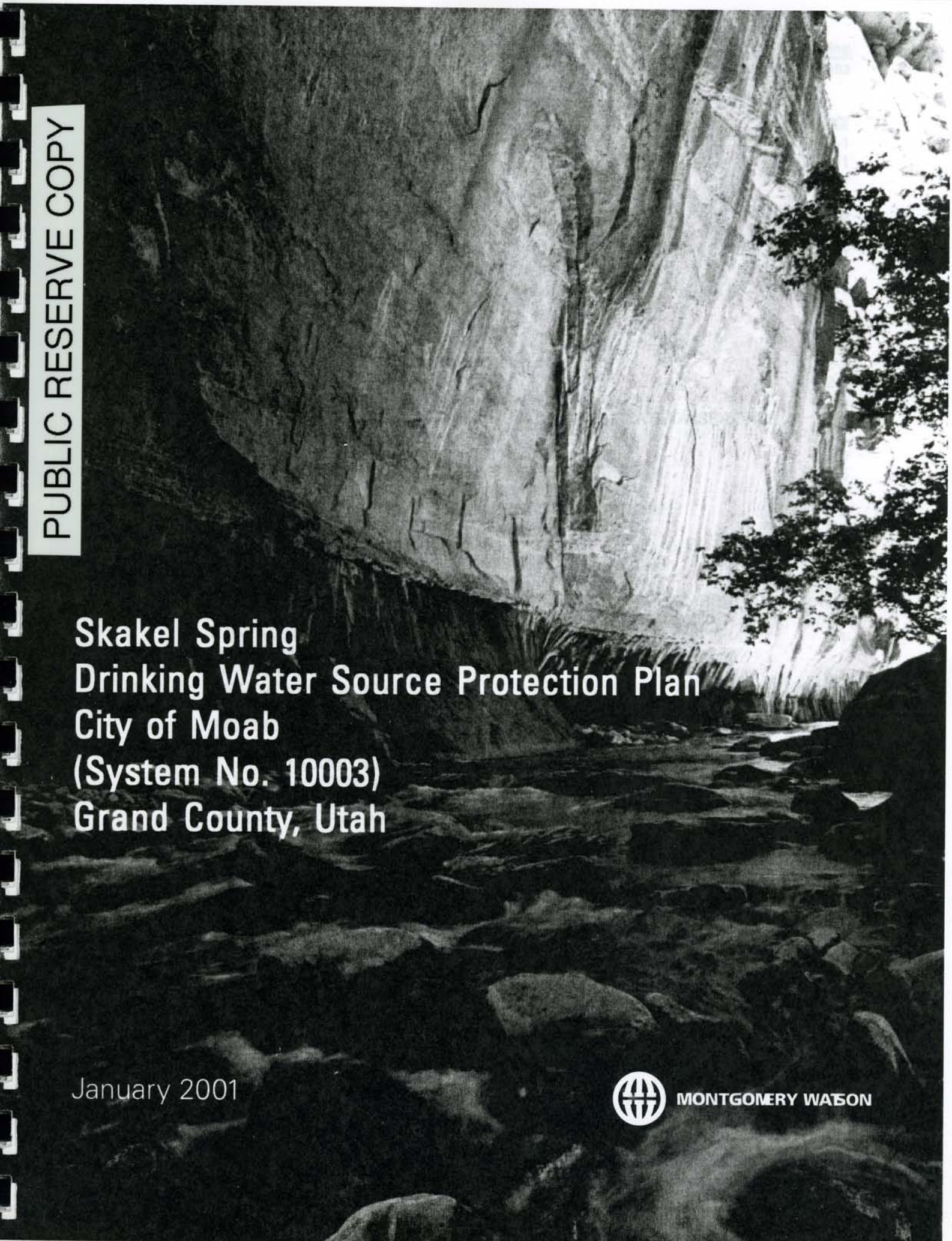

Skakel Spring Drinking Water Source Protection Plan City of Moab (System No. 10003) Grand County, Utah

January 2001

MONTGOMERY WATSON

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EXECUTIVE SUMMARY

OVERVIEW

The following document is a Drinking Water Source Protection (DWSP) Plan for Skakel Spring located near Moab, Utah. The plan was prepared by Montgomery Watson staff for the City of Moab in accordance with UAC R309-113, DWSP, Revision dated January 15, 1999.

The overall approach used to prepare this DWSP Plan was to: (1) compile, evaluate, and use, to the degree feasible, applicable data from previous work; (2) follow the step-by-step instructions and format provided by Division of Drinking Water (DDW) guidance documents; and (3) provide a document that can be submitted to DDW for review and approval.

This DWSP Plan characterizes and outlines specific source water areas (watershed, wellhead, or recharge areas), identifies threats to water quality (pollution sources), determines the potential risk these threats pose to the water supply and provides a strategy for ongoing and future management of conditions and activities within these areas that may adversely affect source water quality. Because a source water contamination incident can have high financial and public health costs, a long-term commitment is necessary to assure the protection of high-quality water sources so that they remain available for future generations.

OBJECTIVES

The primary objectives of this DWSP Plan were to:

- Determine where the water originates and outline the drinking water protection zones for Skakel Spring;
- Determine whether any existing potential contamination source (PCS) exists within each of these protection zones and prioritize any risk that they might present so that Moab can manage them;
- Develop comprehensive and reasonable management practices which can be implemented by Moab in order to protect the future of this drinking water source; and
- Prepare a document that can be presented to the Utah Department of Environmental Quality (DEQ), Division of Drinking Water (DDW) that meets the requirements of UAC R309-113, DWSP, Revision dated January 15, 1999.

FINDINGS

Following extensive investigations, site reviews and hydrogeologic evaluation, four distinct drinking water source protection areas for each drinking water source were identified. Following DDW protocol, a survey of the source protection areas was performed to determine what PCSs exist within these four protection zones. A PCS is defined by DDW as "*any facility or site which employs an activity or procedure which may potentially contaminate ground water. Further, for it to be a PCS, a hazardous substance is usually associated with the procedures employed at the facility. This includes use, storage, manufacture, transportation, and disposal of hazardous substances. They may be chemical, biological, or radiological.*" Identified PCSs were then prioritized according to the potential threat they pose to future water quality. Controls and management strategies for protecting the drinking water sources from these threats were then identified for each source.

THE DWSP PLAN DOCUMENT

The DWSP Plan includes the following sections:

- Introduction, system information and contact person;
- The delineation of the protection zones;
- The inventory of potential contamination sources;
- The assessment of potential contamination source hazards;
- The management program for existing potential contamination sources;
- The management program for future potential contamination sources;
- The implementation schedule;
- An evaluation of the operational and financial management resources of Moab;
- A recordkeeping section;
- A contingency plan; and
- A waiver section addressing water quality sampling waivers for Moab.

This DWSP Plan provides a universal tool for the City of Moab to use in the future to review any potential impacts that might affect water quality and to implement the strategies identified in this document to manage those risks. The plan will be updated as required by DDW rules.

1.0 INTRODUCTION

The purpose of this document is to present the Utah Department of Environmental Quality (DEQ), Division of Drinking Water (DDW) with a Drinking Water Source Protection (DWSP) Plan for Moab that meets the requirements of Utah Administrative Code (UAC) R309-113, Drinking Water Source Protection (DWSP), Revision dated January 15, 1999 and associated DDW guidance documents including the *Drinking Water Source Protection Standard Report Format for Existing Wells and Springs* dated October 1998.

Skakel Spring is located as shown on Figure 1-1, about one mile north of the City of Moab in Grand County, Utah. The approximate coordinates of the spring are listed in Table 1-1.

TABLE 1-1

CITY OF MOAB SELECTED DRINKING WATER SOURCE LOCATIONS

Source	Location
Skakel Spring	South 400 feet, West 100 feet from the Northeast corner of Section 35, Township 25 South, Range 21 East (SLB&M)

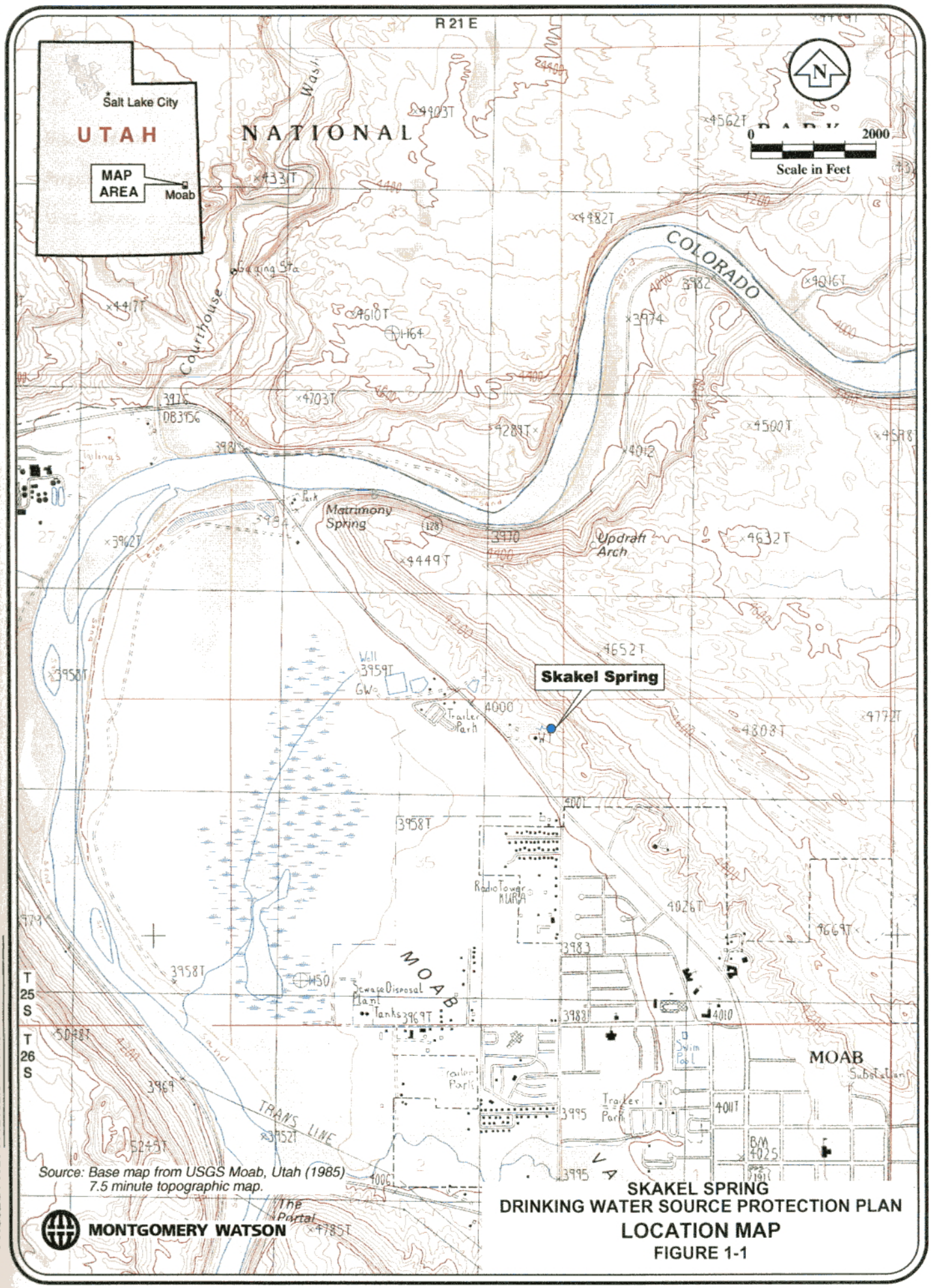
Sources: Division of Drinking Water records and Blanchard (1990)

The overall approach used to prepare this DWSP Plan was to: (1) compile, evaluate, and use, to the degree feasible, applicable data from previous work; and (2) follow the step-by-step instructions and format provided by DDW guidance documents. The principal documents that were used as guidance in the preparation of this DWSP Plan include:

- UAC R309-113, DWSP, Revision, dated January 15, 1999;
- Division of Drinking Water *Source Protection User's Guide*, dated October 1998;
- Division of Drinking Water *Source Protection Workbook*; and
- Division of Drinking Water *Standard Report Format for Existing Wells and Springs, dated October 1998.*

1.1 SYSTEM INFORMATION

Water System Name:	***City of Moab***
System Number:	***10003***
System Address:	***City of Moab*** ***115 West 200 South*** ***Moab, Utah 84532***
New or Existing System:	***Existing***
Public or Non-Public:	***Public***
Type of Public System:	***Community***



Source: Base map from USGS Moab, Utah (1985) 7.5 minute topographic map.

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SKAKEL SPRING
DRINKING WATER SOURCE PROTECTION PLAN
LOCATION MAP
FIGURE 1-1

PROJECT NO. 1142152.011801.ai 09/08/00 SLC

1.2 SOURCE INFORMATION

Source Name:	***Skakel Spring***
Proposed New or Existing Source:	***Existing***
Well, Spring, or Tunnel:	***Spring***
Individual Source, Wellfield or Springfield:	***Individual Source***

1.3 DESIGNATED PERSONS

The Designated Person for the water system is as follows:

Designated Person:	***Brent Williams, Public Works Director***
Address:	***City of Moab*** ***115 West 200 South*** ***Moab, Utah 84532***
Phone Number:	***(435) 259-7485***

2.0 DELINEATION REPORT

This Delineation Report: (1) contains the geologic data, aquifer characteristics summary, aquifer test summary, and spring data required by UAC R309-113; (2) summarizes the data and methods used to establish the Zone Two (250-day time of travel), Zone Three (3-year time of travel), and Zone Four (15-year time of travel) DWSP areas; and (3) provides the maps and narrative descriptions of the DWSP Zones. Hydrogeologic mapping, based on data available through the Utah Geological Survey (UGS), the U.S. Geological Survey (USGS), and other sources, were used to establish the DWSP Zones. The Delineation Report contains the supporting information identified in the Source Protection User's Guide and Source Protection Workbook including the boundaries of the DWSP Zones drawn on the *Moab* USGS 7.5-Minute topographic base maps.

2.1 GEOLOGIC DATA

This section includes a "*...summary description of the surface and subsurface geology in the well and protection zone areas*". The purpose of this section is to identify, characterize, and map the extent of: (1) geologic units which provide groundwater flow (aquifers) to the springs; (2) geologic units which may provide vertical and horizontal limits to groundwater flow (aquitards or confining beds) to the springs; (3) faults which may be barriers or preferential paths to groundwater flow; and (4) fractures and/or karst features which may provide local and regional controls on groundwater flow.

2.1.1 Previous Investigations

Skakel Spring lies within the USGS *Moab* 7.5-Minute topographic map (see Figure 1-1). The geology of the area has been mapped by Williams (1964) at a scale of 1:250,000 and by Doelling (1993, 1995) at scales of 1:100,000 and 1:24,000, respectively. Figure 2-1 depicts the areal extent of the various geologic units in the vicinity of the spring, based on the geologic map by Doelling (1995). Figure 2-2 is a generalized cross section of the Skakel Spring area.

