TO: Kent L. Jones, State Engineer, Utah Division of Water Rights

FROM: R. Scott Wilson, General Manager Central Iron County Water Conservancy District

Date: November 9, 2011

Subject: Beryl/Enterprise Groundwater meeting

The State Engineer faces difficult policy choices in developing a ground water management plan for the Beryl Enterprise hydrologic basin which has been allowed to develop beyond available water resources. This situation is a dramatic illustration of how important water resources are in sustaining a region's economic activity.

The *Draft October 7, 2011 Beryl/Enterprise Groundwater Plan* (the Draft Plan) has not had much public exposure time. For example, I have visited with two governmental agencies, three of the District's industrial taxpayers, and numerous residential water users and none have known about the draft plan or were aware of this meeting prior to our conversation. This represents a significant challenge when asking for public input on the draft plan.

The draft plan proposes a scheduled reduction of outstanding water rights as measured by "depletion". For example in the first cut (October 31, 2030), 14,499 acre-feet of "diversions" are cut to achieve 3,355 acre-feet of "depletion". Water is typically bought and sold in the marketplace in terms of "diversions" so the draft plan's "Table 1 - Groundwater Management Plan Regulation Schedule" is misunderstood.

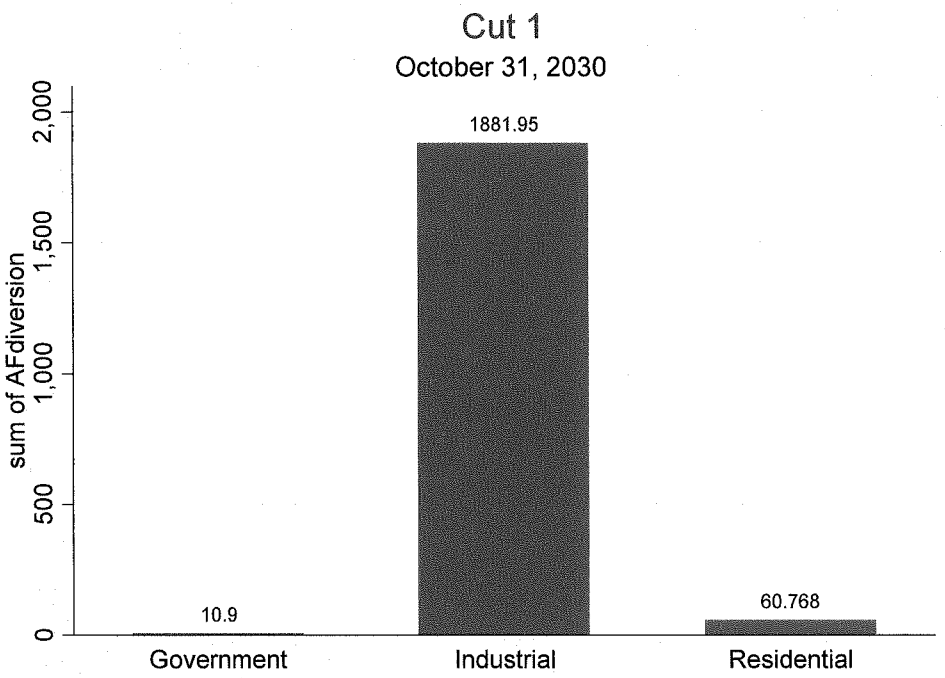
During the passage of groundwater management district legislation (SB 20, introduced and passed during the 2010 legislative session and modified during the 2011 legislative session), it was represented that a ground water management district would not impact the rail corridor contained within the Central Iron County Water Conservancy District's boundaries. However, the map on the Draft Plan clearly includes this important corridor.

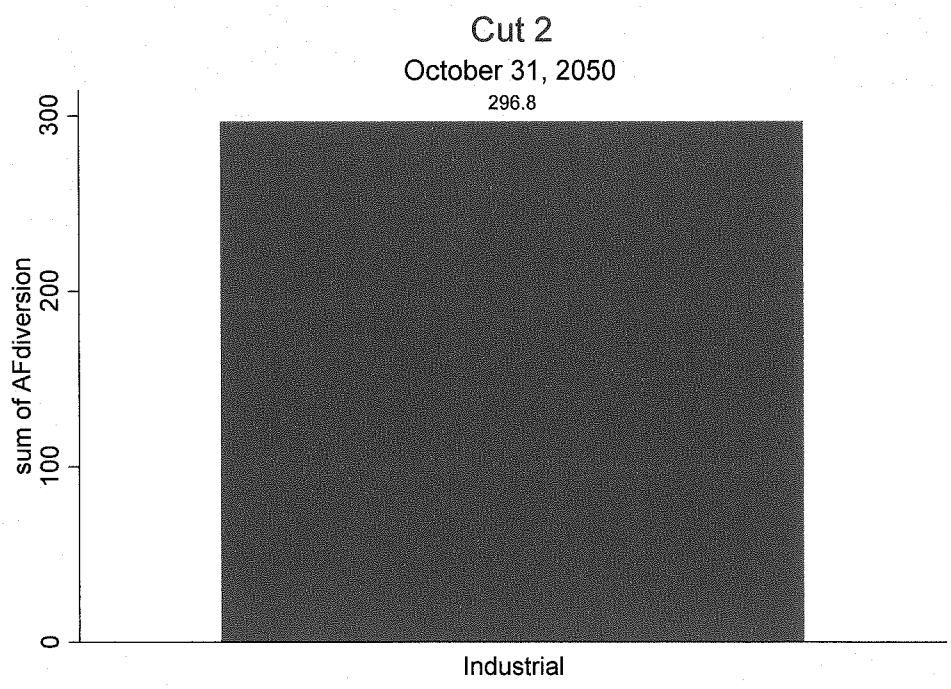
The Draft Plan allows water users to "to participate in a voluntary arrangement to manage withdrawals based on a system other than priority date". If these voluntary arrangements are unsuccessful in their efforts, the scheduled reductions would revert to strict priority identified in the Draft Plan's "Table 1 - Groundwater Management Plan Regulation Schedule".

