

REVIEW OF PROPOSED CLASSIFICATION AND WATER QUALITY STANDARDS FOR GROUND WATER IN THE CHERRY CREEK BASIN

At the request of the Cherry Creek Basin Water Quality Authority, Leonard Rice Consulting Water Engineers, Inc. (LRCWE) reviewed the proposed classification of the alluvial aquifer and Dawson Aquifer within the Cherry Creek Basin. This testimony was prepared by Jon R. Ford, P.E., Ground water Geologist and Geological Engineer with LRCWE. We believe that significant changes as discussed below should be made prior to adoption of the classification proposal.

I. CLASSIFICATION AS DOMESTIC USE-QUALITY

Classification of the alluvial aquifer of Cherry Creek and its tributaries and of the Dawson Aquifer as Domestic Use-Quality is appropriate. Both aquifers currently provide domestic and municipal water supplies.

II. SPECIFIED AREA

The proposed Specified Area for both aquifers is the Cherry Creek watershed. The area is apparently based on the map in the Cherry Creek Master Plan. That area was selected based upon drainage from topographic maps. It is not the appropriate area for ground water classification, and this should be changed for the following reasons:

- 1) The area proposed for classification does not coincide with the lateral limits of either the Cherry Creek Alluvial Aquifer or the Dawson Aquifer.
- 2) The proposed area does not adequately describe the extent of the aquifers.



- 3) The hydrogeologic properties of the two aquifers are different.

Lateral Limits

The map entitled "Extent of Cherry Creek Alluvium" shows the lateral extent of the alluvial deposits of Cherry Creek and the proposed Specified Area (Cherry Creek Basin). The proposed area includes significant areas where the Cherry Creek alluvium is not present. However, it does not include, as it should, the alluvium present in the reach between Cherry Creek Reservoir and the South Platte River. This map is based upon maps prepared by the U.S. Geological Survey and on well data obtained from the files of the Colorado State Engineer.

There is a widely held misconception that the Cherry Creek Alluvial Aquifer is not continuous beneath Cherry Creek Dam. During dam construction, much of the alluvium was not removed, so ground water migrates beneath the dam. Downward leakage from the reservoir has increased the amount of ground water moving down gradient below the dam. The Cherry Creek Dam is an artificial northern boundary of the proposed area. The entire alluvium, including the reach between the Dam and the South Platte River, should be included in the classification.

The lateral extent of the Dawson Aquifer is shown on the map entitled "Lateral Extent and Depth to the Base of the Dawson Aquifer". The proposed Specified Area does not coincide with the limits of the aquifer. The Dawson Aquifer serves as a domestic water supply essentially wherever it is present and not just within the proposed Specified Area. Therefore, the entire Dawson Aquifer should be classified.



Vertical Limits

A full description of the Specified Area must include in addition to the lateral extent, the subsurface extent of each aquifer. For example, the map "Extent of Cherry Creek Alluvium" shows the Specified Area in that it defines both the lateral and vertical extent of the alluvial aquifer.

Similarly, the lateral extent and depth to the bottom of the Dawson Aquifer are shown on a map entitled "Lateral Extent and Depth to the Base of the Dawson Aquifer". Because the aquifer is not fully water saturated, a map "Depth to Water-Dawson Aquifer" is also necessary to define the top of the Specified Area. These maps are based upon maps developed by the Colorado State Engineer.

The "Geologic Cross Section Cherry Creek Alluvium at Arapahoe Road" and "Generalized East-West Geologic Cross Section Across the Denver Basin" were prepared to show the relationship between the ground surface, water table and top and bottom of the aquifers and to help visualize the information portrayed on the maps.

An alternative way of defining the vertical extent of the aquifers is the use the aquifer designation included on well permits and in water right decrees. This is not workable for the following reasons:

- 1) Well drillers and other nongeologists frequently inaccurately complete these documents.
- 2) The understanding of the limits of the Dawson Aquifer has evolved over the last 20 years. In fact, it continues to be refined. Originally, the Dawson also included what today are known as the Denver and Arapahoe Aquifers. Thus, many older wells are reported in the State Engineer's records as being



Dawson wells when in fact they may be either Denver or Arapahoe Aquifer wells.