2.1.2 Lithologic Descriptions of Sedimentary Units

The sedimentary rocks within the area are primarily Mesozoic sandstones and siltstones that are locally overlain by Quaternary sands, gravels, and clay derived from weathering of older bedrock. Wide ranges in thicknesses reported for the Mesozoic units are probably a result of syndepositional salt tectonics (Doelling, 1995). The following lithologic descriptions are modified from Doelling (1993, 1995) and Blanchard (1990) and are arranged from youngest to oldest (shallowest to deepest).

Quaternary unconsolidated deposits. Unconsolidated deposits consist of Quaternary gravels, sands, and silts derived from weathering of local bedrock and deposited by fluvial and eolian processes. Locally, this unit mantles bedrock outcrops.

Navajo Sandstone. The Lower Jurassic Navajo Sandstone is a light colored, fine- to medium-grained sandstone with conspicuous eolian cross beds. Thin, resistant beds of gray limestone occur locally. Subvertical joints are common. The unit is approximately 300 to 700 feet thick.

Kayenta Formation. The Lower Jurassic Kayenta Formation contains reddish-brown to reddish-gray fine- to coarse-grained sandstone with local thin beds of intraformational conglomerate and limestone. The unit is approximately 250 to 400 feet thick.

Wingate Sandstone. The Lower Jurassic Wingate Sandstone is a reddish-brown, dark-brown-weathering, fine-grained sandstone with prominent eolian cross beds. The unit is approximately 250 to 400 feet thick.

Chinle Formation. The Upper Triassic Chinle Formation contains reddish-brown siltstone, mudstone, sandstone, and pebble conglomerate. The unit is approximately 100 to 640 feet thick.

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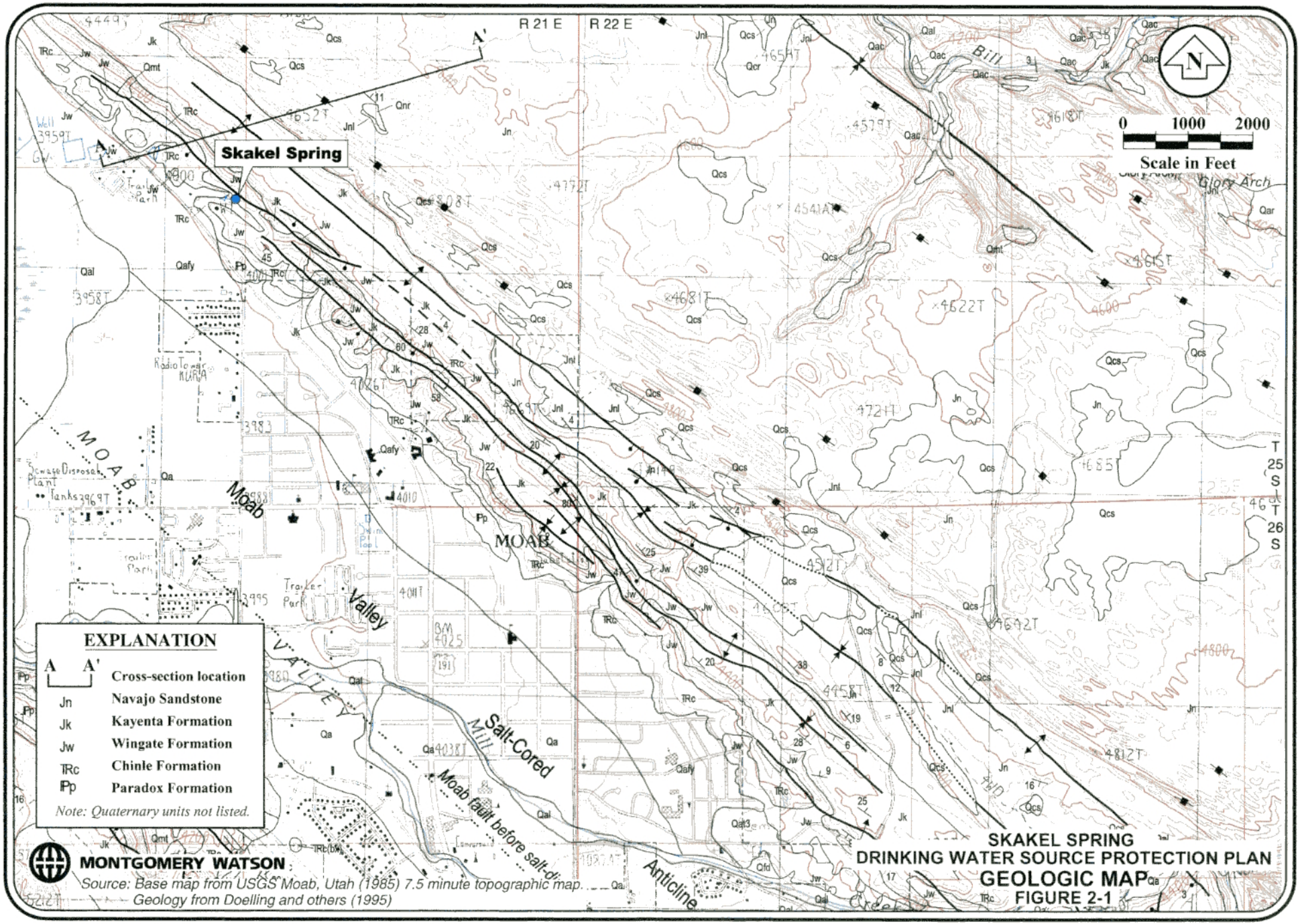

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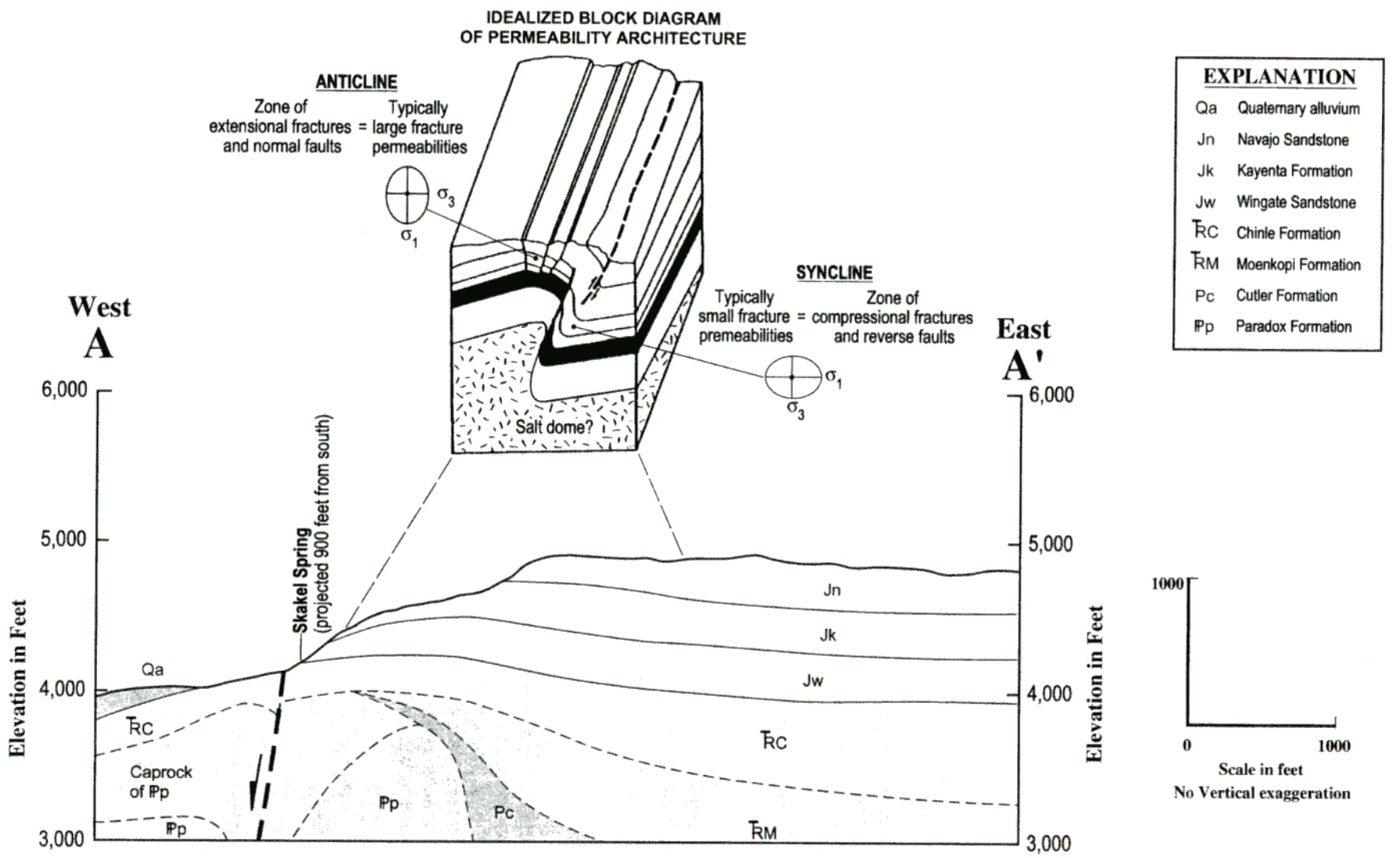

Adapted from: Doelling and others (1995) and Jarvis (1986)

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SKAKEL SPRING
DRINKING WATER SOURCE PROTECTION PLAN
GEOLOGIC CROSS SECTION A-A'
FIGURE 2-2

2.1.3 Structural Geology

Skakel Spring is located along the eastern flank of Moab Valley, a topographically depressed region created by the dissolution and collapse of the northwest plunging Moab Valley salt anticline (Sumsion, 1971; Doelling, 1995). Mesozoic sedimentary rocks in the area of Skakel Spring dip gently to the west.

Folds, Faults, and Fractures. Doelling (1995) mapped several northwest-striking structures along the eastern flank of the Moab Valley salt anticline. These structures include normal faults and open anticlines and synclines. The faults and folds are intimately related because many of the folds are probably the result of fault propagation (Doelling, 1995). Northwest-trending, subvertical fractures and joints are common in the sedimentary rocks near Skakel Spring. A minor down-to-the-southwest fault is located approximately 50 feet east of Skakel Spring (Doelling, 1995).

2.2 SPRING CONSTRUCTION DATA

Skakel Spring discharges from the base of the Wingate Sandstone. A concrete spring box near the base of the hill receives water from the source. The spring area is fenced. The spring discharges approximately 450 gallons per minute (gpm).

2.3 AQUIFER DATA

Pursuant to UAC R309-113-9, and as discussed in Section 2.4, hydrogeologic mapping was used to determine the DWSP zones for Skakel Spring. As such, quantitative values for hydraulic conductivity, transmissivity, saturated thickness, and effective porosity values for the Wingate Sandstone were not used to determine the groundwater boundaries of the DWSP zones. Rather, hydrogeologic mapping requires a thorough understanding of the aquifers, and the overall circulation patterns that allow groundwater to flow to and be produced by the springs.

This section: (1) identifies the hydrogeologic units which yield groundwater to the springs; (2) describes the permeability architecture present within these geologic units; (3) provides an overview of the circulation patterns that allow groundwater to flow from recharge areas, through the geologic units, to the springs; and (4) provides the framework for the delineation of the DWSP zones presented in Section 2.4, Method Used to Delineate DWSP Zones.

2.3.1 Identification of Hydrogeologic Units

Skakel Spring discharges groundwater from the Wingate Sandstone. The Wingate Sandstone is locally exposed along the eastern flank of Moab Valley and is overlain by the Kayenta Formation and the Navajo Sandstone. In the Moab region, the Navajo Sandstone, the Kayenta Formation, and the Wingate Sandstone are porous, fractured sandstones that allow water to pass through easily. East and southeast of Skakel Spring, the Navajo Sandstone is subaerially exposed over a broad region, allowing recharge to the Wingate aquifer. The Chinle Formation lies beneath the Wingate Sandstone and acts as a confining bed due to the presence of mudstones in the upper part of the unit.

Wingate Sandstone Aquifer. This formation yields water to Skakel Spring.

2.3.2 Permeabillity Architecture

Structurally, the area is characterized by faulting, fracturing, and minor folding. It is this same permeability architecture that transports groundwater to the springs.

Permeability Architecture. Permeability architecture is defined herein as the spatial arrangement of permeable zones emplaced in a formation or group of formations by physical and chemical processes. Permeable zones consist of faults, fracture, joints, and interconnected pores in rock units, which allow for the movement of groundwater. Inherent in the definition of permeability architecture is the understanding that several distinct permeable zones can be superimposed within a formation, and the connection of the

various permeable zones yields a network of permeable pathways for groundwater circulation. These permeable pathways are commonly oriented either parallel or perpendicular to bedding.

Permeability Associated with Joints. Joints are the predominant fracture type in the geologic units present in the area. Joints can allow groundwater to move both parallel to and at angles to bedding within a geologic formation. Physical characteristics which affect the ability of joints to transmit groundwater include, but are not necessarily limited to, aperture (thickness of fracture opening), persistence (distance that individual fractures can be traced), and mineralization or other infillings present. Geologic units with fractures that are wide, persistent, and open tend to be more transmissive than geologic units with fractures that are narrow, short, and filled in with clay or minerals.

Permeability Associate with Faults. Depending on the rock types that have been faulted and the nature of the fault zone, faults can be barriers to groundwater flow or can provide conduits to groundwater flow. Open fractures are commonly found in competent rocks that fail in a brittle manner. Faults can also present barriers to groundwater where: (1) a fault offsets an aquifer against an aquitard, effectively severing the aquifer; and (2) where an impermeable gouge or breccia develops in the fault zone.

Permeability Associated with Anticlines/Synclines. An understanding of the permeability distribution in these structures is required to interpret the mechanics of groundwater circulation in the region east of Skakel Spring and to better understand the location of the DWSP zone boundaries. Numerous field and subsurface studies reveal that extensional fractures parallel to strike accentuate the permeabilities of rocks found in the crests of anticlines throughout the Colorado Plateau and Rocky Mountain region.

The Moab region contains numerous open, northwest-trending anticlines and synclines. The folds range from a few hundred feet to several miles in breadth. Doelling (1995) suggested that the anticlines and synclines are likely rooted by high-angle normal faults because the axial traces of the folds changes to high-angle normal faults. In the vicinity of Skakel Spring, the crest of an open anticline is located approximately 950 feet east of the spring (see Figure 2-2). An open syncline is located east of this anticline.

The hydrologic significance of these fractures is two-fold:

- Open fractures are commonly found in competent rocks that fail in a brittle manner. These fractures remain open in the anticlinal crests due to extensional stresses inherent in this part of the fold; these fractures provide conduits for groundwater flow.

- Fractures in the competent rocks located along the axes of synclines typically remain closed and serve as barriers to groundwater circulation due to the compressive stresses operative within the fold.

The importance of fracture enhanced permeabilities in anticlinal flexures is observed through (1) increased penetration rates during drilling through the well-cemented sedimentary rocks along anticlinal folds, (2) aquifer tests, (3) spring locations, and (4) oil field reservoir studies. All of these data demonstrate that fractures are important in enhancing permeabilities in the well-cemented sedimentary and overlying rocks.