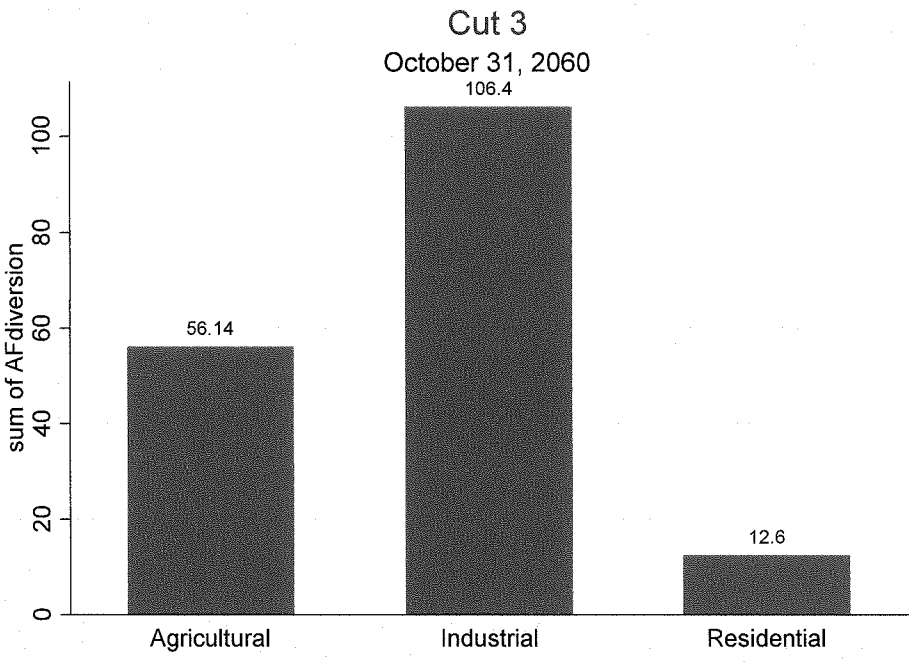
The voluntary arrangement (proposed groundwater management district) is an untested experiment that has not been attempted before and therefore has no history to judge success. Therefore, this places the Central Iron County Water Conservancy District's taxpayers at considerable risk if the proposed voluntary arrangement is unsuccessful. For example, this would result in the Central Iron Water Conservancy District's taxpayers being subject to the priority reduction identified in the Draft Plan's Table 1 even if they have participated in the proposed voluntary arrangement.

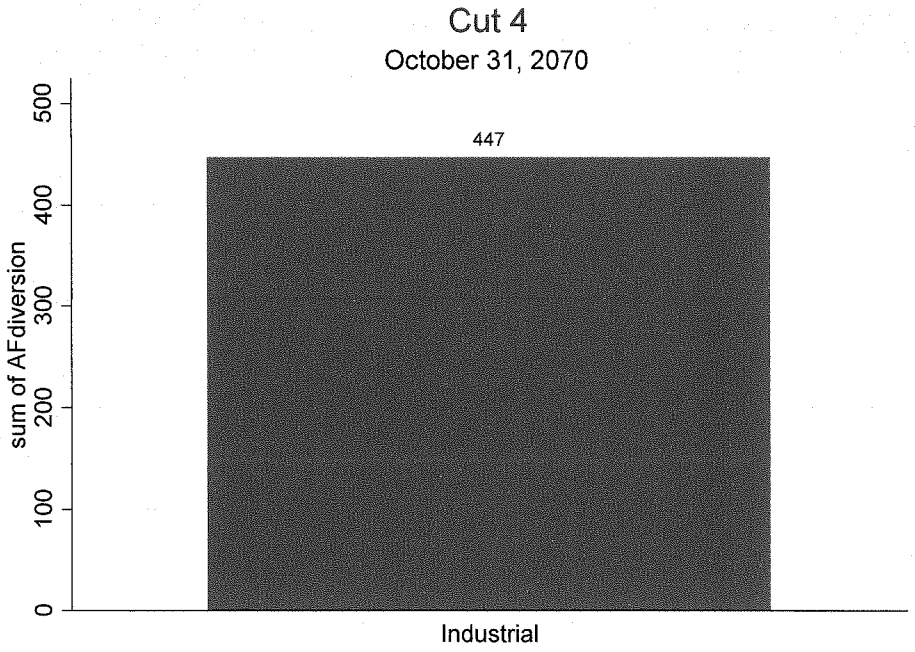
Water Cuts Proposed by the Draft Plan

The following graphic's illustrate the heavy proposed water reductions (acre-feet of diversions) in the first four cuts proposed cuts in the Draft Plan.









Cuts # 5 include no reductions Central Iron County Water Conservancy District taxpayers. Cut # 6 includes 2 acre-feet and Cut # 8 includes a 10.9 acre-feet reduction for a total of 2,885.458 acre-feet of diversion reductions. Note that the vast majority of these targeted cuts include industrial taxpayers of the Central Iron County WCD. This will significantly impair future tax revenues of the Central Iron County WCD.

Scientific and Engineering Reports

The enclosed Nolte Associates, Inc. (2007) *Basin Area 71 Groundwater Study for the Iron Springs Area* (Nolte Report) used the same USGS model that the State Engineer used to determine the safe yield of the Beryl/Enterprise Area. The Nolte report concludes that "the estimated safe yield of the aquifer from the Iron Springs Area is between 5,000 and 10,000 acre-feet" annually.

The enclosed Bowen and Collins (2008) *West Side Drainage Master Plan* (Drainage Report) that has been adopted by Cedar City, Iron County, and the Central Iron County Water Conservancy District. The Drainage Report identifies Iron Springs as a flood channel that would ordinarily carry flood high water designated for Quichapa Lake to drain through Iron Springs.

The calculated evaporation loss from Quichapa Lake has ranged from 2093 acre-feet per year in 2009 to 7,227 acre-feet per year in 2005 and has averaged just over 5,000 acre-feet per year since 2005.

USGS. (2005). *Hydrology and Simulation of Ground-Water Flow in Cedar Valley, Iron County, Utah* shows a downward water gradient from the Cedar City Regional Waste Water Treatment Plant out toward the Mud Springs Gap that adjoins the Beryl/Enterprise Water Basin. Recent field investigations revealed that water levels measured in wells in the Mud Springs Gap Area indicate that water levels are about 10 feet below the surface.

Proposal

- Treat the property located within the Central Iron County WCD boundaries as a separate hydrologic management area that has the option of organizing as a separate voluntary arrangement independent from the proposed Beryl/Enterprise Area ground water management district. Limit this area to the 5,000 to 10,000 acre-feet annually of Beryl/Enterprise groundwater withdrawals.

- Allow for the West Side Flood channel, when developed, to bank water in this rail corridor to bank water against the Draft Plan's scheduled reductions. An estimated 5,000 acre-feet of water annually is expected from this policy tool.

- Allow for the Central Iron County WCD to enter into an inter local agreement with the Iron County School District (one of the Central Iron County WCD's) as part of the Draft Plan to ground water bank water resources to prevent reduction of their water right number 71-2023 (priority 1950, scheduled to be reduced in cut #3, October 31, 2060).

- Allow for ground water credits to offset Central Iron County WCD taxpayers and the Iron County School District covered under an inter-local agreement. The source of these groundwater credits would be from quantified and measurable outflows from the Cedar

Valley Water Basin from the Regional Waste Water Treatment Plant and any Rush Lake flood water that exit the Cedar Valley Water Basin through the Mud Springs Gap.

- Allow the District adequate time to hold public discussions with our taxpayers and the broader community to obtain public input regarding this policy and allow for the Central Iron County WCD Board of Trustees adequate time to make these decisions.

References

USGS. (2005). *Hydrology and Simulation of Ground-Water Flow in Cedar Valley, Iron County, Utah.* By Lynette E. Brooks and James L. Mason.

Bowen and Collins (2008) *West Side Drainage Master Plan*

Legislative history of Senate Bill 20, introduced and passed 2010 and modified in the 2011 Legislative Session, House Natural Resources Subcommittee hearing.

