BEFORE THE COLORADO WATER CONSERVATION BOARD

STATE OF COLORADO

Prehearing Statement of the Norwood Water Commission and the Lone Cone Ditch and Reservoir Company

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IN THE MATTER OF PROPOSED INSTREAM FLOW APPROPRIATION IN WATER DIVISION 4, ON THE SAN MIGUEL RIVER (CONFLUENCE OF CALAMITY DRAW TO CONFLUENCE OF DOLORES RIVER), CWCB ID: 09/4/A-009

Pursuant to Rule 5n(2) of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program ("ISF Rules"), the Norwood Water Commission and the Lone Cone Ditch and Reservoir Company ("NWC/LC") hereby submit this prehearing statement in opposition of the Colorado Water Conservation Board ("CWCB") staff's recommendations for an instream flow appropriation on the San Miguel River between the confluence with Calamity Draw and the confluence with the Dolores River. NWC/LC oppose both the reach and the amounts of appropriation adopted by the CWCB at its January 2011 board meeting, which adjusted the amounts set forth in the CWCB staff recommendation report made available to the CWCB and the public at the January 2011 CWCB regularly scheduled Board meeting.

1. **Background Concerning Status of Opposers NWC/LC**

The Town of Norwood ("Town") and its water activity enterprise, the Norwood Water Commission (NWC) are located on Wrights Mesa in San Miguel County, 35 miles west of Telluride. NWC also serves areas in Montrose County. NWC operates the Town's water system as a government-owned business, maintaining 85 miles of distribution lines on a very limited budget funded by user fees. Norwood is a small community, with a population of approximately 518 within its corporate limits. Together with the surrounding unincorporated rural area, the total population number currently served by NWC is about 1,100 people. The NWC is the sole supplier of potable water for the area, serving about 780 households and businesses (2009), half of which are in the Town and the other half in the rural areas. Of the 780 taps, 58 are industrial and commercial taps (or 7 percent of total taps), one is a community water station, and the remaining 721 are household taps (93 percent).

In order to assess future water needs, the NWC hired Wright Water Engineers, Inc. (WWE) to prepare a "Raw Water System Update and Future Needs Assessment" ("Assessment"). As part of the Assessment, WWE evaluated future water demands through a review of the CWCB's Statewide Water Supply Initiative ("SWSI"), population data from DOLA, as well as historical tap growth data from the NWC.[1] As a result of WWE's findings in its Assessment, NWC filed

[1] CWCB's SWSI 2010 Report quantified ranges for future M&I water demands in Southwest Colorado, which includes the NWC service area. For San Miguel County and the portion of Montrose County within the Southwest Basin, the projected M&I demand increase ranges from 5,900 AF to 11,000 AF by the year 2050. The projected M&I water supply gap for the same area by 2050 ranges from 4,500 AF to 10,000 AF. SWSI did not address the M&I water supply gap specifically for the NWC service area. WWE, in its report, did not extrapolate NWC specific

two water rights applications in Division 4: (1) 10CW202 for additional direct diversion and water storage rights, and (2) with LC, 10CW203, for the enlargement of Lone Cone Reservoir and additional sources of fill for the Reservoir. The application seek water rights to meet future needs of the NWC service area, currently 40.5 square miles, but anticipated to grow to over 56 square miles by 2060.

The NWC's main water supply consists of surface flows and springs, transported through open ditches to small storage reservoirs, in large part dependent on reservoir seepage and continued flood, as opposed to sprinkler, irrigation.

For the period from 1999 through 2009, WWE found that the NWC's growth in water tap numbers averaged 2.02 percent per year, with growth as high as 5 percent (2005) and nearly zero in 2007. WWE examined various growth scenarios to evaluate water demands for a tap expansion from 1 percent to 3 percent. Given the proposed expansion of the existing NWC service area of roughly 40 percent and the historical average growth rate of over 2 percent, for the purposes of long-term water supply planning, an average annual tap growth of 3 percent was used. With a three percent annual growth in tap demand over the next 50 years based on current water use practices, WWE stated in its report that the NWC will require 1,034 AF of firm annual supply to provide water to 3,522 taps by 2060. Projections of future water demand based on both population growth and tap increases are similar. Based on a three percent tap growth scenario and the historical occurrence of drought, WWE found that a future storage capacity with multiple years of carry-over storage to provide three years of supply to the NWC service area would require 4,000 AF of storage capacity.[2] The WWE report suggested several options for new NWC water sources and new NWC reservoirs, which were applied for in Case Nos.

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data from the SWSI 2010 report. The 2010 census data, compiled by DOLA, and DOLA's growth projections for unincorporated San Miguel County, indicate a 2.6 percent/year growth rate over the next 30 years. There are no projections for growth in Norwood specifically. The Town population grew at an average annual rate of 1.7 percent from 2000 to 2010; and, over the same period, unincorporated San Miguel County population grew at an average annual rate of 1.1 percent. WWE used the rate of 2.6 percent projected by DOLA for unincorporated areas of San Miguel County to project Town population growth, a conservative assumption since the Town grew at a faster rate than San Miguel County over the previous decade.

WWE used the ratio of people per tap, to estimate population-based future residential tap numbers for both the Town and the NWC. Within the Town, the ratio is approximately one tap per 1.7 people. In the unincorporated areas within the NWC, the ratio is one tap per 1.4 people. The resulting future population-based residential tap numbers are 1,273 taps in unincorporated NWC and 661 taps within the Town by 2040, for a total of NWC residential taps, 1,934 taps by 2040, not including industrial or commercial taps. If commercial and industrial taps are assumed to grow at the same rate as the population (2.6%), there would be 2,059 taps in the future NWC service area by 2040. Using NWC historical tap growth rates, WWE calculated NWC 1,950 taps (including industrial and commercial taps) by 2040, based on population growth 1,934 residential taps plus an additional 125 commercial and industrial taps, a total of 2,059 taps, by 2040.

[2] This figure assumes 7.5 percent dead storage as well as 20 percent allowance for system losses, including conveyance and treatment plant losses. Evaporation rates for the reservoir options included in the WWE report, based on CDSS evaporation contours, range from 2.9 to 3.75 feet per year. The reservoir options vary in surface area from 55 acres to 215 acres, assuming full pools. Therefore, full pool evaporation estimates would range from 159 AF per year to 806 AF per year.

10CW202 and 10CW203, Division 4. More than 20 objectors have filed Statements of Opposition (including the CWCB in Case 10CW202). If decreed, these water rights would be senior to a CWCB ISF water right.

2. Factual Issues/Claims

a. The proposed ISF amounts are not adequately supported. NWC/LC agree with the concerns regarding the proposed ISF amounts and the CWCB staff, CDOW and BLM methodologies expressed by the experts of Montrose County ("Montrose"), the Southwestern Water Conservation District ("SWCD") and the Farmers Water Development Company ("Farmers"), attached to their Prehearing Statements.

b. The ISF segment length proposed by the CWCB staff is inappropriate. The CWCB staff analysis states that transect data were collected approximately 1.5 miles upstream from the confluence of the San Miguel River with Tabeguache Creek, apparently the only location for the collection of transect data. The staff's hydrology analysis was based on the USGS streamflow gage at Uravan. The transect data and the hydrologic analysis are based on data between the mouth of the San Miguel River and Coal Creek. The proposed segment extends upstream to Calamity Draw, however. Calamity Draw and Coal Creek have significant return flow from the CC Ditch irrigation. The San Miguel River segment from Coal Creek to Calamity Draw was included in the ISF segment even though biological and hydrologic data used to determine the ISF amounts were not collected in this five to six mile length. The flow in this section is less than that downstream of Coal Creek because of irrigation return flows and there are existing irrigation water rights within the segment that divert and have return flow. Synthetic hydrology was developed for the lower terminus of the segment to evaluate water availability. Since it is possible that the San Miguel River is a gaining stream, the availability of the recommended flows may be inflated by the downstream hydrology. For evaluating water availability, consideration must be given to the hydrology at the study reach. Because of the lack of data collected between Coal Creek and Calamity Draw, the ISF amounts are not reflective of the flows in this section, the upper terminus of the ISF Segment should end immediately below the confluence with Coal Creek.

3. Legal Issues.

a. The NWC/LC are parties to these proceedings pursuant to Rule 51(1) of the ISF Rules.

b. In formulating the amounts for the proposed ISF, the CWCB staff applied an incorrect legal standard. The degree of protection for the natural environment within the claimed reach of the San Miguel River is not a reasonable degree or minimum amount. The "Staff Analysis and Recommendation" ("Analysis") for the proposed San Miguel ISF consistently emphasizes maximum habitat protection, rather than "reasonable" protection for the "minimum flows" for the ISF, as legally required. See Analysis at p. 5 under "Field Survey Data," first full paragraph, last sentence; page 7, "Biological Flow Recommendations" footnote under Table 1, and second and third full paragraphs; ISF Rules, Rule 5i(2); C.R.S. § 37-92-

103(4) and § 37-60-102(3). See also *Aspen Wilderness Workshop, Inc. v. Colorado Water Conservation Bd.*, 901 P.2d 1251 (Colo. 1995):

> . . . [C.R.S.] Section 37-92-102(3) . . . grants the . . . [CWCB] the right to determine and appropriate only the minimum amount of water necessary for the preservation of the environment. . . . [T]he Conservation Board has "exclusive authority" only to appropriate "such waters of natural streams and lakes as the board determines may be required for *minimum* stream flows to preserve the natural environment to a reasonable degree." § 37-92-102(3). Because the Board has the duty to appropriate *only* the minimum amount of water necessary to reasonably preserve the environment, its water rights, as determined by the water court, and its actual appropriation must comport with that duty. (Emphasis added.)

901 P.2d at 1257.

Accordingly, the proposed ISF amounts are too high to constitute "a reasonable degree" of protection for the natural environment in the San Miguel River. See the analyses of the experts for Montrose, SWCD and Farmers for the amounts to which the proposed CWCB ISF should be reduced.

c. The proposed ISF conflicts with the CWCB's charge to "correlate the activities of mankind with some reasonable preservation of the natural environment. The CWCB's appropriation of the proposed ISF water right will not further the express intent of C.R.S. § 37-92-102(3) to "correlate the activities of mankind with some reasonable preservation of the natural environment." The CWCB's statutory charge is set forth at C.R.S. § 37-92-102(3), as follows:

> Further recognizing the need to *correlate* the *activities of mankind* with *some reasonable preservation of the natural environment*, the Colorado water conservation board is hereby vested with the exclusive authority, on behalf of the people of the state of Colorado, to appropriate in a manner consistent with sections 5 and 6 of article XVI of the state constitution, such waters of natural streams and lakes as the board determines may be required for *minimum stream flows* . . . to preserve the natural environment to a reasonable degree. . . . (Emphasis added.)

The "activities of mankind", include the development of sufficient water for the next 50 years for the growing population of the NWC for municipal and industrial, commercial and irrigation uses.[3] Therefore, the natural environment within the claimed reach of the San Miguel River

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[3] In balancing the activities of "mankind", the CWCB's duties also include assisting water districts and towns, such as Norwood, and helping develop water for the state's future needs.

> CWCB's duties include:
> . . . foster[ing] and encourage[ing] irrigation districts, public irrigation districts, water users' associations, conservancy districts, drainage districts, mutual reservoir companies, mutual

cannot exist with the proposed ISF amount without material injury to water rights. It is not yet certain that the water rights applied for by NWC in Cases 2010CW202 and 203 will be fully decreed. It is also uncertain whether NWC will be granted needed federal permits if the proposed ISF is decreed, based on the potentially decreed amounts. Therefore, the proposed ISF could preclude NWC's vitally needed water development by limiting the availability of water for NWC's uses. The proposed ISF appropriation could deprive the people of the state of Colorado of the beneficial use of those waters available by law and interstate compact. Therefore, to "correlate the activities of mankind with some reasonable preservation of the natural environment," CWCB should agree that entry of NWC's decree in Cases 10CW202 and 10CW203 is a pre-condition to the entry of any CWCB ISF water rights decree on the San Miguel River.

d. There is insufficient flow available to support the proposed ISF. The recommended instream flows for the proposed ISF do not appear to be available about half the time, based on the Uravan Gage as indicated in flow duration table in the DRAFT CDOW/BLM document. This document indicates that the existing aquatic environment is being preserved with much lower flows that in the recommendations. The FINAL CDOW/BLM document demonstrates that the recommendations are close to average flows in winter, but average flow levels would not be met in approximately half the years. Since the purpose of instream flows is to preserve the existing natural environment, the recommended flows are more than the necessary amount. Flows that are met more frequently with existing hydrology would be more reasonable as minimum flows.

e. The natural environment proposed to be preserved to a reasonable degree with the CWCB's proposed ISF water right extends beyond the indicated reach on the San Miguel River. The natural environment to be preserved also include the Dolores River. This is inappropriate.

> irrigation companies, grazing districts, and any other agencies which are formed under the laws of the state of Colorado, or of the United States, for the conservation, development, and utilization of the waters of Colorado. (Emphasis added.)

C.R.S. § 37-60-106(1)(a)

> . . . foster[ing] the conservation of the water of the state of Colorado by the promotion and implementation of sound measures to enhance water use efficiency in order to serve all the water needs of the state, to assure the availability of adequate supplies for future uses, and to assure that necessary water services are provided at a reasonable cost. (Emphasis added.)

C.R.S. § 37-60-106(1)(r)

> . . . aiding in the protection and development of the waters of the state, for the benefit of the present and future inhabitants of the state. . . (Emphasis added.)

C.R.S. § 37-60-102

> . . . devise[ing] and formulate[ing] methods, means, and plans for bringing about the greater utilization of the waters of the state. . .

C.R.S. § 37-60-106(1)(c)

> . . . gather[ing] data and information looking toward the greater utilization of the waters of the state . . . (Emphasis added.)

C.R.S. § 37-60-106(1)(d)

The PowerPoint presentation of the CDOW, "Native Fish of the Lower Dolores River: Status, Trends, and Recommendations," prepared by Dan Kowalski, Jim White, Rick Anderson and Barry Nehring, states as follws:

> Protecting flows in the San Miguel River is essential for sustaining viable native fish populations in the Dolores River. State instream flow protection and/or Wild and Scenic Designation should be explored to protect San Miguel River flows. (Emphasis added.)

Therefore, there is a sub rosa agenda for the CWCB ISF on the San Miguel River not included in the CWCB staff analysis. The environment to be protected by an ISF is that for which the ISF is appropriated, not that for another river downstream.

4. **NWC Exhibits to be Introduced at Hearing.**

A. NWC Raw Water System Needs Assessment, dated May 2011, by Wright Water Engineers (without appendices), attached as NWC Exhibit "A"

B. CDOW PowerPoint, "Native Fish of he Lower Dolores River: Status, Trends, and Recommendations", prepared by Dan Kowalski, Jim White, Rick Anderson and Barry Nehring, attached as NWC Exhibit "B"

C. Any Exhibit identified by any other Party

5. **Witnesses**.

The following witnesses may testify at the hearing as described below, may give rebuttal testimony and may be available at the hearing to answer questions from the CWCB.

1. Patti Grafmyer, Administrator, Town of Norwood, Norwood Sanitation District and Norwood Water Commission, 1670 Naturita Street, P.O. Box 528, Norwood, CO 81423, will testify to (1) efforts NWC has made and is making to secure water rights to meet its future water needs and reduce its future demand; and (2) the need for appropriate terms and conditions in any San

2. Kerry A. Welch, Mayor, Town of Norwood, 1670 Naturita Street, P.O. Box 528, Norwood, CO 81423, will testify to (1) efforts NWC has made and is making to secure water rights to meet its future water needs and reduce its future demand; and (2) the need for appropriate terms and conditions in any San Miguel River ISF to allow NWC to actually develop its needed water supply.

3. Finn Kjome, Chairman, Norwood Water Commission, 1670 Naturita Street, P.O. Box 528, Norwood, CO 81423, will testify to (1) efforts NWC has made and is making to secure water rights to meet its future water needs and reduce its future demand; and (2) the need for appropriate terms and conditions in any San Miguel River ISF to allow NWC to actually develop its needed water supply.

4. Jim Wells, Board Member, Norwood Water Commission, 1670 Naturita Street, P.O. Box 528, Norwood, CO 81423, will testify to (1) efforts NWC has made and is making to secure water rights to meet its future water needs and reduce its future demand; and (2) the need for appropriate terms and conditions in any San Miguel River ISF to allow NWC to actually develop its needed water supply.

5. Pete Foster, Wright Water Engineers, Inc., 1666 North Main, Ste. C, Durango, CO 81301, is the primary author of the WWE Assessment, and will testify to the future water demands of NWC, and potential options to meet those demands.

6. NWC/LC may call any witness declared by any other party to this hearing.

6. **Written Testimony**.

NWC/LC does not seek to enter any written testimony at this time.

7. **Legal Memoranda**.

NWC/LC does not seek to enter any legal memoranda at this time, other than the legal position what has been set forth herein.

8. **Requested CWCB Actions, Including Alternative ISF Proposals.**

A. Based on the concerns in the reports of Montrose, SWCD and Farmers, NWC/LC request the CWCB to instruct the CWCB staff as follows:

1. Provide formal written documentation of the bases for the determination of the PHABSIM reach as "representative" of the proposed 17 mile ISF segment with respect to river morphological characteristics, to allow a more thorough evaluation of the validity of the characterization of such study reach.

2. Consider all life stages of the bluehead and flannel mouth suckers and, in addition, the roundtail chub, in completing the biological justification for the staff's flow recommendations.

3. Provide written documentation that verifies that the habitat suitability curves developed for the Yampa and Colorado Rivers are suitable for the smaller San Miguel River.

4. Revise the R2CROSS modeling to include only riffle habitat.

5. Justify the use of the R2CROSS method for a stream as large as the San Miguel River.

6. End the upper terminus of the ISF segment immediately below the confluence with Coal Creek.

7. Re-evaluate the determination of the flows at which the maximum weighted usable area for the bluehead and flannel mouth suckers is attained, as these rates may be flawed.

In addition, the CWCB should provide ample time for the Parties to evaluate the new staff data and analyses and provide a response.

B. Based on the legal issues set forth in Section 3 above, NWC/LC asks the CWCB to:

1. Agree that entry of NWC's decrees in Cases 2010CW202 and 203, Division 4, is a pre-condition to the entry of any CWCB ISF water rights decree on the San Miguel River in order to "correlate the activities of mankind with some reasonable preservation of the natural environment."

2. Include in its proposed ISF appropriation, terms and conditions, without limitation, (1) to insure that the ISF will be subject to the present uses or exchanges of water being made by water users pursuant to appropriation or practices existing as of the date of such appropriations, whether or not previously confirmed by court order or decree; and (2) for the withdrawal of statements of opposition in current water court cases; entry of the stipulations for decrees or other forms of contractual agreements, including enforcement agreements, to preserve the natural environment to a reasonable degree in a manner consistent with its CWCB obligations under Colorado law.

3. Allow NWC the opportunity to develop the water rights needed for its future growth and agree not to file a statement of opposition to adjudications of water rights made after the date of filing that: (1) result in depletions that do not exceed 100 acre feet; or (2) are for changes of water rights, that do not seek to change more than 2,500 acre feet, provided such changes of water rights do not involve an exchange through the ISF reaches; and (3) do not exceed a 1% depletive effect on the instream flow right decreed herein in accordance with the *de minimis* Rule 8e of the Rules Concerning the Instream Flow and Natural Lake Level Program. This term and condition does not preclude the CWCB from enforcing this ISF appropriation in accordance with the priority system. The CWCB may also evaluate applications for water rights made after the date of this filing to determine whether they are appropriate for application of the Injury with Mitigation Rule 8i.(3) of the Rules Concerning the Instream Flow and Natural Lake Level Program.

4. Provide protection of the natural environment only to the extent authorized by state statute, i.e., require the proposed ISF to meet all of the substantive and procedural requirements outlined in the ISF Rules.

5. Clearly state that any ISF water right appropriation is not appropriate for consideration as a streamflow standard in other administrative or regulatory permitting contexts.

Respectfully submitted this 15th day of July 2011.