2.3.3 Groundwater Flow Directions

Gravity is the driving force that moves groundwater through any flow system. Water enters the groundwater system at the highest point on its flow path and leaves by discharging to a surface water feature at a lower point. In the vicinity of Skakel Spring, groundwater in the Wingate Sandstone moves downgradient to the northwest toward the Colorado River. Additionally, near Skakel Spring, the movement of groundwater is controlled by; (1) geologic structures that acts as conduits or barriers to groundwater flow, and (2) the contact between the Wingate Sandstone and the underlying Chinle Formation.

2.4 HYDROGEOLOGIC METHODS USED TO DELINEATE DWSP ZONES

According to the Source Protection User's Guide, a source protection area is the "... *surface and subsurface area around a well, spring, or tunnel through which contaminants are reasonably likely to move toward and contaminate the [drinking water] source.*" Two methods are allowed under R309-113 to determine this area: (1) the Preferred Delineation Procedure; and (2) the Optional Two-Mile Radius Delineation Procedure. The Preferred Delineation Procedure was selected because it uses local hydrogeologic conditions to determine the drinking water source protection (DWSP) area and it is more accurate than the Optional Two-Mile Delineation Procedure.

2.4.1 DWSP Zone Definitions

The four protection zones delineated by the Preferred Delineation Procedure include:

- **Zone One** - the area within a 100-foot radius around the wellhead, spring, or tunnel collection area;
- **Zone Two** - the 250-day time-of-travel (TOT), the boundary of the aquifer(s) which supplies water to the source, or the groundwater divide, whichever is closer;
- **Zone Three** - the area within a 3-year TOT to the source, the boundary of the aquifer(s) which supplies water to the source, or the groundwater divide, whichever is closer; and
- **Zone Four** - the area within a 15-year TOT to the source, the boundary of the aquifer(s) which supplies water to the source, or the groundwater divide, whichever is closer.

Zone One - 100-Foot Fixed-Radius Accident Prevention Zone. Zone One is a 100-foot fixed radius around the spring collection area and is referred to as the accident prevention zone. Its purpose is to prevent accidents and to protect the spring.

Zone Two - 250-day Attenuation Zone. Zone Two is sometimes referred to as the attenuation zone. Its purpose is to reduce concentrations of pathogenic microorganisms and some chemicals to levels below maximum contaminant levels before groundwater reaches a well, spring or tunnel. Zone Two represents a moderate level of protection.

Zone Three - 3-year Waiver Criteria Zone. Zone Three is a three-year groundwater time-of-travel to the spring referred to as the waiver criteria zone. This zone has been established to provide a basis for granting monitoring wavers in the future. Use waivers may be granted for either the volatile organic compounds (VOC) or the pesticide parameter group. To qualify for a use waiver, a system must verify that none of the chemicals or pesticides in the parameter groups have been used in the three-year time-of-travel zone. If a system does not qualify for a use waiver, it may still qualify for a susceptibility waiver. A susceptibility wavier allows the use, disposal, storage, transport, and manufacture of chemicals within Zone Three as long as they are controlled in such a manner as to prevent contamination of the system's well or spring. The DWSP Plan must verify that land management strategies which will control the chemicals that are being used in Zone Three are implemented.

Zone Four - 15-year Remedial Action Zone. Zone Four is defined as the 15-year groundwater time-of-travel to a well, spring or tunnel referred to as the remedial action zone. Its purpose is to provide protection to the drinking water source and to afford sufficient time for remediation or developing a new source in case of a contamination incident. Zone Four represents a moderate level of protection.

2.4.2 Delineation Method and Assumptions

Regulatory mandate defines Zone One as a fixed 100-foot radius around each spring collection area. Zones Two, Three, and Four were delineated using hydrogeologic mapping. The DWSP zones delineated

for Skakel Spring are shown on a topographic base map (Figure 2-3) and a geologic map (Figure 2-4). Assumptions used to delineate the DWSP boundaries for Skakel Spring include the following:

- Groundwater in the Wingate Sandstone, Kayenta Formation, and Navajo Sandstone flows to the springs;
- Groundwater travels through open fractures along the crests of anticlines which act as conduits;
- Syncline axes contain no open fractures and therefore impede groundwater movement;
- The syncline that represents the eastern boundary of the DWSP zone separates the Skakel Spring system from the Matrimony Spring system (see Figure 1-1).
- Faults are barriers to groundwater flow;
- Groundwater enters the aquifer along losing sections of Mill Creek (see Figure 2-3); and
- The Wingate Sandstone/Chinle Formation contact is a barrier to groundwater flow.

Using the same approach to developing catchment area calculations as Jensen and others (1997) including average annual precipitation, recharge estimates, and the method of Todd (1980), a catchment area approaching 4 to 6 square miles would be required to provide enough water for the 450 gpm discharged from Skakel Spring. Examination of the DWSP Zone for Skakel Spring depicted in Figure 2-3 indicates a catchment area of approximately 1 to 2 square miles. Therefore, this catchment area accounts for approximately 1/3 (150 gpm) of the total spring discharge (450 gpm). Mill Creek loses approximately 220 gpm over a distance of about 3000 feet along the southern boundary of the DWSP Zone. Combining the amount of discharge predicted by the spring catachment area (150 gpm) with the amount of water lost along the losing sections of Mill Creek (220 gpm) yields 370 gpm of total spring discharge. This is close to the 450 gpm discharge reported for Skakel Spring. The discrepancy between the values is likely a result of the discharge and stream flow being measured during different seasons.

2.5 MAP AND DESCRIPTIONS OF DWSP ZONES

The outlines of the Zone Two (250-day TOT), Zone Three (3-year TOT), and Zone Four (15-year TOT) DWSP areas for Skakel Spring are superimposed at a scale of 1:24,000 on the *Moab* 7.5-Minute USGS topographic and geologic maps depicted on Figures 2-3 and 2-4. The DWSP Zone One, a 100-foot radius zone around the spring, is not shown. The approximate dimensions of DWSP Zones Two, Three, and Four are summarized in Table 2-1.

The DWSP zones were delineated using a straightforward approach that relied on readily-available existing information and hydrogeologic knowledge. It should be noted that delineation of DWSP zones is a dynamic process and the DWSP zones should be updated as:

- The protection goals of the DWSP Plan are modified;
- More hydrogeologic data become available;
- New wells, if any, are developed in the DWSP zones;
- Annual production from any well(s) within the zones are significantly changed over time.

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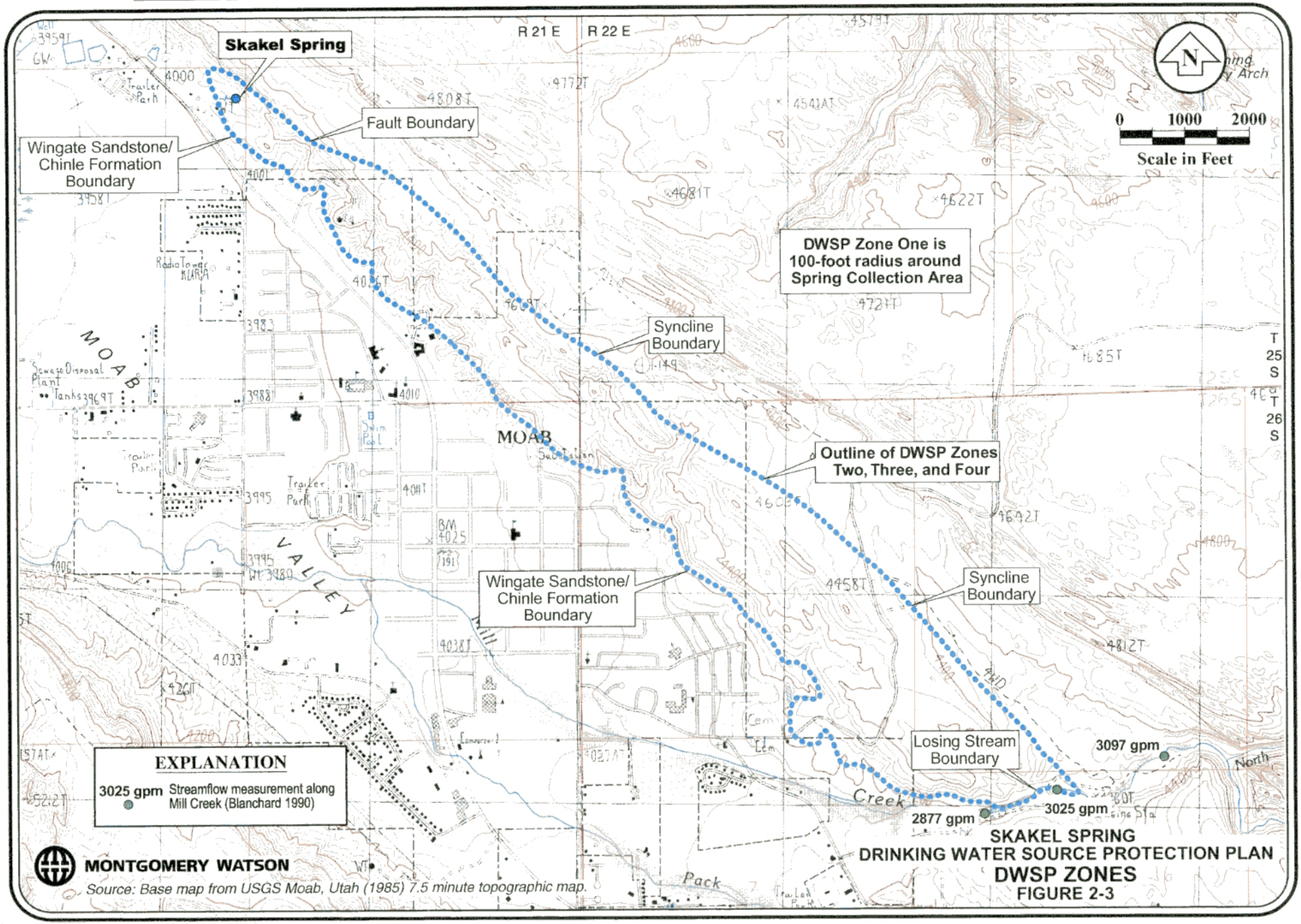

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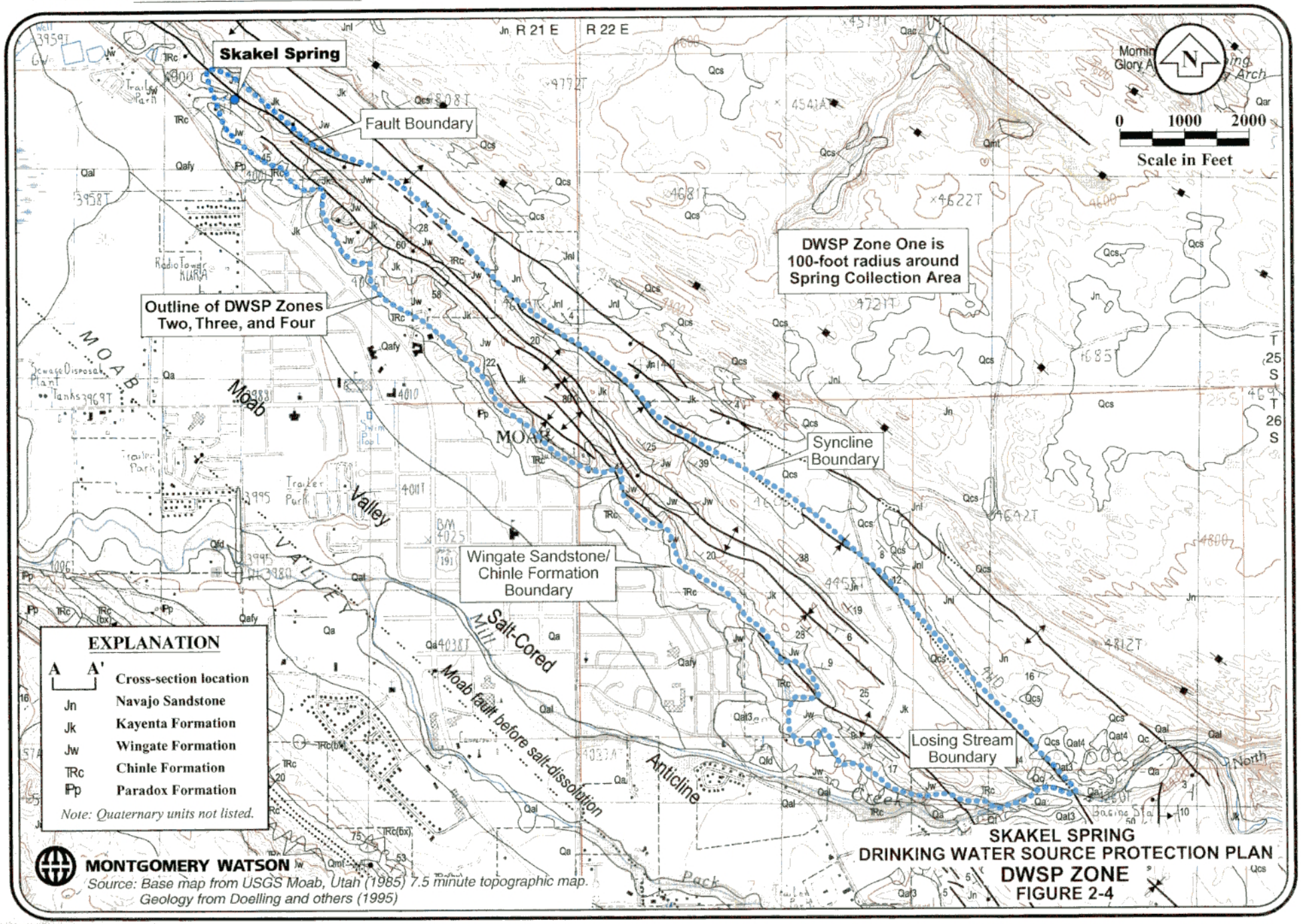

TABLE 2-1

APPROXIMATE DIMENSIONS OF DWSP ZONES

DWSP Zone	Length Northwest to Southeast Dimension (feet)	Width Southwest to Northeast Dimension (feet)
Zone Two 250-Day TOT	17,500	1,500
Zone Three 3-year TOT	17,500	1,500
Zone Four 15-year TOT	17,500	1,500

3.0 INVENTORY OF POTENTIAL CONTAMINATION SOURCES

The approach used to identify and assess the potential contamination sources (PCSs) located in the Drinking Water Source Protection (DWSP) areas for Moab's drinking water source followed guidance provided in:

- UAC R309-113, DWSP, Revision dated January 15, 1999;
- Division of Drinking Water *Source Protection User's Guide* dated October 1998;
- Division of Drinking Water *Source Protection Workbook* (undated);
- Drinking Water Source Protection Plan, *Standard Report Format for Existing Wells and Springs,* dated October 1998;
- Wellhead Protection: *A Guide for Small Communities* (EPA, 1993);
- *Managing Ground Water Contamination Sources in Wellhead Protection Areas*, A Priority Setting Approach (EPA, 1991a); and
- Review of Sources of Ground-Water Contamination from Light Industry (EPA, 1990a).

