RU 220

AN EVALUATION OF NONPOINT SOURCE POLLUTION RISKS FROM ON-SITE WASTEWATER SYSTEMS IN THE FRANKTOWN PLANNING AREA

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August 2003

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List of Acronyms and Abbreviations

AWT	Advanced Wastewater Treatment
CCBWQA	Cherry Creek Basin Water Quality Authority
CDPHE	Colorado Department of Public Health and Environment
CRS	
DRCOG	Denver Regional Council of Governments
EPA	United States Environmental Protection Agency
gpd/ft	gallons per day per foot
ISDS	Individual Sewage Disposal Systems
lbs	pounds
mg/L	milligram per liter
OWS	On-site Wastewater Systems
Pinery	Pinery Water and Sanitation District
STE	Septic Tank Effluent
TMAL	Total Maximum Annual Load
Tri-County	Tri-County Health Department
UDFCD	Urban Drainage and Flood Control District
USGS	United States Geological Survey
WHP	Wellhead Protection Program
WQCC	Water Quality Control Commission

At the request of Douglas County, URS was retained to provide *"An Evaluation of Nonpoint Source Pollution Risks from On-Site Wastewater Systems (OWS') in the Franktown Planning Area"*. Three future development scenarios were compared to evaluate the nonpoint pollution risk from OWS', including the risk to downstream drinking water supplies located in the Cherry Creek alluvium. Considerable existing studies and research on OWS' provided the foundation to these evaluations. The three evaluation scenarios were identified as part of the Douglas County Franktown Sub-Area Plan Revision process and differ in the number of residential dwellings, square-footage of commercial development, service by public sanitary sewer or OWS and/or public water supply service.

As described in Section 4, the study evaluation resulted in the following conclusions:

- **Potential long-term impacts of Franktown OWS' in environmentally sensitive areas, including the Cherry Creek floodplain, alluvium, and stream preservation areas are substantial.**
- **Conventional wastewater treatment options result in less nonpoint pollution risk.**
- **There is a role for appropriately sited designed, constructed, operated and maintained OWS in outlying areas of Franktown.**
- **Pumping and hauling septage from existing, aged OWS' to an adjacent wastewater treatment facility is not an appropriate long-term water quality treatment option.**

Based on the aforementioned conclusions, the following recommendations are described in Section 4.

- **Nonpoint pollution risk in the Franktown Village Core Area should be minimized by phasing out OWS use in this area and converting to conventional wastewater treatment.**
- **Evaluate funding options for conversion of the Franktown Village Core Area OWS' to conventional wastewater treatment.**

1.1 INTRODUCTION AND OVERVIEW

URS was retained by Douglas County to examine and compare the extent of the nonpoint pollution risk from on-site wastewater systems (OWS'), (commonly referred to in previous studies and discussions as individual sewage disposal systems (ISDS) or septic systems) to water quality in the Cherry Creek Watershed. The Franktown Planning area lies within the Cherry Creek Basin, an environmentally sensitive watershed recognized by the Colorado Water Quality Control Commission (WQCC) and United States Environmental Protection Agency (EPA). As such, special consideration must be given to the impacts of future development, potential proliferation of OWS', wastewater issues, water quality, and source water protection of drinking water supplies. This study evaluated potential water quality impacts from existing and future development in the Franktown Planning Area.

Three future development scenarios were compared to evaluate the nonpoint pollution risk from OWS', including the risk to downstream drinking water supplies located in the Cherry Creek alluvium. The three evaluation scenarios were identified as part of the Douglas County Franktown Sub-area Plan Revision process and differ in the number of residential dwellings, square-footage of commercial development, service by public sanitary sewer or OWS and/or public water supply service. The three scenarios are summarized as follows:

Scenario a

Additional development in the Franktown Village Core Area served by public sanitary sewer and water. Such development will ultimately include an additional 1,125 residential dwelling units and 235,000 commercial square feet. Assume an additional 25 residential dwelling units and 25,000 commercial square feet in the Cherry Creek alluvium, as well as 200 single-family dwellings on large lots scattered throughout the rural Franktown area served by OWS and well. Assume all existing development in the core area will hook up to public sanitary sewer and water.

Scenario b

Additional development in the Franktown Village Core Area served by public sanitary sewer, but with no public water supply. Such development will ultimately include an additional 225 residential dwelling units and 235,000 commercial square feet. Assume an additional 25 residential dwelling units and 25,000 commercial square feet in the Cherry Creek alluvium, as well as 200 single-family dwellings on large lots scattered throughout the rural Franktown area served by OWS and well. Assume all existing development in the core area will hook up to public sanitary sewer and water.

Scenario c

Additional development in the Cherry Creek alluvium within the Franktown Planning Area served only by OWS and well. Such development may include an additional 25 residential dwellings and 25,000 commercial square feet (note: commercial uses are limited to those with low water and sanitary sewer requirements). Also assume an additional 200 single-family dwellings on large lots scattered throughout the rural Franktown area served by OWS and well.

Water quality impacts from OWS' are occurring in a number of specific areas in Colorado, particularly where OWS' are sited at or near urban densities (Denver Regional Council of Governments [DRCOG], 1999). The impacts associated with the three aforementioned scenarios are of particular interest due to the nonpoint pollution risk that may result from the potential long-term impacts of OWS' in the Cherry Creek Watershed, including the Franktown Planning Area and other downstream municipalities.

2.1 STUDY AREA

The Franktown Planning area lies within the Cherry Creek Watershed, approximately 17 miles south of the widely recreated Cherry Creek Reservoir and 2 miles south of the Pinery Water and Sanitation District (Figure 2-1). Over 75 residential and commercial OWS' are currently located within the core Franktown planning area (Douglas County, 2002). From a national perspective, the Cherry Creek Basin has been recognized as an environmentally vulnerable watershed due to the phosphorus impacts on water quality in Cherry Creek Reservoir (WQCC, 2001).

2.2 WATER QUALITY ISSUES

Water quality has been on the forefront of issues in the Cherry Creek Watershed for nearly two decades. The most significant watershed issue is that of point and nonpoint source control of phosphorus in the Cherry Creek Basin and reducing phosphorus and chlorophyll a concentrations in the extensively used Cherry Creek Reservoir. The Cherry Creek Control Regulation (5 CCR 1002-72) sets forth the basic elements of the Total Maximum Annual Load (TMAL) and point and nonpoint source reduction strategies.

This section provides an overview of key water quality issues within the Cherry Creek Basin, including water quality impairment in the Cherry Creek Basin, on-site wastewater and disposal systems, conventional wastewater treatment in the Cherry Creek Basin, and source water protection of drinking water supplies in the Cherry Creek alluvium.

2.2.1 Water Quality Impairment in the Cherry Creek Basin

The chlorophyll a standard of 15 µg/l and the phosphorus goal of 40 µg/l were established by the Colorado Water Quality Control Commission (WQCC) to protect the aquatic life and recreational uses of the reservoir. These standards and goals have not been met. The Cherry Creek mainstem upstream of the reservoir is "Use Protected" and classified for the following uses: Recreation, Class 2; Aquatic Life, Class 2; Agriculture; Water Supply (WQCC, 2002). Segment 1 of Cherry Creek is listed on the State of Colorado's 2002 "303(d) List of Impaired Waterbodies" for phosphorus. Pursuant to the 2001 Cherry Creek Control Regulation, the TMAL of phosphorus shall be implemented under a phased approach consistent with EPA guidance until further studies support development of a new TMAL (WQCC, 2001). The evolving phased TMAL of 14,270 pounds includes the following annual mass loads of phosphorus from these sources annually:

- Nonpoint and Regulated Stormwater Sources — 10,290 Pounds/Year
- Background Sources — 1,170 Pounds/Year
- Wastewater Facilities — 2,310 Pounds/Year
- Industrial Process Wastewater — 50 Pounds/Year
- On-site Wastewater and Disposal Systems — 450 Pounds/Year

Seven specific wastewater facilities have been authorized as centralized wastewater service providers in the Cherry Creek Control Regulation and Cherry Creek Basin Master Plan (DRCOG, 1985):

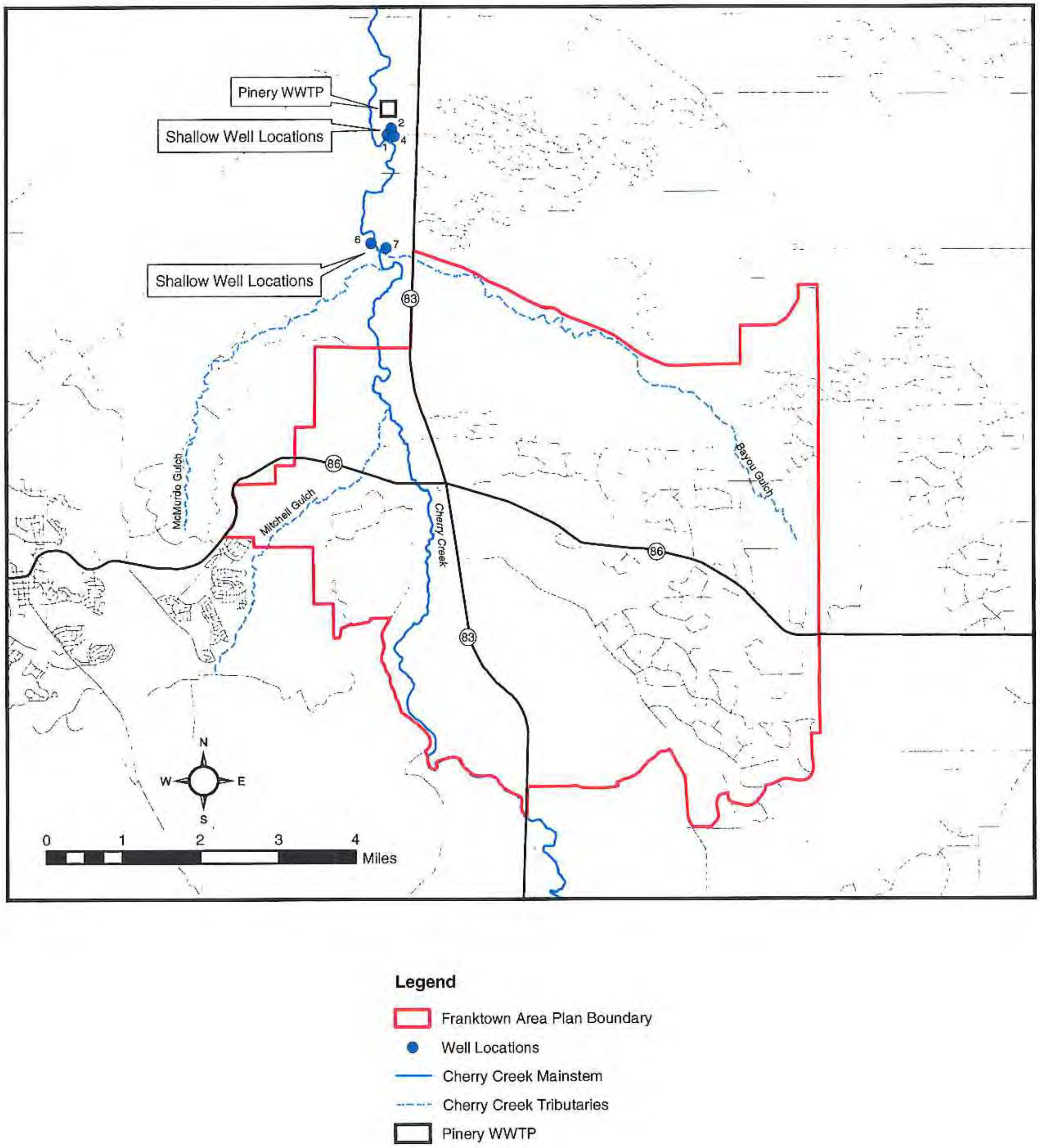

Figure 2-1

General Location Map

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1. Arapahoe County Water and Wastewater Authority,
2. Cottonwood Water and Sanitation District,
3. Pinery Water and Sanitation District,
4. Inverness Water and Sanitation District,
5. Meridian Water and Sanitation District,
6. Parker Water and Sanitation District, and
7. Stonegate Village Metropolitan District.

