REFINING THE GROUND-WATER MANAGEMENT PLAN FOR TOOELE VALLEY

April 17, 2000

The intent of this document is to set forth facts which have been gathered by the State Engineer in his studies of the ground-water resources of Tooele Valley.

For the purposes of this document, Tooele Valley is defined as that area in northeast Tooele County, Utah, which is bounded on the north by the Great Salt Lake, on the east by the Oquirrh Mountains, on the south by South Mountain, and on the west by the Stansbury Range. See figure 1 for a general map of the study area.

INTRODUCTION

Recently, Tooele Valley has experienced a rapid increase in population. This increase has been accompanied by a commensurate increase in the demands being placed upon the valley's water resources, including ground water. Water rights, which have previously been used largely for agriculture and mining, are being transferred to municipal, domestic, commercial, and industrial uses. To ensure that the available water supply is not overtaxed, the State Engineer instituted a ground-water management plan on February 27, 1996, which placed a moratorium on the granting of new water rights in all but the shallow unconfined aquifer until a more detailed investigation of the valley's hydrology could be completed.

In 1997, Water-Resources Investigations Report (WRI) 97-4005 was released, which mapped the valley's recharge and discharge areas along with water quality. In 1999, WRI 99-4014 was released, outlining the hydrology of the ground-water flow system and presenting a digital model simulating the system. The digital model was developed by the United States Geological Survey (USGS) using their MODFLOW ground-water modeling package.

With the release of these reports, the State Engineer has begun an analysis of the data therein and the water rights on file, with the objective of revising the current management plan to give water users more definitive guidance in the development of water. Among the issues the State Engineer will be addressing are:

1) the safe yield of the aquifer system,
2) the areal distribution of ground-water withdrawals,
3) the amount of "paper" water rights in relation to the amount of "wet" water available

for use and the amount of water actually being diverted, and
4) the impact of additional diversions on springs and flowing wells.

WATER RIGHTS STRUCTURE

The State Engineer has estimated the potential diversions for Tooele Valley based on the water rights on file in his office. In making these estimates, the following assumptions were used. The irrigation diversion rate was set at 4.0 acre-feet per acre per year (af/ac) as per the *Proposed Determinations of Water Rights*, issued for the Tooele Valley area in the general adjudication of pending in the Tooele County district court. Domestic uses were assumed to divert 0.45 acre-feet per year (afy). Stock watering was assumed to divert 0.028 afy per standard animal unit (i.e., a cow). Municipal use was assumed to divert 362 afy for each cubic foot per second (cfs) of water right. Other types of uses, such as mining and commercial, were assumed to divert 181 afy for each cfs of water right. Given these assumptions, the estimates were further refined by classifying them by their status, source of supply, and use.

Potential Diversion by Status

An examination of the water rights records for wells in Tooele Valley indicates that a total of 96,362 afy of water has been filed on, of which 73,112 afy has been, or can be, developed . The breakdown by sub-basin[1] and status yields the following.

Sub-basin	Approved	Perfected	App & Per	Unapproved
Grantsville	6,458 afy	23,732 afy	30,190 afy	10,991 afy
Lake Point	141 afy	613 afy	754 afy	3,522 afy
Tooele-Erda	8,763 afy	33,405 afy	42,168 afy	8,737 afy
All	15,362 afy	57,750 afy	73,112 afy	23,250 afy

Potential Diversion by Source of Supply

Estimates of potential ground-water diversions by source of supply, for each sub-basin according to the water rights records, using approved and perfected water rights, are summarized in the following table.

Sub-basin	Wells	Springs	Drains	Total
Grantsville	30,190 afy	2,328 afy	387 afy	32,905 afy
Lake Point	754 afy	120 afy	0 afy	874 afy
Tooele-Erda	42,168 afy	3,645 afy	1,860 afy	47,673 afy
All	73,112 afy	6,093 afy	2,247 afy	81,452 afy

[1] For a discussion of the valley's sub-basins, see the Flow Patterns section under Further Investigations.

Potential Diversion by Use

A breakdown of the approved and perfected well rights by use yields the following.