The overall approach used to compile a list of PCSs, identify the hazards, identify and assess the controls, identify and assess management procedures, and assess risk can be summarized as follows:

- A site reconnaissance conducted by Montgomery Watson personnel on September 26, 2000 to identify and confirm the locations of all PCSs, identify their hazards, and identify and assess any controls that are in place; and
- Identification and screening of PCSs and hazards present through a review of various State of Utah, Grand County, EPA, and other databases.

General guidelines to identifying and assessing PCSs were as follows:

- A PCS was dropped from the inventory if it was not included on the master list of PCSs provided in Chapter 5 (a copy of this list is provided in Appendix A) of the DDW's *Source Protection User's Guide*, unless professional judgement indicated otherwise;
- As per UAC R309-113-10(5), a potential source was assessed to be "adequately controlled" if the "*...current controls are stringent enough to prevent pollution from a potential contamination source from reaching a ground-water source of drinking water.*" This section of UAC R309-113 further states that the "*...DDW will consider a PWS's assessment that a potential contamination source which is covered by a permit or approval under one of the regulatory programs listed below sufficient to demonstrate that the source is adequately controlled unless otherwise determined by the Executive Secretary.*" A PCS was characterized as "adequately controlled" if was found to be regulated by one of the programs identified in UAC R309-113-10(5); and
- Professional judgement as recommended in DDW guidance.

3.1 LIST OF POTENTIAL CONTAMINATION SOURCES

Possible PCSs identified in the DWSP Zones One, Two, Three, and Four for Skakel Spring are listed in Table 3-1 as follows:

TABLE 3-1

SKAKEL SPRING
LIST OF IDENTIFIED PCSs

Name of *Possible* PCS	Address of *Possible* PCS	Name, Address Phone No. of Contact Person
Unimproved and Improved Roadways	Various locations	Utah Department of Transportation Division Four Maintenance phone: (435) 259-7636
Residential Water Well	1277 Sand Flats Road	Ken and Kathy Shoulder 1277 Sand Flats Road Moab, UT 84532 phone: (435) 259-3372
Residential Septic Tank	1277 Sand Flats Road	Ken and Kathy Shoulder 1277 Sand Flats Road Moab, UT 84532 phone: (435) 259-3372
Grand County Landfill	Along Sand Flats Road	Jane Jones 125 East Center Street Moab, Utah 84532 phone: (435) 259-3867
Septic Tank at Sunset Grill Restaurant	900 North Hwy 191	John and Laurie Clayton Sunset Grill Restaurant 900 North Hwy 191 Moab, Utah 84532 phone: (435) 259-7146
Moab Springs Ranch	1266 North Hwy 191	Katie Victor 1266 North Hwy 191 Moab, Utah 84532 phone: (435) 259-5753

3.2 IDENTIFICATION OF PCS HAZARDS

Identified activities and hazards associated with the PCSs found in the DWSP areas for Skakel Spring are listed in Table 3-2 as follows:

TABLE 3-2

SKAKEL SPRING
IDENTIFICATION OF PCS HAZARDS

Name of *Possible* PCS	Identified Activity	PCS No.[a] in DDW Guidance for Identified Activity	Identified Hazards [b]
Unimproved and Improved Roadways	Motor vehicle accidents and spills. Winter de-icing salts and chemicals.	Not on list	Hydrocarbons from fuels, oils, hydraulic fluid, antifreeze fluid, road salts, and de-icing chemicals.
Residential Water Well	Underground water well	1	Conduit to groundwater
Residential Septic Tank	Septic tank	43	Human and household waste
Grand County Landfill	Landfill	22	Solid and liquid waste
Septic Tank at Sunset Grill Restaurant	Septic tank	43	Human and household waste
Moab Springs Ranch	Pesticides, herbicides, fertilizers	37	Pesticides, herbicides, fertilizers

a = Chapter 5 of the October 1998 Source Protection User's Guide
b = chemical, biological, and radiological substances used, stored, manufactured, transported, and disposed at the PCS which could contaminate water

3.3 PRIORITIZED INVENTORY

A semi-quantitative approach was used to assign a numerical risk value to and develop a prioritized ranking for each PCS. The following factors were considered in the assignment of a numerical risk value: (1) the estimated distance from the PCS to the spring; (2) the estimated volume of the hazard present at the PCS; and (3) the presence and degree of controls in place at the PCS which would prevent accidental spills. In general, it was assumed that:

- PCSs located closer to the drinking water sources represent a greater risk than PCSs located farther away.
- PCSs with a greater volume of a hazard represent a greater risk than PCSs with a smaller volume of a hazard.
- PCSs with no controls represent a greater risk than PCSs with controls.

It was further assumed that distance represents 34 percent and volume and presence and degree of controls each represent 33 percent of the total relative risk.

The total relative risk (R) was calculated for each PCS using the following equation:

R = D+V+C; where,

R = Total relative risk,
D = Distance from PCS to the drinking water source,
V = Volume of hazard present at the PCS, and
C = Presence and degree of controls present at the PCS.

Points for distance (D), volume (V), and controls (C) were assigned as follows:

- Distance to Drinking Water Source (D)
  - 0 to 100 feet (DWSP Zone One) = 34 points
  - 100 to 500 feet = 25 points
  - 500 to 2,000 feet = 17 points
  - more than 2,000 feet = 8 points

- Volume of Hazard (V)
  - more than 500 gallons = 33 points
  - 50 to 500 gallons = 22 points
  - less than 50 gallons = 11 points

- Presence and Degree of Regulatory Control (C)
  - No controls = 33 points
  - Some controls = 22 points
  - Full controls = 11 points
  -

Professional judgement, as recommended by the DDW *Source Protection User's Guide*, was also used, as appropriate, if two or more PCSs were assigned the same number of points for total relative risk. Factors considered in using professional judgement included, but were not limited to: (1) the chemical, physical, and toxicological properties of the hazard present at the PCS; and (2) the type of control present. Hazards that are characterized as soluble, persistent, mobile, and toxic or carcinogenic were considered to represent a greater relative risk than hazards that are not characterized as such. PCSs without regulatory controls were considered to represent a greater relative risk than PCSs with regulatory controls. In accordance with the DDW *Recommended Report Format for Existing Sources*, individual controls are assessed as part of Section 4.0.

Table 3-3 lists the PCS priority order for Skakel Spring.

TABLE 3-3

PRIORITIZED LIST OF PCSs FOR SKAKEL SPRING

Rank	Name of *Possible* PCS	Distance to spring (34%)	Volume of hazard (33%)	Controls in Place: (33%)	Total Risk Points
1	Grand County Landfill	8	33	22	63
2	Moab Springs Ranch	25	11	22	58
3	Unimproved and Improved Roadways	25	11	22	58
4	Septic Tank at Sunset Grill Restaurant	8	22	22	52
5	Residential Septic Tank	8	22	22	52
6	Residential Water Well	8	11	22	41

3.4 POTENTIAL CONTAMINATION SOURCE LOCATIONS

Table 3-4 lists the location of the PCSs in relation to the DWSP Zones for Skakel Spring.

TABLE 3-4

POTENTIAL CONTAMINATION SOURCE ZONE LOCATION SKAKEL SPRING

Rank and Map Identification Number	Name of PCS	Protection Area Zone
1	Grand County Landfill	Zones Two, Three, Four
2	Moab Springs Ranch	Zones Two, Three, Four
3	Unimproved and Improved Roadways	Zones Two, Three, Four
4	Septic Tank at Sunset Grill Restaurant	Zones Two, Three, Four
5	Residential Septic Tank	Zones Two, Three, Four
6	Residential Water Well	Zones Two, Three, Four

3.5 POTENTIAL CONTAMINATION SOURCE MAP

Figure 3-1 is the Potential Contamination Source Location Map for Skakel Spring.

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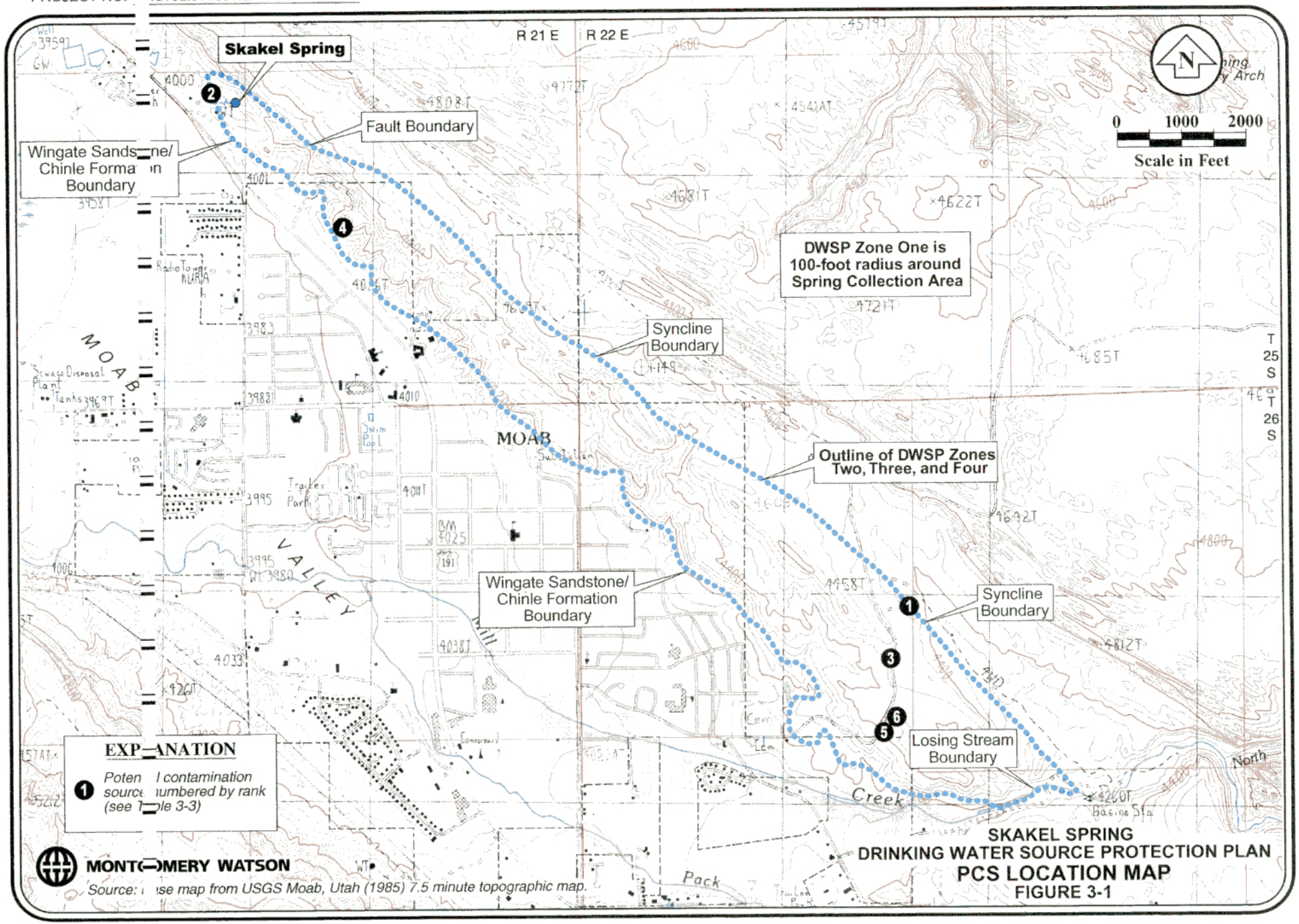


4.0 ASSESSMENT OF POTENTIAL CONTAMINATION SOURCE HAZARDS

This section presents the assessment of potential contamination source (PCS) hazards for Skakel Spring.

Four types of hazard controls are recognized by the DDW for PCSs: 1) regulatory, 2) operational, 3) physical, and 4) negligible quantity controls. Identified hazards were assessed as *adequately controlled* or *not adequately controlled.* Each potential contamination hazard for the four protection areas is discussed in the following sections. General guidelines to the assessment the controls present at each PCS were as follows:

- As per the recommendation of the *Source Protection User's Guide*, all septic systems, animal feeding areas (over ten animal units), and manure piles were assessed to be *"not adequately controlled."*

- As per UAC R309-11310 (5), a potential source was assessed to be "adequately controlled" if the "*...current controls are stringent enough to prevent pollution from a potential contamination source from reaching a ground-water source of drinking water."* This section of UAC R309-113 further states that the "*...DDW will consider a PWS's assessment that a potential contamination source which is covered by a permit or approval under one of the regulatory programs listed below sufficient to demonstrate that the source is adequately controlled unless otherwise determined by the Executive Secretary."* A PCS was characterized as "adequately controlled" if it was found to be regulated by one of the programs identified in UAC R309-113-10 (5).

- Although hazardous materials and waste transport is regulated by the U.S. Department of Transportation (DOT) and response to and cleanups of spills are regulated by various federal, state, and local agencies, the major transportation routes were assumed to be *"not adequately controlled."*

- All water wells which were reported to be grouted in accordance with DWR and DDW regulations were assessed to be *adequately controlled.*

- In the case where more than one control exists, only one control was listed (This is according to Utah DDW guidance given by Bob Lowe at DDW's Source Protection Seminar - March 9, 1998)

- Reassessment of Hazards has been set for six (6) years, which is based on the DDW requirement for updating DWSP Plans.

The identified control for each PCS hazard assessed for Skakel Spring is listed in Table 4-1:

TABLE 4-1

SKAKEL SPRING
PCS HAZARD CONTROLS

Rank	Name of *Actual* PCS	Controls	Verification of Enforcement Agency or Contact	Control is Adequate or Not Adequate	Date to Reassess Hazard
1	Grand County Landfill	UAC R315-301 through R315-320, Solid Waste Rules	Ralph Bohn Utah Department of Environmental Quality, Division of Solid and Hazardous Waste, Solid Waste Branch Salt Lake City, UT (801) 538-6170	Not Adequate	2006
2	Moab Springs Ranch	UAC R68-7, Pesticide Control Rule Recommended storage, use, and disposal instructions provided on chemical packages	Michael Johnson Grand County Agricultural Agent USU Extension Service Moab, UT (435) 259-7558	Not Adequate	2006
3	Unimproved and Improved Roadways	40 CFR Part 302, Designation, Reportable Quantities and Notification 49 CFR Part 171.15, Immediate Notice of Certain Hazardous Materials Incidents Utah Code Annotated, Section 63-5-5, Hazardous Chemical Emergency Planning and Information Act of 1987 State of Utah, Emergency Operations Plan, Hazardous Materials Response Support Plan	Doug Squire Grand County Emergency Management Committee Moab, UT (435) 259-8115	Not Adequate	As needed – check with Moab Valley Fire Protection District and review records of releases with Local Emergency Planning Commission

Rank	Name of *Actual* PCS	Controls	Verification of Enforcement Agency or Contact	Control is Adequate or Not Adequate	Date to Reassess Hazard
4	Septic Tank at Sunset Grill Restaurant	UAC R317-501 through R317-513, Individual Wastewater Disposal Systems	Grand County Health Department Moab, UT (435) 259-5602	Not Adequate	2006
5	Residential Septic Tank	UAC R317-501 through R317-513, Individual Wastewater Disposal Systems	Grand County Health Department Moab, UT (435) 259-5602	Not Adequate	2006
6	Residential Water Well	UAC R655-4-8.2, Sealing of Casing UAC R309-106-5(5)(g), Grouting Techniques and Requirements UAC R655-4-12, Abandoned Water Well Rule	Jerry Bronicel Utah Division of Water Rights Salt Lake City, UT (801) 538-7382 Michael Georgeson Utah Division of Drinking Water Salt Lake City, UT (801) 536-4197 Jerry Bronicel Utah Division of Water Rights Salt Lake City, UT (801) 538-7382	Adequate	2006

5.0 MANAGEMENT PROGRAM TO CONTROL EXISTING POTENTIAL CONTAMINATION SOURCES

Land management, management practices or pollution prevention strategies must be implemented for any of the potential contamination sources that have been determined *not adequately* controlled. Table 5-1 presents land management strategies for PCSs that were assessed as *not adequately controlled* in Section 4.0, and summarizes the management strategies that are proposed by Moab to address these hazards.