In order to meet the established water quality standards and to preserve the beneficial uses of the reservoir, the Cherry Creek Basin Water Quality Authority (CCBWQA), comprised of elected and governor appointed representatives within the Cherry Creek Basin, have committed to implement water quality management strategies for the watershed. These strategies complement the development and implementation of the phosphorus TMAL and support comprehensive water quality improvement in the Cherry Creek Basin.

For water quality purposes, the CCBWQA has identified *"Stream Preservation Areas"* within the Cherry Creek Watershed as special lands requiring additional levels of water quality protection (CCBWQA, 2000). Stream preservation areas include those areas within the Cherry Creek Basin that transport a higher percentage of stormwater runoff and nonpoint source pollutants to the water system and Reservoir, including:

- All direct flow sub-basins to the Reservoir,
- All of Cherry Creek State Park,
- Drainage discharged to the Park within 100 feet of the Park boundary,
- Lands overlying the Cherry Creek alluvium, and
- All lands within the 100-year floodplain, as defined by the Urban Drainage and Flood Control District (UDFCD).

2.2.2 On-site Wastewater Treatment and Disposal Systems (OWS)

The primary water quality issues associated with OWS use is the accumulative amount of phosphorus and nitrogen species reaching waterbodies and the high threat of pathogenic bacteria contamination of groundwater (EPA, 1977). Cumulative phosphorus and nitrogen loading from OWS' can be a significant nonpoint nutrient contributor in urbanized watersheds (DRCOG, 1999). In Colorado, OWS' are regulated by the Individual Sewage Disposal Systems Act (CRS 25-10-101) and play a role in water quality management in the watershed (Appendix A). The State Board of Health is responsible for the adoption of statewide guidelines and rules governing OWS' (DRCOG, 1999). An OWS provides wastewater treatment and disposal, primarily for individual homes (as well as some commercial and businesses), in those areas primarily considered rural or large lot (greater than five acres) where central sewer systems and wastewater treatment plants do not provide service.

Issues have been raised regarding potential water quality impacts from OWS' and the adequacy of current efforts to minimize such impacts, particularly as growth has led to a rapid proliferation of OWS' in some portions of Colorado. One-fourth of the population in Colorado is served by such systems, rather than by centralized wastewater treatment (Colorado Department of Public Health and Environment [CDPHE], 2002). It is estimated that there are currently over 600,000 OWS' in the state, with roughly 7,000 to 8,000 permits issued each year. Pursuant to state statute, the State Board of Health has adopted guidelines on OWS'. The guidelines establish minimum standards for location, construction, performance, installation, alteration and use of OWS'. These guidelines are implemented principally through rules and regulations adopted by local Boards of Health (CDPHE, 2002). The CCBWQA has addressed installation of OWS' in the Cherry Creek Watershed and does not allow for construction of OWS' in stream preservation areas due to potential water quality impacts (CCBWQA, 2000).

The Tri-County Health Department (Tri-County) is the local health department with jurisdiction on OWS issues in Douglas County. Tables 2-1a and 2-1b summarize the evolutionary nature of Tri-County's OWS regulations over the past 35 years. Prior to 1973, there were no minimum standards or regulatory requirements for OWS'. According to Douglas County and Tri-County data, there are an estimated 174 OWS' located within the vicinity of Cherry Creek in the Franktown Planning Area (Appendix B), many of which were installed prior to 1950, some even installed in the 1800's (Douglas County, 2002).

Typically, OWS' have septic tank effluent or drainfield influent phosphorus concentrations ranging from 4 milligrams per liter (mg/L) to 90 mg/L with a mean concentration of about 15 mg/L (EPA, 1977). In the Cherry Creek Basin, influent data has characterized total phosphorus concentrations to an average of 10 mg/L. In OWS', phosphorus is typically fixed in soil by sorption reactions or as phosphate precipitates of calcium, iron or aluminum. Generally speaking, the greater the distance from the waterbody the greater the potential for total phosphorus removal. The type of soil will affect the phosphorus sorption reaction with clays and silts generally having better adsorption characteristics (DRCOG, 1999). Phosphorus can leak into either the underlying groundwater system or adjacent waterways, where systems have been built in areas of coarse sand, gravel and alluvial soils or where surface malfunctions have occurred because of heavy hydraulic loading. Total phosphorus concentrations over 5 mg/L have been measured under these circumstances (EPA, 1977). From a national perspective, the phosphorus removal efficiency of more sophisticated, recent technology OWS' (including recirculating sand filter systems), can be as high as 95% effective in appropriate conditions and soil types. Studies in Colorado have documented phosphorous removal in the range of 20% to 42%, averaging 28% (Van Cuyk, 2001).

Nitrogen concentrations of OWS influent are 40 to 60 mg/L. Recent ammonia (a form of nitrogen) concentrations were characterized at the Parker Water and Sanitation District and averaged 27 mg/L. OWS' do not provide effective nitrogen removal, with documented removal efficiencies ranging from 25% to 50% (DRCOG, 1999). Recirculating sand filter systems report total nitrogen performance of 40% to 50% removal. Van Cuyk (2001) recently completed extensive studies at the Colorado School of Mines documenting OWS treatment effectiveness. These studies documented an average of 6% nitrogen removal for OWS'.

2.2.3 Conventional Wastewater Treatment

Conventional wastewater treatment in the Cherry Creek Basin is extensively regulated, with wastewater treatment facilities meeting some of the most stringent phosphorus reduction

Table 2-1a

Tri-County Health Department
Summary of Requirements for ISDS'

Regulation and Effective Date	Soils Test Required?	Percolation Test Required?	Setbacks? (e.g. minimum distance between well leachfield, etc.)	Minimum Sizing Requirements For Absorption Areas ("leachfields") Conventional (non-engineered systems) (Percolation Rates less than 5 mpi or greater than 60 mpi require an engineered system)
2-69 (3/11/69)	No	No	No	none
I-72 (4/11/72)	No	No	No	none
I-73 (10/1/73)	Yes	Yes	Yes	Based on percolation rate from 5 minutes per inch (mpi) to 60 mpi, square feet per bedroom, in increments of 5 mpi (See Table #2)
I-80 (5/16/80)	Yes	Yes	Yes	Based on percolation rate from 5 minutes per inch (mpi) to 60 mpi, square feet per bedroom, in increments of 5 mpi (See Table #2)
I-85 (12/1/85)	Yes	Yes	Yes	Based on percolation rate from 5 minutes per inch (mpi) to 60 mpi, square feet per bedroom, in increments of 5 mpi (See Table #2)
I-88 (2/1/88)	Yes	Yes	Yes	Based on percolation rate from 5 to 60 mpi, square feet per bedroom in three categories (5-20 mpi, 21-40 mpi and 41-60 mpi)
I-96 (6/3/96)	Yes	Yes	Yes	Based on percolation rate from 5 to 60 mpi, square feet per bedroom in three categories (5-20mpi, 21-40 mpi and 41-60 mpi)
I-02 (6/3/02)	Yes	Yes	Yes	Based on percolation rate from 5 to 60 mpi, square feet per bedroom in three categories (5-20mpi, 21-40 mpi and 41-60 mpi)

Table 2-1b

Tri-County Health Department
Summary of Sizing Requirements for Conventional (Non-Engineered) Absorption Area, Based on Regulation

Percolation Rate (minutes per inch)	Per Bedroom Minimum Soil Absorption Area (square feet) Regulations I-73, I-80, I-85	Per Bedroom Minimum Soil Absorption Area (square feet) Regulations I-88, I-96 and I-02
5	165	325
10	225	325
15	275	325
20	325	325
25	365	450
30	400	450
35	425	450
40	450	450
45	475	560
50	500	560
55	525	560
60	550	560

requirements nationally. Water and sanitation districts (Districts) within the basin have implemented sophisticated treatment technologies to reduce point source contributions. Similarly, the Districts and municipalities have worked aggressively to address nonpoint source controls in the adoption and implementation of the "*Cherry Creek Reservoir Watershed Stormwater Quality Requirements*" (CCBWQA, 2000) and Cherry Creek Control Regulation. The point source controls for phosphorus reduction include advanced wastewater treatment (AWT) processes, such as the addition of chemicals (aluminum sulfate or ferric chloride) to precipitate phosphorus.

At the 2000 WQCC hearing, wasteload allocations were set at levels based on the design capacity that is expected to serve the respective service area until the 2007 to 2010 timeframe, reasonably available treatment technology, and the fact that water quality standards are not currently being met. The wasteload allocations were also based on a maximum allowable effluent concentration of 0.05 mg/L total phosphorous. The Control Regulation states that, "by no later than August 1, 2004, no direct discharger within the Cherry Creek Watershed shall discharge an effluent with a total phosphorus concentration greater than 0.05 mg/L total phosphorus as a 30-day average". Each District is limited to an annual wasteload allocation of total phosphorus as specified in the Control Regulation. Wastewater treatment facilities in the basin also provide significant nitrogen removal – typically greater than 95% removal of nitrogen species.

2.2.4 Source Water Protection of Drinking Water Supplies

Based on nationwide research and published reports, the most serious threat to groundwater drinking supplies is caused by the movement of pathogenic bacteria and/or viruses from OWS'. The movement of nitrate into groundwater from on-site systems also poses a potential health risk, as OWS' are very ineffective in the removal of nitrogen (Van Cuyk, 2001). While phosphorus is generally bound by soil systems, some fractured bedrock, sand and gravel areas (such as that identified in the vicinity of the Cherry Creek floodplain) transport phosphorus from on-site systems directly into surface or groundwater (DRCOG, 1999).

