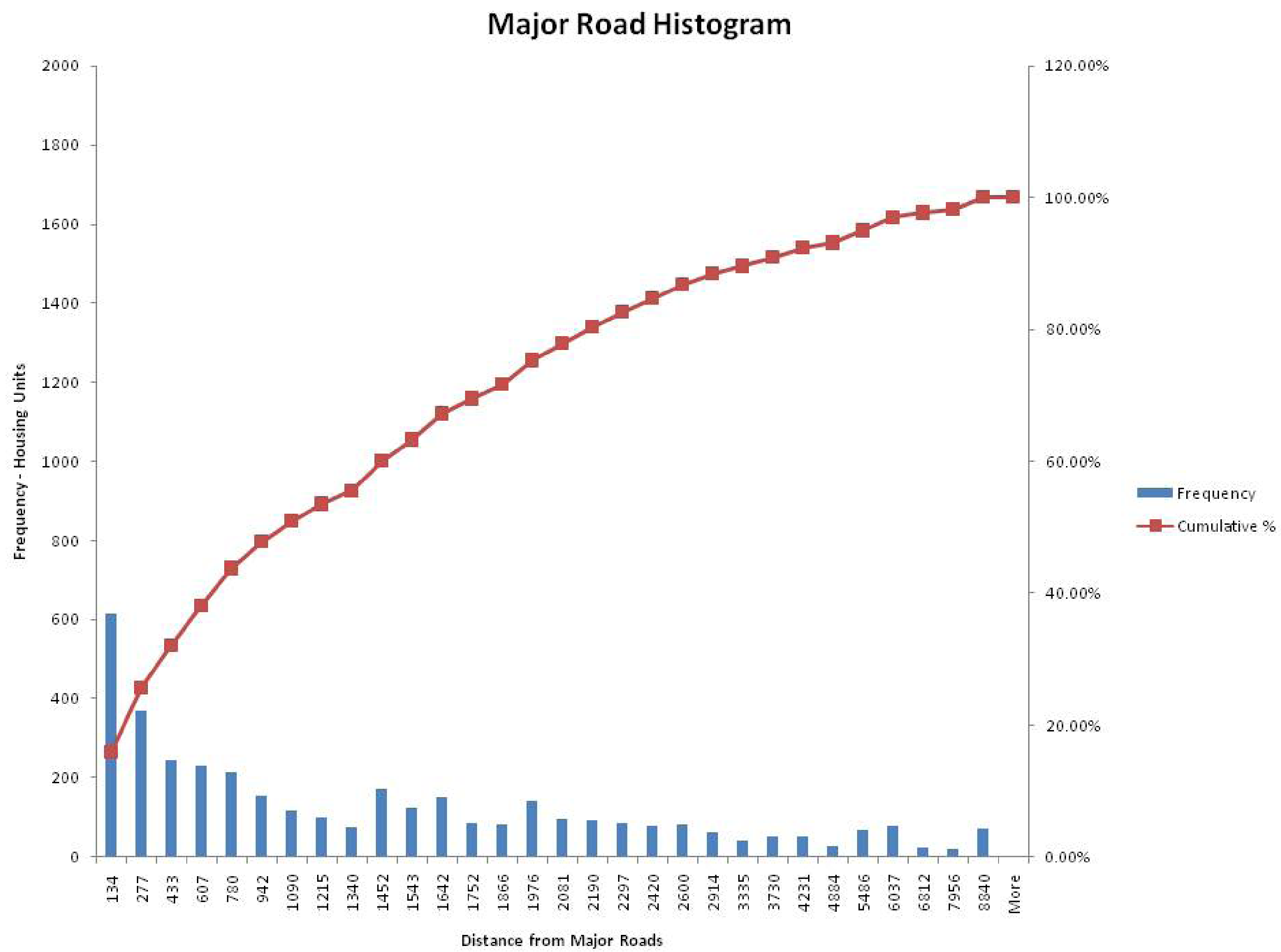
GIS Database

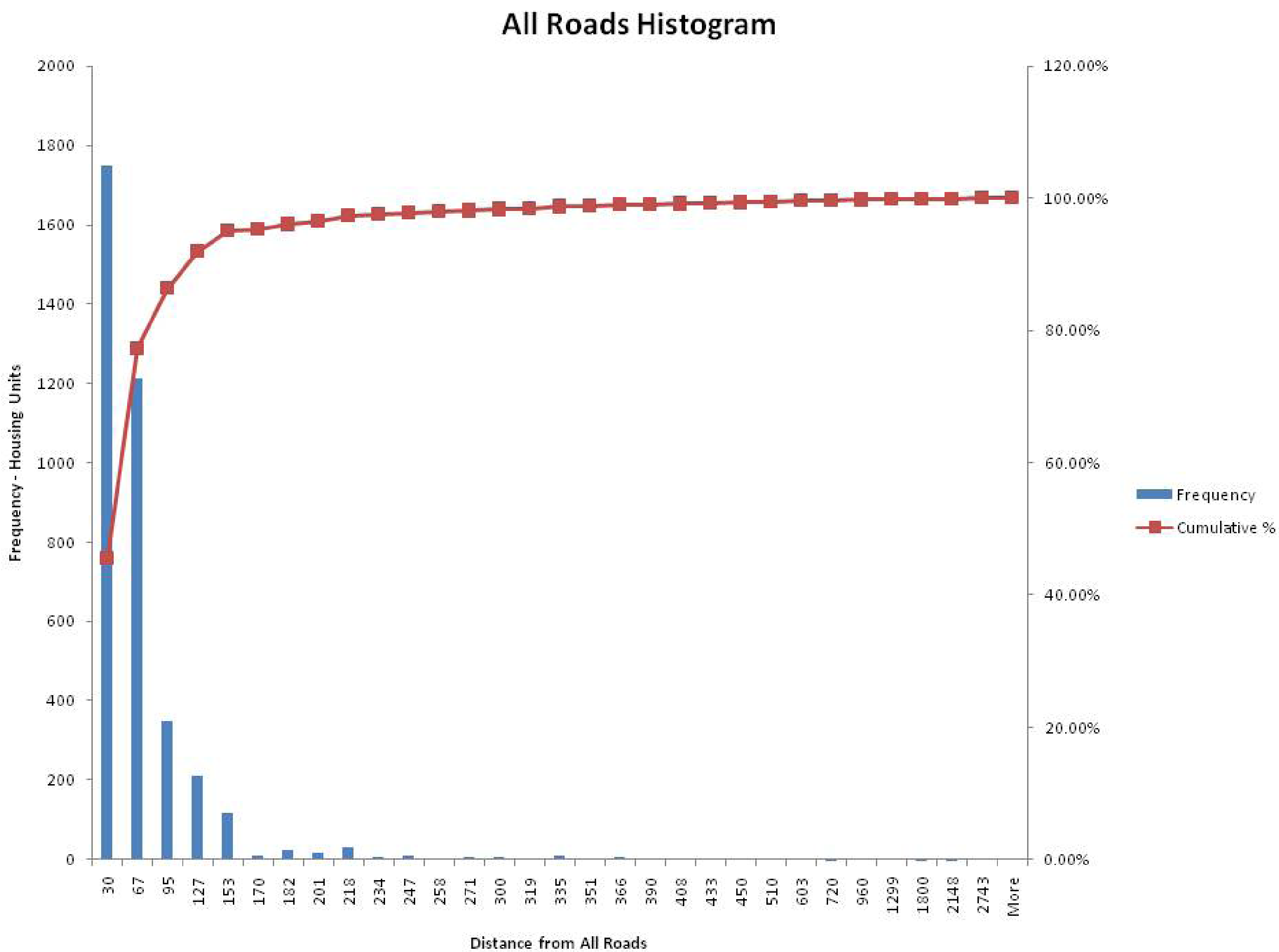
Description	Source	Scale	Format
Lakes -National Hydrological Dataset - High Resolution - Weber County	Utah Automated Geographic Reference Center	1:24,000	Vector
Floodplains - Digitial Insurance Rate Map Base Flood Elevation	Utah Automated Geographic Reference Center	1:24,000	Vector
Springs - Weber County	Utah Automated Geographic Reference Center	1:24,000	Vector
Streams - Utah	Utah Automated Geographic Reference Center	1:24,000	Vector
Streams - National Hydrological Dataset - High Resolution - Weber County	Utah Automated Geographic Reference Center	1:24,000	Vector
Wetlands - Utah	Utah Automated Geographic Reference Center	1:24,000	Vector
Dams - GNIS - Utah	Utah Automated Geographic Reference Center	1:100,000	Vector
Digital Flood Insurance Program	Utah Automated Geographic Reference Center	1:24,000	Vector
Hydrologic Unit Delineations	Natural Resource Conservation Service	1:24,000	Vector
Source Water Protection Zones	Utah Department of Drinking Water	1:24,000	Vector
Groundwater Recharge Areas	Utah Geologic Service	1:24,000	Vector
Aquifers	Utah Geologic Service	1:24,000	Vector
Imagery			
National Aerial Imagery Projection	Utah Automated Geographic Reference Center	1 meter	Raster