TABLE 5-1

SKAKEL SPRING
MANAGEMENT STRATEGIES FOR EXISTING PCSs
ASSESSED AS *NOT ADEQUATELY CONTROLLED*

Name of *Actual* PCS	Identified Hazard	Proposed Management Strategy
Grand County Landfill	Solid and liquid waste	***Prepare and deliver a letter to the Grand County Landfill Manager.*** This letter will: (1) inform the manager that the landfill lies within the DWSP Zone for Skakel Spring; and (2) request that they do not accept any solid or liquid hazardous waste.
Moab Springs Ranch	Pesticides, herbicides, fertilizers	***Prepare and deliver a letter to the general manager of Moab Springs Ranch.*** This letter will: (1) inform the manager of the business of their location within the Skakel Spring DWSP Zone; and (2) request that they take an active role in protecting their drinking water sources through proper storage, use, and disposal of fertilizers, pesticides, cleaners, oils, and other household chemicals.
Unimproved and Improved Roadways	Hydrocarbons from fuels, oils, hydraulic fluid, antifreeze fluids, road salts, and de-icing chemicals	***Prepare and deliver a letter to the Grand County Emergency Management Committee.*** This letter will: (1) show the location of the DWSP Zones for Moab's drinking water sources; and (2) request that Moab be notified of any accidents or hazardous waste spills that occur within these zones.
Septic Tank at Sunset Grill Restaurant	Human and household waste disposed in septic system	***Prepare and deliver a letter to manager of Sunset Grill Restaurant.*** This letter will: (1) inform the manager that their septic system is located within the Skakel Spring DWSP Zone; (2) request that they do not dispose of hazardous materials in the septic system; and (3) that they follow Grand County Health Department guidance for the construction and maintenance of septic systems.
Residential Septic Tank	Human and household waste disposed in septic system	***Prepare and deliver a letter to Septic System Owner.*** This letter will: (1) inform the septic system owner that their system is located within the Skakel Spring DWSP Zone; (2) request that they do not dispose of hazardous materials in the septic system; and (3) that they follow Grand County Health Department guidance for the construction and maintenance of septic systems.

6.0 MANAGEMENT PROGRAM FOR FUTURE POTENTIAL CONTAMINATION SOURCES

The DWSP Rule (UAC R113-12) requires that a program be established to manage potential contamination sources (PCSs) that, in the future, may want to locate within the DWSP zones. Some of these future PCSs may be similar to existing PCSs, or they may present hazards that were not previously encountered.

Because much of the land within the delineated DWSP zones is managed under the auspices of the U.S. Bureau of Land Management and the Manti-La Sal National Forest, the potential threats to the recharge area are related to forest harvesting, mining, and recreation. The possibility of mineral exploration on public or private lands in the highlands surrounding Spanish Valley, as well as septic tank installation related to development of recreational properties in the area, may also become future potential sources of contamination. Given these scenarios, Moab is pursuing a Sole Source Aquifer (SSA) Designation Petition for the Mesozoic aquifers in the Moab area hosting Skakel Spring. According to McCabe and others (1997) and EPA (1987), the criteria for SSA designation include the following items:

- The aquifer must be the sole or principal source of drinking water for the area;
- No economically feasible alternative drinking water sources exist within the area or nearby that could supply all those who now depend upon the aquifer as their source of drinking water; and
- If the aquifer were contaminated, a significant hazard to public health would result.

Moab is requesting the SSA aquifer designation for the Mesozoic aquifers in the Moab area to protect the drinking water supply beyond what Moab could achieve through land use agreements, memoranda of agreement or understanding, and local or county ordinances. Moab desires this status for these sources so the EPA would review federally-funded projects located in the Moab area to insure that the projects are conducted in a manner which will not negatively impact the drinking water supplies. In order to control future PCSs, Moab will pursue adopting a zoning ordinance that will closely regulate development and growth in the Skakel Spring source protection area. An example of a drinking water source protection ordinance is included in Appendix B.

7.0 IMPLEMENTATION SCHEDULE

The Implementation Schedule basically outlines the dates that Moab will implement the land management strategies which have been addressed in this DWSP. Each potential contamination source listed on the PCS inventory and assessed as *not adequately controlled* must implement land management strategies that have been identified to control future potential contamination sources. Land management strategies will be implemented according to this schedule. Table 7-1 outlines the Moab DWSP implementation schedule for Skakel Spring.

TABLE 7-1

SKAKEL SPRING
DWSP PLAN IMPLEMENTATION SCHEDULE

Description	Implementation Date	Frequency
Prepare Sole Source Aquifer Designation Petition to EPA, Region VIII. The SSA petition review process consists of four phases (EPA, 1987).		Once
Phase 1 – Petition preparation. The petitioner uses EPA guidance to prepare and submit the petition using available information, rather than obtaining new data.	Winter, 2000	
Phase 2 – Initial review/completeness determination. EPA staff will review the petition for completeness and ascertain if it contained plausible, current information.	Spring, 2001	
Phase 3 – Detailed review/technical verification. EPA staff will verify that the aquifers supplying Skakel Spring are the sole or principal source of drinking water for the people living in Moab. This phase will also verify the boundaries of the designated area and project review area.	Summer, 2001	
Phase 4 – Designation determination. The EPA regional administrator may approve or deny the petition in this final phase. If major issues are identified in the petition review process, a public meeting may be held to hear different perspectives on designation.	Fall, 2001	
Prepare and deliver a letter to the Grand County Landfill Manager. This letter will: (1) inform the manager that the landfill lies within the DWSP Zone for Skakel Spring; and (2) request that they do not accept any solid or liquid hazardous waste.	Spring, 2001	Annually
Prepare and deliver a letter to the general manager of Moab Springs Ranch. This letter will: (1) inform the manager of the business of their location within the Skakel Spring DWSP Zone; and (2) request that they take an active role in protecting their drinking water sources through proper storage, use, and disposal of fertilizers, pesticides, cleaners, oils, and other household chemicals.	Spring, 2001	Annually
Prepare and deliver a letter to the Grand County Emergency Management Committee. This letter will: (1) show the location of the DWSP Zones for Moab's drinking water sources; and (2) request that Moab be notified of any accidents or hazardous waste spills that occur within these zones.	Spring, 2001	Every 3 years
Prepare and deliver a letter to manager of Sunset Grill Restaurant . This letter will: (1) inform the manager that their septic system is located within the Skakel Spring DWSP Zone; (2) request that they do not dispose of hazardous materials in the septic system; and (3) that they follow Grand County Health Department guidance for the construction and maintenance of septic systems.	Spring, 2001	Annually

Description	Implementation Date	Frequency
Prepare and deliver a letter to Septic System Owner. This letter will: (1) inform the septic system owner that their system is located within the Skakel Spring DWSP Zone; (2) request that they do not dispose of hazardous materials in the septic system; and (3) that they follow Grand County Health Department guidance for the construction and maintenance of septic systems.	Spring, 2001	Every 3 years

8.0 RESOURCE EVALUATION

The Moab water system has qualified and trained personnel handling the day-to-day operations. The Moab City Council meets twice a month, and as part of its agenda, will review the operational and financial status of the system.

Brent Williams, Public Works Director, is in charge of the day-to-day operations of the water system. Lloyd Swenson, serves as Water and Sewer Systems Superintendent. Both individuals are state-certified water system operators.

9.0 RECORDKEEPING

This section of the DWSP Plan will be updated by Moab as steps are taken to implement the items covered in this document. Such changes may include:

- The identification of new potential sources of groundwater contamination that were either not identified earlier or are new to the area;
- Changes in management practices at existing potential sources;
- The acquisition of new information which significantly affects the assessment of a potential source of groundwater contamination;
- Relevant changes in land use ordinances, such as revisions to the local zoning, as approved by Moab, permits, memoranda of understanding; and
- Implementation of public education programs, letters and other correspondence about preventing groundwater contamination.

10.0 CONTINGENCY PLAN

10.1 INTRODUCTION TO CONTINGENCY PLAN

A contingency plan to provide potable water to the public during emergencies must be submitted with a Drinking Water Source Protection (DWSP) Plan to fulfill the requirements set forth in Utah Administrative Code (UAC) R309-113 for sources of drinking water. Many of the elements required in the Moab emergency management plan are similar to those identified for inclusion in the DWSP Contingency Plan. Therefore, the contingency plan provided herein will eventually become part of the Moab emergency plan. Potential emergencies such as wellfield or spring contamination, water shortages due to droughts or fire, and interruption of water supply are addressed in this contingency plan.

10.1.1 Organization Of Plan

In formulating this contingency plan, Moab must address the following: (1) present water source capacity, water demand, and storage capacity; (2) chain of command and area of responsibilities during an emergency; (3) short-term emergency responses, including developing conservation measures and water decontamination measures; and (4) long-term shortages or abandonment of contaminated supplies, including the development of new ground and surface water sources.

10.1.2 How The Plan Was Developed

This contingency plan was developed on the basis of the following references:

- Emergency Response Handbook, Utah Department of Environmental Quality, Division of Drinking Water (DDW), March 1992;
- Guide to Ground-Water Supply Contingency Planning for Local and State Governments, Technical Assistance Document, EPA 440/6-90-003, May 1990; and

10.1.3 Plan Distribution

Copies of the plan should be distributed to Moab, the Utah Division of Drinking Water, Grand County Public Works and Sheriffs Departments and made accessible to the general public upon request.

10.1.4 Procedures For Review And Update

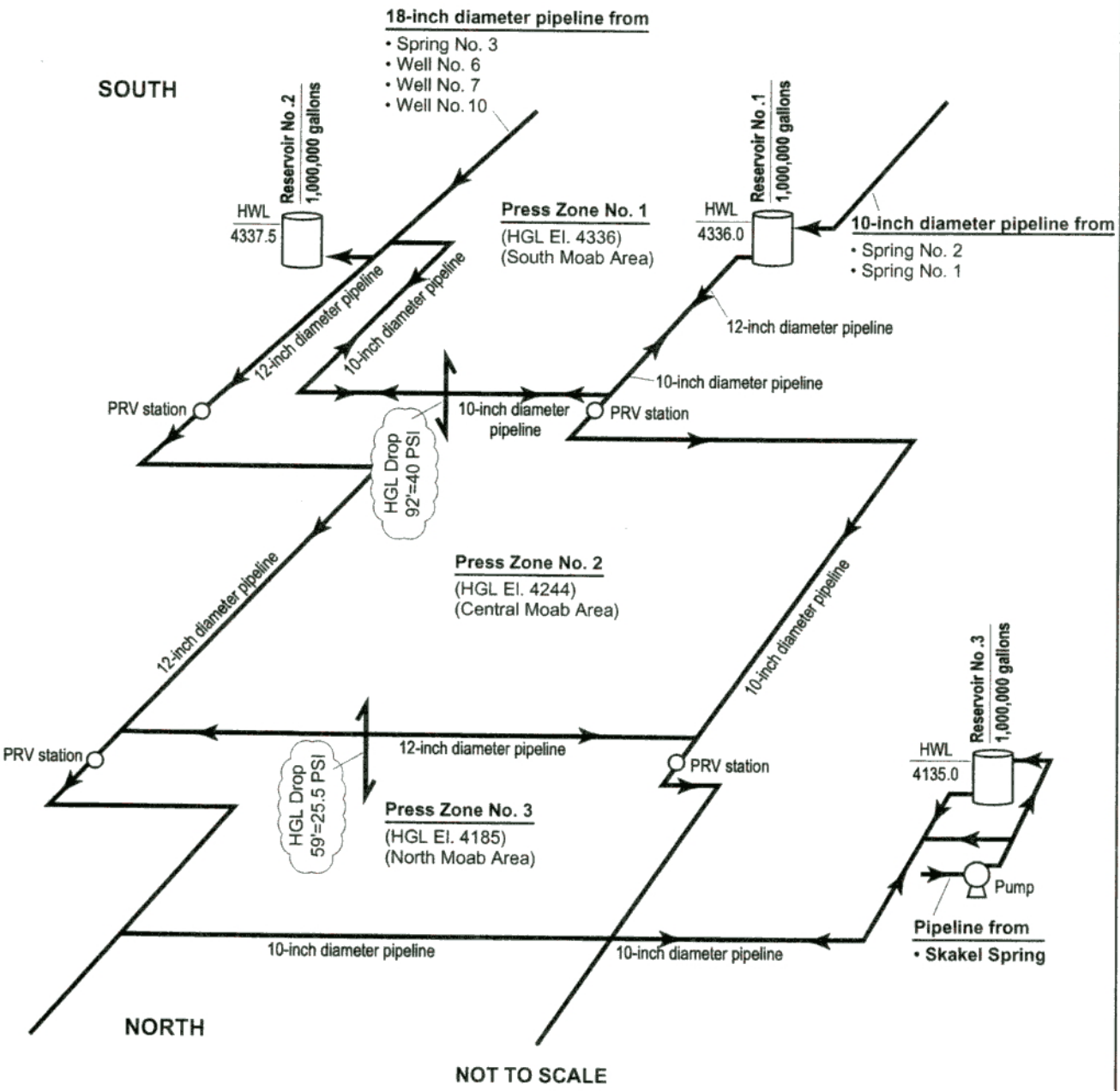
Because contingency planning is a dynamic process, Moab will be responsible for maintaining the DWSP Plan, noting the frequency with which the DWSP Plan will be routinely updated, and briefly describing how the plan testing and review process works. All reviews and updates will be amended to the DWSP Plan as described in the Recordkeeping sections of Moab Drinking Water Source Protection Plans.

10.2 WATER SYSTEM DESCRIPTION

Figure 10-1 depicts a sketch of the existing source and storage capacity of the water system operated by the city of Moab. The following sections are brief overviews of each water supply source and the storage system.

10.2.1 Source Capacity

Table 10-1 provides a summary of the existing source capacity for the Moab water system using data provided by Al Anderson (Senior Consulting Engineer) and historic data reported by Blanchard (1990).