Source water protection is critical in the Cherry Creek Watershed, given the extensive drinking water use of the alluvial groundwater and the decades it would take to self-flush tainted groundwater from the system. Recent studies completed in cooperation with the United States Geological Survey (USGS), the CDPHE, the EPA, and the United States Soil Conservation Service assessed the vulnerability of the shallow groundwater resources in the greater Denver area (Water Resources Investigation Report 92-4143). According to the study, the alluvial aquifer is vulnerable to contamination because of the shallow depth of groundwater and the transmissive nature of the alluvial aquifer sediments. Therefore, a contaminant introduced at the surface can easily enter the aquifer system, is not likely to be attenuated or dispersed significantly, and will move rapidly away from the point of entry in a relatively short period of time.

2.3 PREVIOUS WATER QUALITY AND OWS STUDIES

Numerous OWS' are located in the Cherry Creek Basin and the uplands adjacent to the basin. Several studies that document the water quality and impact of OWS' have been performed and will provide a foundation to this evaluation.

2.3.1 State of Colorado OWS Steering Committee

In 1999, the Governor of Colorado requested the Colorado Board of Health and WQCC convene an OWS Steering Committee to address critical water quality issues that have resulted from the proliferation of OWS' in Colorado. The OWS Steering Committee identified higher water quality risk when OWS' have the following five characteristics:

1. Present in high numbers and density,
2. Present in areas served by privately owned drinking water wells that are shallow or poorly constructed,
3. Improperly sited, particularly in sensitive environments,
4. Installed prior to 1973, when uniform design and siting standards were first established, and
5. Inappropriate or inadequate design, installation, operation, and maintenance.

The recommendations from the steering committee included the following:

- Establish new OWS performance criteria so a performance-based OWS program can achieve adequate protection of public health and water quality,
- Enhance local programs, including authorization for local governments to implement OWS renewable permits,
- Provide more state leadership on OWS issues and authorize resources for one full-time employee to provide state level leadership,
- Develop model management strategies, including system inventory and maintenance needs, operating permits, and utility ownership and management, and
- Advance education and training efforts and address ongoing OWS research needs.

As recommended by the Steering Committee, an effective OWS program needs to be performance-based. That is, there is a need to identify the levels of performance that OWS' should be expected to achieve in order to provide adequate protection of public health and water quality. In contrast, the existing Colorado program is based on specific design requirements that are focused primarily on disposal of wastewater rather than treatment. OWS' need to provide long-term solutions to wastewater management in those areas where they exist, and will continue to exist (CDPHE, 2002).

Appropriate performance criteria may vary by location, depending on different receiving environments. However, the overall management strategy needs to define such criteria to provide a target or reference point for formulating the other elements of program and assessing their success.

2.3.2 Tri-County Health Department Studies

In order to implement the recommendations of the 1985 Cherry Creek Watershed Master Plan, Tri-County proposed a phased study approach to determine phosphorus contributions to Cherry Creek Reservoir from OWS'. Phase 1 of the study provided a 1987 assessment of present and future phosphorus contributions to Cherry Creek Reservoir from OWS'. The preliminary assessment was based upon existing data relative to basin soils, geology, and hydrology and did not include any on-site field investigations or laboratory testing. The loading projections were obtained by:

1. Utilizing existing data to assign basin soils a Phosphorus Removal Classification,
2. Projecting probable ranges of phosphorus removal for each soil type,
3. Determining the approximate number of present and future residences in each soil classification, and
4. Estimating present and future loads.

2.3.3 Denver Regional Council of Governments OWS Task Force

The OWS Task Force identified significant issues and problems associated with OWS programs and recommended potential solutions. The OWS Task Force developed and evaluated pilot load studies in selected watersheds to ascertain pollutant risks and water quality issues. The OWS Task Force recommendations focused on the following four categories:

1. Problem identification – Constituents of concern and extent of problem areas in Colorado.
2. Growth and development – Appropriate setbacks, minimum lot sizes, registration of existing OWS', and permitting.
3. System Performance – Operation and maintenance of the OWS', homeowner responsibilities, education, and inspection.
4. Information and Technology – Alternate technologies, alternate development patterns, and record-keeping processes.

2.3.4 Cherry Creek Basin Water Quality Authority

In 1997, the CCBWQA authorized John C. Halepaska and Associates, Inc. to conduct a one-year study to evaluate the potential impacts on water quality in the Upper Cherry Creek Basin and/or to Cherry Creek Reservoir as a result of development of large-lot homes which utilize OWS'. These OWS' generally discharge water into alluvial/co-alluvial soils in the near-surface profile. This study provided additional information regarding potential water quality impacts from nonpoint sources along two sub-drainages of Cherry Creek, Bayou Gulch and Baldwin Gulch. The study found nitrogen-nitrate loads relatively elevated in Baldwin Gulch, which could be attributable to OWS' in this drainage (CCBWQA, 2000).

2.3.5 Pinery Water and Sanitation District Source Water Protection Studies

The Pinery Water and Sanitation District's (Pinery) drinking water supply is obtained from both deep Denver Basin aquifer wells and shallow wells completed within the Cherry Creek alluvial aquifer system. Shallow alluvial water supply wells typically produce water that is in close contact to the surface. As a result, groundwater supplies not only require protection from contamination in the immediate vicinity of the wellhead, but also require large surface areas beneath which protection is needed.

The initial phase of the Pinery study provided a general understanding of the hydrogeology of the Cherry Creek Alluvial System in the vicinity of the Pinery and the Pinery wellfield operations and well ownership in the study area. Data needs were identified relative to the development of the Pinery's wellhead protection program (WHP).

According to alluvial well information obtained from the Pinery's files, the average alluvial thickness is approximately 61 feet and thickness generally decreases with distance away from the creek bed. For the wells where transmissivity values were reported, fairly high values were indicated with the average value being 90,000 gallons per day per foot (gpd/ft). The high transmissivity values indicate that at the locations tested, the aquifer sediments are quite permeable.

Subsequent phases of the Pinery study included development of a Groundwater Protection Program geared toward protection of the District's drinking water supplies from potential contamination. The wellhead protection area delineation included a vulnerability analysis and contaminant inventory. An assessment of the vulnerability of the alluvial aquifer to contamination indicated that due to the shallow depth to groundwater and the transmissive nature of the alluvial aquifer sediments, a contaminant introduced upstream of the supply can easily enter the aquifer system and will move rapidly away from the point-of-entry in a relatively short period of time. As a result, protection of the alluvial water supply should focus on the management of the surface areas beneath which the waters are derived.

2.3.6 Colorado School of Mines OWS Research

In 2001 a team of researchers at the Colorado School of Mines performed a study to characterize the hydraulic and purification behaviors and their interactions during wastewater treatment in soil infiltration systems. Four three-dimensional lysimeters were established in a pilot laboratory. Each lysimeter was dosed four times daily with septic tank effluent (STE). Weekly monitoring was performed to characterize the STE. Bromide tracer tests were completed at weeks 0, 8, and 45. After 48 weeks, soil cores were collected and analyzed for chemical and microbial properties. It was found that the nitrogen removal treatment efficiency ranged from 3% to 11%, with an average removal of 6%. Ammonia removal treatment efficiency was on the order of 100%. This efficiency was gained after a 10-week period in which the ammonia fully converted to nitrate. Phosphorous removal treatment efficiency ranged from 20% to 42%, with an average removal of 28%.

As part of this study, the existing and long-term nonpoint source pollution impacts from OWS development in the Franktown Planning Area on water quality of Cherry Creek and the alluvium were evaluated.

3.1 EVALUATION APPROACH AND ASSUMPTIONS

Similar to the study performed by Tri-County (in conjunction with Dr. Thomas C. Peterson), the approach taken to evaluate the nonpoint pollution risk of three different OWS development scenarios within the vicinity of Cherry Creek in the Franktown Planning Area considers soil type and accounts for the phosphorus removal classification referenced in Tri-County studies (Tri-County, 1985). Ground and surface water quality data and approximate number of existing and future residences are also taken into account.

For purposes of this evaluation, several assumptions were made, which include:

- 2.5 people per residential dwelling unit,
- 100 square feet per person as it applies to future commercial development,
- 20 people per business as it applies to existing commercial development,
- 75 gal/day/person as an average residential effluent flow,
- 50 gal/day/person as an average commercial effluent flow, .
- 27 mg/L average Ammonia concentration of influent,
- 65 mg/L average Total Nitrogen concentration of influent,
- 10 mg/L average Total Phosphorous concentration of influent,
- Soil Hydrologic Group Loading:
  - 45% unretained (i.e. reaches the alluvial groundwater) Phosphorous and Nitrogen for OWS' in the floodplain, alluvium, and stream preservation areas.
  - 25% unretained (i.e. reaches the alluvial groundwater) Phosphorous and Nitrogen for OWS' in soil hydrologic group B.
  - 10% unretained (i.e. reaches the alluvial groundwater) Phosphorous and Nitrogen for OWS' in soil hydrologic group C.
- 28% Phosphorous removal efficiency for future OWS',
- 6% Nitrogen removal efficiency for future OWS',
- 18% Phosphorous removal efficiency for existing OWS', and
- 5% Nitrogen removal efficiency for existing OWS'.

3.2 EXISTING OWS ANALYSIS

Figure 3-1 identifies existing OWS' within the Franktown Planning Area, including failed OWS', and the different soil types within this region. Appendix B summarizes existing OWS' in the planning area. The information contained in Appendix B includes the land use, location and

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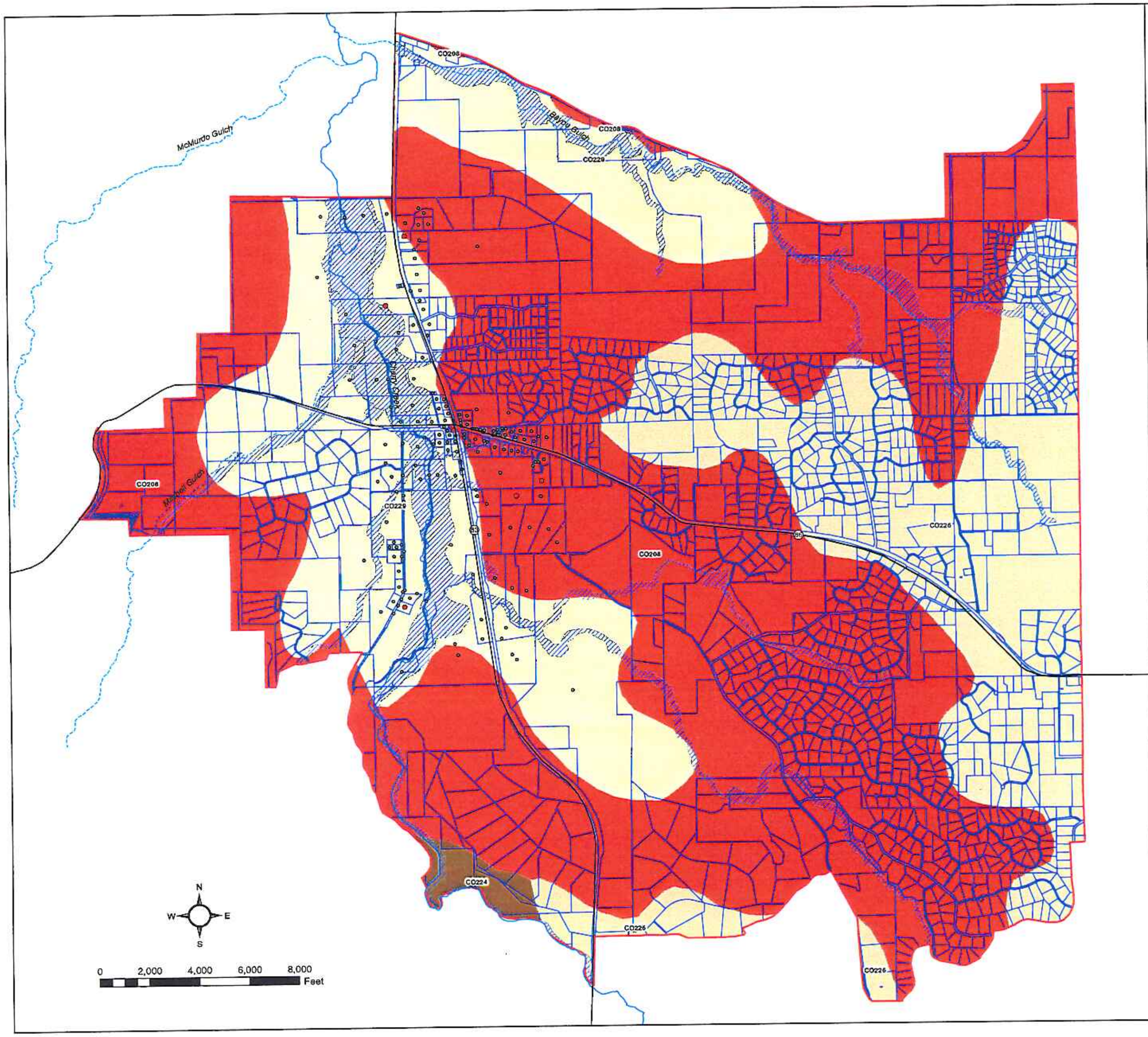