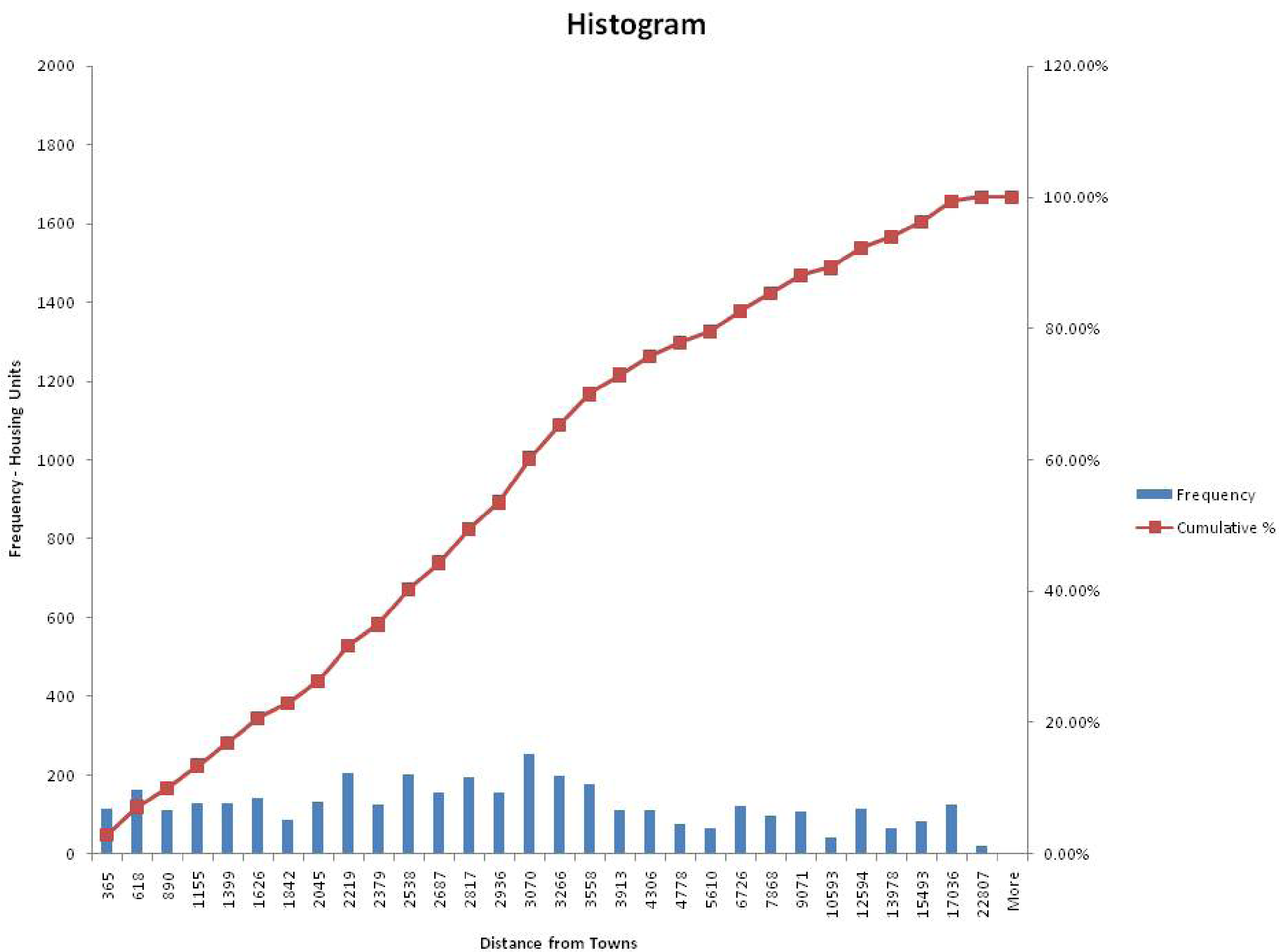
GIS Database			
Description	**Source**	**Scale**	**Format**
Landcover			
SWreGap	Southwest Regional Gap Analysis Program	30 meter	Raster
Water Related Land-use	Utah Automated Geographic Reference Center	1:24,000	Vector
2001 National Land Cover Dataset	United States Geologic Service	30 meter	Raster
Percent Tree Cover	United States Geologic Service	30 meter	Raster
Percent Impervious Surface	United States Geologic Service	30 meter	Raster
Ecoregions - Level 4	Environmental Protection Agency	1:250,000	Vector
Wildlife Habitats	Utah Department of Wildlife Resources	30 meter	Raster
Topography			
National Elevation Dataset	Utah Automated Geographic Reference Center	30 meter	Raster
National Elevation Dataset	Utah Automated Geographic Reference Center	10 meter	Raster
Soils			
Soils - Utah	Utah Automated Geographic Reference Center	1:250,000	Vector
Ssurgo Soils Data - Utah	Natural Conservation Resource Service	1:24,000	Vector