Nolte Associates, Inc. (2007) *Basin Area 71 Groundwater Study for the Iron Springs Area*

BOWEN COLLINS & Associates, Inc.
Consulting Engineers

DRAFT TECHNICAL MEMORANDUM No. 2

West Side Drainage Master Plan

TO:

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US Army Corps of Engineers
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Kit Wareham, P.E.
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File

FROM:

Craig Bagley, P.E. & Todd Olsen, P.E.
Bowen, Collins & Associates
756 East 12200 South
Draper, Utah 84020

DATE: April 9, 2008

SUBJECT: Cedar City West Side Flood Control and Management Plan – Ground Water Recharge Alternatives

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INTRODUCTION

This Technical Memorandum has been prepared as part of the West Side Master Plan Project, a project jointly funded by Cedar City, Iron County, Central Iron County Water Conservancy District, and the U.S. Army Corps of Engineers. The primary purpose in completing the Westside Flood Control and Management Plan is to identify drainage and flood control improvements needed in the area west of I-15 in Cedar City, Utah. Historically, the area west of I-15 in the vicinity of Coal Creek was agricultural crop or range land that periodically experienced shallow flooding in response to large runoff events from Coal Creek. However,

now that this area is experiencing development pressure, periodic shallow flooding is no longer acceptable because of the damage that flooding can cause to structures and property.

West Side Master Plan Draft Technical Memorandum No. 1, prepared on March 21, 2008, identified deficiencies in existing drainage and flood control facilities west of I-15 and recommended improvements to resolve those deficiencies. Those recommended improvements included constructing or developing one or more storm water detention facilities that could be used to attenuate peak discharges from large cloudburst runoff events. The purpose of this Technical Memorandum is to evaluate the feasibility of implementing a long-term joint flood control/groundwater recharge project in the study area west of I-15.

BACKGROUND INFORMATION

The Cedar Valley is located along the eastern margin of the Great Basin at the transition between the Basin and Range and Colorado Plateau Physiographic Provinces (Reference 1). The Cedar Valley Drainage Basin varies in elevation from about 5,300 feet (above mean sea level) on the valley floor to about 10,400 feet on the plateau to the east and covers an area of approximately 570 square miles. Average annual precipitation in the drainage basin varies from about 10.6 inches on the valley floor to about 35 inches near the headwaters of Coal Creek in the Markagunt Plateau. Coal Creek, with a drainage area of approximately 80 square miles, is the largest perennial stream (and the only gaged stream) in Cedar Valley (Reference 2). The average annual runoff from the Coal Creek drainage basin is 24,600 acre-feet, and most of which is generated from snowmelt in the higher elevations of the watershed (Reference 3).

Most of the water in Coal Creek is diverted into a fairly complex system of ditches and used for irrigation. The water is diverted into ditches or canals based on priority water rights defined by the Coal Creek Decree filed in 1922. Streamflow less than 102.02 cfs are distributed in accordance with the decree. Flows in excess of that amount are distributed to low priority rights filed after 1903 (Reference 2). During periods of high runoff, water from Coal Creek that is not utilized for irrigation may be conveyed to Quichapa Lake or Rush Lake, two terminal playa lakes in Cedar Valley.

Over geologic time Coal Creek has created an alluvial fan in the Cedar City area. That fan extends from its apex at the mouth of Cedar Canyon to the valley floor to the west. The slope of the ground surface on this alluvial fan decreases in the westward direction. This means that the larger and coarser alluvial deposits can be found on the eastern, steeper portion of the fan. Finer grained deposits are located on the flatter portion of the fan. Field observations of sediment deposits indicate that the groundwater recharge is much more efficient in areas east of Airport Road than in areas west of Airport Road. Fine-grain soils and natural topographic depressions have created Quichapa Lake and Rush Lake in areas west and north of Airport Road, far away from the alluvial fan apex, where seepage losses are minimal.

Previous studies have shown that Coal Creek channel seepage losses that could contribute to groundwater recharge between the USGS streamflow gage 10242000 and Main Street in Cedar City are minimal. It is believed that fine-grained sediment eroded from the watershed during thunderstorms have settled into the sands and gravels along the channel bed, to significantly decreasing seepage losses.

Groundwater from the aquifer in the unconsolidated basin fill of Cedar Valley is withdrawn for irrigation and municipal uses. The level of the water table in the Cedar City area has been steadily declining over the past 50 years. Therefore, there is great interest by water users in the area to develop means of increasing aquifer recharge to stabilize the average annual water levels in the aquifer.

In the spring of 2005 record snowpack in the mountains east of Cedar City produced 84,270 acre-feet (Reference 3) of runoff from the Coal Creek watershed, more than 3.4 times the average annual runoff from that drainage basin. In an effort to reduce anticipated flooding west of I-15 and maximize groundwater recharge during the 2005 high runoff period, Central Iron County Water Conservancy District completed a groundwater recharge pilot project that diverted water from Coal Creek into the Bulldog gravel pit. That pilot project proved to be successful and Central Iron County Water Conservancy District officials are now interested in developing long-term groundwater recharge projects (Reference 4). They plan to work with representatives from Iron County, Cedar City, and local irrigation companies in developing a groundwater recharge plan that will benefit all these stakeholders. The issues that will need to be addressed in implementing a recharge project include:

- Water rights and permits
- Managing sediment and debris
- Design and maintenance issues

Each of these issues will be addressed below.

WATER RIGHTS AND PERMITS

One or more permits will have to be obtained from the State Engineer's Office before a long term groundwater recharge project can be implemented. The first required State permit would be a Groundwater Recharge Permit. However, it should be noted that before beginning the permitting process, the sponsoring agency or individual must have the legal rights to the water that is to be used for groundwater recharge. If the agency desires to utilize the recharge project to create a groundwater right for beneficial use, then a Groundwater Recovery Permit must also be obtained by the State Engineer. The recovery of groundwater will not be addressed as part of this project. In the process of obtaining one or both of these permits, a detailed evaluation will have to be performed to describe how the recharge and recovery system will be operated and maintained and all impacts, both positive and negative, will have to be evaluated. If any federal funds are utilized in developing a groundwater recharge project, it is likely that either an environmental assessment or an environmental impact study will have to be completed to meet NEPA requirements.

MANAGING SEDIMENT AND DEBRIS

Since most of the low-flow water rights are linked to irrigation and stock watering, it is likely that the only surface water from Coal Creek that can be made available for utilization in a groundwater recharge project will be during periods of high runoff from snowmelt and cloudburst events (i.e., when there is more that 1,000 cfs in the creek). During periods of high runoff Coal Creek runoff water also transports sediment. For the purposes of this report, two types of sediment are identified as being conveyed with runoff water: wash load and bed load. Wash load is the fine-grained sediment that the flowing water can easily convey in large

quantities (usually suspended in the water) and is limited by its availability in the watershed and channel banks. The coarser part of the sediment load, commonly known as bed load (i.e., coarse sands, gravels, and cobble), is more difficult for flowing water to move and is limited in discharge rate by the transporting ability of the stream (i.e., water depth and velocity).

It is recommended that sedimentation basins be constructed upstream of any recharge basin to allow as the bed load and as much of the wash load as is feasible to settle out of the runoff and minimize maintenance and management of the recharge basins. These sedimentation basins will have to be designed and constructed in a manner that will allow the deposited sands and gravels to be easily removed on a regular basis. In Technical Memorandum No. 1, it was recommended that the reach of Coal Creek between I-15 and Airport Road and the reach of the Quichapa Channel between Coal Creek Road and I-15 be purchased, revised, and modified so that it can be perpetually utilized to collect sediment. Additional sedimentation facilities should also be constructed upstream of infiltration basins. Potential locations for groundwater recharge facilities are shown in Figure 1.