Hydrogeologic Properties

In the case of either the alluvial or Dawson aquifers there is no coincidence between the surface water divide (Cherry Creek Drainage basin) or a ground water divide or any other geological property of the aquifers. In other words, surface runoff in the basin may or may not infiltrate into one of the aquifers. If it does, it may flow to wells in the basin or flow to wells outside of the basin. Likewise, ground water from outside the basin may flow to wells within the drainage basin. Ground water flow direction and rate are functions of the slope of the water table, the permeability of the aquifers and the location of pumping from the aquifers. Available data shows that the flow path and rate is different for each aquifer. Consequently, the use of the surface water divide as the boundary for classification of the alluvial or Dawson aquifers is not appropriate.

Although the aquifers are hydrologically interconnected in the vicinity of Cherry Creek Reservoir, they are not interconnected over most of the area of the Dawson Aquifer and probably not over most of the proposed Specified Area (Cherry Creek Basin). They are interconnected in the vicinity of Cherry Creek Reservoir because ground water flows from the Dawson Aquifer to the Cherry Creek Alluvial Aquifer. In the reach of the drainage basin from Parker to Franktown, the two aquifers may also be hydrologically interconnected, however, south of Franktown there appears to be no interconnection between the two aquifers.

Recommendations

Because of the different lateral and vertical extent of the aquifers plus the differences in hydrogeologic properties, we



recommend that the two aquifers be separately classified. The Cherry Creek basin drainage area should not be used because it has no relationship to the aquifers. We propose that the specified area for the Cherry Creek Alluvial Aquifer be defined as shown on the map "Extent of Cherry Creek Alluvium". We recommend that the Dawson specified Area be defined by maps such as "Lateral Extent and Depth to the Base of the Dawson Aquifer" and "Depth to Water Dawson Aquifer". An alternative definition for the Dawson Aquifer might include only those areas in the vicinity of Cherry Creek where the depth to ground water is less than 100 feet. This depth is reasonable because it includes ground water shallow enough that there is a reasonable possibility that surface activities could contaminate the aquifer.

III. WATER QUALITY STANDARDS

Existing Ground Water Quality

Water quality records from the Colorado Department of Health, U.S.G.S., and municipal water suppliers were compiled for the Cherry Creek alluvial and Dawson Aquifers. Water quality data are available from 26 Cherry Creek alluvial wells and 43 Dawson Aquifer wells. The data were compared to the standards for an aquifer classified as "Domestic Use-Quality" (standards outlined in tables A, B, 1 and 2 in "The Basic Standards For Ground Water 3.11.0 (5CCR 1002-8)"). Most of these analyses were incomplete.

The water quality in some areas of the Cherry Creek Alluvium exceeds "Domestic Use-Quality" standards for manganese, gross-alpha and total coliform. The water quality in some areas of the Dawson Aquifer exceeds the standards for manganese, gross-alpha and iron. The number of samples and well sites testing for the above constituents are shown in Table 1.



TABLE 1

SUMMARY OF GROUND WATER QUALITY DATA IN EXCEEDANCE
OF PROPOSED STANDARDS

CHERRY CREEK ALLUVIUM

CONSTITUENT	SITES	SAMPLES	SITES EXCEEDING STANDARDS	SAMPLES EXCEEDING STANDARDS	PERCENT OF SITES EXCEEDING STANDARDS	PERCENT OF SAMPLES EXCEEDING STANDARDS
Manganese	8	13	1	3	13%	8%
Gross-Alpha	4	5	3	3	75%	60%
Fecal Colliform*	12	99	4	13	33%	13%

DAWSON AQUIFER

CONSTITUENT	SITES	SAMPLES	SITES EXCEEDING STANDARDS	SAMPLES EXCEEDING STANDARDS	PERCENT OF SITES EXCEEDING STANDARDS	PERCENT OF SAMPLES EXCEEDING STANDARDS
Manganese	8	9	4	4	50%	44%
Iron	6	7	1	1	17%	14%
Gross-Alpha	24	26	16	15	58%	67%

* Standards exist for Total Colliform which includes Fecal Colliform. At four sites, the average fecal colliform counts (per 100 ml) taken within the 1982 water year exceeded 1 organism per 100 ml of sample.

The number of analyses for these parameters is extremely low compared to the number of wells in both the Cherry Creek Alluvium and Dawson Aquifer. However, the high percentage of samples exceeding the gross-alpha standard in the Cherry Creek Alluvium and the high percentage of samples exceeding the manganese and gross-alpha standards in the Dawson Aquifer indicate that the naturally occurring ground water may exceed the standards over a large area.