John Barlow Spear
Adam T. Reeves
Janice C. Sheftel, #15346
MAYNES, BRADFORD, SHIPPS & SHEFTEL, LLP
835 East Second Ave., Ste. 123
Durango, CO 81301
Telephone: 970-247-1755
Fax: 970-247-8827
E-Mail: bspear@mbssllp.com; areeves@mbssllp.com;
jsheftel@mbssllp.com

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the enclosed documents were served as indicated on the following person(s) this 15th day of July, 2011:

Colorado Water Conservation Board
Linda Bassi
1313 Sherman Street, Room 721
Denver, CO 80203
(303) 866-3441-ext 3204
Via Hand Delivery
(22 paper copies)

Colorado Dept. of Law
Natural Resources & Environmental Section
Susan Schneider – Staff Attorney
1525 Sherman St., 7th floor
Denver, CO 80203
(303) 866-5046
Susan.schneider@state.co.us
Via Email

Colorado Division of Wildlife
Mark Uppendahl
6060 Broadway
Denver, CO 80216
(303) 291-7267
Mark.uppendahl@state.co.us
Via Email

Bureau of Land Management
Roy Smith
DOI, BLM, Colorado State Office
2850 Youngfield Street
Lakewood, CO 80215-7093
(303) 239-3940
Roy_smith@co.blm.gov
Via Email

Farmer's Water Development Company
David Alexander, President
PO Box 10
Norwood, CO 81423
(970) 327-4844
farmerWDC@yahoo.com
Via Email

Felt, Monson & Culichia, LLC
319 North Weber St.
Colorado Springs, CO 80903
cdc@fmcwater.com
Via Email

Board of County Commissioners of Montrose County
Charles B. White
Robert Hayes
Petros & White, LLC
1999 Broadway, Suite 3200
Denver, CO 80202
(303) 825-1980
cwhite@petros-white.com
rhayes@petros-white.com
Via Email

San Miguel Water Conservancy District
Raymond Snyder, President
San Miguel Water Conservancy District
PO Box 126
Norwood, CO 81423
Via U.S. Mail
(1 paper copy)

Robert W. Bray, Secretary
San Miguel Water Conservancy District
PO Box 65
Redvale, CO 81431
Via U.S. Mail
(1 paper copy)

Board of County Commissioners of San Miguel County
Becky King
San Miguel County Attorney's office
PO Box 791
Telluride, CO 81435
(970) 728-3879
bekcyk@sanmiguelcounty.org
Via Email

Colorado Environmental Coalition
San Juan Citizens Alliance
American Whitewater
Western Colorado Congress
Center for Native Ecosystems
Becky Long
Colorado Environmental Coalition
1536 Wynkoop Street #5C
Denver, CO 80202
(303) 534-7006
becky@ourcolorado.org
Via Email

Sheep Mountain Alliance
Jennifer Russell
Nathaniel Smith
Russell & Pieterse, LLC
PO Box 2673
Telluride, CO 81435
(970) 728-5006
Jenny.russell@lawtelluride.com
Nate.smith@lawtelluride.com
Via Email

Western Resource Advocates
The Wilderness Society
Robert Harris
Bart Miller
Western Resource Advocates
2260 Baseline Road, #200
Boulder, CO 80302
(303) 444-1188
bmiller@westernresources.org
rharris@westernresources.org
Via Email

Casey Shpall, Hearing Officer
Casey.shpall@state.co.us
Via Email

Original Signature on File
Linda A. Winters

NWC EXHIBIT A

Norwood Water Commission

Raw Water System Updates and Future Needs Assessment

Prepared for:

The Town of Norwood
Norwood Water Commission
PO Box 528
Norwood, CO 81423

Wright Water Engineers, Inc.

May 2011

091-039.010

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1.0 INTRODUCTION

1.1 Location

The Norwood Water Commission (NWC) was formed on December 23, 1992, as a water activity enterprise of the Town of Norwood that operates a potable water system. See Appendix A for Resolution of the Town creating the Enterprise.

The Town of Norwood is generally located in an area known as Wrights Mesa on a bench south of the San Miguel River in western San Miguel County and south-western Montrose County (see Location Map, Figure 1). The NWC water system serves both the incorporated Town of Norwood and surrounding unincorporated areas of San Miguel and Montrose Counties.

The NWC service area is in the San Miguel River basin, Water Division 4, Water District 60. The service area is bound on the east by the Beaver Creek drainage basin, on the west by Naturita Creek, and on the north by the San Miguel River. The existing NWC service area, which encompasses approximately 40.5 square miles, as shown in Figure 2A, is supplied water solely by gravity pressure. The extent of the future NWC service area, determined during WWE meetings with the NWC Board of Directors, is shown in Figure 2B. The service area is projected to increase by 40 percent to approximately 56.4 square miles by 2060 or earlier.

1.2 Objectives/Purpose

The purpose of this study is to evaluate the current water supplies available to the NWC for both current and future demands through 2060 and to make recommendations to the NWC on how to meet projected future water needs. This project is partially funded through a grant from the Colorado Water Conservation Board (CWCB). Tasks identified in the grant include:

- Assess average and dry year water supply yield including the 2002 and 2003 drought.

- Incorporate the provisions of the latest NWC contract with the Farmers Water Development Company (Farmers) for Gurley Reservoir storage water into the supply analysis.

- Provide updated estimates of current and future water demand.

- Provide recommendations on protection and enhancement of the NWC portfolio of water rights and strategies for water measurement, conservation and management.

2.0 WATER DEMANDS

2.1 Current

The NWC currently serves approximately 780 taps (2009) in the NWC's existing service area (see Figure 2A). Of the 780 taps, 58 are industrial and commercial taps (or 7 percent of total taps), one is a community water station, and the remaining 721 are household taps (93 percent). While commercial and industrial tap growth tend to outpace residential tap growth, WWE has conservatively set the ratio of industrial and commercial taps to household taps constant over time. Tap growth over the 11-year period of record, from 1999-2009, averaged 2.02 percent per year (see Table 1) with a low of 0.13 percent annual growth in 2007 and a high of 5.45 percent in 2005.

Annual water production for the period of record (2001-2009) at the NWC water treatment plant, by month, is provided in millions of gallons and in acre-feet (AF) in Table 2. Average annual water production over the period of record was 215 AF and ranged from 181 AF (2002) to 241 (2004) AF for the same period (see Table 2).

Water production figures from the water treatment plant on a per tap basis, as provided in Table 3, indicate that the NWC average use of water is 289 gallons/day/tap (gpd/tap). The water demands represent a combination of indoor water use and outdoor landscape irrigation. Average summer water use (May-August) is 364 gpd/tap and winter water use (November – February) averages 230 gpd/tap (see Table 3). The maximum per tap demand was 581 gpd/tap in September 2008.

2.2 Drought

According to the CWCB, Office of Water Conservation and Drought Planning, short duration droughts, of up to three months, occur somewhere in Colorado 9 out of every 10 years. Severe droughts, those lasting multiple years and affecting most of the state, have occurred six times in the past 115 years.

During 2002 through 2003, western Colorado experienced a significant drought that put pressure on many rural water providers, including the NWC. As shown in Table 1, the NWC in 2002 and 2003 was serving 685 and 699 taps, respectively. Treated water production during the drought was 181 AF in 2002 and 194 AF in 2003, compared to an average annual production of 215 AF (see Table 2). According to the Town of Norwood Public Works Director, the bulk of the decrease in water demand came during the summer months when watering restrictions were in place to conserve available supplies.

In order to conserve limited supplies during the drought, the NWC suspended the sale of additional water taps from April of 2002 to October of 2002. Signs were posted at the public community water station in May 2002 to inform users that the water was restricted to indoor use only. Trees were watered with assistance from San Miguel County, delivering through water trucks. In June of 2002, NWC leased an additional 154 shares of water from Farmers, on a one year basis, to address water shortages, and informed customers that use of that water was restricted to indoor use only. From February of 2003 through October of 2003 the NWC instituted a Drought Relief Rate Structure, as a financial incentive for conservation, which raised rates for water use.

2.3 Future Water Demands

WWE evaluated future water demands through a review of the Colorado Water Conservation Board's (CWCB's) Statewide Water Supply Initiative (SWSI), population data from the Department of Local Affairs (DOLA), as well as historical tap growth data from the NWC.

2.3.1 Colorado Water Conservation Board – SWSI 2010

CWCB's SWSI 2010 Report quantified ranges for future Municipal and Industrial (M&I) water demands in the Southwest Basin of Colorado, which includes the NWC service area. For San Miguel County and the portion of Montrose County within the Southwest Basin combined, the projected Municipal and Industrial (M&I) demand increase ranges from 5,900 AF to 11,000 AF by the year 2050. SWSI also attempted to identify the gap in water supply, defined by SWSI as "*a future water supply need for which a project or method to meet that need is not presently identified.*" The projected M&I water supply gap for the same area by 2050 ranges from 4,500 AF to 10,000 AF. SWSI did not address M&I water supply gaps specifically for the NWC service area. Extrapolation of NWC specific data from SWSI 2010 was not carried out under the scope of this report.

2.3.2 Population Growth

WWE evaluated 2010 census data, as compiled by DOLA and growth projections for unincorporated San Miguel County. DOLA projects an average growth rate in unincorporated San Miguel County of 2.6 percent over the next 30 years. There are no projections for growth in the Town of Norwood specifically. The Town of Norwood population grew at an average annual rate of 1.7 percent from 2000 to 2010; and unincorporated San Miguel County population grew at an average annual rate of 1.1 percent over the same period. To project the future population of the Town of Norwood, WWE used the rate of 2.6 percent projected by DOLA for unincorporated areas of San Miguel County. This assumption is conservative since the Town of Norwood grew at a faster rate than San Miguel County over the previous decade.

WWE used the current ratios, of people per tap, to estimate population-based future residential tap numbers for both the Town of Norwood and the NWC, as shown in Table 4-B. Within the Town of Norwood, the ratio is approximately one tap per 1.7 people. In the unincorporated areas within the NWC, the ratio is one tap per 1.4 people. The resulting future population-based residential tap numbers are 1,273 taps in unincorporated NWC and 661 taps within the Town of Norwood by 2040. The combined Town and NWC future residential taps, within the future service area shown in Figure 2B, total 1,934 taps by 2040. It is important to note, this growth in

residential taps does not include growth in industrial or commercial taps. If commercial and industrial taps are assumed to grow at the same projected rate as the population (2.6%), there would be 2,059 taps in the future NWC service area by 2040.

2.3.3 Tap Growth

For the period from 1999 through 2009 (See Table 1), the historical growth in water tap numbers for the NWC averaged 2.02 percent per year, with growth as high as 5 percent (2005) and nearly zero in 2007. For this reason, growth scenarios were developed to evaluate water demands for a tap expansion of from 1 percent to 3 percent. Given the proposed expansion of the existing NWC service area of roughly 40 percent and the historical average growth rate of over 2 percent, for the purposes of long-term water supply planning, an average annual tap growth of 3 percent is used in this study.

Using NWC historical tap growth rates, WWE calculated total taps (industrial and commercial included) in 2040 would equal 1,950 taps (see Table 4-A). As discussed in section 2.3.2, population growth would result in 1,934 residential taps plus an additional 125 commercial and industrial taps, a total of 2,059 taps, by 2040.

2.3.4 Future Water Demands

With a three percent annual growth in tap demand over the next 50 years, based on current water use practices, the NWC will require 1,034 AF of firm annual supply to provide water to 3,522 taps by 2060 (Table 4-A). Projections of future water demand based on both population growth and tap increases are similar.

Based on a three percent tap growth scenario and the historical occurrence of drought, a future storage capacity with multiple years of carry-over storage is recommended. As shown in Table 5, to provide three years of supply to the NWC service area would require 4,000 AF of storage capacity. This figure assumes 7.5 percent dead storage as well as a 20 percent allowance for system losses, including conveyance and treatment plant losses.

Evaporative losses from the water surface of a reservoir vary based on pool size and reservoir elevation. Evaporation rates for the reservoir options, included in Section 5.0, below, based on CDSS evaporation contours, range from 2.9 to 3.75 feet per year. The reservoir options vary in surface area from 55 acres to 215 acres, assuming full pools. Therefore, full pool evaporation estimates would range from 159 AF per year to 806 AF per year.

2.4 Conservation

As a result of NWC actions taken during the drought of 2002 and 2003, per tap water demand was reduced by 16 percent. It is not uncommon for water conservation programs to generate up to 20 percent reductions in water demand. It is recommended that the NWC develop and adopt long-term conservation measures to realize measurable reductions in water demand during non-drought periods as well. The NWC should also evaluate water lost to the system between the treatment plant and points of delivery to identify where system improvements could conserve water supplies. Based on the results of these conservation measures and actions, long-term projections in demand growth should be adjusted accordingly.

3.0 WATER SUPPLY – EXISTING

The NWC uses adjudicated domestic/municipal water rights (see Figure 3) and contract storage water in Farmers' Gurley Reservoir to supply its customers with domestic water supplies. The existing adjudicated direct flow and storage water rights utilized by the NWC system are outlined in Table 6. Decrees are provided in Appendix B.

3.1 Gurley Reservoir

The NWC entered into the Water Supply Agreement (2005 Agreement) with Farmers on April 12, 2005, to receive up to 300 AF of raw water from Gurley Reservoir on an annual basis to provide water for domestic use in the "Norwood Domestic Water System," (Appendix C). This water supply has first priority in Gurley Reservoir and, therefore, is unaffected by the volume of water available to Gurley Reservoir shareholders. The Agreement is perpetual and may be terminated only upon the written agreement of both parties, or unilaterally by Farmers, but only if

the NWC has not requested water for a 36-month period. Water rights for the Gurley system are shown in Appendix E.

In addition to the water available under the 2005 Agreement, the NWC holds 119 shares in the Farmers' system (see Share Certificates in Appendix D). Because these 119 shares are irrigation shares, however, they have not been utilized for domestic supply within the NWC service area and are currently leased for agricultural uses.

Development of a new parallel, raw water irrigation system in the Town of Norwood to utilize the 119 shares of Farmers' water could free up some potable water. Table 7 provides an estimate of future outdoor water use, ranging from 40 AF in year 2010 to 174 AF in year 2060. To obtain a more useable water supply, the NWC might also be able to exchange its 119 shares of Farmers' water with Lone Cone Ditch and Reservoir Company water users for the delivery of Lone Cone Reservoir water to the NWC system because a number of Lone Cone shareholders also own shares in Farmers.

3.2 Priority 214 (Case No. CA4348)

The Town of Norwood was adjudicated first claim to 0.25 cubic feet per second (cfs) of the original 1.0 cfs adjudication decreed to the Farmers Naturita Canal (Priority 214) on October 16, 1933, with an appropriation date of 10/21/1926, in CA4348 (see Appendix B). The point of diversion for NWC's 214 water right is in Gurley Canyon (also known as Maverick Gulch and utilized as the lower Gurley Ditch) (see Figure 3). The water for this right originates from springs and seeps from below the Gurley Dam to the point of the NWC intake. Because of operational limitations of the Gurley Reservoir outlet structure, this water has not historically been a dependable water source for the NWC.

Operational guidelines for NWC's 214 water right promulgated by Kenneth Knox, Division Engineer on November 12, 1996 are as follows (also see Appendix F):

- During spring runoff, the Town of Norwood may exercise its 214 entitlement if senior downstream demand is being met or if the releases from Gurley Reservoir are greater than the 200 cfs combined total of Naturita Canal decrees senior to the 214 right.

- During the irrigation season, when inflows to the Gurley Reservoir are not sufficient to meet senior irrigation water demands, the NWC's 0.25 cfs is deemed out of priority based on the senior direct flow irrigation rights in the Naturita Canal.

- During the post-irrigation season, defined as that period in which senior downstream irrigation demand does not exceed available supplies and the Gurley outlet gate remains partially open, Priority 214 may divert its full entitlement when there is a sufficient surface water supply.

- During the Gurley Reservoir storage season, in the late fall when the reservoir outlet gate is fully closed, Priority 214 may divert excess surface water accruing within Gurley Canyon below the dam that is not necessary to meet senior downstream demands.

Based on a site visit in 2010 with Aaron Todd, District 60 Water Commissioner, WWE's understands that NWC generally can divert its full amount (0.25 cfs) under the 214 water right in periods when Gurley Reservoir is not releasing water during the non-irrigation season. Thus, during the irrigation season, when Gurley Reservoir releases occur, NWC cannot divert water under its 214 water right.

Based on information from the Office of the State Engineer, the source of the water for the 214 water right is water accruing to Gurley Canyon downstream of Gurley Dam, limited to reservoir seepage and irrigation return flows. There are approximately 200 acres of irrigated land upgradient of the 214 water right. WWE's understanding is that:

1) The 214 water right is subject to curtailment during the irrigation season, and

2) The 214 water right relies upon seepage and irrigation return flows which are both subject to irrigation practices and drought.

It is WWE's opinion that the 214 water right is not a dependable water source to meet NWC future needs, especially in a dry year.

3.3 Gardner Pipeline

The Gardner Pipeline was decreed for up to 0.5 cfs in CA9042 with an adjudication date of 1/6/1967 (see Appendix B). This water is diverted into the NWC system via a perforated concrete pipeline. The NWC can pump this water into NWC Reservoir No. 1 (Section 3.6 below) or allow it to gravity flow either to NWC Reservoir No. 2 or directly into the NWC Water Treatment Plant.

The Gardner Pipeline water right is located in Gurley Canyon near the point of diversion for the 214 water right (see Figure 3) and, according to WestWater Engineering, the springs that serve the Pipeline are highly influenced by flow in Gurley Canyon and, historically, by return flows from approximately 188 acres of irrigated fields in the vicinity.

According to WestWater Engineering (1995), the yield of the Gardner Pipeline could be as high as 45,000 to 50,000 gallons per day (gpd) during the irrigation season, decreasing to 20,000 to 25,000 gpd during the winter. Recent conversions from flood to sprinkler irrigation in the 188 acres have decreased the yield at the Gardner Pipeline (per conversations with Town of Norwood Public Works Director). As in the case of the 214 water right, the Gardner Pipeline right may be subject to administration during the irrigation season, which was not accounted for in the WestWater analysis. Water available to the Gardner Pipeline depends upon seepage below Gurley Dam and return flows from irrigated lands and, therefore, the Pipeline water right is not considered a dependable water source for NWC future water supplies, especially during dry years.

3.4 Norwood Infiltration Pipeline

The Norwood Infiltration Pipeline, decreed in Case CA9042 (see Appendix B), has two priorities: Priority No. 513 for 0.57 cfs absolute and No. 513c for 0.18 cfs conditional (see Table 6). Water for this right is collected via an underground perforated pipeline which has had output of up to 0.57 cfs, according to WestWater Engineering (1995). The source is "springs and groundwater in Gurley Canyon." Water in the Gurley Ditch, adjacent to the perforated pipeline, is a likely source of recharge. Per the order from Ken Knox on operation of the 214 right (Appendix F), if and when the production from the infiltration pipeline reaches 0.75 cfs

(approximately 540 AF/yr) the NWC must forego diversions under its Priority No. 214 water right.

The Norwood Infiltration Pipeline may be subject to administration during the irrigation season as are the 214 and Gardner Pipeline rights. The administration of the Norwood Infiltration Pipeline is not accounted for in the WestWater analysis.

In conversations with the Town of Norwood Public Works Director, WWE learned that diversions of this water right are not continuously measured. It is recommended that the NWC install a measuring device and establish an accurate yield for the infiltration pipeline.

As in the case of the 214 and Gardner Pipeline water rights, water available to this diversion depends upon seepage from Gurley Dam and return flows from irrigated lands and is not considered a dependable water source for NWC future water supplies, especially during dry years.

3.5 Town of Norwood Well

As an additional water supply, the Town of Norwood owns a well, with Permit No. 22706-F, issued in December of 1978 (See Appendix G). The well is located on land leased from the State Land Board for a term of 99 years (expiring December, 2077). Pump tests indicated that the well could produce a sustainable water supply of 50 gallons per minute but was limited in the permit to a maximum withdrawal of 28 acre-feet (AF) per year, from unknown reasons. Based on conversations with the Town of Norwood Public Works Director, the well was abandoned due to pumping costs and the limited supply available from the well. Therefore, all pumping and metering equipment has been removed from the well and the Town of Norwood Well is not considered a dependable water supply for future NWC growth.

3.6 NWC Raw Water Storage

The NWC was decreed, in Case 01CW270, raw water storage in the NWC Reservoirs 1 – 4 (see Table 6). Reservoirs 1 and 2 have been constructed with storage capacities of 18.4 AF and 91.0 AF, respectively. When constructed, Reservoirs 3 and 4 could create additional storage capacity

of 91.0 AF and 33.0 AF, respectively. Reservoirs 1 and 2 are filled using water from the 214 water right, the Gardner Springs and Pipeline, and water delivered from Gurley Reservoir under the 2005 water Agreement. Reservoirs 3 and 4, when constructed, would be filled by the same sources.

3.7 Current Water Rights Summary

Based on the analysis by WestWater Engineering, the estimated yield of the NWC's direct flow rights during a dry year is approximately 142 AF (see Appendix D). This estimated yield does not account for water rights administration during the irrigation season and overestimates the annual yield of these water rights. Because the yield of NWC water rights is not clear since there are no reliable long-term diversion records; the rights are highly dependent upon irrigation return flows and seasonal flows in the lower Gurley Ditch; the rights are all located in the same vicinity; and they are subject to administration by senior water rights, the NWC water system is considered vulnerable to supply shortages, especially during drought years. Therefore, the NWC direct flow water rights are not a reliable long term source of water supply during drought years.

4.0 UNDEVELOPED WATER SUPPLY

4.1 NWC River Diversion

The NWC River Diversion is a 5.0 cfs conditional water right on the San Miguel River at the mouth of Beaver Canyon, decreed in Case 94CW244, with a 11/1/1994 appropriation date (see Appendix B). This water right could provide a substantial amount of the water necessary for the future water needs of the NWC. The yield of this water right, however, is restricted by decreed limitations based on streamflow and administrative calls by downstream senior water rights. During drought periods, the full decreed amount would typically be available only during spring runoff.

Based on the timing of water available to this right, sufficient storage to meet future NWC water needs, in addition to that in NWC Reservoirs 1 through 4, would be required to utilize this water right to its full potential.

4.2 Norwood-Nelson Ditch

The Norwood-Nelson Ditch is a conditional water right for 10.0 cfs decreed in Case 91CW0065, with a 7/24/1991 appropriation date, on McCulloch Creek (see Table 6), which is tributary to Beaver Creek. It is senior to the CWCB instream flow on Beaver Creek and is, therefore, not subject to curtailment by the instream flow water right. The contributing area to the Norwood-Nelson Ditch is relatively small and is very high up in the basin. Water would typically be available during snowmelt in large quantities but the supply would be much less dependable later in the year. Therefore, sufficient storage, in addition to that in NWC Reservoirs 1 – 4, would be required to utilize this water right to its full potential.