DESIGN AND MAINTENANCE ISSUES

In designing and constructing any groundwater recharge facilities, it is recommended that following issues be thoroughly addressed and considered:

- If existing inactive gravel pits are used as recharge basins, the basin inlet facilities must be designed to prevent erosion and headcutting in the inlet channel facilities as well as bank erosion in the recharge basin.

- Any diversions to recharge basins that are constructed in the main Coal Creek channel should avoid creating backwater in the Coal Creek channel. Diversions should divert both water and the associated sediment load out of the main channel to appropriate sedimentation basin facilities generally described above. New diversions can create significant sediment deposition and/or erosion problems if are not designed and operated properly.

- Convenient access should be provided to sedimentation facilities and recharge facilities for maintenance purposes.

- The properties to be utilized as sedimentation and recharge facilities should be purchased by the sponsoring agency of the groundwater recharge project.

- The bottom elevation of any recharge basin should be maintained below basement or lowest floor elevations of structures within 1,000 feet of the recharge basin.

- Sedimentation basin and recharge basin owners should contract with one or more local gravel pit owners to remove sediment that is deposited during the operation of those facilities. If the sands and gravels removed from these facilities are made available to the pit owners in exchange for its removal, it is likely that the maintenance of these basins can be accomplished for little to no cost.

- Fine-grained wash load sediments will likely accumulate on the bottom of recharge basins over time. This will significantly reduce the seepage rate and require periodic

removal of sediment to clean and restore the native infiltration characteristics of the soils. If deep gravel pits are utilized, it is likely that significant seepage and recharge would also occur through the walls or banks of the gravel pits. It is also likely that materials on the on the banks or walls of the gravel pits will also need to be cleaned to maintain desired infiltration rates.

RECOMMENDATIONS AND CONCLUSION

Based on the 2005 pilot test results and the interest of local agencies, it appears that the development of a long-term groundwater recharge project in the study area is feasible. However, additional studies and analyses will be required before such a project can be implemented. Those additional studies should address the following issues:

- The feasibility and practicality of utilizing recommended storm water detention facilities jointly as groundwater recharge facilities.

- The availability of surface water rights for use in recharging groundwater.

- A smaller-scale multi-year groundwater recharge pilot project should be implemented to determine the ultimate feasibility of a long-term recharge project and to identify design and operation and maintenance issues that should be addressed in the design and operation of a the full-scale recharge project.

References

1. Fenneman, N.M., 1931, Physiography of the Western United States: New York, McGraw-Hill, 534 p.

2. U.S. Geologic Survey, 2005, Scientific Investigations Report 2005-5170, Hydrology and Simulation of Ground-Water Flow in Cedar Valley, Iron County, Utah, 114 p.

3. U.S. Geologic Survey, 2006, Water-Data Report UT-2005 (accessed and viewed on the Internet).

4. Verbal communications with Scott Wilson and Kelly Crane, Central Iron County Water Conservancy District, April 2008.

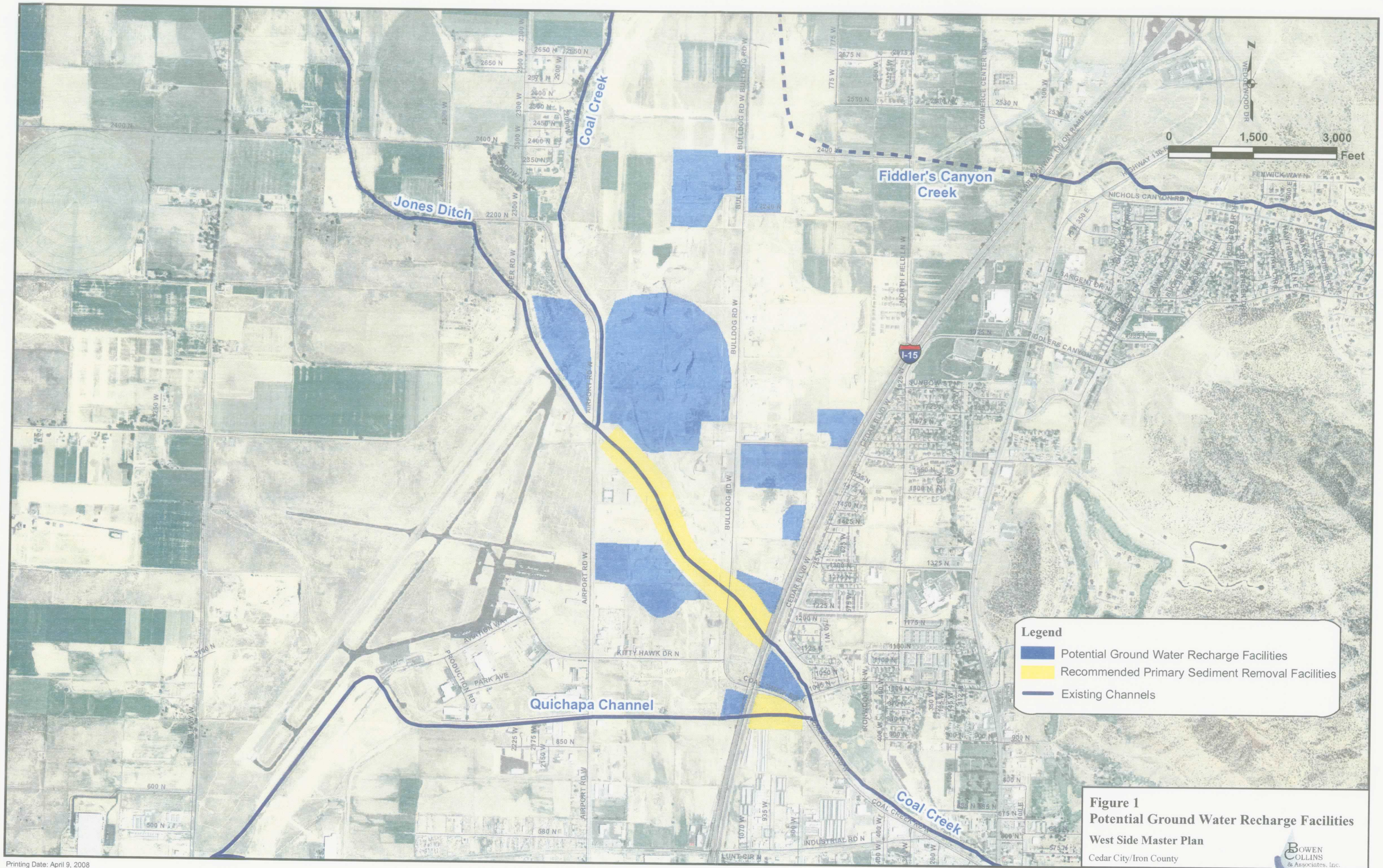

Figure 1
Potential Ground Water Recharge Facilities
West Side Master Plan
Cedar City/Iron County

Bowen Collins & Associates, Inc. Consulting Engineers

Printing Date: April 9, 2008
File: P:\Cedar City\West Side Master Plan\GIS\Projects\TM_2\GWRBasins.mxd

BASIN AREA 71 GROUNDWATER STUDY FOR THE IRON SPRINGS AREA

Prepared by Central Iron County Water Conservancy District

And

Nolte Associates, Inc.