Sub-basin	Irrigation	Dom & Stk	Municipal	Other	Total
Grantsville	20,921 afy	1,907 afy	2,715 afy	4,647afy	30,189 afy
Lake Point	220 afy	354 afy	0 afy	180 afy	754 afy
Tooele-Erda	24,535 afy	1,446 afy	10,272 afy	5,915 afy	42,168 afy
All	45,676 afy	3,707 afy	12,987 afy	10,742 afy	73,112 afy
% of total	62%	5%	18%	15%	

It should be noted that these estimates are based on an irrigation diversion duty of 4.0 af/ac. Recent studies of water use in the valley are indicating that, in actual practice, the irrigation water uses are diverting closer to 3.0 af/ac, which would reduce these estimates accordingly. The reason for this difference is that the 4.0 ac/ac figure is based on flood irrigation practices and most irrigators in the valley are using sprinklers.

BACKGROUND STUDIES

Previous studies of Tooele Valley ground water by the State Engineer date back to at least 1946. Included in this series are Technical Publications Numbers 4, 12, 69, and 107; Water Circular No. 2; Basic Data Report No. 7; and Information Bulletin No. 23. These studies were conducted by the USGS in cooperation with the Utah Division of Water Rights, Utah Geological Survey, Utah Department of Environmental Quality, Tooele County, Tooele City, Grantsville City, and the U.S. Army. The latest and most definitive of these studies are the previously mentioned WRI 97-4005 and WRI 99-4014.

Ground-water Recharge and Discharge

According to the most recent estimates, the long-term average recharge to the Tooele Valley ground-water system totals about 75,000 afy, which is detailed as follows:

Source	Amount	% of total
Bedrock and Stream Channels	48,000 afy	64%
Infiltration of Precipitation	12,000 afy	16%
Unconsumed Irrigation Water	10,000 afy	13%
Rush Valley Subsurface Outflow	5,000 afy	7%

Comparing these recharge amounts with those for potential withdrawal, it is apparent that the water resources of the valley are, for all intents and purposes on paper, fully appropriated.

It is estimated that the long-term average discharge of the Tooele Valley ground-water system is also about 75,000 afy, and is detailed as follows:

Destination	Amount	% of total
Pumped Wells	13,500 afy	18%
Flowing Wells	12,500 afy	17%
Evapotranspiration	23,000 afy	31%
Springs and Seeps	16,000 afy	21%
Great Salt Lake	3,000 afy	4%
Shallow Drains and Ditches	7,000 afy	9%

These recharge and discharge estimates are based on previous field studies.

Well Water Use

Since 1963, the USGS has published annual estimates of well withdrawals. These estimates range from a low of 19,700 afy in 1965 to a high of 32,800 afy in 1974 and 1990. The average withdrawal for the last ten years (1989-1998) is 26,800 afy, which is broken down by use as follows:

Use	Amount	% of Total
Irrigation	21,720 afy	81%
Industrial	877 afy	3%
Public Supply	3,815 afy	14%
Domestic and Stock watering	388 afy	1%

FURTHER INVESTIGATIONS

Having reviewed and analyzed the previous studies dealing with Tooele Valley, the State Engineer conducted further investigations to learn, in greater detail, how the ground-water system works. The main tool used in these investigations was the *Groundwater Modeling System* (GMS) developed by Brigham Young University and marketed by BOSS International. GMS acts as a pre- and post-processor to the USGS's MODFLOW package.

MODFLOW input files, obtained from the USGS, were entered into GMS and the well pumpage files were modified to test various water use scenarios. After modifying the data files, running the various scenarios, and analyzing the results; several things were apparent.

Effects of Future Development

To estimate the effect of additional ground-water development on existing water sources, a 3.0 cfs well was simulated at various points around the valley. The model indicated where those additional wells would "obtain" their water. On average, 71% of the water would come by reducing the flow of springs, seeps, flowing wells and drains, 28% by reducing evapotranspiration, and 1% by reducing outflow to the Great Salt Lake. All of these reductions would be the result of additional ground-water development lowering the water table in the aquifer system.

Flow Patterns

It was apparent from the modeling results, that there are essentially three basic ground-water flow paths in the valley's aquifer system. (See figure 1.) On the west side is a flow path which gathers water entering the aquifers from the Stansbury Range and South Mountain and moves it to the north; the Grantsville sub-basin. On the northeast corner of the valley is a flow path which collects recharge from the drainage east of Adobe Rock and funnels it through the Lake Point area; the Lake Point sub-basin. Between these two flow paths is a third which collects water from the Oquirrh Mountains and Stockton Bar and moves it to the north and northwest; the Tooele-Erda sub-basin.