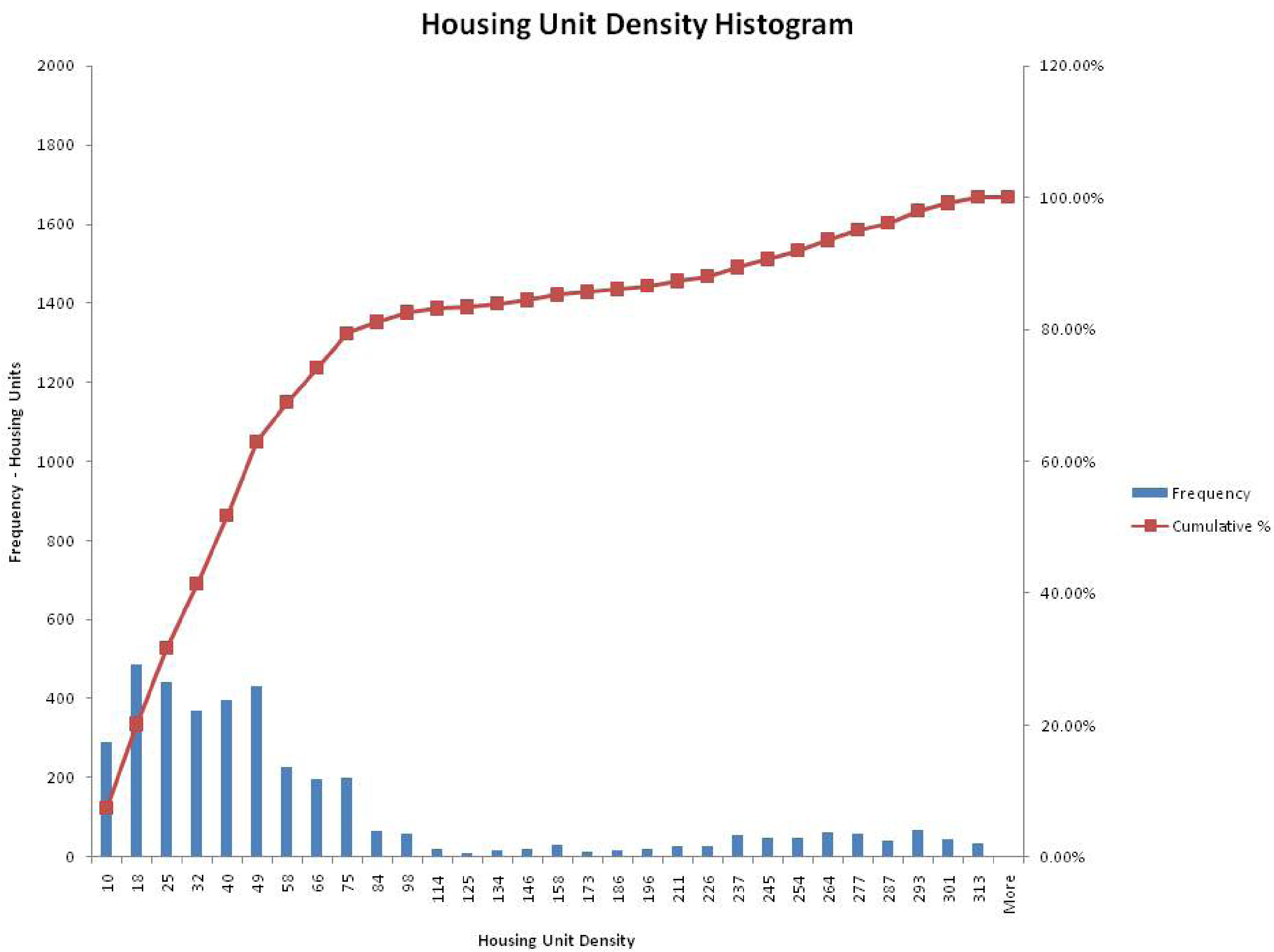
The following histograms were used in creating the housing unit growth model and the alternative futures. They are provided for clarity purposes.