Because there were no analyses for chlordane, chlorophenol, monohydric phenol, benzidine, corrosivity, odor, radium, plutonium, thorium, strontium, cesium and tritium, there is no way to know whether the standards for these parameters may currently be exceeded in the aquifers.

Nitrate is another regulated contaminant which exists at high levels in some parts of the Cherry Creek alluvium. High levels probably result from human influences, including leach fields and the use of fertilizers. Forty-three analyses of dissolved nitrate as nitrogen were found for 21 separate sites in the alluvium. Ten percent of the sites and seven percent of the samples had test results between 70 and 80 percent of the numeric standard (10 mg/l). The data suggests that there may be areas which exceed the standard.

Naturally high background levels of some constituents in some areas within the aquifers may require that a system of variances be established in the regulatory structure. For example the "The Basic Standards and Methodologies for Surface WATER (3.1.0)", allow variances for stream segments which require site-specific classification.

Knowledge of existing ground water quality is important for other reasons as well. Knowledge of the existing quality is paramount



to determining if future activities are causing ground water degradation. This information is also necessary to enforce future ground water discharge regulations.

Recommendation

Because the water quality in each aquifer is different, we recommend separate classification for each aquifer. Because the existing available data demonstrates that some standards already are exceeded, we recommend that the Basic Standards for Ground Water (3.11.0) not be automatically adopted for the Cherry Creek Alluvium or the Dawson Aquifer. We recommend that the existing water quality be documented before the alluvium or aquifer are classified and that no standards should be adopted until testing has been completed to verify the background water quality levels.

IV. POINT OF COMPLIANCE

The proposed point of compliance is the top of the water table or the phreatic zone for each aquifer. There are several problems with this proposal. First, the Basic Standards for Ground Water (3.11.0) indicate that specific points of compliance be designated rather than a continuous surface, i.e. the water table, that can neither be completely defined or sampled for compliance.



Secondly, the current proposal states "...the top of the water table...". Because the water table is a surface, the top would be above the water table in the vadose zone or zone of aeration. We expect that this is an unintentional error.

Defining the point of compliance essentially at the top of the aquifers seems to imply that regulated constituents that enter the aquifer are preserved in the aquifer and are not precipitated or otherwise removed from ground water. For a number of constituents this is not the case. Whether or not regulated constituents remain in solution is related to a number of complicated physical and chemical processes that naturally occur in the subsurface.

However, various studies show many compounds are naturally attenuated during infiltration from the surface to the water table and within the aquifers themselves. In fact, infiltration of water is utilized for point and nonpoint source water quality control, and, as such is identified as a best management practice (BMP) by the U.S. Environmental Protection Agency and others.

The currently proposed Point of Compliance would preclude the use of infiltration BMP's. This is because infiltration usually causes the water table to rise beneath the infiltration site (often to very near the surface). A rise in the water table would also be a rise in the Point of Compliance. However the design of infiltration sites relies on progressive constituent removal between the ground surface and the normal water table. Thus,



designating the water table as the Point of Compliance, while simple in definition, may prevent the pragmatic removal of regulated constituents.

Recommendation

Site specific data should be used to determine Points of Compliance. We recommend that the Points of Compliance be selected so as to recognize that the chemistry of ground water often changes beneficially as it migrates through the subsurface and to allow infiltration of surface water. If the water table is accepted as the Point of Compliance, there should be separate definitions for the Cherry Creek and Dawson aquifers so that where the Dawson Aquifer is beneath the Cherry Creek Alluvium, the Point of Compliance for the Dawson is just beneath the geologic contact between the Dawson Aquifer and the overlying Cherry Creek Alluvial Aquifer.

CONCLUSIONS

Based upon our review of the hydrogeologic setting in the area of the proposed classification, we conclude the following:

- 1) Each aquifer should be classified separately.
- 2) The Specified Area as proposed is incomplete and is not related to the hydrogeology of either aquifer.



- 3) Little is known regarding the existing water quality in either aquifer; however, available data show that ground water exceeds some standards and may exceed others. To properly classify these aquifers, a better understanding of the existing quality is necessary.

- 4) The proposed point of compliance needs to be modified to consider the hydrogeology of the aquifers and to allow infiltration of surface water.