Figure 3-1

Existing On-site Wastewater Systems (OWS) in Franktown Planning Area

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the year built for each existing OWS'. In addition to the existing OWS' found in Appendix B, 1,125 additional OWS', based on 2000 census data, as well as 27 businesses and 1 school were evaluated for Franktown's outlying areas. Table 3-1 summarizes the results of the evaluation. Based on information obtained from Douglas County staff, the analysis accounted for 100 residential dwelling units and 20 commercial properties in the Cherry Creek alluvium within the Franktown Planning Area and 1,125 residential dwelling units, 27 businesses and 1 school in the outlying areas of the Franktown Planning Area.

The combined residential and commercial annual phosphorous loading was 1,184 pounds for residences and businesses in the Cherry Creek alluvium within the Franktown Planning Area. Assuming 18% removal efficiency for the existing OWS', the resultant annual phosphorous loading was reduced to 971 pounds. A soil hydrologic group loading factor of 45% was applied based upon location of the OWS' in the alluvium (soil group A) resulting in an annual phosphorous load of 437 pounds. Existing OWS' in the vicinity of the Cherry Creek alluvium and floodplain provide a high nonpoint source pollution risk.

The combined residential and commercial annual nitrogen loading was 7,695 pounds. Assuming 5% removal efficiency for the existing OWS', the resultant annual nitrogen loading was reduced to 7,310 pounds. Again, a soil hydrologic group loading factor of 45% was applied based on the proximity to the floodplain, therefore resulting in an annual nitrogen load of 3,290 pounds.

Based on 2000 census data, an estimated 1,125 households are located in outlying areas of Franktown. Based on information from Douglas County staff, it is estimated that 27 businesses and 1 school, served by OWS' exist in outlying areas of the Franktown Planning Area. The vast majority of these homes and businesses are located in soil group B and rely on OWS' for treatment of wastewater. Including a soil hydrologic group loading factor of 25% based on the properties of soil group B, the annual phosphorus loading from these rural residences is estimated at 1,610 pounds. The annual nitrogen loading from these rural residences and businesses, including the same soil group B hydrologic group loading factor is estimated at 11,960 pounds. It should be emphasized that while these loads are quite high, the nonpoint source pollution risk from these outlying areas is very low due to a number of factors, including the soil type in these areas, greater distance from stream preservation areas (i.e. alluvium, floodplain, and Cherry Creek Reservoir), and the extensive assimilation of phosphorus and nitrogen that occurs in the hydrologic/soil system.

3.3 FUTURE OWS ANALYSIS

Three future development scenarios were compared to evaluate the nonpoint pollution risk from OWS', including the risk to downstream drinking water supplies located in the Cherry Creek Alluvium. The three evaluation scenarios (Scenarios "a", "b" and "c") were identified as part of the Douglas County Franktown Sub-area Plan Revision process and differ in the number of residential dwellings, square-footage of commercial development, service by public sanitary sewer or OWS' and/or public water supply service. Future Douglas County land use projections provided the foundation for a long-term evaluation of OWS impacts in the Franktown Planning Area. Figure 3-2 represents future community development planning in the area and projects future OWS installation in Franktown. Table 3-2 summarizes the results of the future OWS analysis, which includes OWS' proposed in the Cherry Creek alluvium within the Franktown Planning Area and OWS' in outlying, rural areas. Generally, OWS' located in the outlying areas

Table 3-1

Existing OWS Analysis[7]

	Existing Development in Cherry Creek Alluvium served by OWS'	Existing Outlying Development served by OWS
Existing Residential Dwelling Units	100	1125
Number of people, assuming 2.5 people per household[1]	250	2813
Residential Flows (gal/day/person)[2]	75	75
Ammonia (mg/l)[3]	27	27
Residential Ammonia Loading (lb/day)	4.2	47.7
Total Nitrogen (mg/l)[4]	65	65
Residential Total Nitrogen Loading (lb/day)	10.2	114.8
Phosphorous (mg/l)[5]	10	10
Residential Phosphorous Loading (lb/day)	1.6	17.7
Annual Residential Phosphorous Loading (lb/year)	573	6444
Existing Businesses (1 school equates to 15 businesses)	20	42
Number of People, assuming 20 people per business[6]	400	840
Commercial Flows (gallons/day/employee)	50	50
Ammonia (mg/l)[3]	27	27
Commercial Ammonia Loading (lb/day)	4.5	9.5
Total Nitrogen (mg/l)[4]	65	66
Commercial Total Nitrogen Loading (lb/day)	10.9	23.2
Phosphorous (mg/l)[5]	10	11
Commercial Phosphorous Loading (lb/day)	1.7	3.9
Annual Commercial Phosphorous Loading (lb/year)	611.0	1411.4
Total Daily Phosphorous Loading (lb/day)	3.2	21.5
Total Annual Phosphorous Loading (lb/year)	1,184	7,856
Phosphorous Loading With 18% Removal (lb/year)	971	6,442
Additional Phosphorous Loading Risk Factors for Core Area (lb/year):		
OWS in the floodplain/alluvium- 45% Unretained Phosphorous[6]	437	
Additional Phosphorous Loading Risk Factors for Outlying Areas (lb/year):		
OWS in soil hydrologic group B- 25% Unretained Phosphorous[6]		1,610
Total Phosphorous Loading including Risk Factors (lb/year)	**437**	**1,610**
Total Daily Nitrogen Loading (lb/day)	21.1	138.0
Total Annual Nitrogen Loading (lb/year)	7,695	50,356
Nitrogen Loading With 5% Removal (lb/year)	7,310	47,839
Additional Nitrogen Loading Risk Factors for Core Area (lb/year):		
OWS in the floodplain/alluvium- 45% Unretained Nitrogen	3,290	
Additional Nitrogen Loading Risk Factors for Outlying Areas (lb/year):		
OWS in soil hydrologic group B- 25% Unretained Nitrogen		11,960
Total Nitrogen Loading including Risk Factors (lb/year)	**3,290**	**11,960**

~176 systems listed in Appen. B but some outside alluvium

Notes:

1 From Metro Vision 2020 Clean Water Plan: Wastewater Utility Plan Guidance, January 2001.

2 From Wastewater Engineering: Collection and Pumping of Wastewater, Metcalf & Eddy, Inc.

3 From Parker Water and Sanitation District Wastewater Utility Plan, 2002.

4 From Dr. Bob Siegrist, Colorado School of Mines.

5 From Pinery Water & Wastewater District Wastewater Utility Plan, June 2000.

6 Tri-County Health Department (Tri-county), in cooperation with Dr. Thomas C. Peterson, 1987, pp.36.

7 Evaluation of residential and commercial uses only; does not include agricultural, vacant or exempt.

8 Based on 2000 Census data.

9 27 businesses plus one school (approximately 275 enrolled- equivalent to 15 businesses) resulting in 42 businesses.

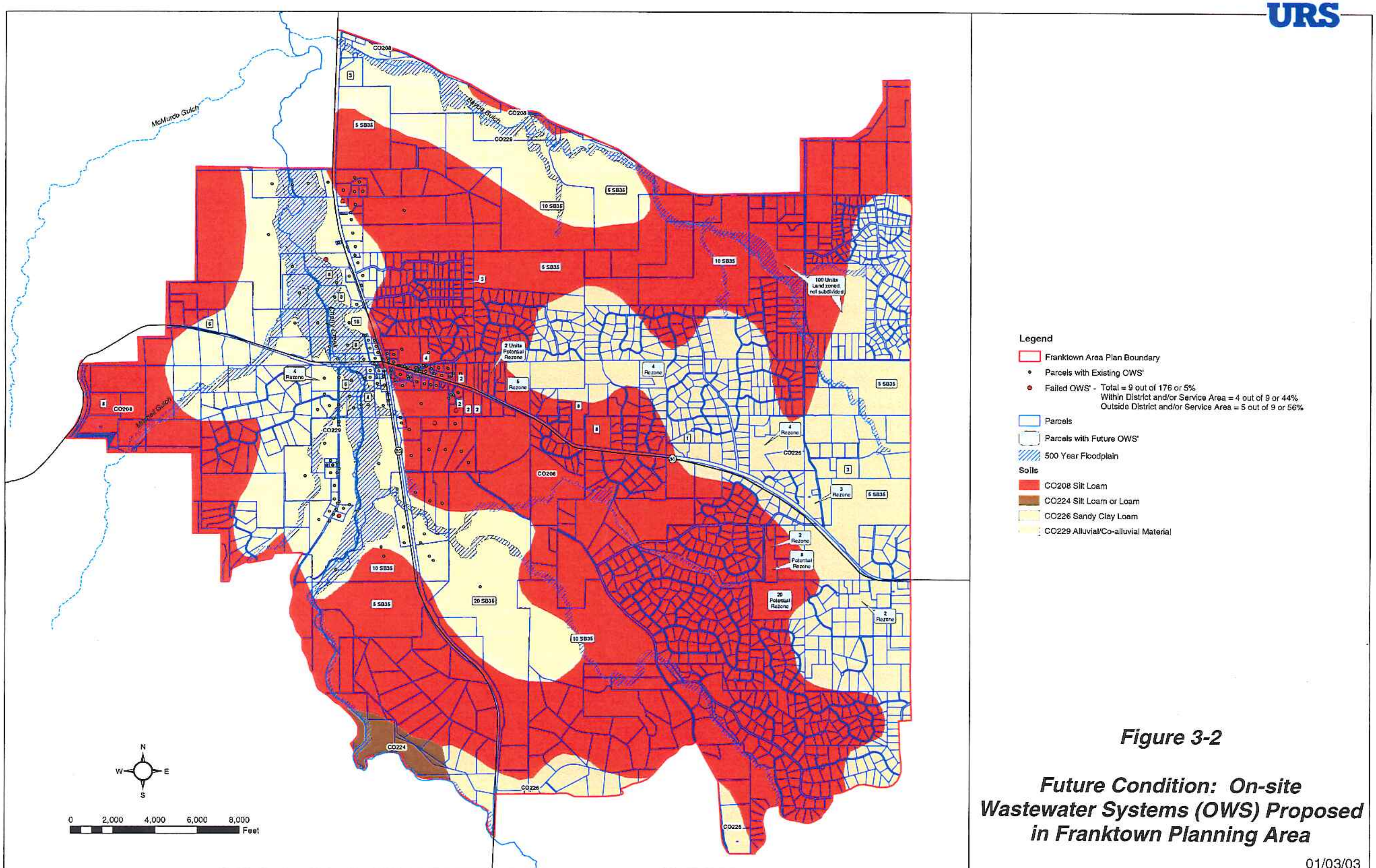

Figure 3-2

Future Condition: On-site Wastewater Systems (OWS) Proposed in Franktown Planning Area