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MONTGOMERY WATSON

CITY OF MOAB
DRINKING WATER SOURCE PROTECTION PLAN
SCHEMATIC MAP OF WATER SYSTEM
FIGURE 10-1

TABLE 10-1

SUMMARY OF WATER SOURCES SUPPLYING MOAB

Source Name	Depth (feet)	Existing Capacity (gpm)	Comments
Skakel Spring	N/A	450	Presently not used by Moab. A new pump station for this spring is currently being designed.
Moab City Spring No. 1	N/A	215	
Moab City Spring No. 2	N/A	215	
Moab City Spring No. 3	N/A	415	
Moab City Well No. 4	100	600*	Presently not used by Moab
Moab City Well No. 5	270	180*	Presently not used by Moab Occasionally used for watering golf course
Moab City Well No. 6	181	1400	
Moab City Well No. 7	325	700	Presently not used by Moab
Moab City Well No. 10	300	600	
TOTAL SOURCE CAPACITY		**4,775**	

* capacity reported by Blanchard (1990)

Skakel Spring. Skakel Spring discharges from the base of the Wingate Sandstone. A concrete spring box near the base of the hill receives water from the source. The spring area is fenced. Flow from the spring is approximately 450 gallons per minute (gpm). Skakel Spring is presently not used by the City of Moab as a source of drinking water. A new pump station is currently being designed to deliver this water to City Pressure Zone No. 3.

Moab City Springs Nos. 1, 2, and 3. Moab City Springs Nos. 1, 2, and 3 discharge from the Navajo Sandstone. All spring areas are fenced. Flow from Moab Spring No.1 is approximately 215 gpm, Moab Spring No. 2 discharges approximately 215 gpm, and Moab Spring No. 3 discharges approximately 415 gpm for a total of 845 gpm or 1.2 million gallons per day. Currently, Moab City Springs Nos. 1, 2, and 3 are used by Moab as a source of drinking water.

Moab City Wells Nos. 4, 5, 6, 7, and 10. Moab City Wells Nos. 4, 5, 6, 7, and 10 produce from the Navajo Sandstone. Currently, Moab City Wells Nos. 6 and 10 are the only wells used by the city for drinking water. Moab City Well No. 6 yields approximately 1,400 gpm and Moab City Well No. 10 yields approximately 600 gpm for a total of 2,000 gpm or 2.9 million gallons per day. Moab City Well No. 7 is connected to the water system, but is presently not used and yields approximately 700 gpm. Moab City Well No. 5 has been used by the city in the past with a reported yield of 180 gpm, but is now only used occasionally by Moab Golf Course for watering purposes. Moab City Well No. 4 has yielded 600 gpm in

the past, but currently contains no pump and has a sealed wellhead. The city plans to bring this well on line in the future.

10.2.2 Existing Storage Capacity

Moab has three water reservoirs (tanks) that are each capable of storing 1,000,000 gallons for a total of 3,000,000 gallons. Two reservoirs are located near the center of Moab and one is located south of Skakel Spring.

10.2.3 Disinfection

Moab has three chlorination stations. All stations presently add approximately 0.3 mg of chlorine per liter of water for disinfection. The Old City Park Station is used to disinfect the water from Moab City Springs Nos. 1 and 2. The White Ranch Station disinfects the water from Moab City Spring No.3 and Moab City Wells Nos. 6, 7 (when used), and 10. A new disinfection system is currently being designed in association with the new Skakel Spring pump station.

10.2.4 Water Demand

Because Moab is a popular tourist destination and the water system serves many businesses, it is difficult to assess water demand in terms of customer use without further study. The peak day system water demand during the summer of 2000 was 3.02 million gallons.

10.2.5 Water Supply Obligations and System Interconnections

The Spanish Valley water system has connections to the Moab transmission system (for feed to the city), but these are currently not used.

10.3 EMERGENCY RESPONSE PLAN

10.3.1 Introduction to Emergency Response Plan

According to EPA (1990), Moab must decide for itself what it will consider a threat or contingency that needs to be addressed in the contingency plan. Regardless of how Moab sets its priorities, it is useful to think of selecting the appropriate contingencies as a screening process. The Moab DWSP management committee first identifies a variety of contingencies and then screens these contingencies to assess their importance. Table 10-2 presents a format that was adapted from EPA (1990) using estimates of local conditions which may be used for evaluating potential threats by assigning estimates for both probability and severity. Those threats with a high probability are more likely to occur, while those with high severity will have more of an effect on the water system.

Whatever method or format is selected, the screening of a large set of potential contingencies should yield a smaller set of "primary" contingencies. These threats will then receive the most urgent attention in the planning process; other threats would either receive less detailed consideration or be deferred entirely to a later plan review and update process.

Once the Moab DWSP management committee has selected an initial or priority set of supply disruption contingencies, these threats must be summarized in a way that is useful in designing appropriate response actions. One of the most effective ways of capturing threats for planning purposes is to write likely water supply disruption scenarios that summarize situations in brief, narrative form. The best way to illustrate this technique is by example:

Scenario 1 - Water System Pipeline Rupture: Because of the absence of bedding material or shallow burial depths in certain areas, pipeline breaks are a possibility. Water shortages and property damage from erosion and flooding may result from this scenario. A pipe rupture and its subsequent repair may introduce contamination to the water system.

The key elements of planning scenarios can be seen by this example – a brief description of the event triggering a supply disruption, perhaps a few facts or other events that complicate matters, and a summary of the immediate water supply implications.

It is most important to develop scenarios for those disruption threats considered as priorities for planning purposes. If there are numerous priority threats, however, it may not be necessary to capture all of them in scenario form. Many emergencies will involve similar response procedures. Within the set of priority threats planners should develop a variety of scenarios that will require use of different response equipment, personnel, and procedures (for example, contamination in the wellhead area, well collapse, line break, or power loss) to allow development of different response approaches.

As more information regarding Moab's water system is developed with future DWSP Plans, the contingency plan should contain a list of potential threats. This list can be updated, as needed, to help maintain discussion of prevention and mitigation steps in a current list of priorities for preventive measures and response needs. The plan should also provide several of the disruption scenarios to help members of the response team identify appropriate responses.

TABLE 10-2

EXAMPLE OF EMERGENCY RELATIVE POTENTIAL AND SEVERITY CHART

TYPE OF EMERGENCY	RELATIVE POTENTIAL[a] 10-High - 1-Low	RELATIVE SEVERITY[a] 10-High - 1-Low	REMARKS
Natural			
Drought	10	10	
Flash Flood	8	7	Seasonal only
Ice & Snow Storm	4	2	
Wind	5	5	
Earthquake	8	10	
Forest Fire	1	1	
Man-Made			
Vandalism	5	3	
Strike	1	1	
Sabotage	5	8	
Power Outage	10	7	
Poor Operation/Maintenance	2	2	
Fire	6	4	
Explosion	6	5	
Chemical Contamination	5	5	

a) Relative potential and relative severity are subjective and not based on any quantitative or statistical calculations

10.3.2 Lines Of Authority

Table 10-3 identifies personnel responsible for coordinating activities during an emergency or disaster.

TABLE 10-3
EMERGENCY NOTIFICATION ROSTER

Positions	Name	Work Phone	Home Phone	Mobile Phone
Public Works Director (Water System Operator)	Brent Williams	(435) 259-7485	(435) 259-5844	(435) 260-1946
Water and Sewer Systems Superintendent (Alternate Water System Operator)	Lloyd Swenson	(435) 259-7485	(435) 259-6487	-
Grand County Emergency Management Committee	Doug Squire	(435) 259-8115	(435) 259-8568	(435) 260-1024
Moab Valley Fire Protection District	Corky Brewer (Fire Chief)	(435) 259-5557	911 for non-work hours	911 for non-work hours
Grand County Sheriff	Doug Squire	(435) 259-8115	(435) 259-8568	(435) 260-1024
Utah DEQ-DDW	Mark Jensen	(801) 536-4200	-	-
News Media	Ken Davy Channel 6 News	(435) 259-8444	-	-

Prior to and during an emergency, the **EMERGENCY COORDINATOR** will inventory the organization and make the following assignments:

- Appoint responsible personnel for plan development, training, and security.
- Designate disaster organization staff and teams:
  - Designate alternates;
  - Prepare alerting list with phone numbers; and
  - Define responsibilities and channels of command.
- Make contact with civil defense and military authorities:
  - To learn local plans;
  - For possible help in planning;
  - For information about funding or other support, if any available; and
  - To establish liaison channels.

10.3.3 Clarification Of The Emergency Or Disaster

The **EMERGENCY COORDINATOR** will classify the degree of the emergency or disaster based on the information listed on Table 10-4. This will prioritize response, expedite activities, and establish action levels of response.

- **LEVEL I - NORMAL (ROUTINE):** Personnel and equipment presently on duty can handle system problems. The "Emergency Control Center" not activated or manned.
- **LEVEL II - ALERT (MINOR EMERGENCY):** Personnel and equipment presently on duty can handle system problems, but may require off duty or additional personnel to be put on alert, be re-routed to other than their normal working areas, or work additional shifts. The "Emergency Control Center" may be activated and manned.
- **LEVEL III - MAJOR EMERGENCY:** Problems beyond the capabilities of the drinking water system personnel and equipment, and may require a "Declaration of Emergency" to authorize shortcut procedures. Requires employees to work additional shifts and may need additional assistance of personnel and equipment, either by mutual aid or private contracts. The "Emergency Control Center" will be activated and manned.
- **LEVEL IV - DISASTER:** Problems clearly and immediately beyond the capability of the drinking water system. Recovery time will exceed one week, costs will be great, large amounts of assistance of personnel and equipment by mutual aid or private contracts will be required, extended shifts will be needed for at least one week. A "Declaration of Emergency" will be required, the "Emergency Control Center" will be activated and manned.

TABLE 10-4
EXAMPLE OF EMERGENCY NOTIFICATION REPORT

This notification report represents a typical form that might be adapted for use in the Moab water supply contingency plan and completed and used by water supply system personnel.

PART I – WATER SYSTEM	***EMERGENCY NOTIFICATION REPORT***
Date, Time	
Person reporting emergency	
Telephone number or radio frequency	
Location of emergency	
Other descriptive information (approximate location)	
Nature of emergency (e.g., broken water main, chemical spill, low pressure, other)	
Condition at the scene	
Actual or potential damage – describe the problem	

Who is already on the scene?	
Water system personnel completing this report (name and department)	

PART II - EMERGENCY	***INVESTIGATION***
Personnel investigating emergency	
Reported results of investigation	
Date and Time assessed	

PART III - EMERGENCY	***ACTION TAKEN***
What steps were taken to respond to the problem?	
Were water system personnel contacted?	
Was an emergency crew dispatched? **If so, what time were they called and what time did they arrive?**	
Does problem require public notice? **If so, who was contacted? (Division of Drinking Water, Police, Fire, Health Department, Radio Station, Newspaper)**	
Notes	

Prior to and during an emergency, the **EMERGENCY COORDINATOR** will inventory the organization and make the following assignments:

1. Appoint responsible personnel for plan development, training, and security;

2. Designate disaster organization staff and teams;

   - Designate alternates;
   - Prepare alerting list with phone numbers;
   - Define responsibilities and channels of command;

3. Make contact with civil defense and military authorities;

   - To learn local plans;
   - For possible help in planning;
   - For information about funding or other support, if any is available; and
   - To establish liaison channels.

10.3.4 Preliminary Damage Assessment

The **ASSESSMENT COORDINATOR** will oversee or conduct the system assessment immediately after the emergency or disaster occurs. The assessment will address the following items:

1. Identify and assess damage to separate components of entire system

   - Sources
   - Pump stations and supply lines
   - Transmission lines (sources to tanks and tanks to distribution system)
   - Storage tanks
   - Distribution system
   - Personnel
   - Power supply
   - Materials and supplies
   - Communications
   - Present emergency plans
   - Mutual-aid agreements and/or interconnections

2. Develop characteristics of disaster

   - Flood or mud slides
   - Earthquake
   - Windstorm
   - Explosion
   - Evaluate effects of disaster on each component of the system

3. Assess the degree of impact to each system component from disaster to each system component.

4. Estimate water requirements

   - Fire fighting
   - Potable water
   - Decontamination and sanitary

5. Estimate capability of system to meet requirements. This point is the "balance point"; if capability exceeds requirements, there is an estimated margin of safety and it could be expected that priorities could be relaxed. If requirements exceed capabilities, there is indicated urgency for improving or "upgrading" the system.

6. Identify critical system components. These components form the basis for immediate restudy for improving capability.

10.3.5 Prioritize Requirements And Specify Program

The **EMERGENCY COORDINATOR**, in association with the **ASSESSMENT COORDINATOR**, will evaluate data gathered during the damage assessment task and prioritize the following system components for repair and replacement:

1. Establish baselines on water-quality levels.

2. Determine needs and priorities.

3. Allocate water under assumed conditions for potable, sanitary decontamination.

4. Prepare guidelines for water allowances, priorities, rationing, and time-phasing of estimated water requirements.

5. Establish procedures for emergency treatment, pumping, and distribution of water, and for stations for service of emergency water.

10.3.6 Implementation

The **EMERGENCY COORDINATOR** will implement the necessary plan and notify the users of the system through the **PUBLIC RELATIONS COORDINATOR**. Information will be released to the public through news releases (see Table 10-5) in accordance with the following guidelines:

- Only the **EMERGENCY COORDINATOR** or designated representative will speak with the media or press.
- The **EMERGENCY COORDINATOR** will set up public meetings to routinely inform the users of the status of system improvements, progress and details.

TABLE 10-5

EXAMPLE NEWS RELEASE

SAMPLE INITIAL NEWS RELEASE
(For distribution to previously identified television, radio, and newspaper personnel.)

The following information regarding (1) protecting the Moab city water supply, (2) substance has been detected in the Moab city water supply, or (3) water shortage problem:

It is vital that all residents in the Moab city water supply service area observe the following water use restrictions until further notice:

The characteristics and potential public health hazards associated with this contaminant are as follows:

Water system personnel are taking the following steps to address the problem:

For further information please contact _____ at this phone number: _____.

A press conference is scheduled for _____ to be held at _____.

News updates will be provided as additional information becomes available.

Attached please find a copy of an information sheet which provides details concerning the physical plans, organization structure, and function of the Moab city water supply.

Time:

Date:

Signed:

10.4 RATIONING PLAN

The following Rationing Plan has been developed to establish guidelines for implementing a water rationing plan during times of shortages. This plan is broad and encompassing, highlighting the different factors which need to be considered before implementing and enforcing a water rationing plan.

10.4.1 Lines Of Authority

Table 10-3 identifies personnel responsible for assessing supply and demand requirements and implementing a water conservation program.

10.4.2 Determination Of Action Level

Based on the following factors, an "action level" will be determined to initiate the appropriate level of rationing. These environmental factors include:

- forecast duration of shortage (short-term vs. long-term)
- reason for shortage (drought, mechanical malfunction, loss of storage capacity)
- time of the year which the shortage is forecast (summer vs. winter)

Water system factors which need to be evaluated include:

- current supply
- current storage capacity
- current number of connections to the system
- current demand projections
- current system user conservation practices

Water resources available to alleviate short term shortages that will be investigated include:

- emergency water supply
- emergency generators for power
- replacement mechanical equipment (spare parts)
- spare pumps and motors in storage for rapid installation within a 48-hour period

10.4.3 Public Education

The users of the water system will be notified immediately of the current or potential water shortage problem and any rationing or conservation measures to be implemented, through the local newspapers and local radio stations using a press release (see Table 10-6).

TABLE 10-6

EXAMPLE NEWS RELEASE FOR WATER RATIONING

SAMPLE INITIAL NEWS RELEASE
(For distribution to previously identified television, radio, and newspaper personnel.)