4.3 NWC Gurley Diversion

The NWC Gurley Diversion is a conditional water right for 5.0 cfs on Maverick Draw near the NWC Reservoir No. 1, decreed in Case 94CW245 with an appropriation date of 11/1/1994 (see Appendix B). The contributing basin for this diversion extends from the outlet of Gurley Reservoir downstream to the point of diversion. It is possible that some water may be available to this right during the non-irrigation season when releases from Gurley Reservoir are not occurring. However, because the operations of Gurley Reservoir dictate the flow regime in Maverick Draw, this water right is not considered a dependable source for a sustainable future water supply to the NWC.

4.4 Shares in Farmers' Water Development Company

The NWC has 119 shares of irrigation water in the Farmers' Water Development Company's (FWDC) Gurley Reservoir that are currently leased to others (share certificates are in Appendix D). According to WestWater Engineering (1995), there are a total of 7,113 shares in the FWDC. With average Reservoir releases totaling 18,597 AF/yr, each share yields an average of 2.6 AF/yr (1978-2009). NWC's FWDC shares in Gurley Reservoir represent an average yield of 309.4 AF/yr (2.6 AF/share x 119 shares).

The average water demand per NWC tap during the summer (May - August) from 2000-2009 was 364 gpd/tap, 134 gpd/tap more than the average winter demand (November - February). The

majority of the additional water use is for landscape irrigation. Therefore, the NWC might be able to increase the amount of treated water available to meet future demand through the construction of a parallel raw water irrigation system designed to utilize NWC's FWDC shares for landscape irrigation. Such a parallel system could have increased current water available for indoor use by 41 AF/year during 2010 for the months of May-August (see Table 7). The NWC could potentially increase its treated water supply by 178 AF in 2060 by developing a parallel raw water system for outdoor use, also shown in Table 7. The feasibility and costs of this new raw water system have not been evaluated.

5.0 OPTIONS FOR FUTURE WATER SUPPLY TO THE NWC SERVICE AREA

In 2010, WWE developed a series of preliminary options to address NWC's future water supply needs. These options include various combinations of new surface and storage water rights and reservoir enlargements. The water storage volume needed to provide one year of supply and two years of carryover storage was determined to be 4,000 AF, as described in Section 2.3 and shown on Table 5. Because of the junior nature of any new water rights, their yield in dry years will be limited, necessitating carryover water storage capacity. The locations of the water rights for which applications have been filed with the Division 4 Water Court in Cases 10CW202 and 203 are shown in Figure 4 and the filings are summarized in Table 8.

In developing future water supply options, neither the yield of the 300 AF under the 2005 Agreement nor the 119 additional shares FWDC water in Gurley Reservoir were considered because of delivery issues during the non-irrigation season, legal water availability constraints, and aging Gurley system delivery facilities.

NWC’s direct flow water rights were also not considered in the development of future water supply options because their yield is undetermined due to lack of historical diversion records, the connection of said water rights to irrigation practices and season, as well as the goal of creating redundancy in the water supply system for NWC. The calculated future water supply for the NWC is 4000 AF provided in one or a combination of alternatives to meet future demand.

5.1 Surface Diversions

Water availability was evaluated throughout the Fall Creek, Beaver Creek, and San Miguel River basins, through analyses of call records, streamflow records, amounts of existing CWCB instream flows and potential yield from the basins of interest. Prior reports were reviewed to help identify feasible options for the NWC.

Fall Creek (J. & M. Hughes Ditch)

During the development of the alternatives to the San Miguel Project (Bureau of Reclamation *Planning Report on the San Miguel Project*, Colorado, May 1982), Fall Creek was identified as a potential source for additional water. Therefore, WWE evaluated Fall Creek as a potential future supply for the NWC.

The primary diversion on Fall Creek is the J.&M. Hughes Ditch, which is decreed for 40 cfs (Case Nos. CA5882 and W0680). The Williams Ditch (CA4348) has also historically diverted water at the J.&M. Hughes Ditch point of diversion. The Ditch Company filed an application in Case 10CW210 for alternate points of diversion at newly surveyed points along the Ditch.

The CWCB holds a 5.0 cfs instream flow on Fall Creek in the vicinity of the J.&M. Hughes Ditch. An evaluation of the contributing basin, historical stream gage records, and the amount of the CWCB instream flow right revealed that additional water has historically been available on Fall Creek. The average monthly flows for the period of record, 1941 and 1959, at the Fall Creek gage near Fall Creek, CO (9172000) are presented in Table 9. Runoff modeling for the contributing basin to the J.&M. Hughes Ditch is also provided in Table 9. The NWC J.&M. Hughes Ditch Enlargement (applied for in Case No 10CW202) provides for both a use enlargement and a potential physical enlargement of the J.&M. Hughes Ditch to deliver an additional 40 cfs of water to various reservoirs, both current and future, as discussed in later sections herein. The actual need for a physical J.&M. Hughes enlargement will be assessed in a feasibility analysis of hydrology, ditch capacity, and institutional constraints and opportunities.

Beaver Creek

The 1988 *Interim Report for the San Miguel Project Feasibility Study,* prepared by Boyle Engineering, listed Beaver Creek as one of the proposed additional options for San Miguel Project water supplies, including an increase in diversion by the Naturita Canal of 175 cfs in the upper Beaver Creek drainage.

In Case 10CW202, NWC applied for the NWC Goat Creek Pump Station, with ten alternate points of diversion from the Farmers' Naturita Canal out of Beaver Creek. Beaver Creek is the primary source of water for the Farmers' Naturita Canal, which diverts water high in the Beaver Creek drainage, water for delivery to Gurley Reservoir and the Farmers' irrigation delivery system.

The CWCB holds an instream flow water right of 2.5 cfs from August 1 to May 31 and 5.0 cfs from June 1 to July 31 on the lower section of Beaver Creek which limits the amount of water which would be available to NWC in priority from Beaver Creek.

A water availability analysis, performed at the NWC Goat Creek Pimp Station location directly upstream of the instream flow on Beaver Creek, determined both average and dry year water availability. Table 10 shows the amount of water available at the Beaver Creek stream gage over the period of record (1941-1981) as well as for dry and average years. The analysis assumes an active call from downstream senior water rights and subtracts the decreed CWCB instream flow rates.

During 1977, the driest year for which there are gage records, 776 AF of water was available in Beaver Creek at the upstream terminus of the Beaver Creek instream flow in early spring. The 2002 dry water year is not included in the gage's period of record. After subtracting the CWCB instream flow amount, the average amount of available water over the period of record at the Beaver Creek Gage was 8,909 AF/yr (see Table 10). The average flow rate over the period of record was 12.3 cfs. In the April to July period, the available streamflow averaged 34.4 cfs during the period of record, after subtracting 5 cfs for the CWCB instream flow. The maximum available flow at the Beaver Creek stream gage for the period of record was 473 cfs on June 6, 1957. More recently, on June 8, 1979, 212 cfs was available after subtracting the 5 cfs CWCB

instream flow. These recorded flows, adjusted to meet the CWCB instream flow, are greater than the 175 cfs applied for in Case No. 10CW202.

San Miguel River: Naturita Pump Stations 1 and 2

In Case 10CW202, NWC applied for two additional pump station points of diversion directly out of the San Miguel River. The Naturita Gage on the San Miguel River near Naturita, CO is located downstream of large senior irrigation water rights. During an average water year (1978), nearly 227,000 AF of water was available at the Naturita Gage (see Table 11). The average annual amount of water available over the period of record (1917-1981) is slightly higher, with over 238,000 AF available at the gage. In 1977, the driest year of record, 48,954 AF of water was available at the Naturita Gage. In 1978, flows at the gage averaged 311 cfs. Over the period of record, flows averaged 328 cfs. In the driest year (1977), flows at the Naturita Gage averaged 67.5 cfs (see Table 11).

To meet an annual NWC demand of over 1000 AF in 2060, plus two years of carryover storage, the average flow rate at the two new San Miguel River points of diversion would need to be approximately 6.0 cfs.

A review of administrative records did not identify administration from senior calling water rights in the reach of the San Miguel River downstream of the Naturita Gage and proposed pump station options (PODs). Given the water available in priority, development of the new Naturita pump stations may not require NWC to construct 4,000 AF of storage. However, an analysis of the potential development of conditional water rights and existing water rights in the Uravan area would be required to fully assess the actual amount of water available in priority at the new NWC San Miguel River PODs.

5.2 Storage Reservoirs

Water availability in the NWC service area and contributing areas is driven primarily by snow-melt/spring runoff. During the spring and early summer there is more water available than there is demand and much of the available water is not diverted. This pattern of early season runoff

necessitates some level of new storage for the NWC to provide water to the service area later in the summer and through the winter months.

As discussed earlier (see Section 2.3 above), with a 3 percent growth in tap demand through 2060, the NWC will need to provide 1,034 AF of water per year to satisfy its customers' water demands. Assuming that droughts will continue to occur, as historically (see Section 2.2), WWE has estimated that NWC will need two years of carryover storage. Therefore, each reservoir site will need a capacity of 4,000 AF of storage, assuming 7.5 percent for dead space, 20 percent for system and water treatment losses (Table 5) and reservoir evaporation, as discussed in Section 2.3.3. The six reservoir sites that lie within the basins having an available water supply, in priority, that can deliver to the existing NWC infrastructure (see Figure 4 with locations noted by triangles) are discussed in following sections. Only one reservoir site or a combination of smaller reservoir sites is needed to provide the NWC with the calculated 4000 AF of water supply.

Beaver Park Reservoir – Case 10CW202

This reservoir site lies in Beaver Park, southeast of the Town of Norwood, below the Gurley collection system. The reservoir would receive its water supply primarily from the J.&M. Hughes Ditch, with contributions from Beaver Creek and its tributaries. The Bureau of Reclamation first evaluated this reservoir site in the *Planning Report on the San Miguel Project, Colorado,* May 1982. To convey water from the J.&M. Hughes Ditch to the reservoir would require the construction of approximately 5.5 miles of conveyance canal. Any new structures would require the proper acquisition of easements or authorizations for land use from private and/or public entities.

Huff Gulch Reservoir – Case 10CW202

The Huff Gulch Reservoir is an on-channel reservoir on Huff Gulch, southeast of the Town of Norwood. The reservoir's primary sources of water would be an extension of the J.&M. Hughes Ditch, Beaver Creek, and Huff Gulch itself.

Upper Gurley Reservoir – Case 10CW202

This reservoir site is situated just above and south of the existing Gurley Reservoir and would receive water via the Farmers' Naturita Canal system. Since NWC does not own water rights in the Naturita Canal, it would have to provide a supplemental water source to fill the Upper Gurley Reservoir. The primary potential water sources for the reservoir would be the J.&M. Hughes Ditch and Beaver Creek. This reservoir site was evaluated in the *San Miguel Project Water Supply Study, Phase 1 Final Report — Technical Appendices* prepared by Boyle Engineering Corporation for the CWCB, June 1989. To deliver water to the Upper Gurley Reservoir from the J.&M. Hughes Ditch would require the construction of a siphon or trestle to convey water across Beaver Canyon. Water delivered to Upper Gurley Reservoir from Beaver Creek would require the construction of a pump station and pipeline, with appropriate land use authorization, or use of the Naturita Canal. Any use of the Naturita Canal would require appropriate authorization.

Enlarged Lone Cone Reservoir – Case 10CW203

Enlargement of the existing 1,800 AF Lone Cone Reservoir, directly south of the Town of Norwood, to accommodate an additional water supply, would benefit both the NWC and the Lone Cone Ditch and Reservoir Company. Water could be delivered to this enlarged reservoir via the J.&M. Hughes Ditch or at a point of diversion on Beaver Creek below the Gurley collection system. This reservoir site was evaluated in the November 1984 *Lone Cone Reservoir Enlargement Project Feasibility Study* prepared by Western Engineers, Inc. To deliver water to the Enlarged Lone Cone Reservoir from the J.&M. Hughes Ditch would require the construction of a siphon or trestle across Beaver Canyon. To deliver water to the Enlarged Lone Cone Reservoir from Beaver Creek would require the construction of a pump station and pipeline or use of the Naturita Canal, which would require appropriate authorizations.

Ed Joe Draw Reservoir – Case 10CW202

This on-channel reservoir is located in Ed Joe Draw, south of the Town of Norwood, and downstream of the Lone Cone Reservoir. It would receive storage water from the J.&M. Hughes Ditch or Beaver Creek below the Gurley collection system via the Lone Cone Reservoir and the Lone Cone Ditch and Reservoir Company's delivery system. This reservoir site was evaluated in

the *San Miguel Project Water Supply Study, Phase 1 Final Report — Technical Appendices,* June 1989, prepared by Boyle Engineering Corporation for the CWCB. To deliver water to the Ed Joe Draw Reservoir from the J.&M. Hughes Ditch would require the construction of a siphon or trestle across Beaver Canyon. To deliver water to Ed Joe Draw Reservoir from Beaver Creek would require the construction of a pump station and pipeline or use of the Naturita Canal. Use of the Naturita Canal would require appropriate authorizations.

Old Town Reservoir – Case 10CW202

This site, no longer in use for water storage, located due west of the Town of Norwood, was at one time filled with water from the Lone Cone Reservoir. A small 183 AF reservoir could be constructed at the site to provide water to the NWC service area. Water could be provided to this site via the J.&M. Hughes Ditch or from a point of diversion on Beaver Creek below the Gurley collection system. To deliver water to the Old Town Reservoir site from the J.&M. Hughes Ditch would require the construction of a siphon or trestle across Beaver Canyon. Water delivered to Old Town Reservoir from Beaver Creek would require the construction of a pump station and pipeline.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Summary

The NWC has water rights (conditional and absolute) as well as contract water in Gurley Reservoir to provide potable, industrial and irrigation water to the NWC's service area (see Figure 2A). The NWC currently serves 780 taps. With sustained tap growth, at rate of three percent, NWC would need to serve 3,522 taps by 2060, requiring 1,034 AF of water on an annual basis.

NWC's existing direct flow water rights are located in Gurley Canyon, which also serves as the Farmers' Lower Gurley Ditch. The existing direct flow rights are subject to administration during the irrigation season, rely on irrigation return flows and seepage from Gurley Reservoir

and/or Gurley Ditch and are not considered a reliable municipal source, especially during drought years.

In order to meet NWC's future water demand, as identified in this report and by the CWCB in the SWSI 2010 Report, NWC's current water supplies need to be protected and enhanced and additional water supplies need to be developed to serve the NWC service area. This report developed several options which include surface diversions, storage reservoirs, and a parallel raw water delivery system.

6.2 Recommendations

For the NWC to be able to serve it 2060 water demands, WWE recommends the following:

- To protect and enhance NWC's current water rights:
- Install monitoring equipment at points of diversion for existing absolute direct flow water rights to better quantify the yields of these rights.
- Continue diligence on conditional water rights held by the Town of Norwood and NWC
- Continue to work with the Division of Water Resources on the administration of the Priority 214 Water Right.
- Continue a strong working relationship with Farmers Water Development Company to maintain water supplies as well as to develop future opportunities to meet NWC's growing water demands.
- Improve upon existing metering at the community water station to better determine types of uses and user numbers.
- Evaluate the feasibility of a raw water irrigation system for all or part of the NWC service area, utilizing the 119 shares of Gurley Reservoir water, to free up potable water supplies and reduce treatment costs.
- Investigate the exchange potential between Gurley and Lone Cone Reservoirs.

- Implement long-term conservation measures to realize reductions in water demand during both drought and non-drought periods.

To meet NWC's future demand, WWE recommends that the Town develop future supplies to serve its customer base as follows:

- Work with area water rights holders, ditch companies and landowners to understand institutional constraints to the development of future water supplies.

- Develop a cost-benefit and engineering analysis of the options presented in this report to identify the most feasible options.

- Within institutional and cost-benefit constraints, identify the most feasible combination of existing and future water supply options to secure water to meet the NWC's future demands.

- Pursue water rights applications filed in Case Nos. 10CW202 and 10CW203.

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TABLES

Table 1
Norwood Water Commission
Water Tap Counts

Year	Taps Total	Taps Sold	Percent Change
1999	639		
2000	647	8	1.25%
2001	664	17	2.63%
2002	685	21	3.16%
2003	699	14	2.04%
2004	715	16	2.29%
2005	754	39	5.45%
2006	771	17	2.25%
2007	772	1	0.13%
2008	777	5	0.65%
2009	780	3	0.39%
Average		14.1	2.02%

Notes:
Data Received 7/21/2010 from Patti Grafmyer at the Town of Norwood
In 2007 NWC raised PIF fees from $6000 to $12000.

Table 2

Norwood Water Commission

Water Production Records

(Values in Millions of Gallons)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Monthly Average
Taps	**664**	**685**	**699**	**715**	**754**	**771**	**772**	**777**	**780**	
Jan.	5.6	5.4	4.1	4.5	4.2	4.6	5.6	2.2	4.4	**4.5**
Feb.	5.2	5.6	3.8	4.4	3.9	4.4	4.1	4.7	3.9	**4.4**
Mar.	5.3	5.7	4.6	4.9	4.9	4.7	5.2	4.8	4.5	**4.9**
April.	5.4	5.6	4.8	8.1	4.4	5.2	5.3	4.9	4.5	**5.3**
May	7.0	5.4	5.6	8.8	6.1	7.9	6.0	6.5	6.2	**6.6**
June	9.4	5.5	6.6	7.9	7.2	8.4	8.5	9.4	7.2	**7.8**
July	7.6	5.2	8.2	9.2	9.4	6.5	8.6	9.9	8.7	**8.1**
Aug.	6.9	5.3	7.3	7.0	7.2	5.6	6.6	10.4	8.3	**7.2**
Sept.	8.4	4.0	5.7	5.9	7.5	5.1	6.0	11.6	6.4	**6.7**
Oct.	5.7	3.9	4.7	5.7	6.0	4.9	5.0	5.2	4.9	**5.1**
Nov.	5.0	3.5	3.9	6.1	5.4	4.4	4.5	4.0	4.7	**4.6**
Dec.	5.2	4.0	3.8	6.0	4.6	5.0	4.9	4.3	5.1	**4.8**
Total	**76.6**	**59.0**	**63.1**	**78.5**	**70.7**	**66.7**	**70.2**	**77.8**	**68.6**	**70.1**
Production per Tap	**0.12**	**0.09**	**0.09**	**0.11**	**0.09**	**0.09**	**0.09**	**0.10**	**0.09**	0.10

Notes:

Data Received 7/21/2010 from Patti Grafmyer at the Town of Norwood

Water Production Records

(Values in Acre-Feet)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Monthly Average
Taps	**664**	**685**	**699**	**715**	**754**	**771**	**772**	**777**	**780**	
Jan.	17.2	16.6	12.6	13.8	12.9	14.2	17.3	6.6	13.4	**13.8**
Feb.	16.0	17.2	11.7	13.3	12.1	13.6	12.6	14.4	11.8	**13.6**
Mar.	16.2	17.5	14.1	14.9	14.9	14.4	15.8	14.6	13.8	**15.1**
April.	16.4	17.2	14.7	24.9	13.4	15.9	16.1	15.1	13.8	**16.4**
May	21.3	16.4	17.2	27.1	18.6	24.2	18.4	19.8	18.9	**20.2**
June	28.9	16.9	20.3	24.2	22.2	25.6	26.2	28.9	22.1	**23.9**
July	23.3	16.1	25.2	28.4	28.8	19.9	26.3	30.4	26.5	**25.0**
Aug.	21.2	16.2	22.4	21.4	22.1	17.2	20.2	31.8	25.4	**22.0**
Sept.	25.7	12.1	17.5	18.2	22.9	15.7	18.3	35.5	19.8	**20.6**
Oct.	17.3	11.8	14.4	17.5	18.5	15.0	15.3	15.9	14.9	**15.6**
Nov.	15.3	10.7	12.0	18.8	16.6	13.6	13.9	12.4	14.4	**14.2**
Dec.	16.0	12.3	11.7	18.3	14.0	15.5	14.9	13.2	15.7	**14.6**
Total	**235**	**181**	**194**	**241**	**217**	**205**	**215**	**239**	**211**	**215**
Production per Tap	**0.35**	**0.26**	**0.28**	**0.34**	**0.29**	**0.27**	**0.28**	**0.31**	**0.27**	**0.29**

Table 3
Norwood Water Commission
Historical Water Use per Tap
(All values in Gallons per Tap per Day)

Month	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average	Minimum	Maximum
JANUARY	273	263	199	219	204	224	274	105	212	219	105	274
FEBRUARY	278	298	203	232	210	237	219	251	206	237	203	298
MARCH	257	277	223	236	237	228	251	231	218	240	218	277
APRIL	269	282	241	407	220	261	264	246	226	268	220	407
MAY	338	260	272	429	294	383	291	314	299	320	260	429
JUNE	473	277	331	396	363	419	428	473	362	391	277	473
JULY	369	255	398	449	455	316	416	482	420	396	255	482
AUGUST	336	257	355	338	350	272	320	503	403	348	257	503
SEPTEMBER	421	198	286	298	374	256	300	581	323	338	198	581
OCTOBER	274	187	228	277	293	238	242	252	236	248	187	293
NOVEMBER	251	176	196	307	272	222	227	202	235	232	176	307
DECEMBER	253	194	185	290	222	245	236	208	248	231	185	290
Annual Average	316	244	260	323	291	275	289	321	282	289	244	323
Summer Average	379	262	339	403	366	347	364	443	371	364	262	443
Winter Average	264	233	196	262	227	232	239	192	225	230	192	264
July	369	255	398	449	455	316	416	482	420	396	255	482
January	273	263	199	219	204	224	274	105	212	219	105	274
TAPS	664	685	699	715	754	771	772	777	780			