September, 2007
Ground Water Study

SUMMARY AND BACKGROUND

This report discusses the timing and area that should be included in the groundwater management plan being discussed by the Utah State Engineer for the Basin Area 71. The ground water management plan is being implemented to prevent damage to the aquifer in the Basin due to overuse of groundwater.

The largest number of groundwater users in Basin Area 71 are located in the valley between Beryl, Newcastle, and Enterprise (Beryl-Enterprise Area), located west of the CICWCD boundary. A small number of users are located east of the Beryl-Enterprise Area on the north side of the Antelope Range (Iron Springs Area). This report addresses groundwater withdrawals and their affect on the aquifer in the Iron Springs Area (see Figure 1).

This report yields the following conclusions:

- A well pumping groundwater from the Iron Springs Area has no measurable effect on groundwater levels in the Beryl-Enterprise Area over a period of forty years according to the State's groundwater model (effects, if any, on groundwater levels will not occur before forty years.)

- Based on model results, the estimated safe yield for the aquifer in the Iron Springs Area is between 5,000 and 10,000 acre-feet. The groundwater rights that will be used in the area are within this range.

Based on the these results, this report concludes that the groundwater management plan being considered by the State Engineer can delay water right cancellations in the Iron Springs Area for a period of at least forty years. This will allow the Central Iron County Water Conservancy District time to provide new sources of water to the Area and limit the economic impact the groundwater management plan will have on the area.

ASSUMPTIONS

The State model for the groundwater Basin Area 71 was used for this study. This model was used as it was found on the Utah Water Rights Website and is assumed to be accurate. No modifications were made to the model except to add groundwater demand as shown in Figure 1. The model was set to run for a period of forty years

MODEL RESULTS

The state groundwater model for the Beryl-Enterprise Area was used to determine the following:

- The effect of a large groundwater demand in the Iron Springs Area on the Beryl-Enterprise Area groundwater elevations.

- The estimated sustainable yield of the aquifer in the Iron Springs Area.

September, 2007
Ground Water Study

Effects of Iron Springs Demand on Beryl-Enterprise Area Groundwater

To determine the effect of a large ground water demand on the Beryl-Enterprise Area, the model was run with no groundwater demand in the Iron Springs Area for a period of forty years. The ground water elevation was measured at two points (see Figure 1, Points A and B).

A demand volume, from 1,000 acre-feet a year to 15,000 acre-feet a year, was placed in the Iron Springs Area. The groundwater elevation after forty years was measured at the two points for each of the demands. The groundwater elevations for both of the points, after the forty year period at the given demand, are shown in Figure 2.

As seen in Figure 2, the Points A and B do not show measurable drawdown after the forty year period with any of the demands tested. This indicates that removing groundwater from the Iron Springs Area has very little influence on groundwater elevations in the Beryl-Enterprise Area. The model suggest that a significant period of time must pass (more than 40 years) before removing groundwater in the Iron Springs Area will effect the Beryl-Enterprise Area.

A map showing the measured drawdown from 2001 to 2006 in the Basin Area 71 is shown in Figure 3. The State Engineer presented this map at public meeting on August 6, 2007. The map shows that even though significant drawdown occurred during this time in the Beryl-Enterprise Area, the aquifer remained unchanged in the Iron Springs Area. This implies that a long period of time can pass before removing groundwater in the Iron Springs Area affects the Beryl-Enterprise Area groundwater. The recovery in the Iron Springs Area and the drawdown in the Beryl-Enterprise Area show there is a significant delay in groundwater movement between the Areas.

The hydrological delay between the Iron Springs Area and the Beryl-Enterprise Area is most likely caused by the Antelope Range, located between the two areas. This Range of mountains keeps the groundwater from moving directly between the areas. Any interaction between the groundwater in these areas will only occur over a significant amount of time because any ground water drawdown must extend out into the basin and around the Range. As explained above, this period is more than forty years according to the State's model results.

Estimated Safe Yield of the Aquifer in the Iron Springs Area

The model was run to estimate a safe yield for the Iron Springs Area. Water elevations in the groundwater model were measured for demands ranging from 1,000 to 15,000 acre-feet per year. The model showed that the drawdown was confined to a small area around the groundwater demand at a demand of 5,000 acre-feet or less. Between 5,000 and 10,000 acre-feet, the model showed that the demand began to pull groundwater from the areas north of the well. At a demand of 10,000 acre-feet there were significant drawdown to the north. Based on the model results, the estimated safe yield of the aquifer from the Iron Springs Area is between 5,000 and 10,000 acre-feet.

WATER RIGHTS

A search on the approved underground water rights along the rail corridor from Palladon to Lund (see Figure 4) was performed. The results of the search are shown in Table 1. In addition, Table 1 includes water rights that CICWCD anticipates will be transferred to the rail corridor for future economic development. The allowable diversion of the water rights in this area sums to 7,030 acre-feet a year. The consumptive use (the number used by the model) is less than the allowed diversion.

The majority of the water rights are owned by Palladon, WECCO and Fiddlers Canyon L.L.C. Palladon owns 2,039 acre-feet of water rights and WECCO owns 2,134 acre-feet of water rights under the names AMPAC Development Company of Utah and Western Electrochemical Company. Fiddler Canyon L.L.C. owns 2,096 acre-feet. The remaining 843 acre-feet of water are owned by different entities.

The total number of underground water rights that will be used along the rail corridor is within the estimated range of the safe yield determined from the model. Based on the model results, allowing these water right holders to use underground water in this area of the aquifer will not have an affect on the Beryl-Enterprise Area groundwater. The listed water rights can be used at their allocated diversions for at least forty years before any drawdown in groundwater could affect the groundwater levels in the Beryl-Enterprise Area.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results discussed above, Nolte Associates, concludes that water rights in the Iron Springs Area will not affect the groundwater management plan for at least forty years. This will allow the Central Iron County Water Conservancy District time to provide water from other sources to meet the water needs in this area.

Delaying any action in the Iron Springs area will allow the economic development along the rail spur in the area to continue (see Figure 4). This will allow the region to maintain its economic viability and will not impact the State Engineer's plan to reduce use in the basin to a safe yield.