The following information regarding water shortage problem associated with the Moab city water supply:

It is vital that all residents in the Moab city water supply service area observe the following water use restrictions until further notice:

The characteristics and potential public health hazards associated with this contaminant are as follows:

Water system personnel are taking the following steps to address the problem:

For further information please contact _____ at this phone number: _____.

A press conference is scheduled for _____ to be held at _____.

News updates will be provided as additional information becomes available.

Attached please find a copy of an information sheet which provides details concerning the physical plans, organization structure, and function of the Moab city water supply.

Time:

Date:

Signed:

10.5 WATER SUPPLY DECONTAMINATION PLAN

The DWSP Plan for Moab identified a few potential contamination sources within the protection zones of each source. If one of these sources become contaminated, any developed water would be delivered to the distribution system. Thus, it may be necessary to isolate the contaminated source(s) from the system until remediation or treatment is completed. Water supply decontamination plans have not been developed for other sources due to the low potential of degradation by outside sources. The need for revised plans will be evaluated during future submittals and revisions of the DWSP Plan for the other groundwater resources developed by Moab.

10.6 SOURCE DEVELOPMENT PLAN

New sources of water may be developed in the future to accommodate increasing demand.

10.6.1 Regulatory and Logistical Constraints

- Acquisition of ownership and water rights for each potential new source will be required before embarking on any new well drilling program.
- The approximate protection zones around each potential new source will be required.
- An inventory of potential contamination sources within each approximate protection zone which may affect the quality of the drinking water now or in the future will need to be completed.
- The microbiological, chemical, and radiological quality of each potential drinking water source will need to be completed prior to using the new source as a community drinking water supply.
- The financial resources (and possible sources of revenue) that may be required for each drinking water source development project will need to be identified.
- A Preliminary Evaluation Report will need to be submitted to the DDW concurrently with engineering plans and specifications before construction begins on any new groundwater source of drinking water.

11.0 WAIVERS

Use waivers may be granted for either the volatile organic compounds (VOC) or the pesticide parameter group. To qualify for a use waiver, a system must verify that none of the chemicals or pesticides in the parameter groups have been used in the (Zone Three) three-year time-of-travel zone. If a system does not qualify for a use waiver, it may still qualify for a susceptibility waiver. A susceptibility wavier allows the use, disposal, storage, transport, and manufacture of chemicals within Zone Three as long as they are controlled in such a manner as to prevent contamination of the system's wells or springs. The DWSP Plan must verify that land management strategies are implemented which will control the chemicals that are being used in Zone Three. It is Moab's intent to maintain their existing waivers under the same status as listed in the DDW's Public Water Supply information system database. Appendix C provides a letter from the Mayor of Moab.

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GLOSSARY

The purpose of this Glossary is to provide a list of terms used in this document and commonly used by hydrogeologists, as well as some specific terms used in groundwater contamination assessments and Drinking Water Source Protections. These definitions are adapted from Gill and Lund (1984), EPA (1991) and the Drinking Water Source Protection Rule (UAC R309-113).

Adit: Horizontal or nearly horizontal passage from the surface from which a mine is entered.

Alluvium: A general term for clay, silt, sand, gravel or similar unconsolidated material deposited during comparatively recent geologic time by a stream or other body of running water.

Analytical model: A model that provides approximate or exact solutions to simplified mathematical forms of the differential equations for water movement and solute transport. Analytical models can generally be solved using calculators or computers.

Anisotropy: The condition of having different properties in different directions. The condition under which one or more of the hydraulic properties of an aquifer vary according to the direction of flow.

Anticline: A fold in rock strata that is convex upward.

Aquifer test: A test to determine hydrologic properties of an aquifer, involving the withdrawal of measured quantities of water from, or addition of water to, a well and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition. Same as pump test.

Aquifer/Aquifer System: A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield sufficient, economical quantities of water to wells, springs, and drain tunnels.

Aquitard: The less-permeable beds in a stratigraphic sequence that tend to restrict or impede groundwater flow relative to the more permeable beds that serve as aquifers.

Area of influence: Area surrounding a pumping or recharging well within which the water table or potentiometric surface has been changed due to the well's pumping or recharge.

Artesian Conditions: In a confined aquifer, when the water level in a well rises above the top of the aquifer.

Attenuation: The process of diminishing contaminant concentrations in groundwater, due to filtration, biodegradation, dilution, sorption, volatilization, and other processes.

Collection area: The area surrounding a groundwater source which is underlain by collection pipes, tile, tunnels, infiltration boxes, or other groundwater collection devices.

Colluvium: Loose, heterogeneous, incoherent mass of soil material and/or rock fragments deposited chiefly by mass-wasting.

Cone of depression (COD): A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. Its trace (perimeter) on the land surface defines the zone of influence of a well. Also called pumping cone and cone of drawdown.

Confined aquifer: The following criteria are met in order to verify and maintain an upward hydraulic gradient in the producing aquifer: an effective confining layer must exist between the ground surface and the producing aquifer. This confining layer must have a lower hydraulic conductivity than the producing

aquifer; and the potentiometric surface of the producing aquifer must remain higher in elevation than the potentiometric surface of the overlying aquifer. If there is no overlying aquifer, then the potentiometric surface of the producing aquifer must remain higher in elevation than the upper surface of the overlying confining layer. These criteria must be maintained during periods of maximum and long-term pumping and seasonal groundwater fluctuations. Not all confined aquifers in nature have an upward hydraulic gradient; however, for the purposes of R309-113, an upward hydraulic gradient must be maintained.

Contact: The surface where two different kinds of rock come together.

Contaminant: An undesirable substance not normally present, or an unusually high concentration of a naturally occurring substance, in water, soil, or other environmental medium.

Contamination: The degradation of natural water quality as a result of man's activities.

Controls: The codes, ordinances, rules, and regulations currently in effect to regulate a potential contamination source.

Criteria: The conceptual standards that form the basis for DWSP area delineation to include distance, groundwater time of travel, aquifer boundaries, and groundwater divides.

Criteria threshold: A value or set of values selected to represent the limits above or below which a given criterion will cease to provide the desired degree of protection.

DDW: Division of Drinking Water.

Designated person: The person appointed by a PWS to ensure that the requirements of R309-113 are met.

Dike: Tabular igneous intrusion that cuts across planar bedding or foliation of the surrounding rock.

Dispersion: The spreading and mixing of chemical constituents in groundwater caused by diffusion and mixing due to microscopic variations in velocities within and between pores.

Drawdown: The vertical distance groundwater elevation is lowered, or the amount head is reduced, due to the removal of groundwater. Also the decline in potentiometric surface caused by the withdrawal of water from a hydrogeologic unit. The distance between the static water level and the surface of the cone of depression. A lowering of the water table of an unconfined aquifer or the potentiometric surface of a confined aquifer caused by pumping of groundwater from wells.

DWSP Program: The program to protect drinking water source protection zones and management areas from contaminants that may have an adverse effect on the health of persons.

DWSP Zone: The surface and subsurface area surrounding a groundwater source of drinking water supplying a PWS, through which contaminants are reasonably likely to move toward and reach such groundwater source.

Executive Secretary: The individual authorized by the Drinking Water Board to conduct business on its behalf.

Existing groundwater source of drinking water: A public supply groundwater source for which plans and specifications are submitted to DDW on or before the effective date of the DWSP Rule.

Fissure: A fracture or crack in a rock along which there is a distinct separation.

Flow line: The general path that a particle of water follows under laminar flow conditions. Line indicating the direction followed by groundwater toward points of discharge. Flow lines generally are considered perpendicular to equipotential lines.

Flow model: A computer model that calculates a hydraulic head field for the study area using numerical methods to arrive at an approximate solution to the differential equation of groundwater flow.

Flow path: The path a water molecule or solute follows in the subsurface.

Flow System/Hydraulic Boundary: A hydrologic feature that prevents the flow of groundwater. Examples include groundwater divides or low permeability material that impedes groundwater flow.

Flowing Artesian: When the water level in a well rises above and flows at the ground surface.

Footwall: The lower side of a horizontal or inclined rock body or fault. If the fault has dip-slip translational movement along a normal fault, the footwall block is up thrown; the footwall block is downthrown along a reverse fault.

Fracture: A general term for any break in a rock, which includes cracks, joints, and faults.

Groundwater barrier: Rock or artificial material with a relatively low permeability that occurs (or is placed) below ground surface, where it impedes the movement of groundwater and thus may cause a pronounced difference in the heads on opposite sides of the barrier.

Groundwater basin: General term used to define a groundwater flow system that has defined boundaries and may include more than one aquifer. The basin includes both the surface area and the permeable materials beneath it. A rather vague designation pertaining to a groundwater reservoir that is more or less separate from neighboring groundwater reservoirs. A groundwater basin could be separated from adjacent basins by geologic boundaries or by hydrologic boundaries.

Groundwater divide: Ridge in the water table, or potentiometric surface, from which groundwater moves away at right angles in both directions. Line of highest hydraulic head in the water table or potentiometric surface.

Groundwater mound: Raised area in a water table or other potentiometric surface, aerated by groundwater recharge.

Groundwater source: Any well, spring, tunnel, adit, or other underground opening from or through which groundwater flows or is pumped from subsurface water bearing formations.

Hanging wall: The upper side of a horizontal or inclined rock body or fault . The hanging wall is downthrown along a normal fault with dip-slip movement; the hanging wall is up thrown along a reverse-slip fault.

Head, total: Height of the column of water at a given point in a groundwater system above a datum plane such as mean sea level. The sum of the elevation head (distance of a point above datum), the pressure head (the height of a column of liquid that can be supported by static pressure at the point), and the velocity head (the height to which the liquid can be raised by its kinetic energy).

Heterogeneity: Characteristic of a medium in which material properties vary from point to point.

Homogeneity: Characteristic of a medium in which material properties are identical throughout.

Hydraulic Conductivity (K): A coefficient of proportionality describing the rate at which water can move through a permeable medium. It is a function of the porous medium and the fluid.

Hydraulic Gradient (i): Slope of a water table or potentiometric surface. More specifically, change in head per unit of distance in a given direction, generally the direction of the maximum rate of decrease in head. The difference in hydraulic head divided by the distance along the flow path.

Hydrogeologic methods: The techniques used to translate selected criteria and criteria thresholds into mappable delineation boundaries. These methods include, but are not limited to, arbitrary fixed radii, analytical calculations and models, hydrogeologic mapping, and numerical flow models.

Hydrogeologic unit: Any soil or rock unit or zone that because of its hydraulic properties has a distinct influence on the storage or movement of groundwater.

Impermeable: Characteristic of geologic materials that limit their ability to transmit significant quantities of water under the head differences normally found in the subsurface environment.

Interference: The result of two or more pumping wells, the drawdown cones of which intercept. At a given location, the total well interference is the sum of the drawdowns due to each individual well. The condition occurring when the area of influence of a water well comes into contact with or overlaps that of a neighboring well, as when two wells are pumping from the same aquifer or are located near each other.

Isotropy: The condition in which the properties of interest (generally hydraulic properties of the aquifer) are the same in all directions.

Land management strategies: Zoning and non-zoning controls which include, but are not limited to, the following: zoning and subdivision ordinances, site plan reviews, design and operating standards, source prohibitions, purchase of property and development rights, public education programs, groundwater monitoring, household hazardous waste collection programs, water conservation programs, memoranda of understanding, written contracts and agreements, and so forth.

Leakage: The vertical flow of groundwater; commonly used in the context of vertical groundwater flow through confining strata.

Limestone: A bedded sedimentary deposit consisting chiefly of calcium carbonate.

Management area: The area outside of zone one and within a two-mile radius where the Optional Two-mile Radius Delineation Procedure has been used to identify a protection area.

Maximum contaminant level (MCL). Maximum permissible level of a contaminant in water that is delivered to the users of a public water system. Maximum containment level is defined more explicitly in Safe Drinking Water Act (SDWA) regulations (40 CFR Section 141.2).

Moraine: Mound, ridge, or other distinct accumulation of unsorted, unstratified glacial material deposited chiefly by direct action of glacier ice.

New groundwater source of drinking water: A public supply groundwater source of drinking water for which plans and specifications are submitted to DDW after the effective date of the DWSP Rule.

Nonpoint source: Any conveyance not meeting the definition of point source.

Normal fault: A fault, with an angle usually between 45-90 degrees, at which the hanging wall (upper block) has moved downward relative to the footwall (lower block) .

Observation well: A well drilled in a selected location for the purpose of observing parameters such as water levels or water chemistry changes.

Permeability: Capacity of a rock or soil material to transmit a fluid.

Piezometric surface: See potentiometric surface.

Point source: Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, animal feeding operation with more than ten animal units, landfill, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

Pollution source: Point source discharges of contaminants to ground water or potential discharges of the liquid forms of "extremely hazardous substances" which are stored in containers in excess of "applicable threshold planning quantities" as specified in SARA Title III. Examples of possible pollution sources include, but are not limited to, the following: storage facilities that store the liquid forms of extremely hazardous substances, septic tanks, drain fields, class V underground injection wells, landfills, open dumps, landfilling of sludge and seepage, manure piles, salt piles, pit privies, drain lines, sewer lines, and animal feeding operations with more than ten animal units.

Porosity: The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment.

Potable water: Suitable for human consumption as drinking water.

Potential contamination source: Any facility or site which employs an activity or procedure which may potentially contaminate ground water. A pollution source is also a potential contamination source.

Potentiometric Surface: A surface that represents the level to which water will rise in tightly cased wells. If the head varies significantly with depth in the aquifer, then there may be more than one potentiometric surface. The water table is a particular potentiometric surface for an unconfined aquifer.

Pump Test: A test to determine hydrologic properties of an aquifer, involving the withdrawal of measured quantities of water from, or additional of water to, a well and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition.

PWS: Public water system.

Radial flow: The flow of water in an aquifer toward a well.

Recharge area: Area in which water reaches the groundwater reservoir by surface infiltration. An area in which there is a downward component of hydraulic head in the aquifer.

Residual soil: Unconsolidated or partly weathered material, presumed to have developed in place (by weathering) from the consolidated rock on which it lies.

Reverse fault: Fault with a dip greater than 45 degrees at which the hanging wall (upper block) appears to have moved upward relative to the footwall (lower block).

Sandstone: A cemented or otherwise compacted detrital sediment composed predominantly of quartz sand grains.

Shale: A laminated sediment in which the constituent particles are composed of clay. Same as mudstone, except mudstone may be composed of a percentage of silt and may or may not be laminated.

Stagnation point: A place in a groundwater flow field at which the groundwater is not moving.

Thrust fault: Fault with a dip of 45 degrees or less in which the hanging wall (upper block) appears to have moved upward relative to the footwall (lower block) .

Time of travel (TOT): The time required for a particle of water to move in the saturated zone from a specific point to a groundwater source of drinking water.

Unconfined Aquifer: Any aquifer that does not meet the definition of a confined aquifer. An aquifer over which there is no confining strata and the water table forms the upper boundary.

Well field: An area containing two or more wells supplying a public water supply system.

Wellhead protection area (WHPA): The surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field.

Wellhead: The physical structure, facility, or device at the land surface from or through which groundwater flows or is pumped from subsurface, water-bearing formations.