Source: Town of Norwood

Notes:
1. Water use calculated by dividing water production records by number of taps in use
2. Summer defined as May - August
3. Winter defined as November - February

Table 4-A

Norwood Water Commission

Tap and Water Demand Growth Scenarios

Year	Number of Taps			Total Annual Water Demands						Average July Water Demands			Average January Water Demands		
				Acre-Feet			Millions of Gallons			Acre-Feet			Acre-Feet		
Growth Rate-->	1%	2%	3%	1%	2%	3%	1%	2%	3%	1%	2%	3%	1%	2%	3%
2010	788	796	803	231	234	236	75.3	76.1	76.8	28.7	29.0	29.3	15.9	16.0	16.2
2011	796	812	828	234	238	243	76.1	77.6	79.1	29.0	29.5	30.1	16.1	16.4	16.7
2012	804	828	852	236	243	250	76.9	79.2	81.5	29.3	30.1	31.0	16.2	16.7	17.2
2013	812	844	878	238	248	258	77.6	80.7	84.0	29.6	30.7	32.0	16.4	17.0	17.7
2014	820	861	904	241	253	265	78.4	82.4	86.5	29.9	31.4	32.9	16.5	17.4	18.2
2015	828	878	931	243	258	273	79.2	84.0	89.1	30.1	32.0	33.9	16.7	17.7	18.8
2016	836	896	959	245	263	282	80.0	85.7	91.7	30.5	32.6	34.9	16.9	18.1	19.4
2017	845	914	988	248	268	290	80.8	87.4	94.5	30.8	33.3	36.0	17.0	18.4	19.9
2018	853	932	1018	250	274	299	81.6	89.2	97.3	31.1	33.9	37.1	17.2	18.8	20.5
2019	862	951	1048	253	279	308	82.4	90.9	100.3	31.4	34.6	38.2	17.4	19.2	21.1
2020	870	970	1080	255	285	317	83.2	92.8	103.3	31.7	35.3	39.3	17.6	19.6	21.8
2021	879	989	1112	258	290	326	84.1	94.6	106.4	32.0	36.0	40.5	17.7	20.0	22.4
2022	888	1009	1145	261	296	336	84.9	96.5	109.5	32.3	36.7	41.7	17.9	20.4	23.1
2023	897	1029	1180	263	302	346	85.7	98.4	112.8	32.6	37.5	43.0	18.1	20.8	23.8
2024	906	1050	1215	266	308	357	86.6	100.4	116.2	33.0	38.2	44.2	18.3	21.2	24.5
2025	915	1071	1252	268	314	367	87.5	102.4	119.7	33.3	39.0	45.6	18.4	21.6	25.2
2026	924	1092	1289	271	321	378	88.3	104.5	123.3	33.6	39.8	46.9	18.6	22.0	26.0
2027	933	1114	1328	274	327	390	89.2	106.5	127.0	34.0	40.6	48.4	18.8	22.5	26.8
2028	942	1136	1368	277	334	401	90.1	108.7	130.8	34.3	41.4	49.8	19.0	22.9	27.6
2029	952	1159	1409	279	340	413	91.0	110.8	134.7	34.7	42.2	51.3	19.2	23.4	28.4
2030	961	1182	1451	282	347	426	91.9	113.1	138.8	35.0	43.0	52.8	19.4	23.8	29.3
2031	971	1206	1495	285	354	439	92.9	115.3	142.9	35.4	43.9	54.4	19.6	24.3	30.1
2032	981	1230	1539	288	361	452	93.8	117.6	147.2	35.7	44.8	56.1	19.8	24.8	31.1
2033	990	1255	1586	291	368	465	94.7	120.0	151.6	36.1	45.7	57.7	20.0	25.3	32.0
2034	1000	1280	1633	294	376	479	95.7	122.4	156.2	36.4	46.6	59.5	20.2	25.8	32.9
2035	1010	1305	1682	297	383	494	96.6	124.8	160.9	36.8	47.5	61.3	20.4	26.3	33.9
2036	1020	1331	1733	299	391	509	97.6	127.3	165.7	37.2	48.5	63.1	20.6	26.9	35.0
2037	1031	1358	1785	302	399	524	98.6	129.9	170.7	37.5	49.4	65.0	20.8	27.4	36.0
2038	1041	1385	1838	306	407	539	99.6	132.5	175.8	37.9	50.4	66.9	21.0	27.9	37.1
2039	1051	1413	1893	309	415	556	100.5	135.1	181.1	38.3	51.4	68.9	21.2	28.5	38.2
2040	1062	1441	1950	312	423	572	101.6	137.8	186.5	38.7	52.5	71.0	21.4	29.1	39.3
2041	1072	1470	2009	315	431	590	102.6	140.6	192.1	39.1	53.5	73.1	21.6	29.7	40.5
2042	1083	1499	2069	318	440	607	103.6	143.4	197.9	39.4	54.6	75.3	21.8	30.2	41.7
2043	1094	1529	2131	321	449	625	104.6	146.3	203.8	39.8	55.7	77.6	22.1	30.8	43.0
2044	1105	1560	2195	324	458	644	105.7	149.2	209.9	40.2	56.8	79.9	22.3	31.5	44.3
2045	1116	1591	2261	328	467	664	106.7	152.2	216.2	40.6	57.9	82.3	22.5	32.1	45.6
2046	1127	1623	2328	331	476	683	107.8	155.2	222.7	41.0	59.1	84.8	22.7	32.7	47.0
2047	1138	1655	2398	334	486	704	108.9	158.3	229.4	41.5	60.3	87.3	23.0	33.4	48.4
2048	1150	1689	2470	337	496	725	110.0	161.5	236.3	41.9	61.5	90.0	23.2	34.1	49.8
2049	1161	1722	2544	341	505	747	111.1	164.7	243.3	42.3	62.7	92.6	23.4	34.7	51.3
2050	1173	1757	2621	344	516	769	112.2	168.0	250.6	42.7	64.0	95.4	23.7	35.4	52.9
2051	1185	1792	2699	348	526	792	113.3	171.4	258.2	43.1	65.2	98.3	23.9	36.1	54.5
2052	1197	1828	2780	351	536	816	114.4	174.8	265.9	43.6	66.6	101.2	24.1	36.9	56.1
2053	1208	1864	2864	355	547	841	115.6	178.3	273.9	44.0	67.9	104.3	24.4	37.6	57.8
2054	1221	1902	2950	358	558	866	116.7	181.9	282.1	44.4	69.2	107.4	24.6	38.4	59.5
2055	1233	1940	3038	362	569	892	117.9	185.5	290.6	44.9	70.6	110.6	24.9	39.1	61.3
2056	1245	1978	3129	365	581	918	119.1	189.2	299.3	45.3	72.0	113.9	25.1	39.9	63.1
2057	1258	2018	3223	369	592	946	120.3	193.0	308.3	45.8	73.5	117.4	25.4	40.7	65.0
2058	1270	2058	3320	373	604	974	121.5	196.9	317.5	46.2	74.9	120.9	25.6	41.5	67.0
2059	1283	2099	3419	377	616	1004	122.7	200.8	327.0	46.7	76.4	124.5	25.9	42.3	69.0
2060	1296	2141	3522	380	629	1034	123.9	204.8	336.8	47.2	78.0	128.2	26.1	43.2	71.0

Notes:

1. All values using 0.29 AF/Tap/Month based on average year demand per Tap (2001-2009)
2. July and January demands calculated by using the average July and January demands 2001-2009 multiplied by number of taps in each potential growth scenario

Table 4-B
Norwood/San Miguel County Population and Residential Tap Growth 2000-2040

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Location	**Average Population Growth Rate 2000-2010**	**Population 2010**	**Average Projected Population Growth Rate 2010-2040**	**Projected Population 2040**	**Residential Taps in NWC 2010**	**Persons per Tap - 2010**	**Projected Residential Taps in Current NWC Service Area 2040**	**Projected Residential Taps in Expanded NWC Service Area 2040**
	(percent)	(people)	(percent)	(people)	(units)	(people)	(units)	(units)
Unincorporated San Miguel County	1.1%	2,997	2.6%	6,473	421	1.4	909	1,273
Town of Norwood	1.7%	518	2.6%	1,119	306	1.7	661	661
Total					**727**		**1,570**	**1,934**

Notes:
1) Location
2) Average population growth from 2000 to 2010 based on DOLA Statistics "Colorado Census and Intercensal¹ Population Estimates by County and Muncipality 2000-2010"
3) Population statistics from DOLA
4) Population projection based on average 2.6 percent annual growth rate (2010-2040) as projected by DOLA Updated "TABLE 1. PRELIMINARY POPULATION FORECASTS BY REGION, 2000-2040"
5) Column (3) population projected to the year 2040 at an annual growth rate of 2.6 percent.
6) Residential Taps served by the NWC, per NWC staff. 58 commercial/industrial taps removed from Town of Norwood total.
7) For unincorporated areas, it is assumed there is one tap per household. Value calculated by dividing total Unincorporated San Miguel County Population (2,997) by total Unincorporated San Miguel County Households (2,166) from DOLA. For the Town of Norwood, Column (2) divided by Column (6).
8) For unincorporated areas, Column (8) projected to 2040 at 2.6 percent tap growth per year, assuming taps grow at same rate as population. For Town of Norwood, Column (5) divided by Column (7).
9) Column (9) multiplied by 140 percent expansion in service area outside Town of Norwood. Norwood Tap numbers not affected.

¹ = 2001 -2009 are called intercensal estimates since they are based on censuses at each end of the time series and are therefore between two censuses. The major factor to bear in mind is that the intercensal estimates that DOLA produces are not only based on the two sets of data from the censuses, but also on the original set of postcensal estimates developed during the decade.

Table 5
Norwood Water Commission
Recommended Reservoir Volume

Projected Water Demands - 2060	Water Demands + 20% for system losses and water treatment	Reservoir Volume with 2 Years of Carry-over storage	Total Reservoir Volume
(1)	(2)	(3)	(4)
AF	AF	AF	Af
1,034	1,240	3,720	4,000

Notes

(1) Projected NWC water demands given 3% growth rate
(2) Column (1) + 20% to account for system and water treatment losses
(3) Column (2) x 3 years for carry-over in a drought scenario
(4) Column (3) + 7.5% for dead storage and siltation pool

Table 6
Town of Norwood and Norwood Water Commission
Water Rights

	Name	Amount	Use	Source	Adjudication Date	Appropriation Date	Priority	Case No.
Town of Norwood	Priority 214	0.25 c.f.s.	M	Maverick Draw	10/16/1933	10/21/1926	214	CA 4348
	Town of Norwood Pipeline	0.50 c.f.s.	M	Maverick Draw	7/10/1952	6/1/1935	385	CA5882
	Town of Norwood Pipeline	0.25 c.f.s.	M	Maverick Draw	7/10/1952	6/1/1948	425	CA5882, Absolute, 85CW150
	Norwood Infiltration Pipeline	0.57 c.f.s.	M	Maverick Draw, various springs and seeps	1/16/1967	6/10/1962	513	CA9042
	Norwood Infiltration Pipeline	0.18 c.f.s. conditional	M		1/16/1967	6/10/1062	513c	CA9042; Absolute; 85CW151
	Gardner Springs	0.25 c.f.s	D/S	Maverick Draw, various springs and seeps	1/16/1967	11/13/1950	478	CA9042
	Gardner Springs	0.50 c.f.s.	I/S		1/16/1967	11/1/1960	511	CA9042
Norwood Water Commission	Norwood Nelson Ditch	10 c.f.s.	M	McCulloch Ck	12/31/1991	7/24/1991		91CW0065
	NWC River Diversion	5.0 c.f.s., conditional	M	San Miguel R.	12/31/1994	11/1/1994		Case No. 94CW244; Diligence: Case No. 08CW55
	NWC Gurley Diversion	5.0 c.f.s., conditional	M	Beaver Creek	12/31/1994	11/__/1994		Case No. 94CW245
	NWC Reservoirs Nos. 1, 2, 3, & 4	#1: 18.4 af #2: 91 af #3: 91 af conditional #4: 33 af conditional	M	Gurley Reservoir, Gardner Springs, Priority 214, Infiltration Pipeline, and Town of Norwood Pipeline	12/31/2001	12/1/1994		Case No. 01CW270

	Name	Amount	Use	Comment
Reservoir Shares/Agreements	Farmers Water Development Company Shares (Owned)	119 shares	I	Certificate
				716 (1)
				717 (50)
				721 (60)
				723 (6)
				727 (2)
	Farmers Water Development Company Shares (Contract)	300 a.f. minimum	D	

Use Codes: M - municipal, D - domestic, S - stock, I - irrigation

Table 7
Norwood Water Commission
Outdoor Water Use Estimates

	Gal/tap/day
Average Summer Use	364
Average Winter Use	230
Average Irrigation Use	134
Average Irrigation Use	0.0004 AF/tap/day

Year		2010	2020	2030	2040	2050	2060
(1)	Taps	803	1080	1451	1950	2621	3522
(2)	AF/Day	0.33	0.44	0.60	0.80	1.08	1.45
(3)	AF/Year	**41**	**55**	**73**	**99**	**133**	**178**

Notes:

(1) Tap Estimate from Table 4.

(2) Row (1) * 0.0004 AF/tap/day

(3) Row (2) * 123 days (Irrigation season of May through August, 123 days)

Table 8

Norwood Water Commission

Water Rights Application Case 10CW202

Name	Amount	Source	Claimed Appropriation Date
Diversion	**(cfs)**		
J.&M. Hughes Enlargement	40	Fall Creek	5/1/1982
Goat Creek Pump	175	Beaver Creek	11/9/2010
Naturita Pumps 1 & 2	6	San Miguel River	11/9/2010
NWC River Diversion APOD	5	San Miguel River	11/1/1994
Storage	**(AF)**		
Beaver Park Reservoir	4000	J.&M. Hughes Ditch	5/1/1982
Huff Gulch Reservoir	4000	J.&M. Hughes Ditch, Huff Gulch	11/9/2010
Upper Gurley Reservoir	4000	J.&M. Hughes Ditch, Goat Creek Pump	6/1/1989
Lone Cone Enlargement	4000	J.&M. Hughes Ditch, Goat Creek Pump	11/1/1984
Ed Joe Draw Reservoir	4000	J.&M. Hughes Ditch, Goat Creek Pump	6/1/1989
Old Town Reservoir	183	J.&M. Hughes Ditch, Goat Creek Pump	11/9/2010

Note: Application restricts total combined storage to 4,000 AF and average annual yield to 1,034 AF.

Table 9

Norwood Water Commission

Water Availability at the J.&M. Hughes Ditch and Fall Creek Gage Near Fall Creek, CO

Month	(1)	(2)	(3)	(4)	(5)
	Fall Creek Gage		J.&M. Hughes Ditch		
	Average (1941-1959)	Fall Creek Gage Adjusted Using USGS Regression Analysis	Annual Discharge Using USGS Regression Analysis for the contributing basin to the J.&M. Hughes Ditch	Annual Discharge Using Fall Creek Gage Adjusted flows by the Ratio of Drainage Basin Areas	Annual Discharge Based on Adjusted Gage Data less 5 cfs Instream Flow
	cfs	cfs	cfs	cfs	cfs
October	5.3	13.2	6.9	3.9	0.0
November	2.8	8.6	4.5	2.0	0.0
December	1.0	6.0	2.9	0.7	0.0
January	0.1	4.9	2.3	0.1	0.0
February	0.0	5.5	3.0	0.0	0.0
March	0.4	12.0	9.1	0.3	0.0
April	16.6	40.6	29.3	12.1	7.1
May	67.2	104.3	82.6	48.9	43.9
June	89.5	95.3	75.2	65.1	60.1
July	33.3	31.2	13.3	24.2	19.2
August	14.3	17.6	8.6	10.4	5.4
September	2.7	13.8	6.8	1.9	0.0
Average Annual	19.4	29.4	20.4	14.1	11.3

Column Notes:

1. Based on average daily flows from period of record (1941-1959) for Fall Creek near Fall Creek, CO gage (9172000). Located downstream of J&M Hughes so gage is affected by J&M Hughes Diversions
2. Fall Creek Gage adjusted based on USGS Scientific Investigations Report 2009-5136 "Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado" (using table values from Report).
3. Based on USGS Scientific Investigations Report 2009-5136 "Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado" (24.3 sq. mi. basin, slope 0.22, Mean Elev. 10,199 ft., and 31.7 in. precip)
4. Column (1) x .728 (ratio of area contributing to Fall Creek Gage (33.4 sq. mi.) and area contributing to J.&M. Hughes Ditch (24.3 sq. mi.))
5. Column (4) less 5 cfs to account for the instream flow on Fall Creek (case no. 4-84CW436)

Table 10
Norwood Water Commission
Beaver Creek Water Availability

	(1)		(2)		(3)	
	Monthly Flow Rates and Volumes at USGS Beaver Creek Near Norwood Gage Adjusted for CWCB Instream Flow and San Miguel River Mainstem Call					
	Dry Year (1977)		Average Year (1943)		Average Over Period of Record	
Month	(AF)	(cfs)	(AF)	(cfs)	(AF)	(cfs)
October	1	0.0	61	1.0	162	2.7
November	0	0.0	276	4.5	102	1.7
December	0	0.0	215	3.5	83	1.3
January	0	0.0	167	3.0	55	1.0
February	0	0.0	277	4.5	60	1.0
March	31	0.5	387	6.5	143	2.4
April	650	10.6	3,435	55.9	1,818	29.6
May	93	1.6	2,755	46.3	4,174	70.1
June	0	0.0	715	11.6	2,312	37.6
July	0	0.0	0	0.0	0	0.5
August	0	0.0	0	0.0	0	0.1
September	0	0.0	0	0.0	0	0.2
Average		**1.1**		**11.4**		**12.3**
Total	**776**		**8,288**		**8,909**	

Column Notes:
1. Based on average daily flows from water year 1977, driest on record, assumes call from San Miguel River, June Through September.
2. Based on average daily flows from water year 1943, average year based on annual averages, assumes call from San Miguel River, July through September.
3. Based on average daily flows from period of record (1941-1981), assumes call from San Miguel River, July through September.

Source: USGS Gage 09173000, Beaver Creek Near Norwood Colorado, Period of Record 1941-1981.

Table 11
Norwood Water Commission
Available Water at San Miguel River at Naturita, CO

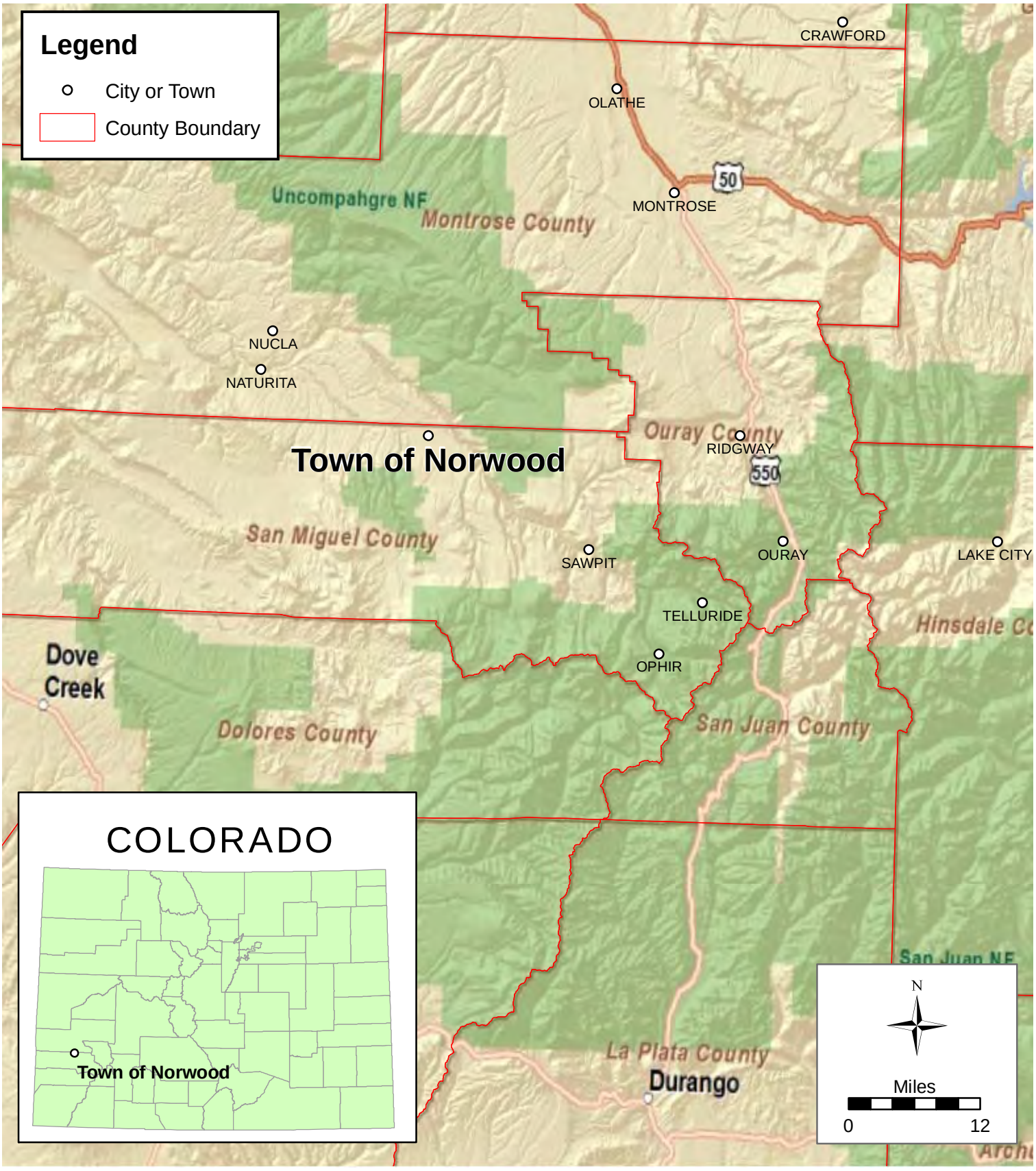
Month	(1) Dry Year Flow (1977) (AF)	(1) Dry Year Flow (1977) (cfs)	(2) Average Year Flow (1978) (AF)	(2) Average Year Flow (1978) (cfs)	(3) Period Average Flow (AF)	(3) Period Average Flow (cfs)
October	6,325	106	4,035	68	7,380	124
November	4,052	66	3,194	52	6,415	104
December	2,896	47	4,169	68	5,560	90
January	2,628	47	3,993	72	4,690	84
February	3,395	55	4,041	66	5,846	95
March	3,739	63	5,720	96	7,664	129
April	6,040	98	54,496	886	37,255	606
May	4,035	68	51,214	861	60,360	1,014
June	8,452	137	68,747	1,118	57,509	935
July	2,496	41	24,060	391	26,803	436
August	3,093	52	2,585	43	11,452	192
September	1,802	29	679	11	7,890	128
Average		**68**		**311**		**328**
Total	**48,954**		**226,933**		**238,825**	

Column Notes:

1. Based on average daily flows from water year 1977, driest on record.
2. Based on average daily flows from water year 1978, average year based on annual averages.
3. Based on average daily flows from period of record (1917-1981).