Major Road Histogram
Frequency - Housing Units
2000
1800
1600
1400
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
134
277
433
607
780
942
1090
1215
1340
1452
1543
1642
1752
1866
1976
2081
2190
2297
2420
2600
2914
3335
3730
4231
4884
5486
6037
6812
7956
8840
More
Distance from Major Roads
Frequency
Cumulative %


All Roads Histogram
Frequency - Housing Units
Distance from All Roads
Frequency
Cumulative %
2000
1800
1600
1400
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
30
67
95
127
153
170
182
201
218
234
247
258
271
300
319
335
351
366
390
408
433
450
510
603
720
960
1299
1800
2148
2743
More


Histogram
2000
1800
1600
1400
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Frequency - Housing Units
365
618
890
1155
1399
1626
1842
2045
2219
2379
2538
2687
2817
2936
3070
3266
3558
3913
4306
4778
5610
6726
7868
9071
10593
12594
13978
15493
17036
22807
More
Distance from Towns
Frequency
Cumulative %


Housing Unit Density Histogram
2000
1800
1600
1400
1200
1000
800
600
400
200
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Frequency - Housing Units
10 18 25 32 40 49 58 66 75 84 98 114 125 134 146 158 173 186 196 211 226 237 245 254 264 277 287 293 301 313 More
Housing Unit Density
Frequency
Cumulative %

Tier 1 Models Evaluation
(Future vs. Future)

Alternative Futures

	Agriculture	Biodiversity	Groundwater	Surface Water	State Selected Wildlife	Viewshed	Air Quality *Non-Tiered*
Trend	0.166395	165.48	0.02067	0.047691	2.10	1.03	753/1890
Town Expansion	0.107575	165.65	0.015096	0.034201	2.09	1.25	1349/1923
Recreation Influence	0.20376	165.53	0.059061	0.075993	2.117	0.76	670/3107
New Town	0.141383	165.56	0.167294	0.063196	2.110	1.04	495/3247

Transportation Analysis (Future vs. Future)

Alternative Futures	Hospital	Fire Station	Weber High	Valley Schools	Valley Market	Smith's Grocery (Ogden City)
Trend	21.5	5.3	17.8	7.3	7.1	14.6
Town Expansion	21.2	3.8	17.3	6.33	6.1	13.5
Recreation Influence	21.4	6.3	16.10	6.9	6.8	14.4
New Town	20.9	7.1	24.1	10.1	9.9	16.6

Tier 2 Models Evaluation (Future vs. Future)

Alternative Futures

	Agriculture	Biodiversity	Groundwater	Surface Water	State Selected Wildlife	Viewshed
Trend	0.166874	119.58	0.026334	0.046684	6.79	2.40
Town Expansion	0.107734	119.53	0.01616	0.034126	6.81	2.95
Recreation Influence	0.192961	119.71	0.06117	0.079517	6.80	1.91
New Town	0.147522	119.50	0.132789	0.069072	6.83	2.07

Tier 3 Models Evaluation (Future vs. Future)

Alternative Futures

	Agriculture	Biodiversity	Groundwater	Surface Water	State Selected Wildlife	Viewshed
Trend	0.155467	98.52	0.040178	0.045696	21.14	3.62
Town Expansion	0.098834	98.58	0.022379	0.033736	21.14	3.69
Recreation Influence	0.183154	98.81	0.072927	0.081386	21.20	2.90
New Town	0.14003	98.71	0.110245	0.073509	21.11	3.43