Zone of Contribution (ZOC): The area surrounding a pumping well, spring, or tunnel that encompasses all areas and features that supply groundwater recharge to the well spring, or tunnel.

APPENDIX A

MASTER LIST OF PCSs

Possible Potential Contamination Sources

(List Adapted from the State of Utah DEQ, DDW *Source Protection User's Guide)*

1. Active and abandoned wells	2. Agricultural pesticide, herbicide, and fertilizer storage, use, filling, and mixing areas
3. Airport maintenance and fueling sites	4. Animal feeding operations with more than ten animal units
5. Animal watering troughs located near unfenced wells and springs that attract livestock	6. Auto washes
7. Beauty salons	8. Boat builders and refinishers
9. Chemical reclamation facilities	10. Chemigation wells
11. Concrete, asphalt, tar, and coal companies	12. Dry cleaners
13. Farm dump sites	14. Farm maintenance garages
15. Feed lots	16. . Food processors, meat packers, and slaughter houses
17. Fuel and oil distributors and storers	18. Furniture strippers, painters, finishers, and appliance repairers
19. Grave yards, golf courses, parks, and nurseries	20. Heating oil storers
21. . Industrial manufacturers: chemicals, pesticides, herbicides, paper and leather products, textiles, rubber, plastic, fiberglass, silicone, glass, pharmaceutical, and electrical equipment, etc.	22. Industrial waste disposal/impoundment areas and municipal wastewater treatment plants, landfills, dumps, and transfer stations
23. Junk and salvage yards	24. Laundromats
25. Machine shops, metal platers, heat treaters, smelters, annealers, and descalers	26. Manure piles
27. Medical, dental, and veterinarian offices	28. Mortuaries
29. Mining operations	30. Muffler shops
31. Pesticide and herbicide storers and retailers	32. Photo processors
33. Print shops	34. Radiological mining operations
35. Railroad yards	36. Research laboratories
37. Residential pesticide, herbicide, and fertilizer storage, use, filling and mixing areas	38. Residential underground storage tanks
39. Salt and sand-salt piles	40. Sand and gravel mining operations
41. School vehicle maintenance barns	42. Sewer lines
43. Single-family septic tank/drain-field systems	44. Sites of reported spills
45. Small engine repair shops	46. Stormwater impoundment sites and snow dumps
47. Subdivisions using subsurface disposal systems (large and individual septic tank/drain-field systems)	48. Submersible pumps used to pump wells
49. Taxi cab maintenance garages	50. Tire shops
51. Toxic chemical and oil pipelines	52. Vehicle chemical supply storers and retailers
53. Vehicle dealerships	54. Vehicle quick lubes
55. Vehicle rental shops	56. Vehicle repair, body shops, and rust proofers
57. Vehicle service stations and terminals	58. Wood preservers

APPENDIX B

EXAMPLE OF DRINKING WATER SOURCE PROTECTION ORDINANCE

The following is an example of a source protection ordinance. Wellhead Protection Technology Transfer Centerpiece Workshop (EPA/600/K-92/015) was used as a reference. It has been changed to reflect recommendations in the Drinking Water Source Protection Rule, R309-113 of the Utah Administrative Code.

BE IT ORDAINED by the Mayor and Council of the City of _____ in Council duly assembled and it is hereby ordained by the authority of same that the following ordinance known as the Drinking Water Source Protection Ordinance is adopted and made a part of the Code of Ordinance of the City of _____, to wit:

Section 1. Short title and purpose.

(a) This ordinance shall be known as the "Drinking Water Source Protection Ordinance."

(b) The purpose of this ordinance is to insure the provision of a safe and sanitary drinking water supply for the City by the establishment of drinking water source protection zones surrounding the wellheads for all wells which are the supply sources for the City water system and by the designation and regulation of property uses and conditions which may be maintained within such zones.

Section 2. Definitions. When used in this ordinance the following words and phrases shall have the meanings given in this Section:

(a) Design standard - means a control which is implemented by a potential contamination source to prevent discharges to the ground water. Spill protection is an example of a design standard.

(b) Land management strategies - means zoning and non-zoning controls which include, but are not limited to, the following: zoning and subdivision ordinances, site plan reviews, design and operating standards, source prohibitions, purchase of property and development rights, public education programs, ground-water monitoring, household hazardous waste collection programs, water conservation programs, memoranda of understanding, written contracts and agreements, and so forth.

(c) Pollution source - means point source discharges of contaminants to ground water or potential discharges of the liquid forms of "extremely hazardous substances" which are stored in containers in excess of "applicable threshold planning quantities" as specified in SARA Title III. Examples of possible pollution sources include, but are not limited to, the following: storage facilities that store the liquid forms of extremely hazardous substances, septic tanks, drain fields, class V underground injection wells, landfills, open dumps, landfilling of sludge and septage, manure piles, salt piles, pit

privies, and animal feeding operations with more than ten animal units. The following clarify the definition of pollution source:

(1) Animal feeding operation - means a lot or facility where the following conditions are met: animals have been or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period, and crops, vegetation forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility. Two or more animal feeding operations under common ownership are considered to be a single feeding operation if they adjoin each other, if they use a common area, or if they use a common system for the disposal of wastes.

(2) Animal unit - means a unit of measurement for any animal feeding operation calculated by adding the following numbers; the number of slaughter and feeder cattle multiplied by 1.0, plus the number of mature dairy cattle multiplied by 1.4, plus the number of swine weighing over 55 pounds multiplied by 0.4, plus the number of sheep multiplied by 0.1, plus the number of horses multiplied by 2.0.

(3) Extremely hazardous substances - means those substances which are identified in the Sec. 302(EHS) column of the "TITLE III LIST OF LISTS - Consolidated List of Chemicals Subject to Reporting Under SARA Title III," (EPA 560/4-91-011).

(d) Potential contamination source - means any facility or site which employs an activity or procedure which may potentially contaminate ground water. A pollution source is also a potential contamination source.

(e) Regulatory agency - means any governmental agency with jurisdiction over hazardous waste as defined herein.

(f) Sanitary landfill - means a disposal site where solid wastes, including putrescible wastes, or hazardous wastes, are disposed of on land by placing earth cover thereon.

(g) Septic tank/drain-field systems - means a system which is comprised of a septic tank and a drain-field which accepts domestic wastewater from buildings or facilities for subsurface treatment and disposal. By their design, septic tank/drain-field system discharges cannot be controlled with design standards.

(h) Wellhead - means the upper terminal of a well, including adapters, ports, seals, valves and other attachments.

Section 3. Establishment of drinking water source protection zones. There is hereby established use districts to be known as zones one, two, three, and four of the drinking water source protection area, identified and described as follows:

(a) **Zone one** is the area within a 100-foot radius from the wellhead.

(b) **Zone two** is the area within a 250-day ground-water time of travel to the wellhead, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

(c) **Zone three** (waiver criteria zone) is the area within a 3-year ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

(d) **Zone four** is the area within a 15-year ground-water time of travel to the wellhead, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Section 4. Permitted uses. The following uses shall be permitted within drinking water source protection zones:

(a) Any use permitted within existing agricultural, single family residential, multi-family residential, and commercial districts so long as uses conform to the rules and regulations of the regulatory agencies.

(b) Any other open land use where any building located on the property is incidental and accessory to the primary open land use.

Section 5. Prohibited uses. The following uses or conditions shall be and are hereby prohibited within drinking water sources protection zones, whether or not such use or condition may otherwise be ordinarily included as a part of a use permitted under Section 4 of the ordinance.

(a) **Zone one** - The location of any pollution source as defined herein.

(b) **Zone two** - The location of a pollution source unless its contaminated discharges can be controlled with design standards.

(c) **Zones three and four** - The location of a potential contamination source unless it can be controlled through land management strategies.

Section 6. Administration. The policies and procedures for administration of any source protection zone established under this ordinance, including without limitation those applicable to nonconforming uses, exception, enforcement and penalties, shall be the same as provided in the existing zoning ordinance for the City of _____, as the same is presently enacted or may from time to time be amended.

This Ordinance shall be effective as of _____ (date). All ordinances and parts or ordinances in conflict herewith shall not be and the same are hereby repealed.

ENACTED AND ADOPTED this _____ day of _____, 19__.

_____
Mayor

Attest: _____
City Clerk

APPENDIX B

EXAMPLE OF DRINKING WATER SOURCE PROTECTION ORDINANCE

The following is an example of a source protection ordinance. Wellhead Protection Technology Transfer Centerpiece Workshop (EPA/600/K-92/015) was used as a reference. It has been changed to reflect recommendations in the Drinking Water Source Protection Rule, R309-113 of the Utah Administrative Code.

BE IT ORDAINED by the Mayor and Council of the City of _____ in Council duly assembled and it is hereby ordained by the authority of same that the following ordinance known as the Drinking Water Source Protection Ordinance is adopted and made a part of the Code of Ordinance of the City of _____, to wit:

Section 1. Short title and purpose.

(a) This ordinance shall be known as the "Drinking Water Source Protection Ordinance."

(b) The purpose of this ordinance is to insure the provision of a safe and sanitary drinking water supply for the City by the establishment of drinking water source protection zones surrounding the wellheads for all wells which are the supply sources for the City water system and by the designation and regulation of property uses and conditions which may be maintained within such zones.

Section 2. Definitions. When used in this ordinance the following words and phrases shall have the meanings given in this Section:

(a) Design standard - means a control which is implemented by a potential contamination source to prevent discharges to the ground water. Spill protection is an example of a design standard.

(b) Land management strategies - means zoning and non-zoning controls which include, but are not limited to, the following: zoning and subdivision ordinances, site plan reviews, design and operating standards, source prohibitions, purchase of property and development rights, public education programs, ground-water monitoring, household hazardous waste collection programs, water conservation programs, memoranda of understanding, written contracts and agreements, and so forth.

(c) Pollution source - means point source discharges of contaminants to ground water or potential discharges of the liquid forms of "extremely hazardous substances" which are stored in containers in excess of "applicable threshold planning quantities" as specified in SARA Title III. Examples of possible pollution sources include, but are not limited to, the following: storage facilities that store the liquid forms of extremely hazardous substances, septic tanks, drain fields, class V underground injection wells, landfills, open dumps, landfilling of sludge and septage, manure piles, salt piles, pit

privies, and animal feeding operations with more than ten animal units. The following clarify the definition of pollution source:

(1) Animal feeding operation - means a lot or facility where the following conditions are met: animals have been or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period, and crops, vegetation forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility. Two or more animal feeding operations under common ownership are considered to be a single feeding operation if they adjoin each other, if they use a common area, or if they use a common system for the disposal of wastes.

(2) Animal unit - means a unit of measurement for any animal feeding operation calculated by adding the following numbers; the number of slaughter and feeder cattle multiplied by 1.0, plus the number of mature dairy cattle multiplied by 1.4, plus the number of swine weighing over 55 pounds multiplied by 0.4, plus the number of sheep multiplied by 0.1, plus the number of horses multiplied by 2.0.

(3) Extremely hazardous substances - means those substances which are identified in the Sec. 302(EHS) column of the "TITLE III LIST OF LISTS - Consolidated List of Chemicals Subject to Reporting Under SARA Title III," (EPA 560/4-91-011).

(d) Potential contamination source - means any facility or site which employs an activity or procedure which may potentially contaminate ground water. A pollution source is also a potential contamination source.

(e) Regulatory agency - means any governmental agency with jurisdiction over hazardous waste as defined herein.

(f) Sanitary landfill - means a disposal site where solid wastes, including putrescible wastes, or hazardous wastes, are disposed of on land by placing earth cover thereon.

(g) Septic tank/drain-field systems - means a system which is comprised of a septic tank and a drain-field which accepts domestic wastewater from buildings or facilities for subsurface treatment and disposal. By their design, septic tank/drain-field system discharges cannot be controlled with design standards.

(h) Wellhead - means the upper terminal of a well, including adapters, ports, seals, valves and other attachments.

Section 3. Establishment of drinking water source protection zones. There is hereby established use districts to be known as zones one, two, three, and four of the drinking water source protection area, identified and described as follows:

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(b) **Zone two** is the area within a 250-day ground-water time of travel to the wellhead, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

(c) **Zone three** (waiver criteria zone) is the area within a 3-year ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

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(b) Any other open land use where any building located on the property is incidental and accessory to the primary open land use.

Section 5. Prohibited uses. The following uses or conditions shall be and are hereby prohibited within drinking water sources protection zones, whether or not such use or condition may otherwise be ordinarily included as a part of a use permitted under Section 4 of the ordinance.

(a) **Zone one** - The location of any pollution source as defined herein.

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(c) **Zones three and four** - The location of a potential contamination source unless it can be controlled through land management strategies.

Section 6. Administration. The policies and procedures for administration of any source protection zone established under this ordinance, including without limitation those applicable to nonconforming uses, exception, enforcement and penalties, shall be the same as provided in the existing zoning ordinance for the City of _____, as the same is presently enacted or may from time to time be amended.

This Ordinance shall be effective as of _____(date). All ordinances and parts or ordinances in conflict herewith shall not be and the same are hereby repealed.

ENACTED AND ADOPTED this _____ day of _____, 19__.

_____
Mayor

Attest: _____
City Clerk

APPENDIX C

WAIVER REQUEST

CITY OF MOAB
115 WEST 200 SOUTH
MOAB, UTAH 84532-2534
MAIN NUMBER (435) 259-5121
FAX NUMBER (435) 259-4135

January 23, 2001

State of Utah
Department of Environmental Quality
Division of Drinking Water
150 North 1950 West
Salt Lake City, Utah 84114-4830

ATTN: Mark Jensen, Hydrogeologist

RE: Monitoring Waivers for Drinking Water Source Protection Plans (DWSP) - City of Moab, Public Water System No. 10003

Dear Mr. Jensen:

The purpose of this letter is to respectfully request that Use and Susceptibly Waivers be granted for the following sources:

Moab City Spring No. 1
Moab City Spring No. 2
Moab City Spring No. 3
Skakel Spring
Moab City Well No. 4
Moab City Well No. 5
Moab City Well No. 6
Moab City Well No. 7
Moab City Well No. 10

Use Waivers

The chemicals within the VOC and/or pesticide parameter group(s) have not been used within the past five years within zones one, two, and three, for the referenced sources. No chemicals are used, disposed, stored, transported, and manufactured within zones one, two, and three. Likewise, none of the VOCs and pesticides within these respective parameter groups have been used, disposed, stored, transported, or manufactured within the past five years within zones one, two, and three.

Susceptibility Waivers

If these sources do not qualify for use waivers as determined by the DDW, then please consider this letter as a request for consideration for susceptibility waivers. Moab is confident that a susceptibility waiver for the VOC and/or pesticide parameter group(s) will not threaten public health. While all sources develop groundwater stored in an unprotected aquifer, Moab is committed to a public education program which addresses proper use and disposal practices for pesticides and VOCs which is described in the management section of the DWSP Plan. Likewise, Moab is pursuing a Sole Source Aquifer (SSA) Designation Petition for the Mesozoic aquifers in the Moab area hosting the above mentioned sources.

If you have questions regarding this request, please contact me directly.

Sincerely,

Karla R. Hancock

Karla Hancock
Mayor