Water Rights

WR Number	Diversion Type/Location	Priority	ACFT	Owner Name
71-433	Underground	1927	294.32	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-434	Underground	1927	294.32	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-435	Underground	1927	294.32	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-436	Underground	1927	294.32	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-437	Underground	1927	294.32	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-142	Underground	1933	10.045	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-438	Underground	1933	4.65	FIDDLERS CANYON L.L.C (JACK E. JR. & PATRICIA J. MOYLE)
71-141	Underground	1934	10.045	FIDDLERS CANYON L.L.C (JACK E. MOYLE)
71-584	Underground	1935	36.2	PALLADON IRON CORPORATION
71-800	Underground	1936	599.39	FIDDLERS CANYON L.L.C (JACK E. MOYLE)
71-155	Underground	1941	474.9	PALLADON IRON CORPORATION
71-1181	Underground	1945	499.8	PALLADON IRON CORPORATION
71-1197	Underground	1946	330.2	PALLADON IRON CORPORATION
71-1205	Underground	1946	116.8	PALLADON IRON CORPORATION
71-2403	Underground	1949	81.08	PALLADON IRON CORPORATION
71-801	Underground	1951	320	PALLADON IRON CORPORATION
71-4510	Underground	1900	8	PATRICK D. AND ENRIQUETA I. ROURKE
71-4521	Underground	1900	1	KENT HYRUM PRISBREY
71-15	Underground	1914	264.8	WESTERN ELECTROCHEMICAL COMPANY
71-207	Underground	1915	0.984	ROBERT RUSSELL & SHIRLEY ANN NEAL
71-3219	Underground	1922	10.9	H. WENDELL AND CARMEN C. JONES
71-580	Underground	1923	241.8	C/O JACK NELSON UNION PACIFIC RAILROAD COMPANY
71-746	Underground	1924	16.8	JONES 1990 INVESTMENT PARTNERSHIP
71-764	Underground	1925	0	GLORIA JEAN BULLOCH
71-432	Underground	1927	38.4	WESTERN ELECTROCHEMICAL COMPANY
71-785	Underground	1927	32.6	ALFRED GRANT BIEDERMAN
71-325	Abandoned Well	1928	5.6	HARRIS MAC & SCOTT LEON NELSON
71-2491	Underground	1929	5.6	GRANT R. AND FERN S. ELLSWORTH
71-131	Underground	1939	6	WESTERN ELECTROCHEMICAL COMPANY
71-3553	Underground	1939	3.2	WESTERN ELECTROCHEMICAL COMPANY
71-4348	Underground	1939	2	WESTERN ELECTROCHEMICAL COMPANY
71-3273	Underground	1941	20	ANNETHE EKMAN
71-3599	Underground	1941	1	THE MARRYAT FAMILY TRUST
71-3743	Underground	1941	2	HOWARD E. WRIGHT
71-3769	Underground	1941	2	WILLIAM YOUNG
71-3806	Underground	1941	1	LYNN R. ELAM
71-4159	Underground	1941	1	ROBERT EUGENE WARD
71-4160	Underground	1941	0.76	N. S. BRANDSTETTER
71-717	Underground	1941	291.78	CHARLES R. REEVE
71-776	Abandoned Well	1942	12.1	LEIGH LIVESTOCK COMPANY
71-1279	Underground	1943	26.1	PALLADON IRON CORPORATION
71-1176	Underground	1944	8.01	GORDON AND GLORIA BULLOCH
71-4422	Underground	1944	1	ROBERT AND JOY GESLER
71-1234	Underground	1945	10.9	PALLADON IRON CORPORATION
71-2844	Underground	1945	15.9	IRON COUNTY
71-4420	Underground	1945	1	STEWART AND JOAN SOMERVILLE
71-4421	Underground	1945	1	PAUL AIZLEY
71-914	Underground	1945	18.71	CEDAR CITY DISTRICT USA BUREAU OF LAND MANAGEMENT
71-1573	Underground	1947	12.6	HENRY WENDELL JONES TRUST
71-2843	Underground	1947	22.44	FRANK W. & CELESTIA A. NICHOLS
71-2425	Underground	1948	25.3	FRANK W. AND CELESTIA A. NICHOLS
71-2402	Underground	1949	106.4	PALLADON IRON CORPORATION
71-1162	Underground	1950	8.4	LEIGH LIVESTOCK COMPANY
71-1938	Underground	1953	160	WESTERN ELECTROCHEMICAL COMPANY
71-3810	Underground	1954	136.8	WESTERN ELECTROCHEMICAL COMPANY
71-2812	Underground	1955	10.9	USA BUREAU OF LAND MANAGEMENT
71-2813	Underground	1956	7	ROBERT S. AND DONNA JEAN W. CLARK
71-2835	Underground	1956	36.2	PALLADON IRON CORPORATION
71-2867	Underground	1962	7.25	SILVIA BUSTAMANTE
71-4277	Underground	1962	1522.75	AMPAC DEVELOPMENT COMPANY OF UTAH
71-4590	Underground	1962	1	BRUCE H. AND JUDITH LEHMAN
71-4632	Underground	1962	1	CARLYLE G. AND FONDA MARIE JOHNSON
71-4640	Underground	1962	1	TALKAD L. AND KATHLEEN M. PATHI
71-4641	Underground	1962	1	JOHN AND BARBARA SHIPP
71-4643	Underground	1962	1	CHARLOTTE PEDERSEN
71-4644	Underground	1962	0.45	GILBERT & GILBERT, L.L.C.
71-4645	Underground	1962	0.45	JAMES W. AND DANA L. DARRIN CAMPBELL
71-4646	Underground	1962	0.9	JEFFREY A. KEYES
71-4647	Underground	1962	0.45	JEANETTE MACDANIELS
71-4648	Underground	1962	0.45	JAMES W. AND DANA L. DARRIN CAMPBELL
71-4649	Underground	1962	4.5	NELSON FAMILY TRUST
71-4651	Underground	1962	11	ZAPHIROPOULOS 1992 LIVING TRUST
71-4653	Underground	1962	1	DONALD E. AND DEBRA L. BAKER
71-4654	Underground	1962	3	DIXIE CABLE SERVICES
71-4655	Underground	1962	1	DONALD E. AND DEBRA L. BAKER
71-4656	Underground	1962	2.7	MARK. A. CARROLL
71-4671	Underground	1962	4	DONALD E. & DEBRA L. BAKER
71-4696	Underground	1962	0.65	JACK L. & ANNA M. DOYLE
71-4717	Underground	1962	1	CRAG-JORGENSEN L.L.C.
71-4889	Underground	1962	4.05	CERVANDO GONZALES
71-4893	Underground	1962	3.15	BERNARD MENAKER
71-2479	Underground	1963	5.768	ROBERT S. AND DONNA JEAN W. CLARK