01/03/03

Table 3-2
Future OWS Analysis

	Case A			Case B			Case C	
	Development served by Public Sanitary Sewer and Water	Development in Cherry Creek Alluvium served by OWS' and Well	Outlying Development served by OWS and Well	Development served by Public Sanitary	Development in Cherry Creek Alluvium served by OWS' and Well	Outlying Development served by OWS and Well	Development in Cherry Creek Alluvium served by OWS' and Well	Outlying Development served by OWS and Well
Future Residential Dwelling Units	1,125	25	200	225	25	200	25	200
Number of people, assuming 2.5 people per household[1]	2813	63	500	563	63	500	63	500
Residential Flows (gal/day/person)[2]	75	75	75	75	75	75	75	75
Ammonia (mg/l)[3]	27	27	27	27	27	27	27	27
Residential Ammonia Loading (lb/day)	47.7	1.1	8.5	9.5	1.1	8.5	1.1	8.5
Total Nitrogen (mg/l)[4]	65	65	65	65	65	65	65	65
Residential Total Nitrogen Loading (lb/day)	114.8	2.6	20.4	23.0	2.6	20.4	2.6	20.4
Phosphorous (mg/l)[5]	10	10	10	10	10	10	10	10
Residential Phosphorous Loading (lb/day)	17.7	0.4	3.1	3.5	0.4	3.1	0.4	3.1
Square Feet of Commercial	235,000	25,000	None	235,000	25,000	None	25,000	None
Sq ft per person	100	100		100	100		100	
Number of People	2350	250		2350	250		250	
Commercial Flows (gallons/day/employee)	50	50		50	50		50	
Ammonia (mg/l)[3]	27	27		27	27		27	
Commercial Ammonia Loading (lb/day)	26.6	2.8		26.6	2.8		2.8	
Total Nitrogen (mg/l)[4]	65	65		65	65		65	
Residential Total Nitrogen Loading (lb/day)	63.9	6.8		63.9	6.8		6.8	
Phosphorous (mg/l)[5]	10	10		10	10		10	
Commercial Phosphorous Loading (lb/day)	9.8	1.0		9.8	1.0		1.0	
Total Daily Phosphorous Loading (lb/day)	27.5	1.4	3.1	13.4	1.4	3.1	1.4	3.1
Total Annual Phosphorous Loading (lb/year)	10,034 *	525	1,146	4,879	525	1,146	525	1,146
Phosphorous Loading With 28% Removal[4] (lb/year)	All loading goes to Public Sanitary Sewer	378	825	All loading goes to Public Sanitary Sewer	378	825	378	825
Additional Phosphorous Loading Risk Factors for Core Area (lb/year):								
OWS in the floodplain/alluvium- 45% Unretained Phosphorous[6]		170			170		170	
Additional Phosphorous Loading Risk Factors for Outlying Areas (lb/year):								
17% OWS in floodplain/alluvium- 45% Unretained Phosphorous[6]			63			63		63
56% OWS in soil hydrologic group B- 25% Unretained Phosphorous[6]			115			115		115
27% OWS in soil hydrologic group C- 10% Unretained Phosphorous[6]			22			22		22
Total Phosphorous Loading Including Risk Factors (lb/year		**170**	**201**		**170**	**201**	**170**	**201**
Total Daily Nitrogen Loading (lb/day)	178.7	9.4	20.4	86.9	9.4	20.4	9.4	20.4
Total Annual Nitrogen Loading (lb/year)	65,221	3,413	7,447	31,711	3,413	7,447	3,413	7,447
Nitrogen Loading With 6% Removal[4] (lb/year)	All loading goes to Public Sanitary Sewer	3,208	7,000	All loading goes to Public Sanitary Sewer	3,208	7,000	3,208	7,000
Additional Nitrogen Loading Risk Factors for Core Area (lb/year):								
OWS in the floodplain/alluvium- 45% Unretained Nitrogen		1,444			1,444		1,444	
Additional Nitrogen Loading Risk Factors for Outlying Areas (lb/year):								
17% OWS in floodplain/alluvium- 45% Unretained Nitrogen			535			535		535
56% OWS in soil hydrologic group B- 25% Unretained Nitrogen			980			980		980
27% OWS in soil hydrologic group C- 10% Unretained Nitrogen			189			189		189
Total Nitrogen Loading including Risk Factors (lb/year)		**1,444**	**1,704**		**1,444**	**1,704**	**1,444**	**1,704**

Notes:
[1] From Metro Vision 2020 Clean Water Plan: Wastewater Utility Plan Guidance, January 2001.
[2] From Wastewater Engineering: Collection and Pumping of Wastewater, Metcalf & Eddy, Inc.
[3] From Parker Water and Sanitation District Wastewater Utility Plan, 2002.
[4] Based on information from Hydraulic and Purification Behaviors and Their Interactions During Wastewater Treatment In Soil Infiltration Systems, Dr. Bob Siegrist, Colorado School of Mines.
[5] From Pinery Water & Wastewater District Wastewater Utility Plan, June 2000.
[6] Tri-County Health Department (Tri-county), in cooperation with Dr. Thomas C. Peterson, 1987, pp.36.

have minimal impact to the floodplain, alluvium, and stream preservation areas because of the considerable distance of the facilities from Cherry Creek.

Scenario a

Additional development in the Franktown Village Core Area served by public sanitary sewer and water. Such development will ultimately include an additional 1,125 residential dwelling units and 235,000 commercial square feet. Assume an additional 25 residential dwelling units and 25,000 commercial square feet in the Cherry Creek alluvium, as well as 200 single-family dwellings on large lots scattered throughout the rural Franktown area served by OWS and well. Assume all existing development in the core area will hook up to public sanitary sewer and water.

The combined future residential and commercial annual estimated phosphorous loading, served by public sanitary sewer and water, is 10,034 pounds. Due to the fact that the entire loading is delivered to the public sanitary sewer and poses no threat of groundwater contamination, a risk of 0% is assumed for unretained phosphorous. The combined residential and commercial annual nitrogen loading, served by public sanitary sewer and water, is 65,221 pounds. Again, 0% risk was assumed for unretained nitrogen.

The combined future residential and commercial annual phosphorous loading, as served by OWS and well in the Cherry Creek alluvium within the Franktown Planning Area was 525 pounds. Assuming 28% removal efficiency, the resultant annual phosphorous loading is reduced to 378 pounds. A soil hydrologic group loading factor of 45% was applied based upon proximity to the floodplain resulting in an annual phosphorous load of 170 pounds. The combined future residential and commercial annual nitrogen loading, as served by OWS and well in the Cherry Creek alluvium within the Franktown Planning Area is 3,413 pounds. Assuming 6% removal efficiency, the resultant annual nitrogen loading is reduced to 3,208 pounds. Again, after applying the floodplain soil hydrologic group loading factor, the resulting annual nitrogen load is 1,444 pounds.

Future residential development located in outlying areas, as served by OWS and well, will produce an annual phosphorous load of 1,146 pounds. Assuming 28% removal efficiency, the resultant annual phosphorous loading is reduced to 825 pounds. Certain soil hydrologic group loading factors were applied, as can been seen in Table 3-2, resulting in an increased annual phosphorous load of 201 pounds per year. From the single-family dwellings located in outlying areas, as served by OWS and well, the annual nitrogen loading is 7,447 pounds. Assuming 6% removal efficiency, the resultant annual nitrogen loading is reduced to 7,000 pounds. Again, soil hydrologic group loading factors were applied resulting in an annual nitrogen load of 1,704 pounds. From a pollution risk and impact standpoint, these loading estimates in rural areas are minimal and not comparable to pollutant loading from OWS' estimated in the vicinity of the Cherry Creek floodplain, alluvium, and stream preservation areas.

Scenario b

Additional development in the Franktown Village Core Area served by public sanitary sewer, but with no public water supply. Such development will ultimately include an additional 225 residential dwelling units and 235,000 commercial square feet. Assume an additional 25 residential dwelling units and 25,000 commercial square feet in the Cherry Creek alluvium, as well as 200 single-family dwellings on large lots scattered throughout the rural Franktown area served by OWS and well. Assume all existing development in the core area will hook up to public sanitary sewer and water.

The combined future residential and commercial annual phosphorous loading, served by just public sanitary sewer, is 4,879 pounds. Again, due to the fact that the entire loading is delivered to the public sanitary sewer and poses no threat of groundwater contamination, a risk of 0% is assumed for unretained phosphorous. The combined residential and commercial annual nitrogen loading, served by just public sanitary sewer, is 31,711 pounds. Again, 0% risk was assumed for unretained nitrogen.

The combined future residential and commercial annual phosphorous loading, as served by OWS and well in the Cherry Creek alluvium within the Franktown Planning Area is 525 pounds. Assuming 28% removal efficiency, the resultant annual phosphorous loading is reduced to 378 pounds. A soil hydrologic group loading factor of 45% was applied based upon proximity to the floodplain resulting in an annual phosphorous load of 170 pounds. The combined future residential and commercial annual nitrogen loading, as served by OWS and well in the Cherry Creek alluvium within the Franktown Planning Area is 3,413 pounds. Assuming 6% removal efficiency, the resultant annual nitrogen loading is reduced to 3,208 pounds. After applying the soil hydrologic group loading factor for soil group A the resulting annual nitrogen load is 1,444 pounds.