Source: USGS Gage 09175500, San Miguel River at Naturita, Colorado, Period of Record 1917-1981.
Based on stream administration from 1996 to 2010.

FIGURES



P:\091-039\010 - Raw Water System Update & Future Needs\Mapping\Figure 1 - Norwood Location Map.mxd

WWE
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1666 N. Main Ave., Suite C
Durango, CO. 81301
(970) 259-7411

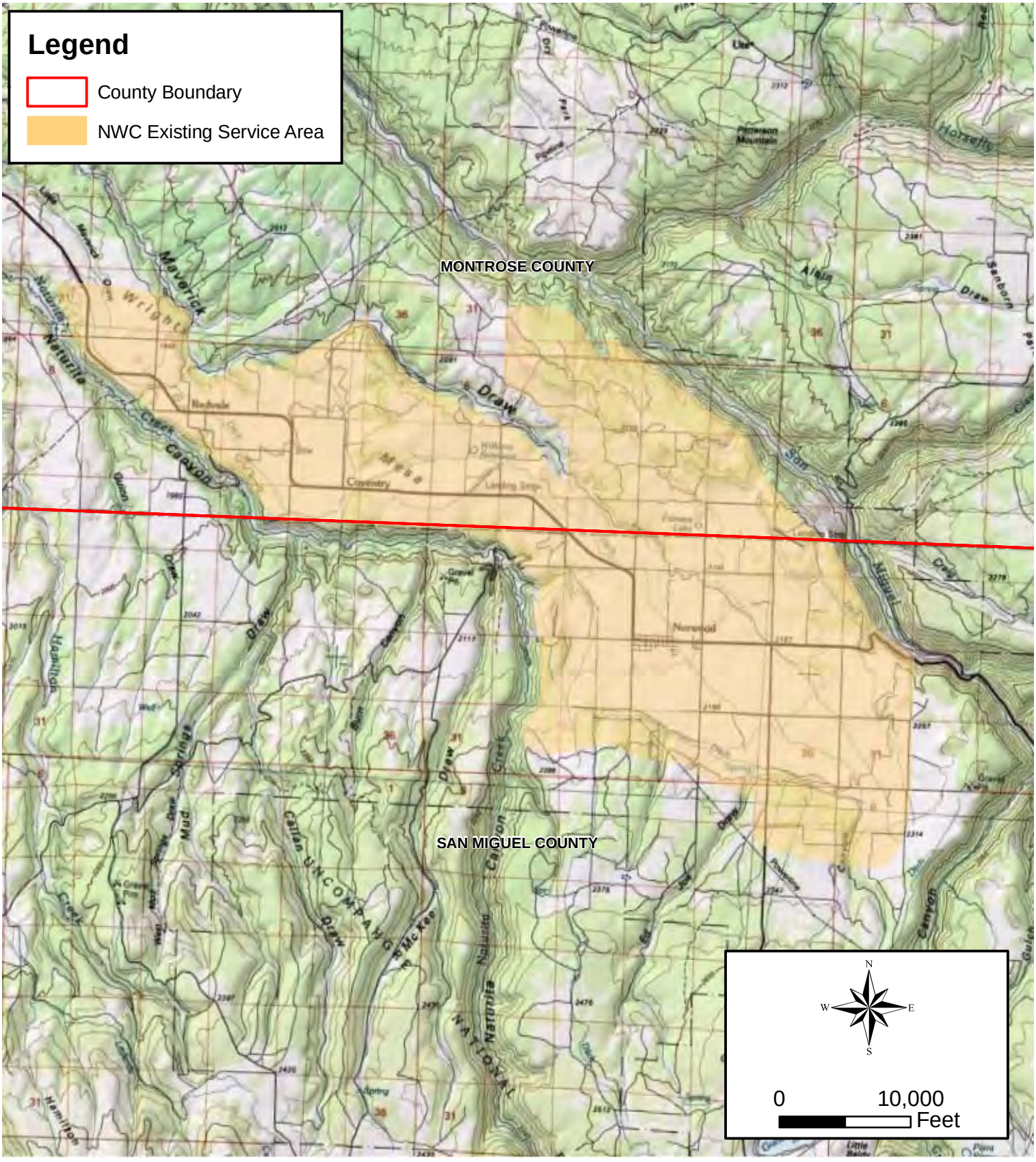
SAN MIGUEL COUNTY, COLORADO

LOCATION MAP

NORWOOD WATER COMMISSION

PROJECT NO. 091-039.010

FIGURE 1



P:\091-039\010 - Raw Water System Update & Future Needs\Mapping\Figure 2A - Existing Service Area.mxd

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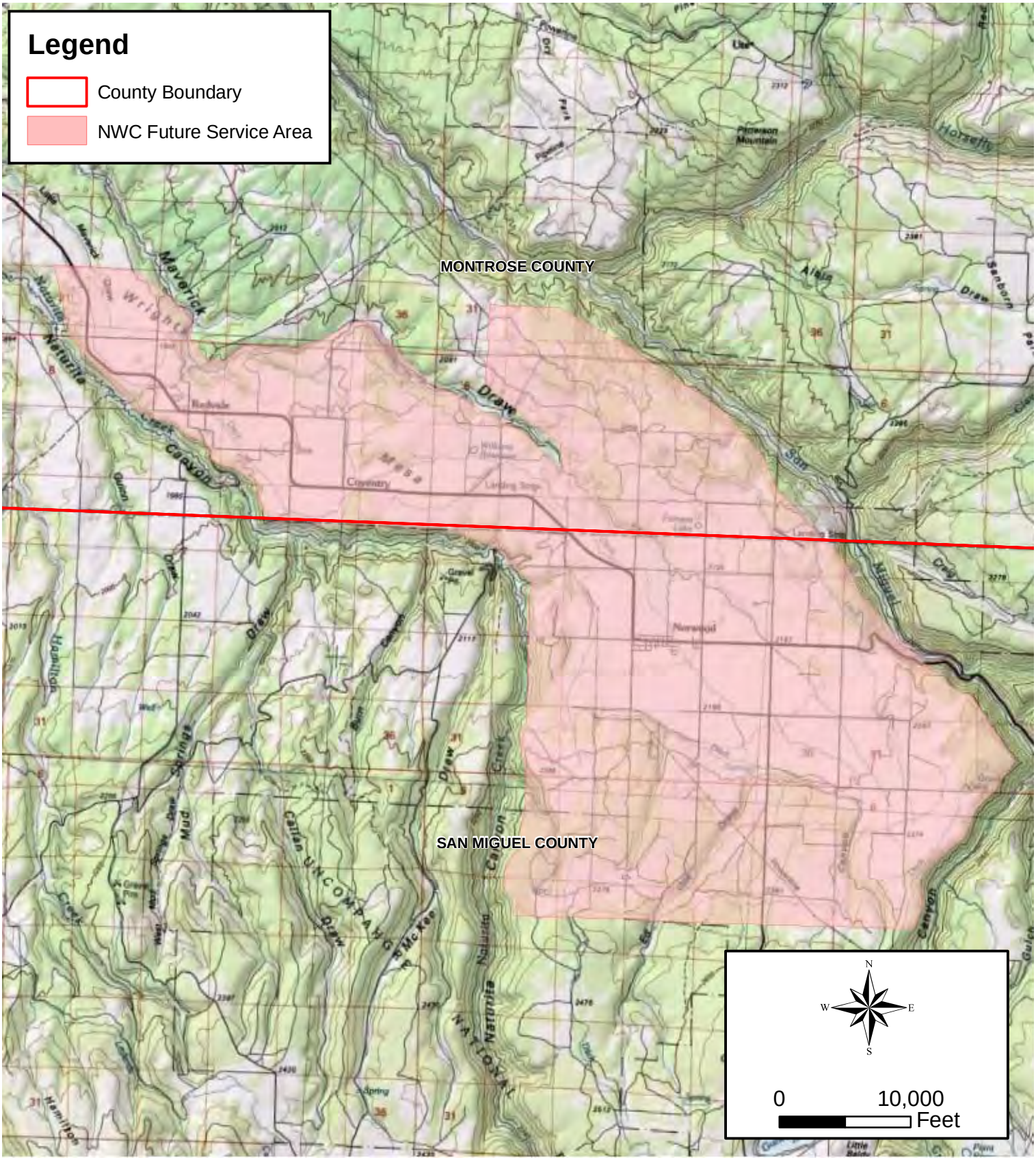
SAN MIGUEL & MONTROSE COUNTIES, COLORADO

NORWOOD WATER COMMISSION
EXISTING SERVICE AREA
NORWOOD WATER COMMISSION

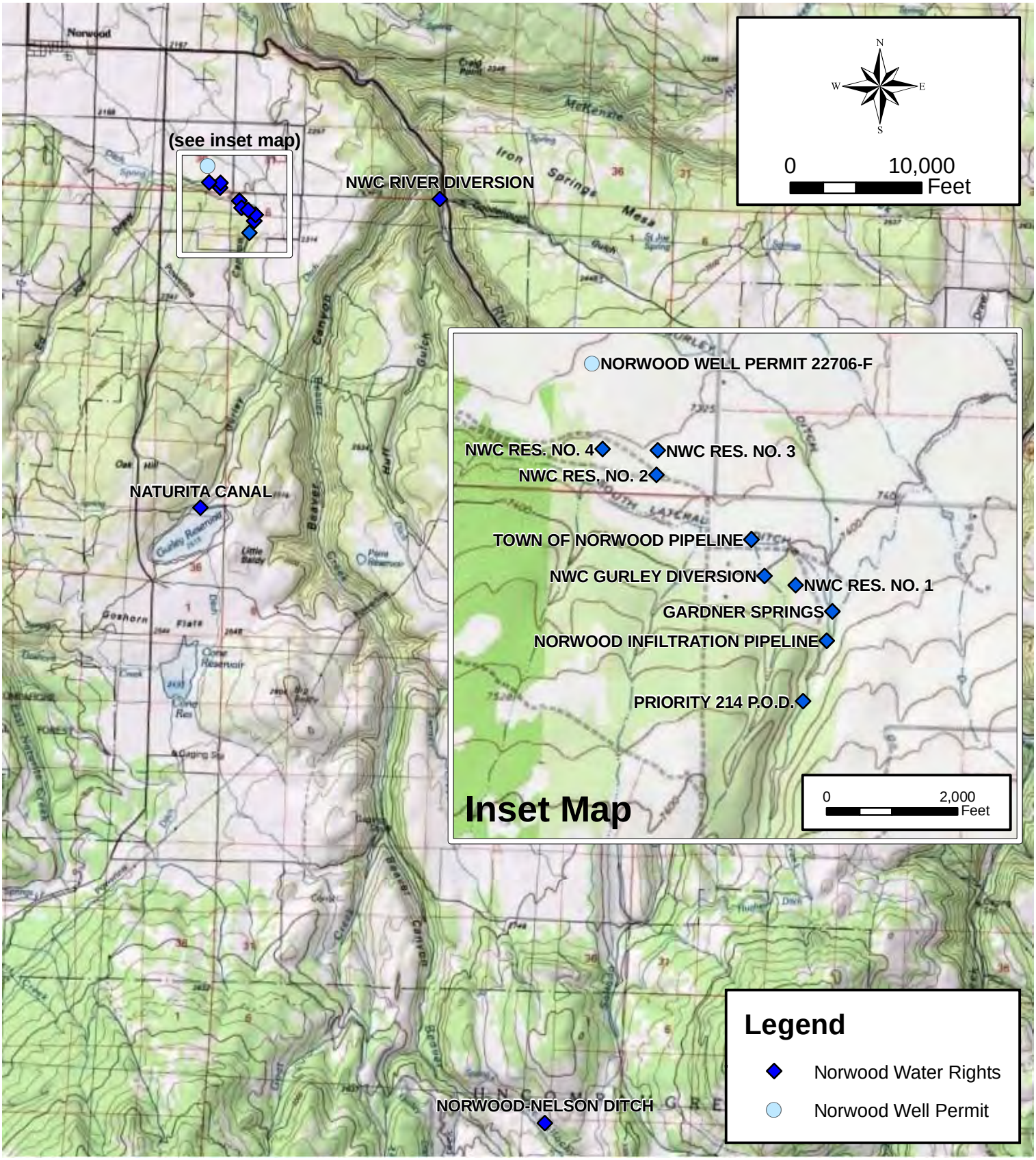
PROJECT NO. 091-039.010

FIGURE 2A



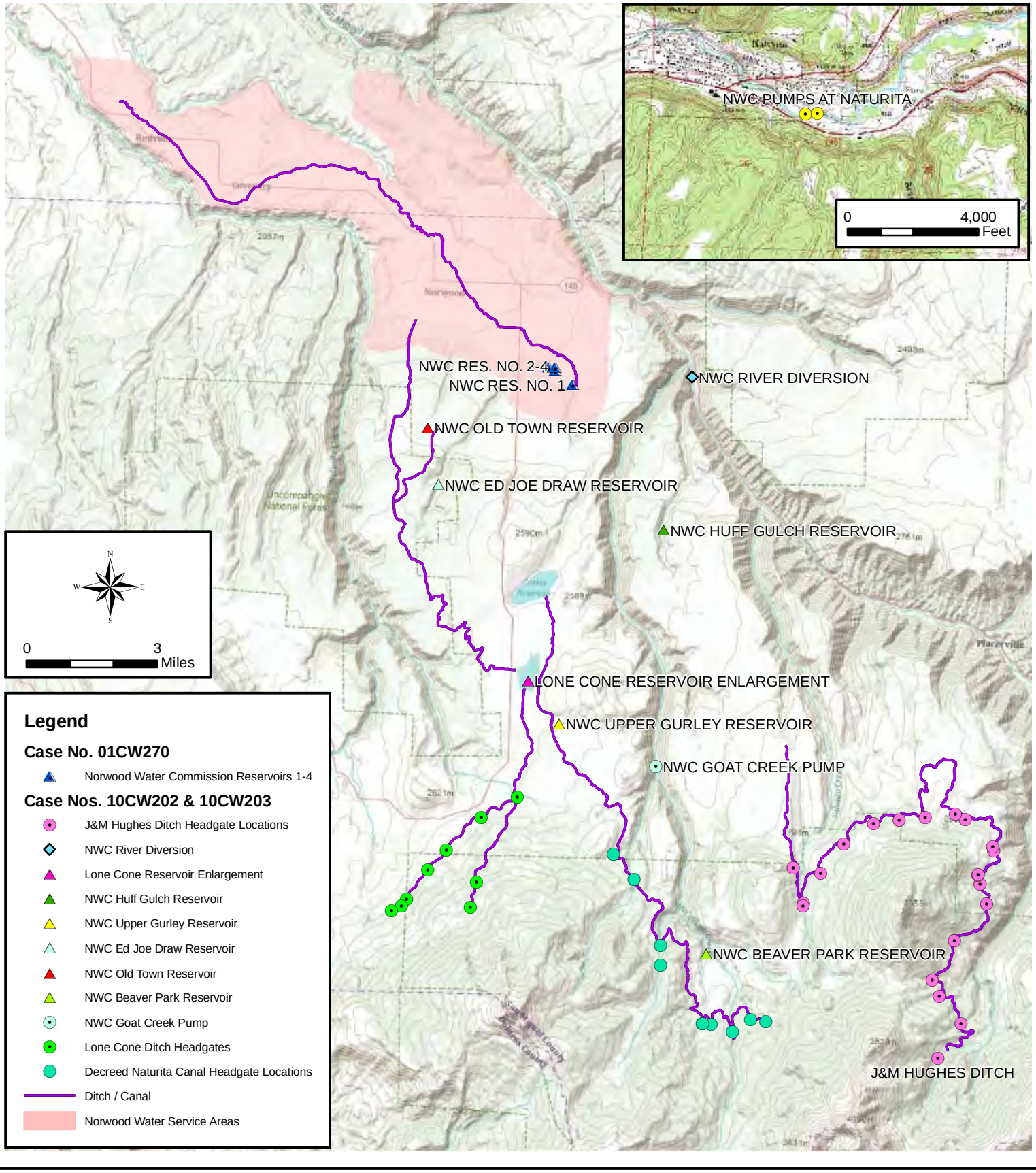
P:\091-039\010 - Raw Water System Update & Future Needs\Mapping\Figure 2B - Future Service Area.mxd

WRIGHT WATER ENGINEERS, INC. 1666 N. Main Ave., Suite C Durango, CO. 81301 (970) 259-7411	*SAN MIGUEL & MONTROSE COUNTIES, COLORADO* **NORWOOD WATER COMMISSION** **FUTURE SERVICE AREA** **NORWOOD WATER COMMISSION**	PROJECT NO. 091-039.010	FIGURE 2B



P:\091-039\010 - Raw Water System Update & Future Needs\Mapping\Figure 3 - Norwood WRs.mxd

WRIGHT WATER ENGINEERS, INC. 1666 N. Main Ave., Suite C Durango, CO. 81301 (970) 259-7411	*SAN MIGUEL COUNTY, COLORADO* **NORWOOD WATER COMMISSION WATER RIGHTS** **NORWOOD WATER COMMISSION**	PROJECT NO. 091-039.010	FIGURE 3



P:\091-039\010 - Raw Water System Update & Future Needs\Mapping\Figure 4 - Summary of 2010 Norwood WRs Filing.mxd

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Durango, CO. 81301
(970) 259-7411

SAN MIGUEL & MONTROSE COUNTIES, COLORADO

NORWOOD WATER COMMISSION
2010 WATER RIGHTS FILING LOCATIONS
NORWOOD WATER COMMISSION

PROJECT NO. 091-039.010

FIGURE 4

Native Fish of the Lower Dolores River

Status, Trends, and Recommendations

NWC EXHIBIT B

Dan Kowalski Rick Anderson
Jim White Barry Nehring

Native Fish of the Dolores River

- Native Fish Species
- Current Status and Trends
- Comparisons to Other Rivers
- Native Fish Habitat-Flow Relationship
- Conclusions and Recommendations
  - Ann Oliver's Questions
  - Non-Native Fish Control
  - Lower Dolores Working Group Wild and Scenic Alternatives
- Discussion

Native Fish Species of the Dolores River

- Colorado Pikeminnow — FE, ST
- Bluehead Sucker — SS
- Flannelmouth Sucker — SS
- Roundtail Chub — SSC, SS
- Speckled Dace
- Mottled Sculpin
- Colorado River Cutthroat Trout — SSC

- Not Confirmed
  - Razorback Sucker — FE
  - Humpback Chub — FE
  - Bonytail — FE

FE- Federally Endangered
ST- State Threatened
SSC- State Species of Special Concern
SS- BLM Sensitive Species

Native Species Accounts

- Colorado Pikeminnow
  - Large predatory fish (70+ inches and 80 lbs)
  - Naturally lower density, move great distances
  - Habitat generalist but dependent on natural peak flows for habitat and spawning cues
  - Population declines associated with reduced peak flows in Colorado and Gunnison rivers
- Bluehead Sucker
  - Facultative herbivore, forages in riffles for algae, detritus, occasional invertebrates
  - Strongly associated with medi-riffle habitat, dependant on adequate base flows and quality of riffle habitat
  - Currently occupy about 50% of historic habitat