Sub-basin Recharge Sources

Using the post-processing capabilities of GMS, it was possible to determine the modeled recharge to each of these sub-basins. The recharge was modeled from three sources; 1) bedrock inflow, 2) spring and streambed seepage, and 3) precipitation and unconsumed irrigation water. The amounts are summarized in the following table.

Source	Grantsville	Lake Point	Tooele-Erda	Total	%
Bedrock Inflow	3,670 afy	4,112 afy	33,935 afy	41,717 afy	55
Spring & Stream	8,570 afy	710 afy	9,251 afy	18,531 afy	25
Precip. & Irrigation	4,772 afy	761 afy	9,842 afy	15,375 afy	20
All Sources	17,012 afy	5,583 afy	53,028 afy	75,623 afy	
% of total	23%	7%	70%		

The modeling further showed that about 20,000 afy of the water which recharges the Tooele-Erda sub-basin moves to the northwest and also serves as recharge to a part of the Grantsville sub-basin. Also, it is important to note that 70% of the valley's recharge enters the ground-water system between Adobe Rock and South Mountain.

Safe Yield

Safe yield is defined as that amount of water which may be withdrawn from an aquifer without an undesirable result in terms of both water quantity and quality. Because even the best well fields can never be totally efficient, not all of the recharge can be physically captured and placed to beneficial use. Therefore, the safe yield of a ground-water system is always going to be less than the actual recharge. The State Engineer is proposing to limit the withdrawals from the ground-water system to the safe yield.

Given these facts, GMS was used to estimate the safe yield of the valley's aquifers. The steady state version of the ground-water model was used and pumping stresses were simulated at various

levels, then the model was allowed to run until a new equilibrium was obtained. Water level drawdowns were not allowed to exceed 50 feet and a positive gradient to Great Salt Lake was maintained. Using these criteria, the following estimates were obtained.

Sub-basin	Safe Yield Estimate
Grantsville	20,500 afy
Lake Point	4,300 afy
Tooele-Erda	25,500 afy
TOTAL	50,300 afy

AREAL DISTRIBUTION OF WITHDRAWALS

Figure 2 shows the areal distribution of diversion points for those water rights whose source of supply is the ground-water system. There are large concentrations of wells in Erda, Grantsville, the Lake Point area, and along Grantsville-Erda Road. Such concentrations could lead to interference problems if water rights are pumped to their fullest extent.

Water diverted for irrigation in the upper elevations, where the water table is deep and a confining layer is absent, has the potential to be reused because of the percolation of excess water past the root zone into the aquifer. However, excess irrigation water applied at lower elevations, where the water table is very shallow, discharges into drains and is carried to the Great Salt Lake or evaporates as overland sheet flow or is consumed by phreatophytes. Because most of the water in the lower elevations is used for irrigation, the opportunities for the reuse of excess irrigation water there are very limited.

ANALYSIS AND DISCUSSION

Tooele Valley is over-appropriated as evidenced by the fact that there are 73,000 afy of water rights on paper but an estimated safe yield of only 50,000 afy. However, actual pumping levels are only about 27,000 afy, which is much lower than the safe yield. It appears that many underground water rights are not being pumped to their full potential or else they are not being used at all. The larger the gap between the amount of paper water and the actual water use, the less efficient it is to manage the water resource.

The majority (62%) of water rights in Tooele Valley are used for irrigation. As growth in the valley continues and farmlands are developed for residential, commercial, and industrial purposes, it is expected that irrigation rights will be converted to those purposes. It is the policy of the State Engineer in Utah to evaluate the historic use of an irrigation water right when allowing its use to be changed. Currently, there exists about 46,000 afy of irrigation water rights. The average amount of water actually used for irrigation, according to records from the USGS, is about 22,000 afy; less than half the total potential use. (The maximum amount used in any one year was 28,000 afy in 1974 and, more recently, 27,000 afy in 1990.) As irrigation water rights are changed to other uses, and thereby quantified based upon their historic uses, the amount of paper water rights will likely be reduced from 73,000 afy.

There is also a substantial gap between the amount of water used for purposes other than irrigation (about 5,000 afy) and the amount of paper water available for those uses (about 27,000 afy). As growth continues, non-irrigation sources, such as public supply and industrial wells, are expected to increase their pumping levels above 5,000 afy. The overall pumping rate of 27,000 afy would increase accordingly. Whether or not there is additional water to be appropriated in Tooele Valley can only be determined when the amount of paper water rights is closer to the amount of water actually being used.