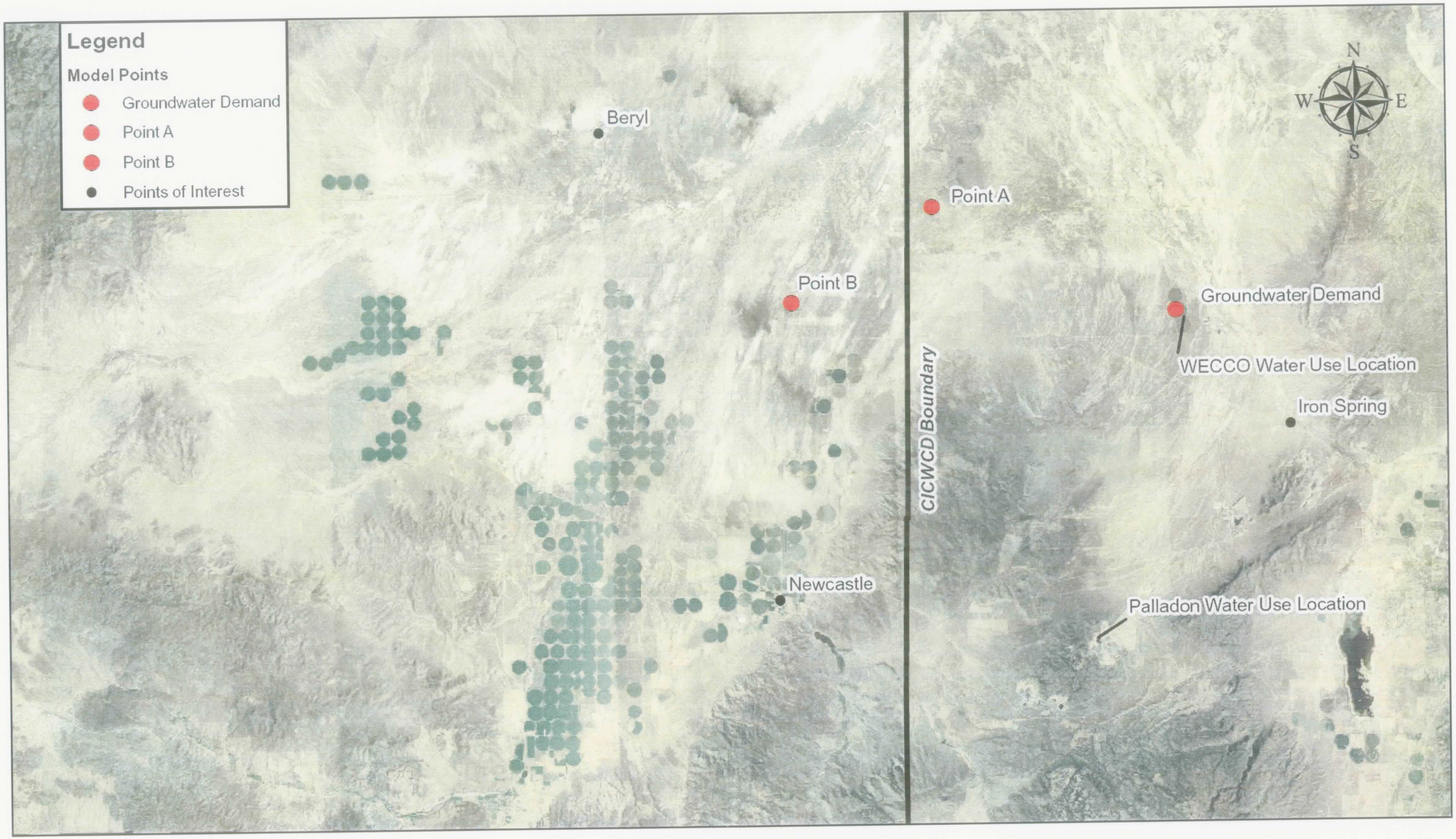

Figure 1
Map of the Beryl-Enterprise Area
Including GMS Monitoring Points Used over a 40-year Period

NOLTE
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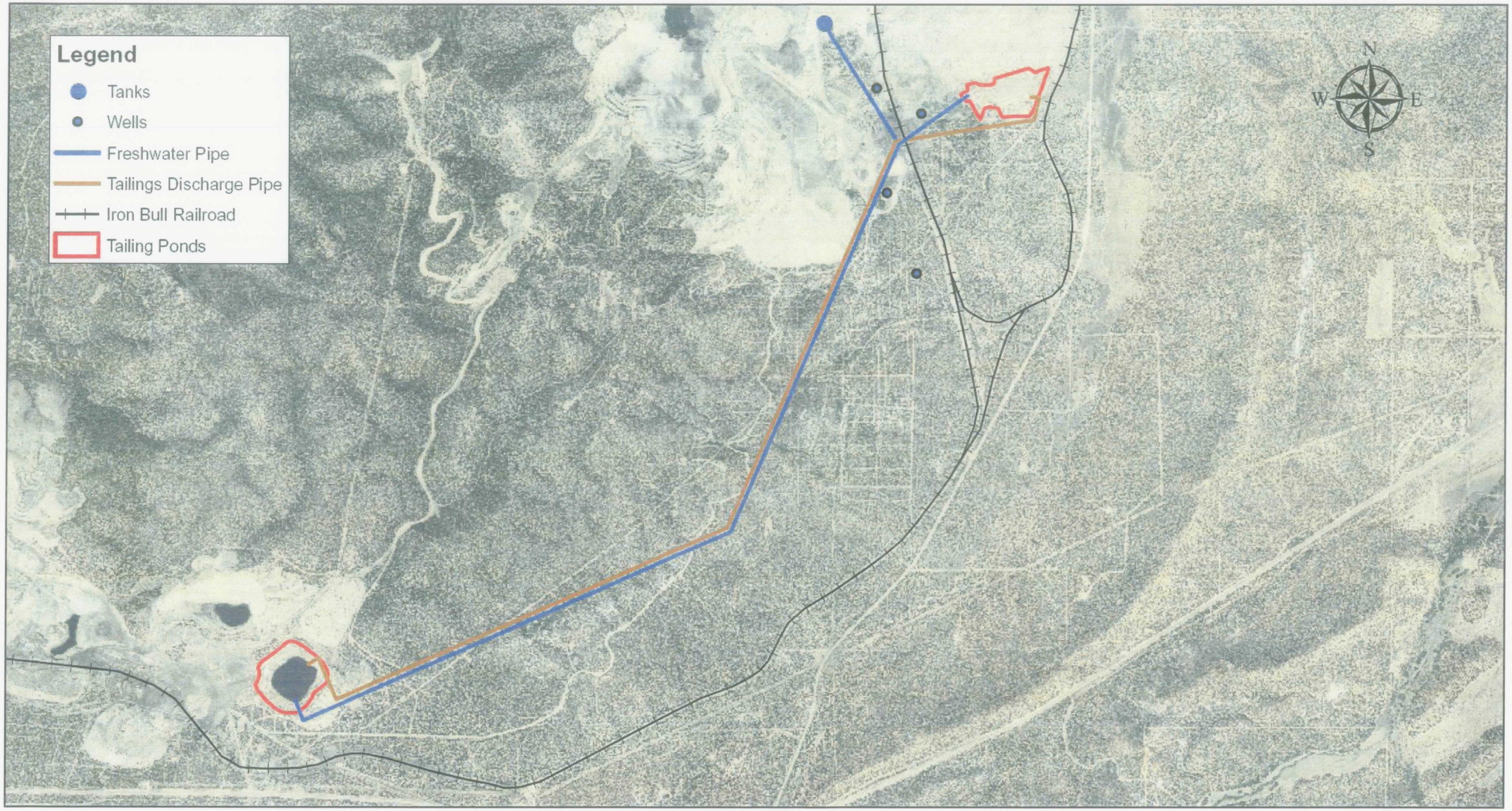
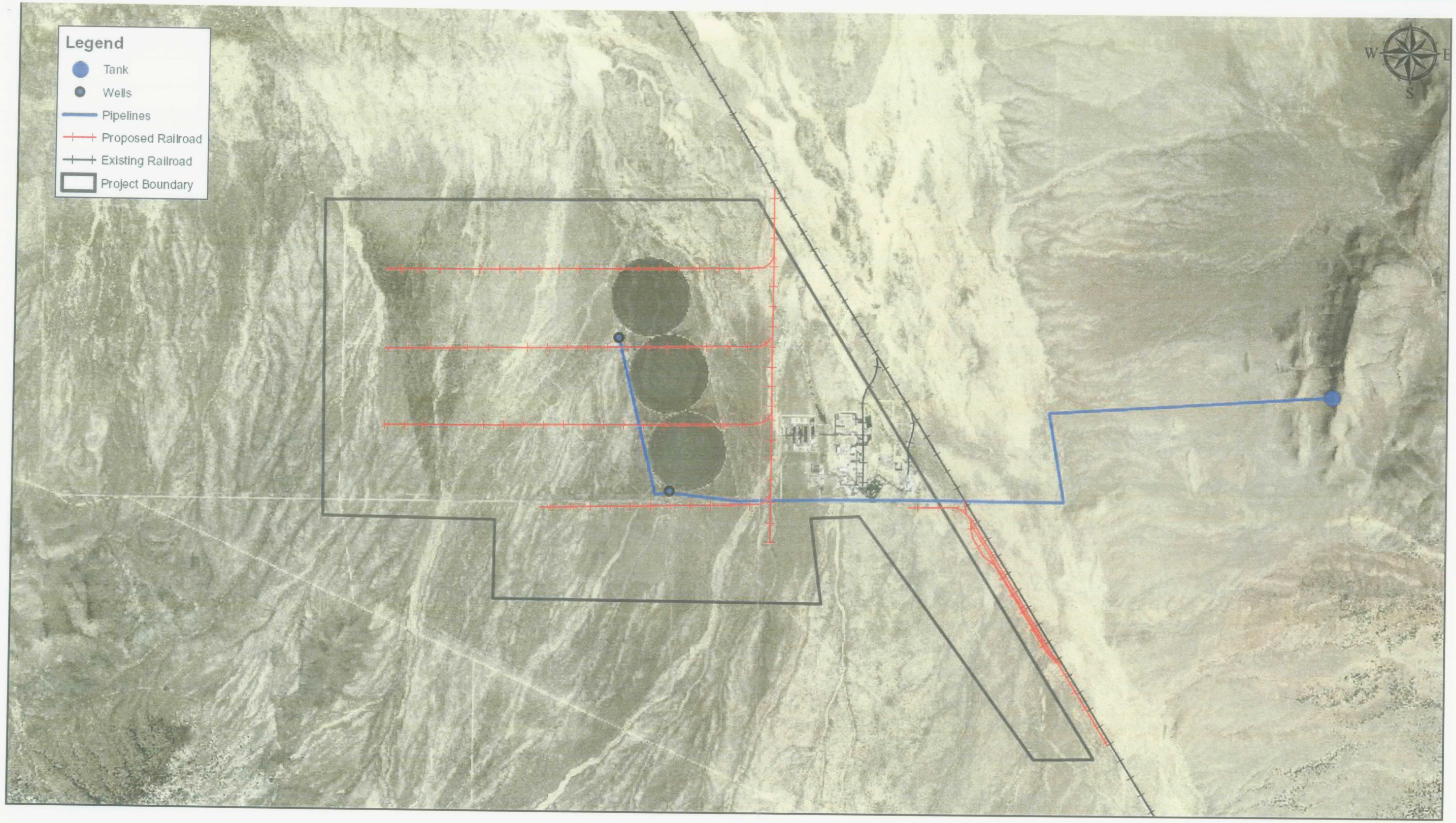