Native Species Accounts

- Flannelmouth Sucker
  - Omnivore consumes algae, detritus, invertebrates
  - Associated with deep semi-swift run habitat, can withstand reduced peak flows but limited by base flows and quality riffle-run habitat
  - Currently occupy about 45% of historic habitat
- Roundtail Chub
  - Opportunistic predator, aquatic insects major prey
  - Habitat generalist more associated with pool habitat, prefer murky water
  - More likely to be limited by food resources than habitat
  - Currently occupy about 45% of historic habitat

Flannelmouth Sucker

Colorado Pikeminnow

Roundtail Chub

Bluehead Sucker

Colorado Pikeminnow in the Dolores River

- Pikeminnow documented in the Dolores from 1950's to 1970's as far up river as Paradox Valley and into the lower end of the San Miguel
- Last sampled in the Dolores in 1992 in Utah and 1973 in CO
- Dolores confluence with the Colorado is an area with documented aggregations of pre-spawn pikeminnow
- 1992 pikeminnow habitat evaluation concluded the Dolores potentially contained habitat to support all life stages of CPM but habitat was severely impacted by low base flows
  - Concluded that base flows of 20 to 40 cfs reduced native fish habitat in the lower 170 miles of the Dolores River through decreased fish holding areas, dewatered nursery backwaters, impeded movement, and enhanced sedimentation

Historic Fish Population Sampling

- 1975 Holden and Stalnacker
  - 11 species, 4 natives: flannelmouth, bluehead, roundtail, speckled dace
- USFWS 1982
  - 16 species, 4 natives: flannelmouth, bluehead, roundtail, speckled dace
- Valdez 1992
  - 19 species, 6 natives: flannelmouth, bluehead, roundtail, speckled dace, mottled sculpin, Colorado pikeminnow
  - Concluded that native fish numbers and distribution were similar to 1982 study

Current Status of Fish Populations

Current Fish Populations

2007 Longitudinal Survey

Catch Per Unit Effort (CPUE) in Fish Per Mile

	Pyramid	Big Gypsum	Slickrock	Gateway
Flannelmouth	0.4	4.5	2.7	2.2
Bluehead	0.1	0.5	0.2	3.9
Roundtail	0.5	18.6	1.8	0.1
3 Native Spp.	1	23.6	4.7	6.2
Native Fish Composition	10%	94%	79%	51%

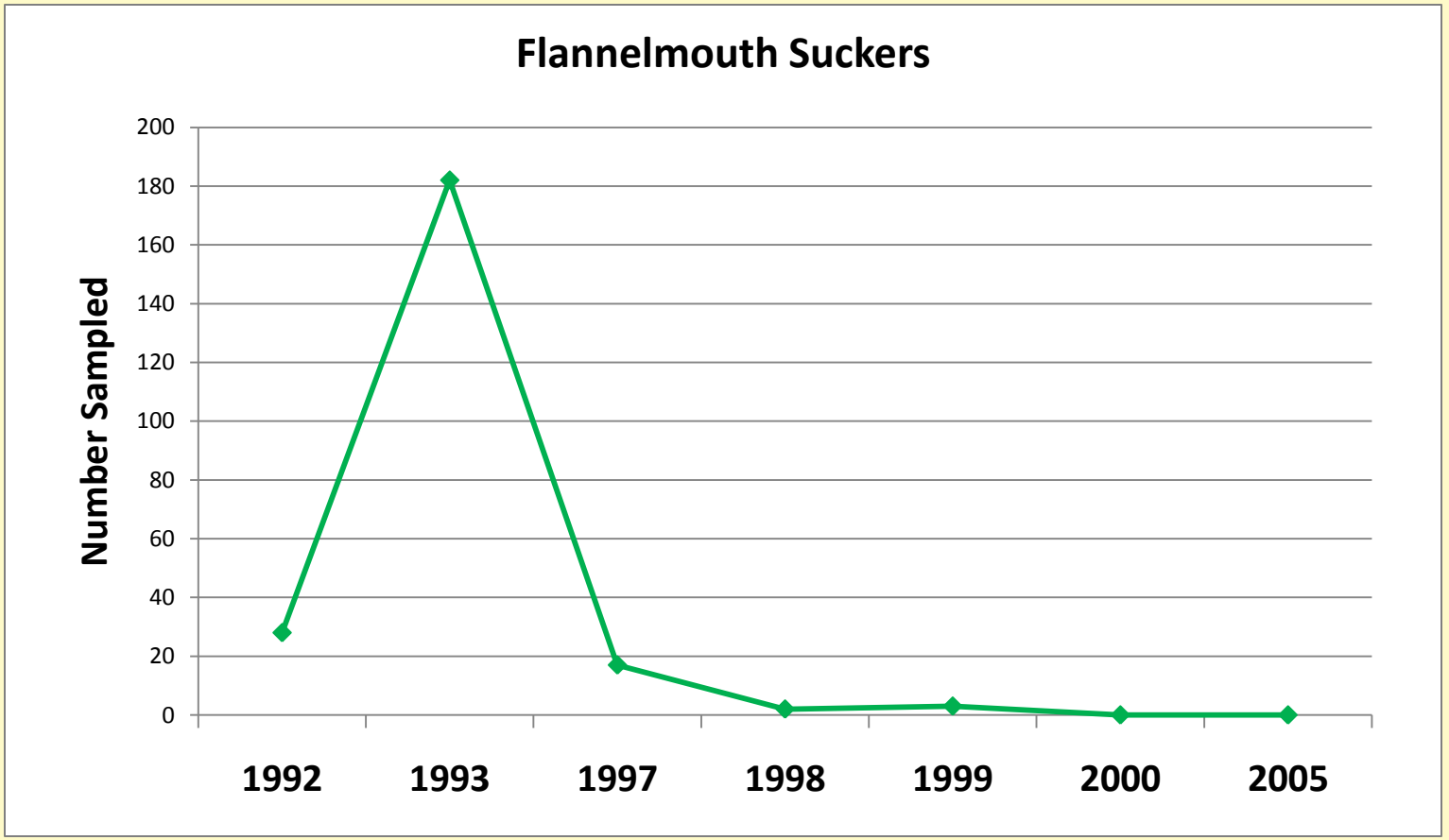
Current Fish Populations

2009 Sampling Below the San Miguel

Species	% Catch	Mean Length (in.)	Length Range (in.)	CPUE (fish/mile)
Bluehead Suckers	33	8.5	4.0-14.2	26.3
Flannelmouth Suckers	33	14.6	4.6-22.1	26.1
Roundtail Chubs	14	7.1	2.7-14.4	11.4
Speckled Dace	9	3.4	2.7-4.4	7.6
Channel Catfish	8	11.1	7.2-21.8	6.3
Common Carp	2	21.3	19.9-22.0	1.6
Red Shiner	1	3.0	2.9-3.1	0.4
Sand Shiner	0	2.8	2.8	0.2

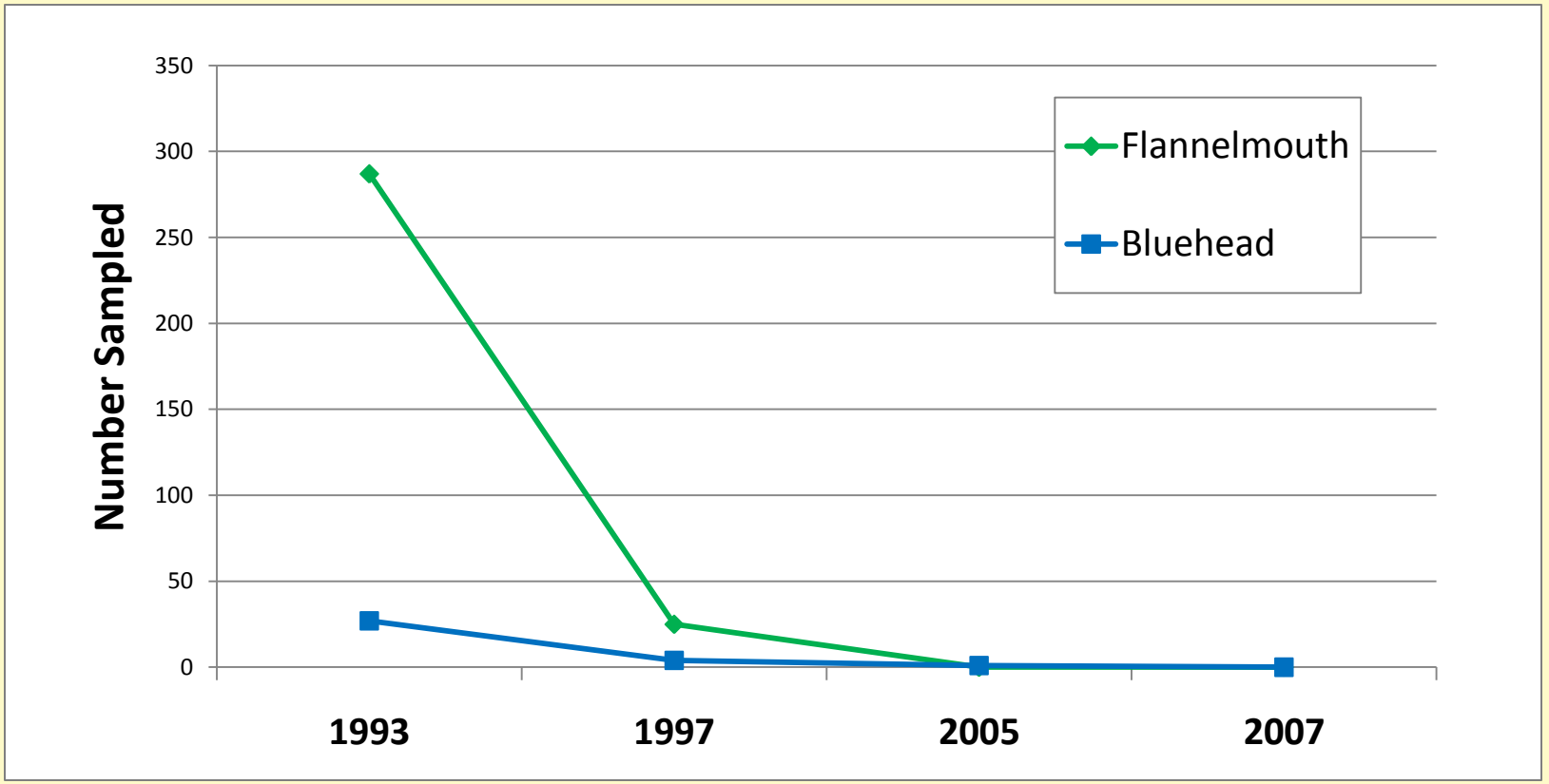
Native Fish Population Trends

Fish Population Trends
Metaska to Bradfield Bridge



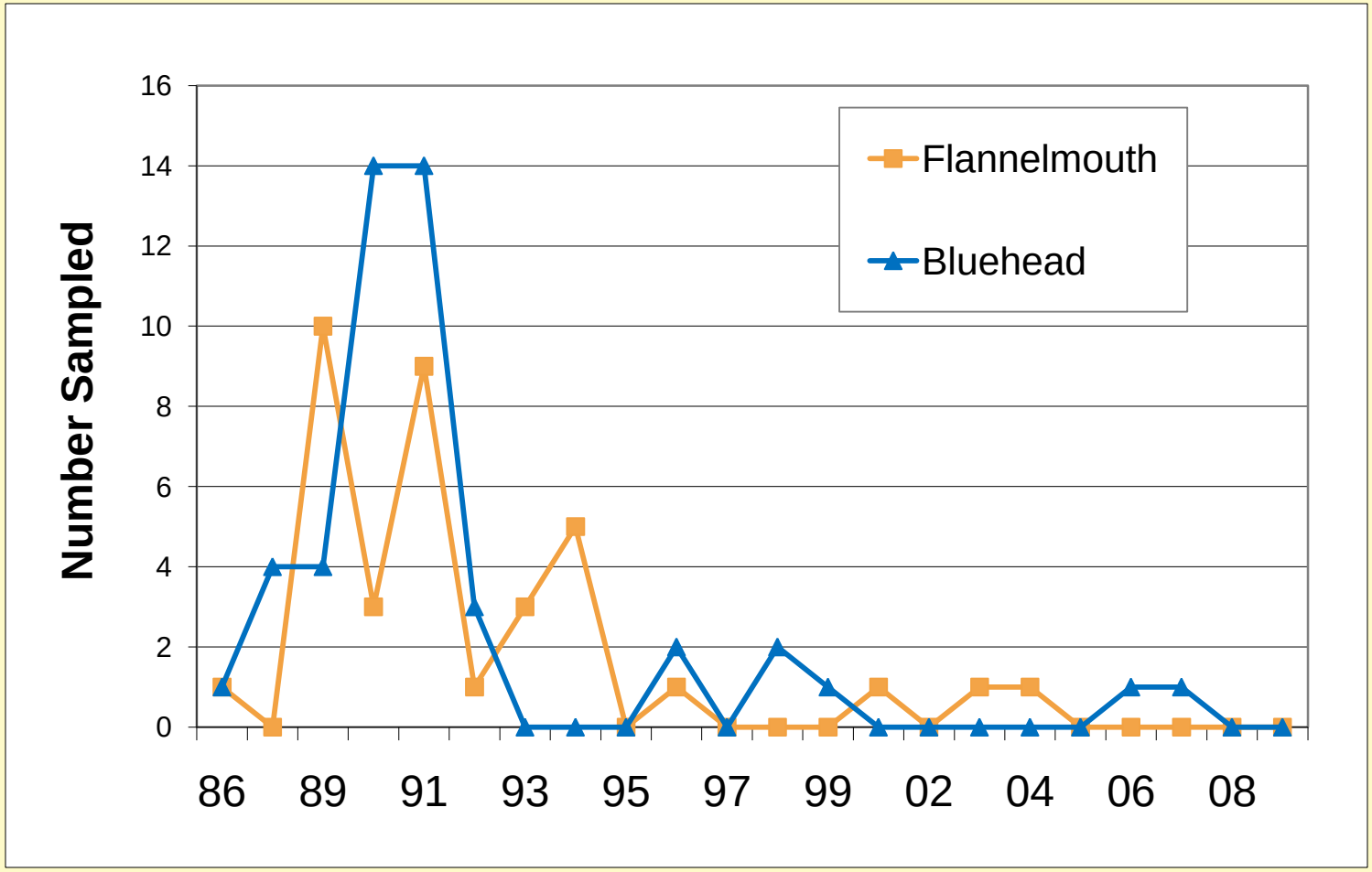
Bluehead suckers were also sampled in low numbers from1992-1997.
Biomass of flannelmouth suckers in 1993 was estimated at 23.1 kg/ha.
Average length of flannelmouths sampled 1992 to 1999 was 415 mm (16 in).

Fish Population Trends
Bradfield Bridge to Dove Creek



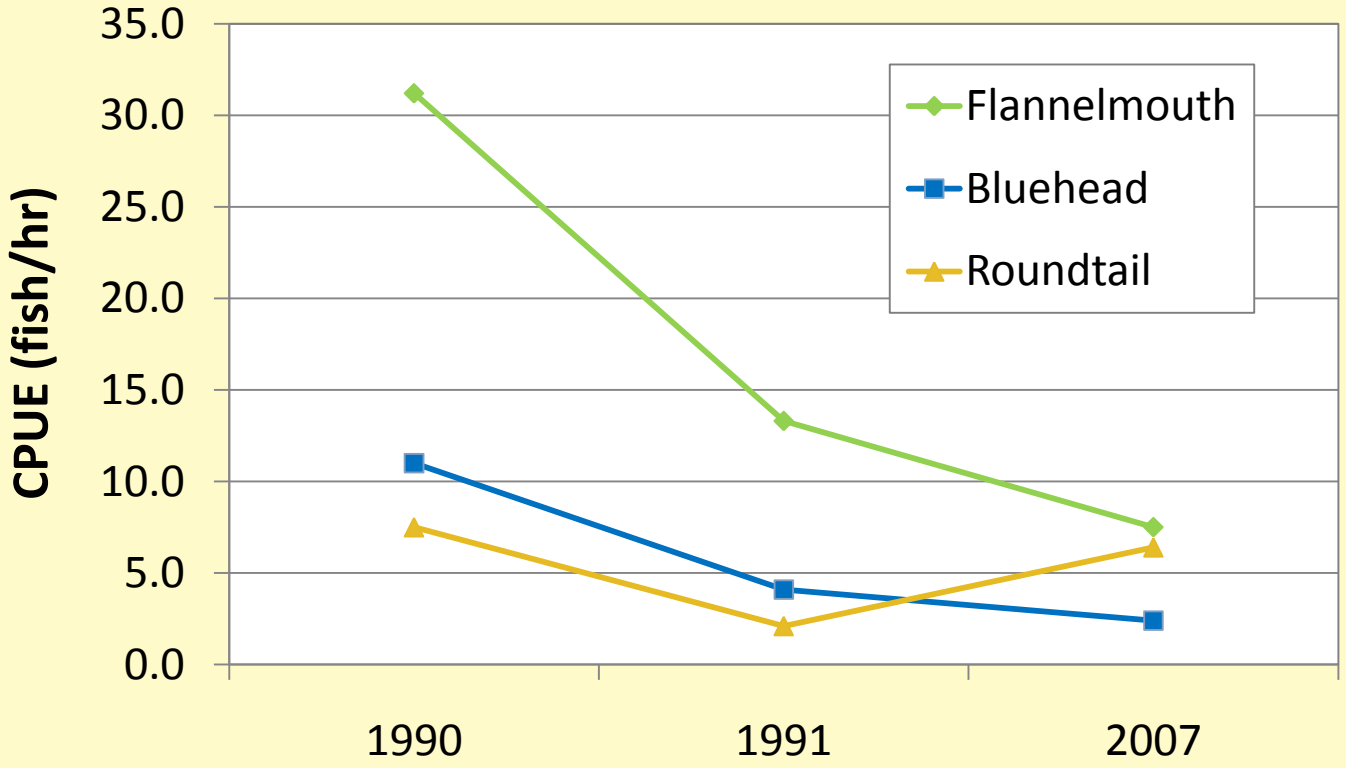
Biomass of flannelmouth suckers in 1993 was estimated at 57.9 kg/ha.
Average length of flannelmouths sampled 1993 to 1997 was 445 mm (17.5 in).