Future residential development located in outlying areas, as served by OWS and well, will produce an annual phosphorous load of 1,146 pounds. Assuming 28% removal efficiency, the resultant annual phosphorous loading is reduced to 825 pounds. Certain soil hydrologic group loading factors were applied, as can been seen in Table 3-2, resulting in an annual phosphorous load of 201 pounds. From the single-family dwellings located in outlying areas, as served by OWS and well, the annual nitrogen loading is 7,447 pounds. Assuming 6% removal efficiency, the resultant annual nitrogen loading is reduced to 7,000 pounds. Again, soil hydrologic group loading factors were applied resulting in an annual nitrogen load of 1,704 pounds. Similar to Scenario "a", from a pollution risk and impact standpoint, these loading estimates in rural areas are minimal and not comparable to pollutant loading from OWS' estimated in the vicinity of the Cherry Creek floodplain, alluvium, and stream preservation areas.

Scenario c

Additional development in the Cherry Creek alluvium within the Franktown Planning Area served by OWS and well. Such development may include 25 additional residential dwellings and 25,000 commercial square feet (note: commercial uses are limited to those with low water and sanitary sewer requirements). Also assume an additional 200 single-family dwellings on large lots scattered throughout the rural Franktown area served by OWS and well.

The combined residential and commercial annual phosphorous loading, as served by OWS and well in the Cherry Creek alluvium within the Franktown Planning Area is 525 pounds. Assuming 28% removal efficiency, the resultant annual phosphorous loading was reduced to 378 pounds. A soil hydrologic group loading factor of 45% was applied based upon proximity to the floodplain resulting in an annual phosphorous load of 170 pounds. The combined residential and commercial annual nitrogen loading, as served only by OWS and well in the Cherry Creek alluvium within the Franktown Planning Area is 3,413 pounds. Assuming 6% removal efficiency, the resultant annual nitrogen loading is reduced to 3,208 pounds. Again, the floodplain soil hydrologic group loading factor was applied resulting in an annual nitrogen load of 1,444 pounds.

From the single-family dwellings located in outlying areas, as served by OWS and well, the annual phosphorous loading is 1,146 pounds. Assuming a 28% removal efficiency, the resultant annual phosphorous loading is reduced to 825 pounds. Certain soil hydrologic group loading factors were applied, as can been seen in Table 3-2, resulting in an increased annual phosphorous load of 201 pounds. From the single-family dwellings located in outlying areas, as served by OWS and well, the annual nitrogen loading is 7,447 pounds. Assuming a 6% removal efficiency, the resultant annual nitrogen loading is reduced to 7,000 pounds. Again, soil hydrologic group loading factors were applied resulting in an annual nitrogen load of 1,704 pounds. As mentioned above, from a pollution risk and impact standpoint, these loading estimates in rural areas are minimal and not comparable to pollutant loading from OWS' estimated in the vicinity of the Cherry Creek floodplain, alluvium, and stream preservation areas.

4.1 CONCLUSIONS

Potential long-term impacts of Franktown OWS' in environmentally sensitive areas, including the Cherry Creek floodplain, alluvium, and stream preservation areas are substantial.

Existing OWS' in the Franktown Village Core Area already contribute an estimated 437 pounds of phosphorus annually to Cherry Creek (including the alluvium). An increase in the number of OWS' would increase the phosphorous loading to Cherry Creek and the Reservoir, which could ultimately exceed the TMAL. The Cherry Creek TMAL has a 450-pound phosphorus allocation for OWS (which assumes all OWS in the Cherry Creek Basin and assimilation of phosphorus from OWS as it is conveyed to the reservoir). The evaluation suggests a potentially significant water quality impact from existing and future OWS in the Franktown area.

Most existing development in the Franktown Village Core Area and environs has occurred within the Cherry Creek alluvium (along Highway 86 and Highway 83). OWS' in the alluvium and floodplain provide a conduit connection to Cherry Creek and its tributaries, ultimately impacting the Pinery's drinking water supply and Cherry Creek Reservoir. The CCBWQA does not recommend OWS treatment within the 100-year floodplain, Cherry Creek alluvium, or stream preservation areas and historically has not recommended approval of such OWS applications.

Conventional wastewater treatment options result in less nonpoint pollution risk.

Authorized dischargers in the Cherry Creek Basin (such as the Pinery Water and Sanitation District) provide advanced wastewater treatment processes that result in a very high quality effluent that meets the permit limits established by CDPHE and EPA. Of the three scenarios evaluated, scenarios "a" and "b" result in less nonpoint pollution risk from OWS, including the risk to downgradient drinking water supplies. Both scenarios "a" and "b" include new development within the Village Core Area being served by sanitary sewer. Service for outlying rural areas within Franktown will continue with OWS. As suggested in scenario "c", new development served by OWS and wells is not desirable due to the pollution risk from OWS.

There is a role for appropriately sited designed, constructed, operated and maintained OWS in outlying areas of Franktown.

OWS provide appropriate wastewater treatment service to outlying rural areas in Franktown. There is a continued role for properly engineered and managed OWS in Franktown. Assuming proper OWS siting, engineering, operation and maintenance, these OWS provide the essential treatment needed in those rural areas within Franktown which have appropriate soils and are not in proximity to the Cherry Creek alluvium.

Recirculating sand filter systems are a more recent OWS technology that provide a higher quality effluent than traditional OWS systems and could be considered for future development in outlying areas within Franktown. These recirculating sand filter systems provide higher pollutant removal efficiencies, while still not being capable of treating to the low effluent limits achieved by the advanced wastewater treatment processes required and utilized in the Cherry Creek basin.

Pumping and hauling septage from existing, aged OWS' to an adjacent wastewater treatment facility is not an appropriate long-term water quality treatment option.

Long-term operation and maintenance costs of this method of sewage disposal are quite high, not to mention the long-term contracted cost to treat and dispose of the effluent at an approved wastewater treatment facility. The environmental issues associated with transporting septage along Highway 83, Highway 86 and the Cherry Creek alluvium and potential septage spills are appreciable. This may be considered as an intermediate short-term solution until other treatment measures are in place (i.e. conventional wastewater treatment).

4.2 RECOMMENDATIONS

Nonpoint pollution risk in the Franktown Village Core Area should be minimized by phasing out OWS use in this area and converting to conventional wastewater treatment.

Based upon the above analysis and conclusions, the nonpoint source risk from OWS' sited in the Franktown Village Core Area are significant due to the location of these systems within the Cherry Creek floodplain, alluvium, and stream preservation areas. Reducing future OWS proliferation within these environmentally sensitive areas can minimize the potential threat to the Pinery's drinking water supply and Cherry Creek Reservoir. In addition, existing OWS' located within the stream preservation areas should be phased out and converted to conventional wastewater treatment.

It is understood that those OWS' in outlying areas, not in connection with alluvium, if well maintained, will not pose a great risk of contamination. It is also more economically feasible to utilize OWS' in those outlying areas, as opposed to using conventional wastewater treatment.

Evaluate funding options for conversion of the Franktown Village Core Area OWS' to conventional wastewater treatment.

Economic consideration needs to play a key role when addressing the approach of phasing out OWS' in the Franktown Village Core Area. Given the magnitude of water quality issues in the Cherry Creek basin, EPA grant dollars may be available to fund conversion of OWS' to conventional sewer. Other research foundations such as the Water Environment Research Foundation (WERF) and American Water Works Research Foundation (AWWARF) may also be potential funding sources to this conversion effort. Very low interest loans may also be available via the Colorado Water and Power Authority and State of Colorado Revolving Loan Program.

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Appendix A

Guidelines On Individual Sewage Disposal Systems

Table #1: TRI-COUNTY HEALTH DEPARTMENT SUMMARY OF REQUIREMENTS FOR INDIVIDUAL SEWAGE DISPOSAL SYSTEMS				
Regulation and Effective Date	**Soils Test Required?**	**Percolation Test Required?**	**Setbacks? (e.g. minimum distance between well leachfield, etc.)**	**Minimum Sizing Requirements For Absorption Areas ("leachfields") Conventional (non-engineered systems)** **(Percolation Rates less than 5 mpi or greater than 60 mpi require an engineered system)**
2-69 (3/11/69)	No	No	No	none
I-72 (4/11/72)	No	No	No	none
I-73 (10/1/73)	Yes	Yes	Yes	Based on percolation rate from 5 minutes per inch (mpi) to 60 mpi, square feet per bedroom, in increments of 5 mpi (See Table #2)
I-80 (5/16/80)	Yes	Yes	Yes	Based on percolation rate from 5 minutes per inch (mpi) to 60 mpi, square feet per bedroom, in increments of 5 mpi (See Table #2)
I-85 (12/1/85)	Yes	Yes	Yes	Based on percolation rate from 5 minutes per inch (mpi) to 60 mpi, square feet per bedroom, in increments of 5 mpi (See Table #2)
I-88 (2/1/88)	Yes	Yes	Yes	Based on percolation rate from 5 to 60 mpi, square feet per bedroom in three categories (5-20 mpi, 21-40 mpi and 41-60 mpi)
I-96 (6/3/96)	Yes	Yes	Yes	Based on percolation rate from 5 to 60 mpi, square feet per bedroom in three categories (5-20mpi, 21-40 mpi and 41-60 mpi)
I-02 (6/3/02)	Yes	Yes	Yes	Based on percolation rate from 5 to 60 mpi, square feet per bedroom in three categories (5-20mpi, 21-40 mpi and 41-60 mpi)

Table #2: SUMMARY OF SIZING REQUIREMENTS FOR CONVENTIONAL (Non-Engineered) ABSORPTION AREAS, BASED ON REGULATION		
Percolation Rate (minutes per inch)	**Per Bedroom Minimum Soil Absorption Area (square feet) Regulations I-73, I-80, I-85**	**Per Bedroom Minimum Soil Absorption Area (square feet) Regulations I-88, I-96 and I-02**
5	165	325
10	225	325
15	275	325
20	325	325
25	365	450
30	400	450
35	425	450
40	450	450
45	475	560
50	500	560
55	525	560
60	550	560

Appendix B

Existing On-Site Wastewater Systems In The Franktown Planning Area

Appendix B
Existing OWS' in the Franktown Planning Area
(Douglas County Planning GIS Department)