Future Palladon Water System

NOLTE
BEYOND ENGINEERING



Future WECCO Water System

NOLTE
BEYOND ENGINEERING

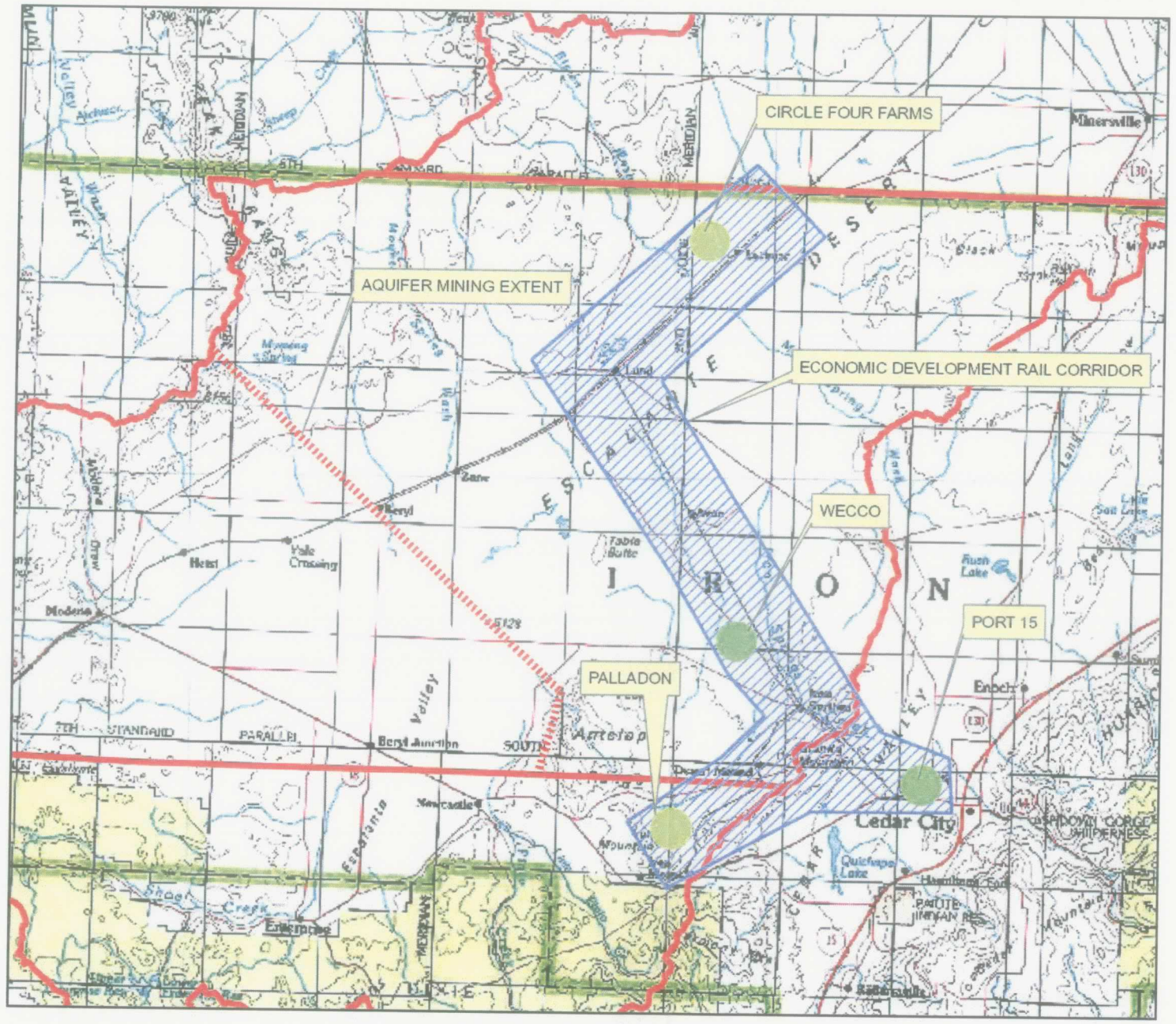


Figure 4
Economic Development Area

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