Fish Population Trends
Dove Creek Native Suckers



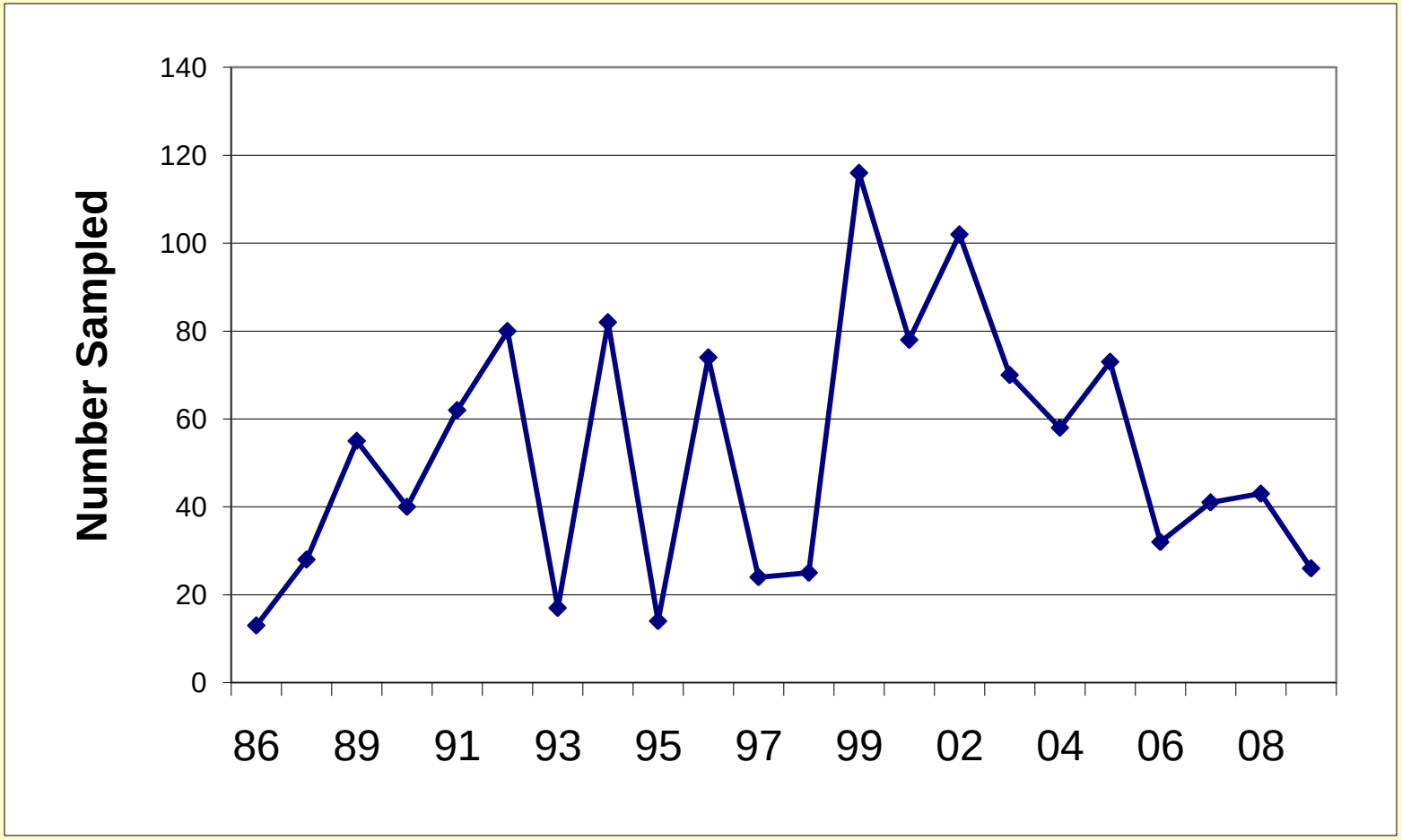
Fish Population Trends

Dove Creek to Gateway

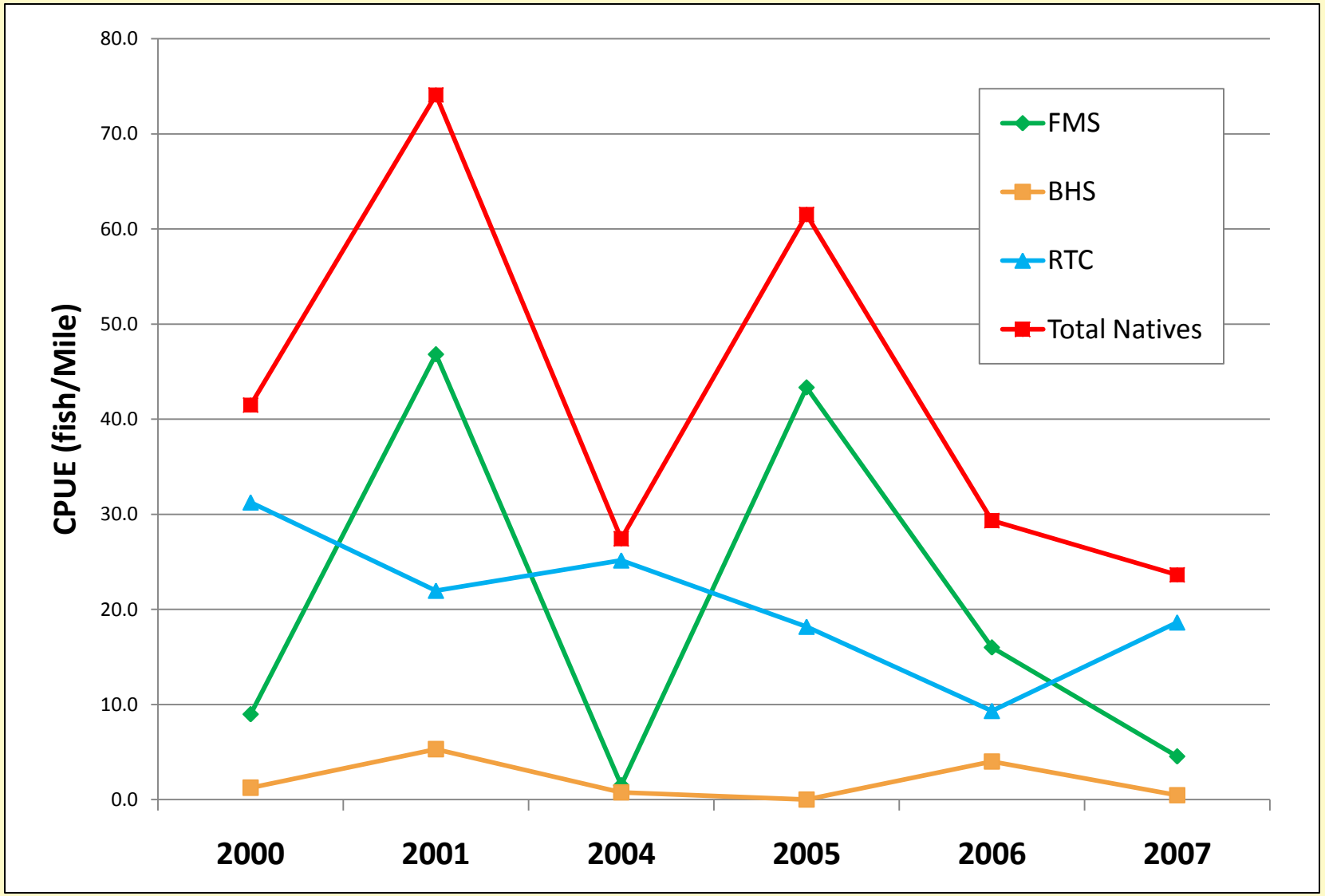


Surveys: 1990, 1991 Valdez, 2007 White and Kowalski

Fish Population Trends
Dove Creek Roundtail Chub



Fish Population Trends Big Gypsum



Native Fish Population Trends

- Native suckers increased in abundance from 1986 to early 1990's and then declined in numbers and range
  - Today native suckers are almost absent from 53 miles of previously occupied habitat above Disappointment Creek and their numbers have declined in the occupied range below
    - Large (>400 mm) adult flannelmouth suckers were common in the late 80's to early 90's up to Bradfield bridge and biomass was estimated between 20 and 60 kg/ha
  - Presently native fish appear no better or worse than pre-dam
  - Colorado pikeminnow has been extirpated from river post-dam
- Trout fishery below dam has followed similar trends

Comparisons to Other Rivers
(Anderson 2002-2006)

	Gunnison (Delta)	Colorado (Clifton)	Yampa (Lily Park)	Dolores (Big Gypsum)
Hydrograph Alterations	**Reduced Peak, Good Base Flows**	**Reduced Peak, Good Base Flows**	**Natural Peak, Reduced base Flows**	**Reduced Peak, Reduced Base Flows**
Mean Annual Flow (cfs)	2,564	2,817	1,546	284
Slope (%)	0.16	0.2	0.2	0.15
Typical Base Flow (cfs)	1000	1000	250	30
Mean Velocity (m/s)	0.69	0.44	0.51	0.28
Mean Width (m)	42	59	57	21
Width/Depth Ratio	52	77	94	46
3 Species Biomass (kg/ha)	422	232	138	0.6*
Native Species Composition	69%	64%	58%	42%

*Dolores River from dam to Dove Creek supported 20-60 kg/ha native suckers in the early 1990's

Dolores and San Miguel River Comparison

	Dolores @ Bedrock	**San Miguel @ Uravan**
Watershed Size (mi^2)	2,024	1,499
Average Annual Discharge (af)	227,186*	262,269
Average Annual Discharge (cfs)	284	347
Native Fish Per Mile	14.2**	45.6

*1985 to present. Pre-dam average annual discharge was 340,526 af

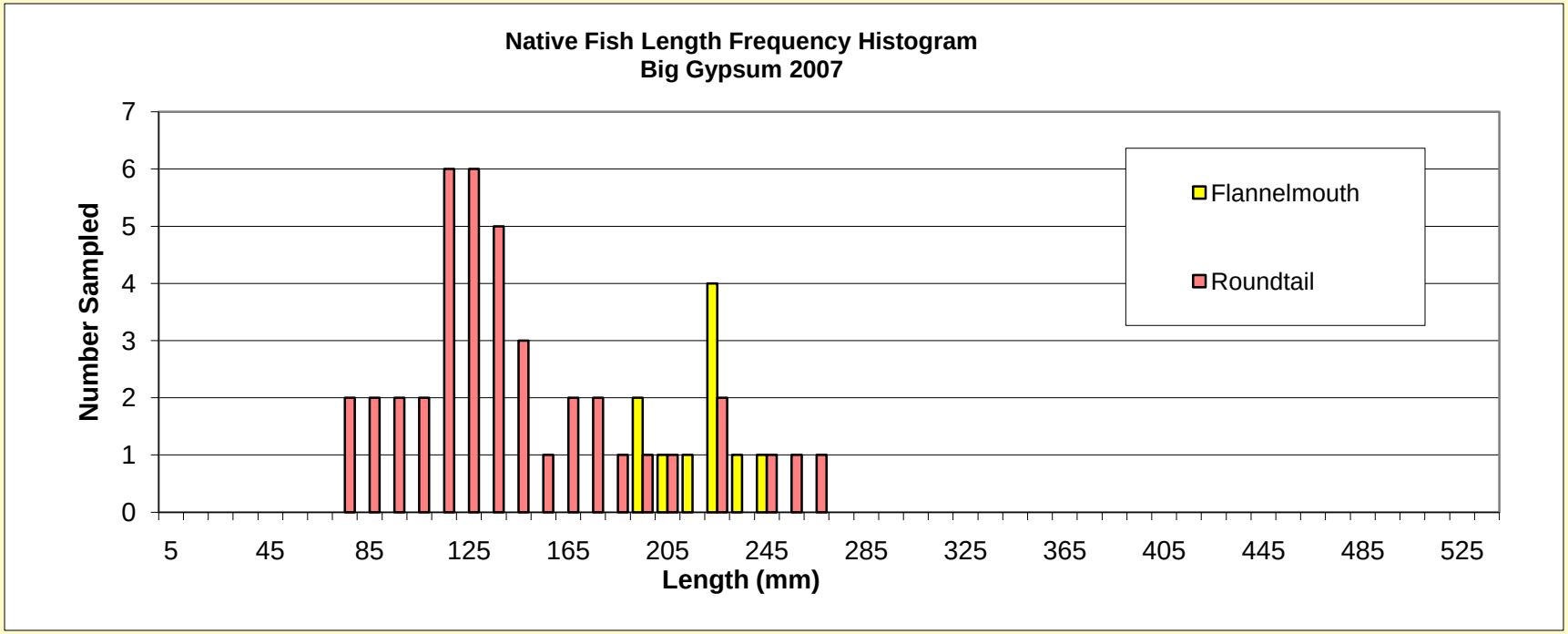
**Average from Big Gyp and Slickrock Canyon data 2007

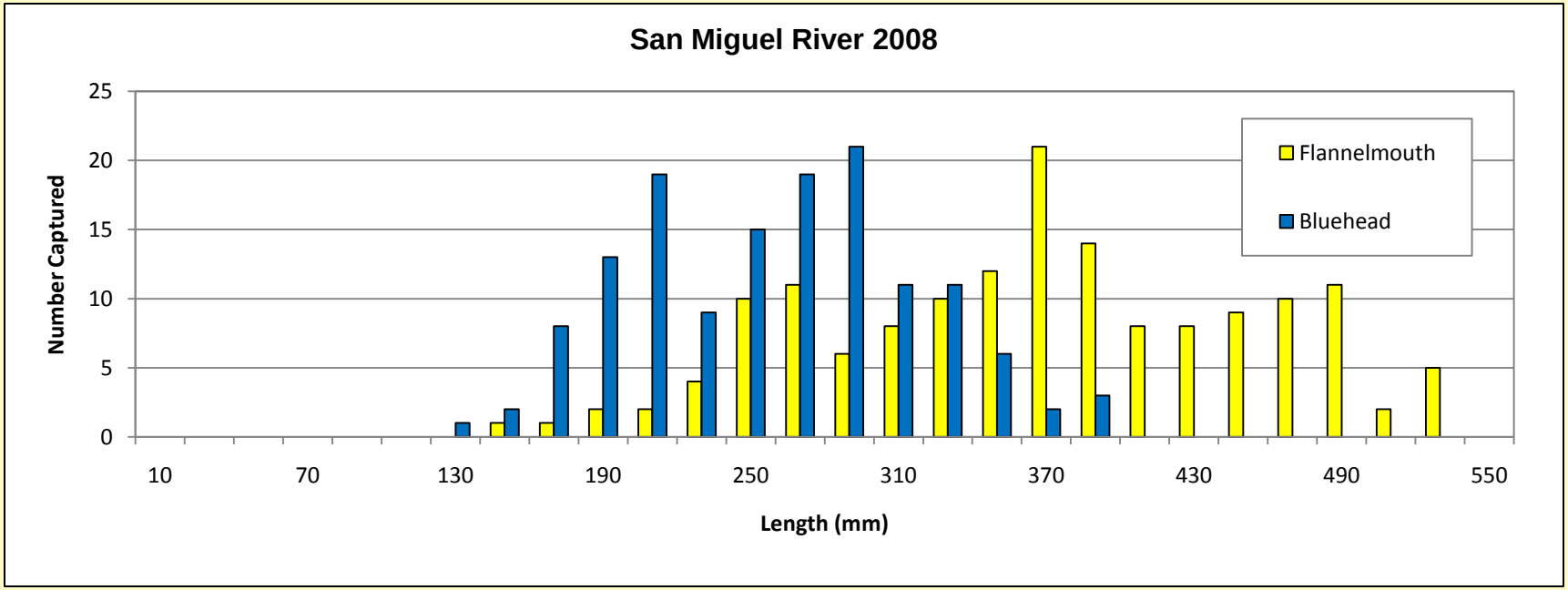
River Comparisons

Average Fish Length (in)

	Big Gyp 2007	San Miguel 2008	Gunnison 2008
FMS	8.6	14.5	13.6
BHS	7.2	10.2	10.7
RTC	5.7	8.2	9.2

- Native fish in the Dolores have a much smaller average size than other populations and sexually mature at smaller sizes
  - FMS usually mature at 4-6 years and 300-400 mm (12-16 in)
  - 2006 Sampling above Disappointment found 182 mm (7 in) FMS ripe with eggs
- Miniaturization could be an adaptation to habitat reductions


Native Fish Length Frequency Histogram
Big Gypsum 2007
Number Sampled
0
1
2
3
4
5
6
7
5
45
85
125
165
205
245
285
325
365
405
445
485
525
Length (mm)
Flannelmouth
Roundtail


San Miguel River 2008
Number Captured
0
5
10
15
20
25
10
70
130
190
250
310
370
430
490
550
Length (mm)
Flannelmouth
Bluehead

Current Native Fish Populations Conclusions

- Native fish have declined significantly in the Dolores in the last twenty years, one species of native fish is functionally extinct from the river
- Dolores River above the San Miguel has one of the poorest native fish population of any large western Colorado river
  - Supports less than 1 kg/ha of native fish compared to 100-400 kg/ha in other rivers and 20-60 kg/ha in Ponderosa Canyon in the late 1980's
  - Supports much smaller average sized fish, smaller size at maturity, and poor year class representation
- Dolores below the San Miguel confluence supports the best populations of native fish in the river

Native Fish Habitat Investigations

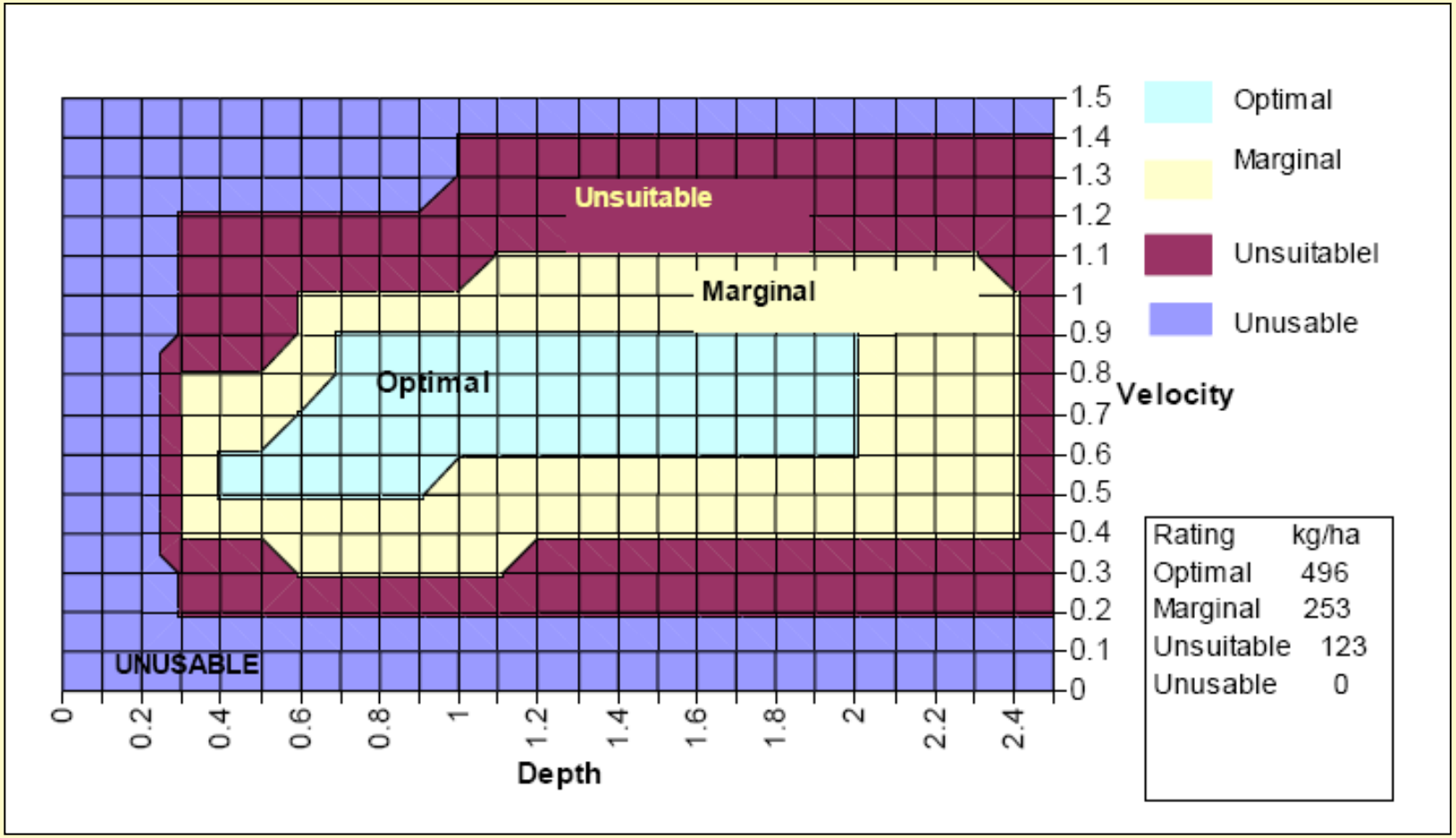
Native Fish Habitat Investigations

- CWCB Instream Flow Recommendation
  - 78 cfs to the San Miguel Confluence
  - R2Cross: 1 dimensional cross section method that focuses on ecological function of rivers indicated by riffle habitat quality
- PHABSIM Habitat Modeling
  - Nehring 1985: 150 cfs below the dam for the trout fishery
  - 1D habitat model that is effective in estimating microhabitat availability and is very useful for coldwater sportfish
- 1992 Pikeminnow Habitat Suitability Study
  - Suitable habitat in Dolores but impacted by low flows
  - Recommended minimum flows of 50-78 cfs for pikeminnow
- 2D Habitat Modeling for Native Fish
  - Anderson 2007

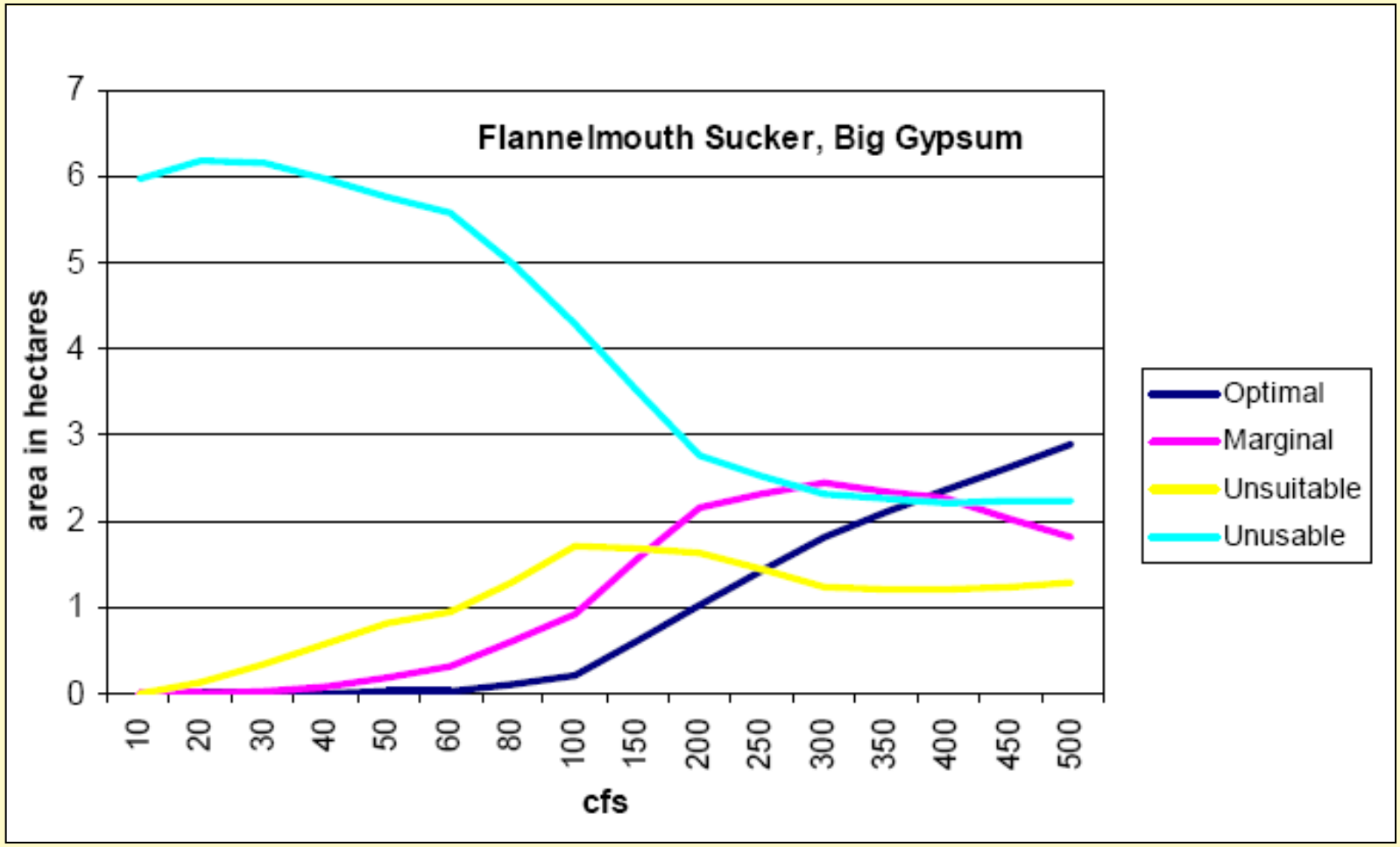
Native Fish Habitat Study 2000-2006

- 2-dimensional habitat modeling used to model fish habitat availability at the micro and meso habitat level
- Research grade sonar and total station GPS was used to survey habitat variables
- Habitat suitability models were developed with site specific electrofishing samples
  - Habitat suitability models were validated and did a good job of predicting observed fish biomass (r^2 of 0.74-0.90)