ACCTTYPE	PROPADD	PROPADD2	OWNERNAME	MAILADD1	MAILADD2	YRBLT
Agricultural		CO	PARKER VISTA LTD ATTN DOUG BARNES	% LAND SERVICES INC	5031 S ULSTER STREET SUITE 420	0
Agricultural		CO	FLEMING PROPERTIES LTD	4225 S EMELITA DR		0
Agricultural		CO	FLEMING PROPERTIES LTD	4225 S EMELITA DR		0
Agricultural		CO	BLONNIE ALAN & FLORA M BATES	P O BOX 303	7316 RAFTER RD	0
Agricultural	2583 N STATE HIGHWAY 83	PARKER CO 80138	CLYDE PEEK & VIRGINIA PEEK	PO BOX 826		0
Agricultural	2310 N KELTY RD	FRANKTOWN CO 80116	KELTY COLORADO FAMILY LLLP	PO BOX 21		0
Agricultural		CO	KELTY COLORADO FAMILY LLLP	PO BOX 21		0
Agricultural		CO	GEORGE F NEZ & MARIJA M NEZ	2570 S IVY		0
Agricultural		CO	GEORGE F NEZ & MARIJA M NEZ	2570 S IVY		0
Agricultural	STATE HIGHWAY 86	FRANKTOWN CO 80116	MARLYS L MARSHALL	139 S EAGLE CIR		0
Agricultural	STATE HIGHWAY 83	FRANKTOWN CO 80116	AYERS OF FRANKTOWN	BOX 9		0
Agricultural		CO	AYERS OF FRANKTOWN	BOX 9		0
Agricultural		CO	CARROLL DEVELOPMENT CORPORATION	7505 VILLAGE SQUARE DR STE 200		0
Agricultural		CO	CARROLL LAND CO INC	7505 VILLAGE SQUARE DR STE 200		0
Agricultural		CO	ROBERT L WOLD & CATHERINE A WOLD	16766 E PRENTICE CIR		0
Agricultural		CO	ROBERT L WOLD & CATHERINE A WOLD	16766 E PRENTICE CIR		0
Agricultural	975 CASTLEWOOD DR	FRANKTOWN CO 80116	RANDY OVERLEY	2731 W WOLFENSBERGER RD		0
Agricultural		CO	MRS ALEXANDRA ISOBEL	21 EXCHANGE STREET	RETFORD NOTTS	0
Agricultural		CO	RANDY OVERLEY	2731 W WOLFENSBERGER RD		0
Agricultural		CO	ELLEN MARRITT	P O BOX 503	792 RUSSELLVILLE RD	0
Agricultural	N RUSSELLVILLE RD	FRANKTOWN CO 80116	AYERS OF FRANKTOWN	BOX 9		0
Agricultural		CO	REED HOLLOW RANCH LPA	441 RUSSELLVILLE RD		0
Agricultural		CO	REED HOLLOW RANCH LPA	441 RUSSELLVILLE RD		0
Agricultural		CO	THE SEVENTH DAY ADVENTIST ADVENTIST	2520 S DOWNING ST		0
Agricultural	550 N STATE HIGHWAY 83	FRANKTOWN CO 80116	RONALD J KMIECIAK TRUST	575 N STATE HWY 83		0
Agricultural		CO	THE RONALD J KMIECIAK TRUST	575 N STATE HWY 83		0
Commercial		CO	JAMES H & VIRGINIA M O'NEILL	P O BOX 95		0
Commercial	7561 E STATE HIGHWAY 86	FRANKTOWN CO 80116	DALE R HOLADAY & BILLIE L HOLADAY	5535 IRISH PAT MURPHY DR		0
Commercial	STATE HIGHWAY 83	FRANKTOWN CO 80116	MEYER J & JUDITH R SUSSMAN	9962 EAST IDA PLACE		0
Exempt		CO 0000000	DOUGLAS COUNTY BOARD OF	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt	2988 STATE HIGHWAY 83	CO	COLORADO DEPT OF HIGHWAYS	4201 E ARKANSAS AVE		0
Exempt		CO	BOARD OF COUNTY COMMISSIONERS	101 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt	STATE HIGHWAY 83	FRANKTOWN CO 80116	DOUGLAS COUNTY SCHOOL DIST RE-1	131 WILCOX		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt		CO	FRANKTOWN FIRE PROTECTION DISTRICT	P O BOX 53		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY	101 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt		FRANKTOWN CO 80116	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS CO BOARD OF COMMISSIONERS	101 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	BOARD OF COUNTY COMMISSIONERS	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0

Appendix B
Existing OWS' in the Franktown Planning Area
(Douglas County Planning GIS Department)

ACCTTYPE	PROPADD	PROPADD2	OWNERNAME	MAILADD1	MAILADD2	YRBLT
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOCC	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	100 THIRD ST		0
Exempt		CO	DOUGLAS COUNTY BOARD OF COMMISSIONERS	100 THIRD ST		0
Producing Mine		CO	WWTR COMPANY	4660 LA JOLLA VILLAGE DR		0
Residential		CO	FRANKTOWN CENTER PARTNERS	589 W ABERDEEN AVE		0
Residential		CO	DEREK M POTTON & RYAN M POTTON	P O BOX 182		0
Vacant Land		CO 0000000	CUSTOM LUMBER INC	4203 W BAYOU HILLS ROAD		0
Vacant Land	2968 STATE HIGHWAY 83	CO	JACK OWEN BANNING & MARY HORNE BANNING	8887 SALTCOATES CT		0
Vacant Land		CO	SUSIE NELSON N/K/A SUSIE PAYNE	1483 S YAMPA CT		0
Vacant Land	KELTY RD	FRANKTOWN CO 80116	ROSE C WILLIS	BOX 6		0
Vacant Land	STATE HIGHWAY 83	FRANKTOWN CO 80116	JCT LIMITED PARTNERSHIP	2195 STATE HIGHWAY 83 #AA		0
Vacant Land	7543 INGA WAY	FRANKTOWN CO 80116	FRANKTOWN SELF STORAGE	7561 EAST STATE HWY 86	P O BOX 941	0
Vacant Land	7696 E BURNING TREE DR	FRANKTOWN CO 80116	PATRICIA A VON PICHL	P O BOX 476		0
Vacant Land		CO	FRANKTOWN CENTER PARTNERS	589 W ABERDEEN AVE		0
Vacant Land	STATE HIGHWAY 83	FRANKTOWN CO 80116	FTCO LLC	2486 S LANSING WY		0
Vacant Land	STATE HIGHWAY 86	FRANKTOWN CO 80116	WALLACE E CARROLL JR, JOHN W LEEVERS,	7505 VILLAGE SQUARE DR STE 200		0
Vacant Land		CO	OWEN BROTHERS CONCRETE CO	5550 SHERIDAN		0
Vacant Land	792 N RUSSELLVILLE RD	FRANKTOWN CO 80116	ELLEN MARRITT	P O BOX 503	792 RUSSELLVILLE RD	0
Vacant Land	1453 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	DEREK M POTTON & RYAN M POTTON	P O BOX 182		0
Vacant Land		CO	JERALYN DENISE GRISWOLD	755 RIATA RD		0
Residential	1868 KELTY RD	FRANKTOWN CO 80116	GEORGE B KAFERLY & NANCY K KAFERLY	P O BOX 112		1876
Residential		CO	ARDELL E ARFSTEN & PATRICIA A	P O BOX 47		1878
Residential	KELTY RD	FRANKTOWN CO 80116	COLUMBINE R WILLIS	BOX 6		1880
Residential	1927 W KELTY RD	FRANKTOWN CO 80116	SHEILA L GALLOWAY	1927 KELTY ROAD		1888
Agricultural	3217 N STATE HIGHWAY 83	FRANKTOWN CO	THOMAS C SUMNERS ETAL	303 E 17TH AVE #550		1898
Agricultural	2579 N STATE HIGHWAY 83	FRANKTOWN CO 80116	TIM WALKER & DELLA WALKER	PO BOX 727		1900
Agricultural	6636 E STATE HIGHWAY 86	CASTLE ROCK CO 80104	CRAIG H MUNDT & CESARE E MORGANTI	6636 E HIGHWAY 86		1900
Commercial	7272 E STATE HIGHWAY 86	FRANKTOWN CO	FRANKTOWN PLAZA I LLC	913 W WOLFENSBERGER RD		1905
Exempt	3093 STATE HIGHWAY 83	CO	PIKES PEAK GRANGE # 163	PO BOX 335		1908
Residential	3590 N STATE HIGHWAY 83	FRANKTOWN CO 80116	WILSON GROEN &	3590 N STATE HWY 83		1908
Commercial	2006 N KELTY RD	FRANKTOWN CO 80116	LJD MARKETPLACE INC	P O BOX 717		1918
Residential	1976 S KELTY RD	FRANKTOWN CO 80116	DORIS B JOHNSTON	927 SIXTH STREET		1918
Agricultural		CO	EDW C LEVY COMPANY	8800 DIX AVE		1928
Agricultural		CO	EDW C LEVY COMPANY	8800 DIX AVE		1928
Agricultural		CO	EDW C LEVY COMPANY	8800 DIX AVE		1928
Residential	1345 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	THOMAS F EDWARDS & LISA C EDWARDS	P O BOX 33		1930
Residential	7909 E STATE HIGHWAY 86	FRANKTOWN CO	HAROLD G HAGLUND	7909 E HIGHWAY 86		1935
Residential	3588 N STATE HIGHWAY 83	FRANKTOWN CO 80116	EUGENE F & ELSIE R WHEELER	BOX 14		1937
Commercial	7531 E STATE HIGHWAY 86	FRANKTOWN CO	THE DONALD D GILBERT	8576 BURNING TREE DR		1940
Residential	11247 N STATE HIGHWAY 83	PARKER CO 80134	M DAVID LEWIS	31217 BAILARD RD		1940
Residential	1669 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	DEREK M POTTON & RYAN M POTTON	P O BOX 182		1940
Residential		CO 0000000	CUSTOM LUMBER INC	4203 W BAYOU HILLS ROAD		1943
Commercial	2024 N STATE HIGHWAY 83	PARKER CO	B ALAN BATES & FLORA M BATES	9259 E DEVILS HEAD DR		1945
Residential	1671 N STATE HIGHWAY 83	FRANKTOWN CO 80116	KEVIN R KING & SHANNON LEE KING	1671 NORTH STATE HIGHWAY 83		1945
Residential	1028 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	MAYNARD D SICKLER LIFE ESTATE	1028 N CASTLEWOOD CANYON RD		1945
Exempt	1959 N STATE HIGHWAY 83	FRANKTOWN CO 80116	NORWEST INVESTMENT SERVICES INC	1740 BROADWAY		1946
Commercial	1966 N STATE HIGHWAY 83	FRANKTOWN CO 80116	J & L LAND & LIVESTOCK CO	8102 SO STATE HWY 83		1949
Commercial	1966 N STATE HIGHWAY 83	FRANKTOWN CO 80116	GLENN A EMERICK & CHERYL S EMERICK	PO BOX 147		1950
Residential	0876 KELTY RD	FRANKTOWN CO 80116	ARDELL E ARFSTEN & PATRICIA A ARFSTEN	P O BOX 47		1950
Residential	894 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	THOMAS J ULVEN & JENNIFER A ULVEN	894 N CASTLEWOOD CANYON RD		1950
Residential	1733 N STATE HIGHWAY 83	FRANKTOWN CO 80116	WAYNE J MALONE	1733 N HIGHWAY 83		1952
Residential	7725 E STATE HIGHWAY 86	FRANKTOWN CO 80116	EUGENE & CHRISTINE WILLIS	PO BOX 43 7725 E ST HWY 86		1956