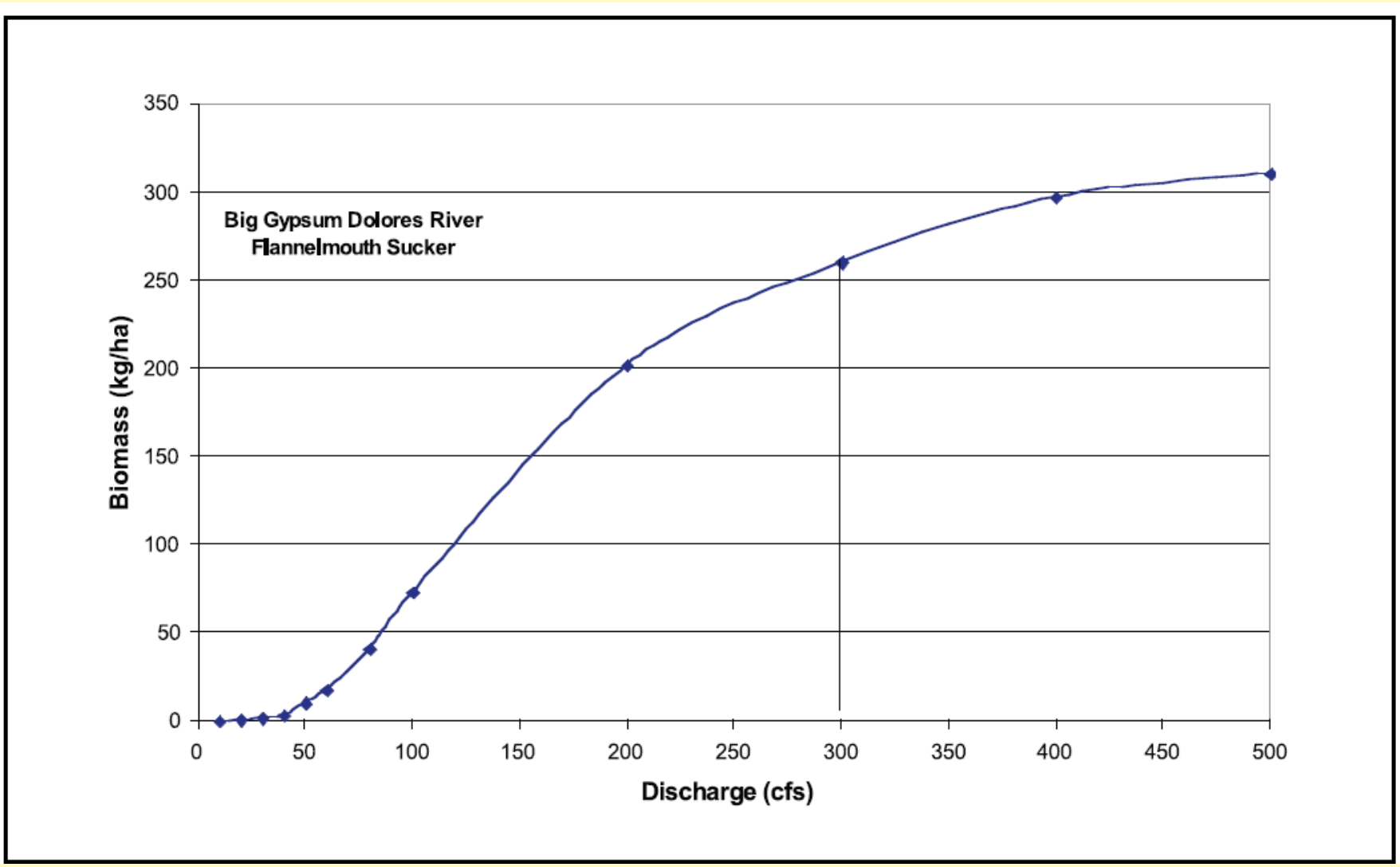
Flannelmouth Sucker Habitat Suitability Modeling



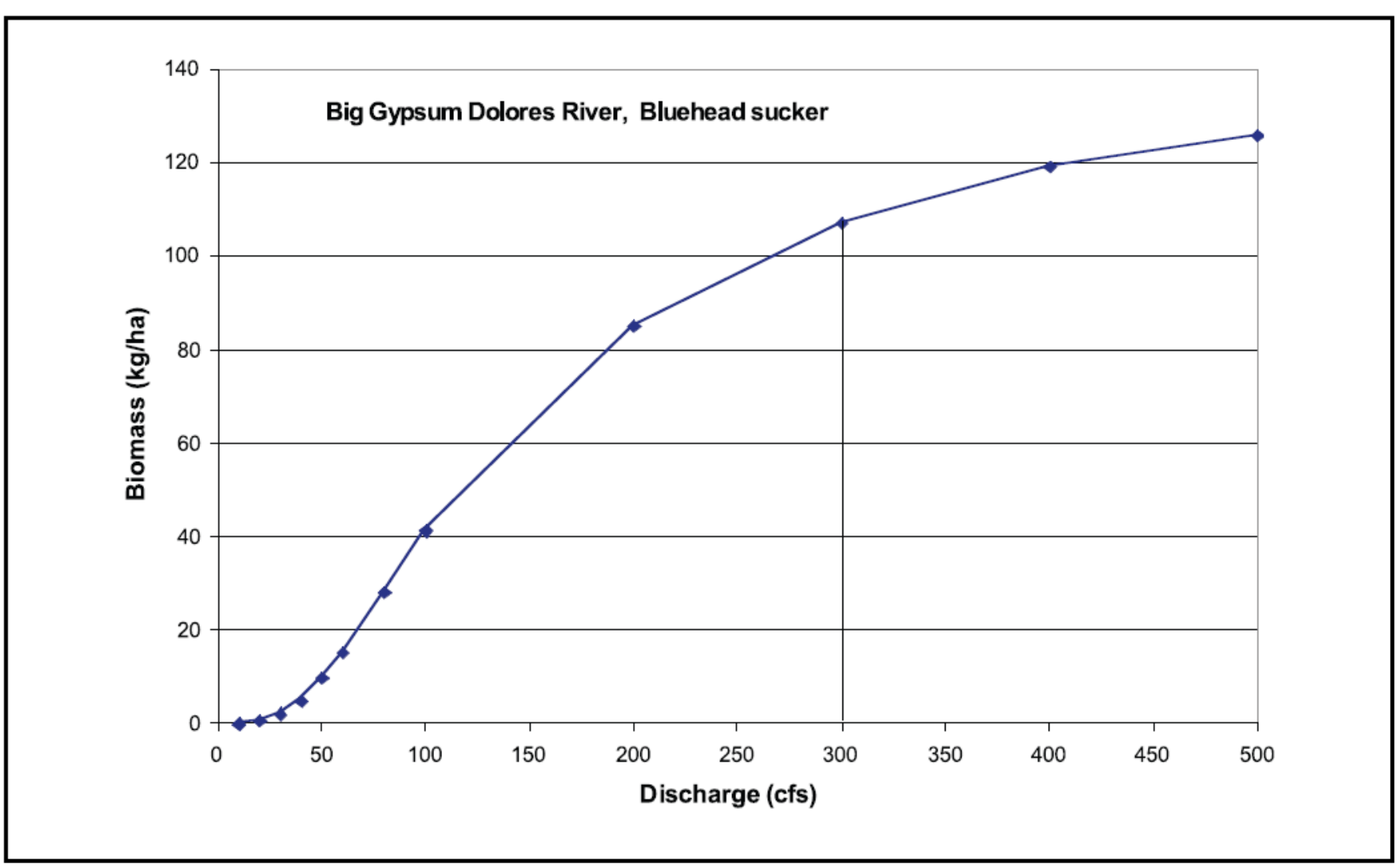
Flannelmouth Sucker Habitat-Flow Relationship



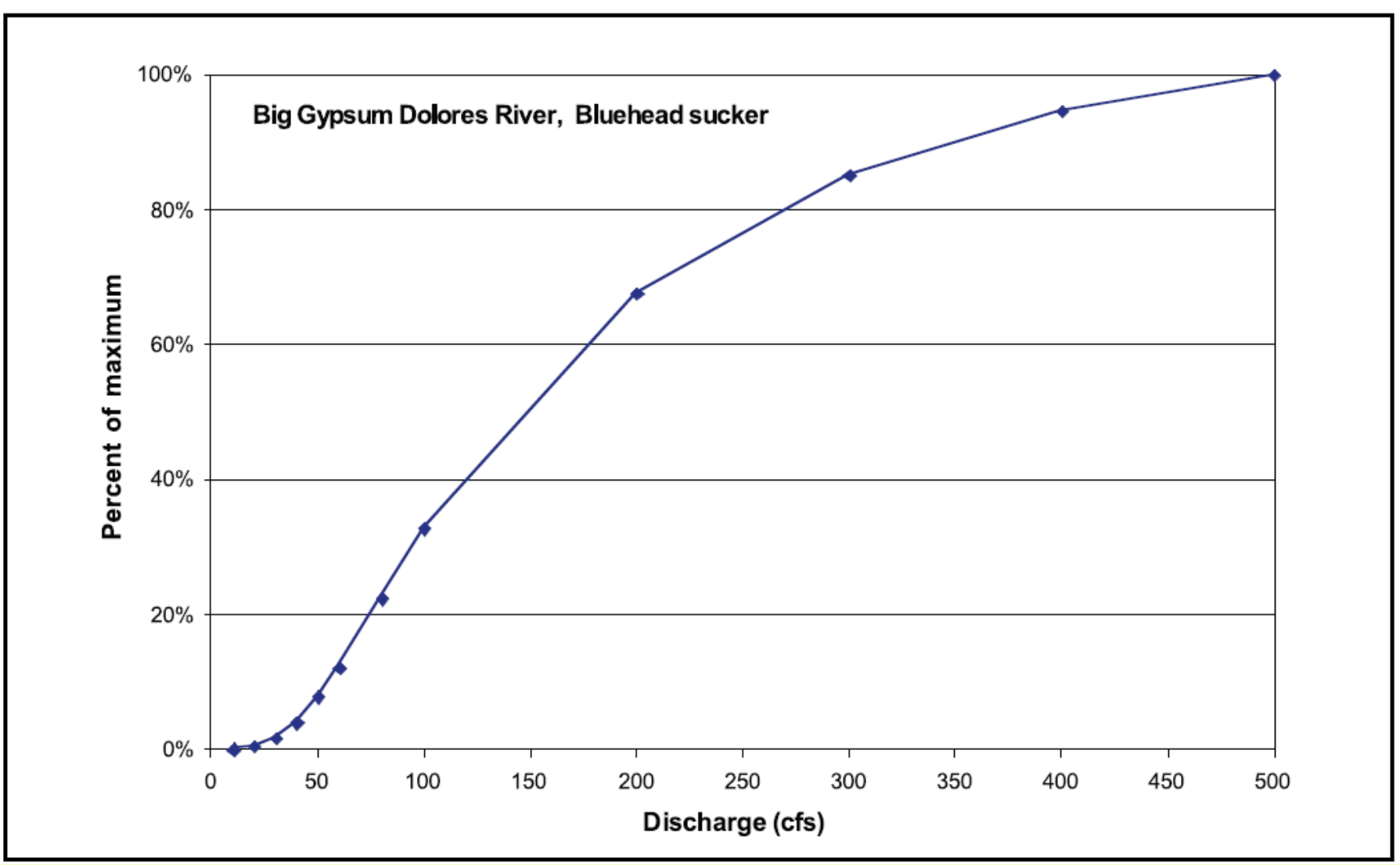
Flannelmouth Sucker Habitat Availability



Bluehead Sucker Biomass-Flow Relationship



Bluehead Sucker Habitat Availability



Summary of Native Fish Flow Study

- Flow of 300 cfs maximizes BHS and FMS habitat in the Dolores
- Concluded that inadequate riffle quantity and quality limited native fish habitat as well as decreased invertebrate productivity
  - Deep, higher velocity riffles were very rare in the Dolores at flows < 60 cfs
- Low flows result in too little velocity and depth in the majority of riffle and run habitats for FMS and BHS
- Poor invertebrate production due to lack of quality riffle habitat limits food resources for roundtail chub
- 80 cfs (60 cfs with spill) minimum flow recommendation at Big Gypsum that would protect 12-22% of maximum native fish habitat

Native Fish Habitat and Non-Native Fish

- Lack of high peak flows have resulted in bank encroachment, decreased width to depth ratio, and increased pool frequency
  - Post dam conditions have altered hydrograph and sediment dynamics
- Unnatural hydrograph, temperature, and sediment regime also creates more favorable conditions for non-native fish
  - NN fish are a problem in Dolores (smallmouth bass, catfish) but impacts pale in comparison to habitat issues
  - NN fish control efforts are not likely to be effective in the Dolores because of species present and available access
    - Extensive experience with fish control for pike, smallmouth, and bass in the Yampa and Colorado Rivers
  - Improving/maintaining native fish habitat is the key in discouraging non-native fish expansion (smallmouth bass)

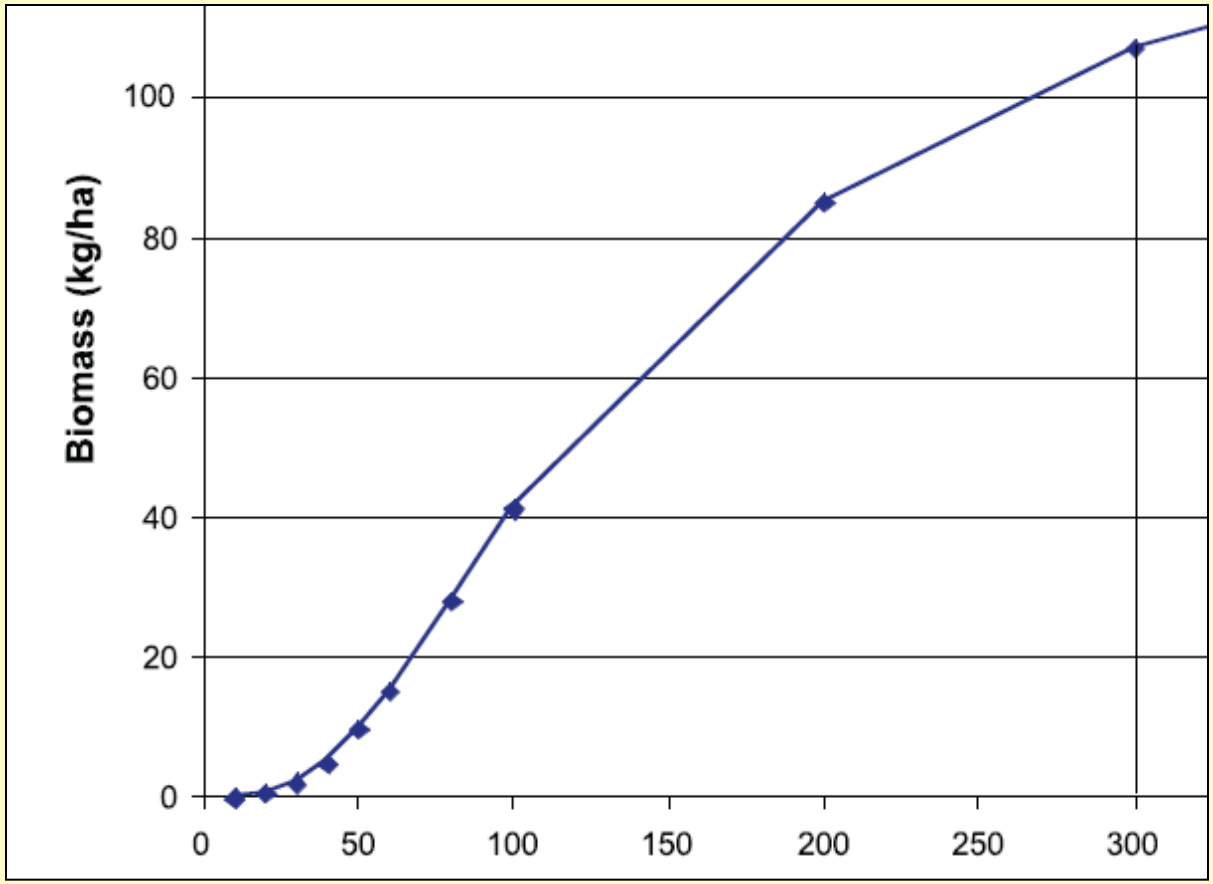
Native Fish Flow Needs

Min Flow Recommendation	Flow (cfs)	Location	Release Necessary (cfs)	Volume (af)	% Max Bluehead Biomass
CWCB Instream Flow	78	McPhee to San Miguel	94	68,037	22
Nehring 1985 (Trout)	150	Below McPhee	150	108,569	33
Anderson 2007 (With Spill)	60	Big Gypsum	72	52,113	12
Anderson 2007 (No Spill)	80	Big Gypsum	96	69,484	22
Current Fish Pool	41 (28 at Gyp)	Below McPhee	41	29,300	3

Current fish pool is 43% of the MINIMUM flow necessary to protect a barely viable fishery and protects less than 5% of native fish habitat

Native Fish Flow Needs

- Bad News: Current fish pool does not provide enough habitat for viable native fish populations
- Good News: Curve is steep, large habitat gains with a little more water



Questions from DRD

- What is known about the status of the 3 natives and the roundtail in particular in the Dolores River? What about the Four Endangered fish?
  - Native fish have declined significantly and are barely viable above the San Miguel
  - Endangered fish have been functionally extirpated from the river since the 1980's
- Is there data on trends? For what time period?
  - Good data on trends from 1986-Present, pre-dam data only spot sampling
- What is the strength of the data - how much certainty/uncertainty is associated?
  - Varies with each data set, sampling is generally CPUE population indices or minimum counts so measures of precision are not possible or necessary
  - High amount of certainty about conclusions due to magnitude of decline, current condition of fish population, and corroboration with habitat modeling studies
- What do we know about the reasons for the trends?
  - Lack of habitat due insufficient flow is the reason for native fish declines

Questions from DRD

- What key data gaps exist with respect to native fish?
  - Age/growth information, spawning ecology of natives, aquatic invertebrate data, temperature and nutrient issues, smallmouth bass age/grown and ecology
  - Data gaps are academically interesting but not necessary for management decisions

- What do we know about the flow needs for the native fish?
  - We have excellent information on flow needs of both native and sport fish, one of the most thoroughly researched subjects with state of the art techniques

- Given the dam, in your opinion, how can we ensure persistence of these fish in the Dolores?

Recommendations

- Increased downstream flows should be first priority
  - Fish pool should at least be at the 36,500 af identified in the 1996 EA with ultimate objective of year round minimum flow of at least 78 cfs
  - Current conditions provide less than 43% of the MINIMUM downstream flow needs and protects less than 4% of potential native sucker biomass
- Spill management is critical with so little water allocated for downstream release
  - Start spill April 1 and extend for as long as possible with clock on fish pool off
  - With 36,500 af fish pool and a 90 day spill would be 85% of minimum downstream flow needs and would protect about 10% BHS biomass

Recommendations

- Alternatives for Wild and Scenic Designations
  - Any alternative that does not increase downstream releases will **NOT** protect the fish ORV in Dolores
  - Status quo produces less than 5% of potential native fish habitat is only about 43% of necessary minimum flows
    - Downstream releases have actually declined and the fish pool has gotten smaller in the last 15 years, the water situation is getting worse not improving
- Protecting flows in the San Miguel River is essential for sustaining viable native fish populations in the Dolores River
  - State instream flow protection and/or Wild and Scenic Designation should be explored to protect San Miguel River flows

Future Plans

- DOW is compiling all Dolores River native fish data into a summary report that will include all historical fish sampling data, current distributions, and population trends
- A range-wide status assessment is also underway to evaluate historical distributions, current distribution, and make specific conservation recommendations
  - Range-wide Conservation Agreement and strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker
  - Signatories include Sate of Colorado, BLM, and BOR
- Further monitoring efforts on the Dolores will not be a priority for DOW unless conditions for native fish improve
  - Spill management has not been favorable for fish sampling conditions and fish pool water is way too scarce to used for monitoring

Questions and Discussion