Appendix B
Existing OWS' in the Franktown Planning Area
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ACCTTYPE	PROPADD	PROPADD2	OWNERNAME	MAILADD1	MAILADD2	YRBLT
Residential	7938 E STATE HIGHWAY 86	FRANKTOWN CO	DEBORAH K MCINTYRE	7938 E HIGHWAY 86	PO BOX 267	1958
Residential	3464 S STATE HWY 83	FRANKTOWN CO 80116	THERESA J BOTTOMS & DAVID BOTTOMS	3426 N STATE HWY 83		1959
Residential	7722 BURNING TREE DR	FRANKTOWN CO 80116	RICHARD E PEARN & SHARON M PEARN	7722 BURNING TREE DR		1960
Industrial	2042 N KELTY RD	FRANKTOWN CO 80116	R A WAFFENSMITH & CO INC	2042 N KELTY RD	PO BOX 888	1961
Agricultural	1867 N STATE HIGHWAY 83	FRANKTOWN CO 80116	AYERS OF FRANKTOWN	BOX 9		1962
Commercial	2077 N STATE HIGHWAY 83	PARKER CO	RUSSELL D BERGET	PO BOX 235		1963
Commercial	7526 STATE HIGHWAY 86	FRANKTOWN CO 80116	GROUP S VENTURES	4738 W JACKSON CREEK RD		1965
Residential	BURNING TREE DR	FRANKTOWN CO 80116	JAMES L HALE & MARGARET T HALE &	7863 HWY 66		1965
Residential	STATE HIGHWAY 86	FRANKTOWN CO 80116	GORDON S WEATHERLY & HELEN E WEATHERLY	BOX 31		1966
Residential	2979 N STATE HIGHWAY 83	PARKER CO	CASTLEROCK TRAILERS LLC	11775 S PARKER RD		1967
Residential	3350 N STATE HIGHWAY 83	FRANKTOWN CO	GERALD W EISLEY & YOLANDA C WIESE	3350 N HIGHWAY 83		1969
Residential	STATE HIGHWAY 86	FRANKTOWN CO 80116	VENA L BRITTON LIFE ESTATE	328 MOOSE CIR		1969
Residential	1255 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	BEVERLY JEAN CAMPBELL	P O BOX 34		1969
Commercial	7524 E STATE HIGHWAY 86	FRANKTOWN CO 80116	FRANKTOWN MANAGEMENT INC	7524 E HIGHWAY 86		1971
Residential	2849 N STATE HIGHWAY 83	FRANKTOWN CO 80116	FRANK & NANCY WASHNIESKI LIVING TRUST	15110 SHADOW MT RANCH RD		1971
Residential	7935 STATE HIGHWAY 86	FRANKTOWN CO 80116	PATRICIA J KELLY & JOHM A MUKAVETZ	7935 E HIGHWAY 86		1971
Commercial	2195 N STATE HIGHWAY 83	PARKER CO	CLOCKTOWER BUILDING LLC	2195 S STATE HWY 83 UNIT AA		1972
Commercial	2129 N STATE HIGHWAY 83	FRANKTOWN CO 80116	FRANKTOWN FEED & RANCH SUPPLY	P O BOX 68		1972
Commercial	7460 STATE HIGHWAY 86	FRANKTOWN CO 80116	DEAN D & EILEEN E STEPHEN	4738 W JACKSON CREEK RD		1972
Commercial	2031 STATE HIGHWAY 83	FRANKTOWN CO	D & E FRANKTOWN LLC	PO BOX 965		1973
Industrial	2571 N STATE HIGHWAY 83	FRANKTOWN CO 80116	CAMAS COLORADO INC	3605 S TELLER ST		1973
Agricultural	851 N RUSSELLVILLE RD	FRANKTOWN CO 80116	REED HOLLOW RANCH LPA	441 RUSSELLVILLE RD		1974
Commercial	7519 STATE HIGHWAY 86	FRANKTOWN CO	TERRY W BORGER	10030 HUMMINGBIRD LN		1975
Commercial	7515 STATE HIGHWAY 86	FRANKTOWN CO 80116	JAMES H & VIRGINIA M O'NEILL	P O BOX 95		1975
Residential	3584 N STATE HIGHWAY 83	FRANKTOWN CO 80116	WENDELL H HARRELL JR & DIANE A HARRELL	3584 N HIGHWAY 83		1975
Residential	7700 E STATE HIGHWAY 86	FRANKTOWN CO	TRISH RENSHAW	7700 E HWY 86		1976
Commercial	7517 STATE HIGHWAY 86	FRANKTOWN CO 80116	JAMES H & VIRGINIA M O'NEILL	P O BOX 95		1978
Residential	3310 N STATE HIGHWAY 83	FRANKTOWN CO 80116	RODNEY HAL TOMSON & JOAN C TOMSON	3310 N HWY 83		1978
Exempt	1958 N STATE HIGHWAY 83	FRANKTOWN CO 80116	COLORADO STATE BOARD OF AGRICULTURE ETAL	ROM 309 ADMINISTRATION BLDG	COLORADO STATE UNIVERSITY	1979
Exempt	1384 N STATE HIGHWAY 83	FRANKTOWN CO 80116	DOUGLAS CO SCHOOL DIST RE-1	131 WILCOX		1979
Residential	7911 E STATE HIGHWAY 86	FRANKTOWN CO 80116	SAMUEL LEON SWEARS &	7911 E HIGHWAY 86		1980
Commercial	1958 N STATE HIGHWAY 83	FRANKTOWN CO 80116	MEYER J & JUDITH R SUSSMAN	9962 EAST IDA PLACE		1983
Residential	1480 N STATE HIGHWAY 83	FRANKTOWN CO 80116	JACK LEROY & CHERYL L ORR	1480 N STATE HWY 83		1983
Residential	1115 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	MENDY L BELTRAN &	1115 N CASTLEWOOD CANYON RD		1983
Commercial	7513 STATE HIGHWAY 86	FRANKTOWN CO 80116	JAMES H & VIRGINIA M O'NEILL	P O BOX 95		1984
Residential	7006 E PARK DR	FRANKTOWN CO 80116	JAMES A & MILDRED E VELVICK	7006 PARK DRIVE		1984
Residential	792 N RUSSELLVILLE RD	FRANKTOWN CO 80116	EMANUEL & ELLEN MARRITT	P O BOX 503		1985
Agricultural	2501 WALKER RD	FRANKTOWN CO 80116	DANIEL & BETTY C ZELEM	2501 WALKER RD	P O BOX 507	1986
Agricultural	2161 KELTY RD	FRANKTOWN CO 80116	JEAN K NOE	3746 E LINCOLN AVE		1986
Industrial	3002 N STATE HIGHWAY 83	FRANKTOWN CO 80116	CHOL ENTERPRISES INC	12831 S FIGUEROA ST		1986
Residential	6737 S STATE HIGHWAY 86	FRANKTOWN CO 80116	DAVID E SEANOR & SABRINA D SEANOR	6737 STATE HWY 86		1986
Agricultural	862 N RUSSELLVILLE RD	FRANKTOWN CO 80116	JANE I MORRELL OR HER SUCCESSOR	JANE I MORRELL REVOCABLE TRUST	862 N RUSSELLVILLE ROAD	1987
Residential	7857 E STATE HIGHWAY 86	FRANKTOWN CO	RICHARD C WEAD	7857 E HIGHWAY 86		1987
Residential	7930 E STATE HIGHWAY 86	FRANKTOWN CO	RONALD J & KATHI J STREETER	7930 E HIGHWAY 86		1988
Residential	7934 E STATE HIGHWAY 86	FRANKTOWN CO	TERRI L WILSON & RONALD T WILSON	7934 E HWY 86		1988
Commercial	7601 E BURNING TREE DR	FRANKTOWN CO 80116	COLO INSTITUTE OF SPINAL ORTHOPEDICS INC	PO BOX 201		1989
Agricultural	575 N STATE HIGHWAY 83	FRANKTOWN CO 80116	THE RONALD J KMIECIAK TRUST	575 N STATE HWY 83		1990
Agricultural	575 N STATE HIGHWAY 83	FRANKTOWN CO 80116	THE DARIE F KMIECIAK TRUST	575 N STATE HWY 83		1990
Residential	1474 N STATE HIGHWAY 83	FRANKTOWN CO 80116	ALVIN B GOLDMAN & MICHEL R GOLDMAN	P O BOX 505		1991
Residential	3580 N STATE HIGHWAY 83	PARKER CO	MICHAEL T SURRAN & JILL A SURRAN	3580 N STATE HIGHWAY 83		1992
Residential	1400 N STATE HIGHWAY 83	FRANKTOWN CO 80116	DANIEL W HORNE & SUSAN G HORNE	PO BOX 523		1994
Commercial	2142 KELTY RD	FRANKTOWN CO 80116	2142 COMPANY LLC	BERGLUND INVESTMENT GROUP	P O BOX 2288	1995
Residential	6870 FOX CREEK TRL	FRANKTOWN CO 80116	DONALD R DOUGLASS & LINDA K DOUGLASS	6870 FOX CREEK TRAIL		1995
Agricultural	2323 WALKER RD	FRANKTOWN CO 80116	JAYE R WILLSON REVOCABLE LIVING	2323 WALKER RD		1996

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ACCTTYPE	PROPADD	PROPADD2	OWNERNAME	MAILADD1	MAILADD2	YRBLT
Agricultural	550 N STATE HIGHWAY 83	FRANKTOWN CO 80116	THE RONALD J KMIECIAK TRUST	575 N STATE HWY 83		1996
Agricultural	550 N STATE HIGHWAY 83	FRANKTOWN CO 80116	DARIE F KMIECIAK TRUST	575 N STATE HIGHWAY 83		1996
Agricultural	441 N RUSSELLVILLE RD	FRANKTOWN CO 80116	REED HOLLOW RANCH LPA	441 RUSSELLVILLE RD		1998
Commercial	7561 E STATE HIGHWAY 86	FRANKTOWN CO 80116	DALE R HOLADAY & BILLIE L HOLADAY	5535 IRISH PAT MURPHY DR		1998
Residential	1830 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	RANDAL LEE MANNING	4833 FRONT ST B-105		1998
Agricultural	1500 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	JOSEPH R MANNING	1500 CASTLEWOOD CANYON RD		1999
Commercial	2128 N STATE HIGHWAY 83	FRANKTOWN CO 80116	DAVID R SWIECKOWSKI	2128 N HIGHWAY 83	P O BOX 832	1999
Commercial	7658 BURNING TREE DR	FRANKTOWN CO 80116	PATRICIA A VON PICHL	P O BOX 476		1999
Residential	7822 STATE HIGHWAY 86	FRANKTOWN CO	A T REINHARDT PATRICIA REINHARDT	7822 HIGHWAY 86		1999
Agricultural	980 N CASTLEWOOD DR	FRANKTOWN CO 80116	WAYNE H DAVIS &	980 N CASTLEWOOD DR		2000
Exempt	389 N CASTLEWOOD CANYON RD	FRANKTOWN CO 80116	LIVING WORD CHRISTIAN ASSEMBLY INC	P O BOX 335		2000
Residential	999 CASTLEWOOD DR	FRANKTOWN CO 80116	ARTURO D GARCIA & DONNA M GARCIA	999 CASTLEWOOD DR		2000

Estimated Phosphorous Loading from OWS' in the Cherry Creek Alluvium within the Franktown Village Core Area and Environs