INSTREAM FLOW RESERVATION TRACKING DATABASE Water Resource Inventory Area 48

Prepared for: Methow Watershed Council

Project No. 080180-003 • June 16, 2011





INSTREAM FLOW RESERVATION TRACKING DATABASE Water Resource Inventory Area 48 Prepared for: Methow Watershed Council

Project No. 080180-003 • June 16, 2011

Aspect Consulting, LLC

Parker P. Wittman Information Mgmt. Specialist pwittman@aspectconsulting.com

William M. Sullivan, LHG Project Hydrogeologist bsullivan@aspectconsulting.com

w:\080180 WRIA 48\Deliverables\IFR Database\WRIA 48 IFR Database Report 6-16-2011.doc

Ino

Timothy J. Flynn, LHG, CGWP Principal Hydrogeologist tflynn@aspectconsulting.com

eorth + woter Aspect Consulting, LLC 179 Madrone Lane N. Bainbridge Island, WA 98110 206.780.9370 www.aspectconsulting.com

Contents

1	Introduction1
2	Purpose of the IFR Database2
3	Background3
4	IFR Database Overview5First Component: Access Database5Second Component: GIS Database5Technology Considerations5
5	Methods7
	Introduction7
	General Methodology Overview8
	Data Sources
	Detailed Methodology11
	Clarify Instream Flow Rule Issues11
	Estimate the number of developed parcels subject to the Instream Flow Rule12
	Estimate Other Water Use Characteristics of Parcels
	Buildout Analysis
	A. Identify developable parcels
	C. Determine the minimum parcel size allowed under current Zoning Code2:
	D. Determine maximum ERUs per parcel allowed under Zoning Code23
	E. Determine developable acreage for each parcel
	F. Identify parcels in conservation easements and determine the future
	G. For each buildout parcel, estimate if it would be served by an exempt well 26
	H. Other buildout considerations: Closed Basins per WAC26
6	Results
	Estimate of Existing Developed Exempt Well Parcels Subject to the Instream
	Buildout Exempt Well Estimates by Reach 28
	Full Buildout with Parcel Subdivision
	Buildout with Current Parcel Size
	Full Buildout Excluding Closed Basins
7	Verification and Error Analysis
•	Comparison of IFR Database Results to Other Subbasin-Level Data

References	
Limitations	

List of Tables

1	Parcel-Level Attributes Tracked by the IFR Database
2	IFR Database Data Sources
3	Assessor's Database DOR Codes and Development Assumptions
4	Example IFR Database Interpretations of Multi-part DOR Codes in the Okanogan County Parcel Database
5	Development Years from Building Permit Database by Subbasin
6	Okanogan County Zoning Codes in Methow Basin
7	Estimated Existing Exempt Well Parcels Subject to the Instream Flow Rule
8	Estimated Exempt Well Parcels Subject to the Instream Flow Rule at Full Buildout
9	Estimated Exempt Well Parcels Subject to the Instream Flow Rule at Buildout with Current Parcel Size (Reduced Buildout)
10	Estimated Exempt Well Parcels Subject to the Instream Flow Rule at Full Buildout - Assuming No Additional Development within Closed Basins
11	IFR Database-Identified Residential Water System Connections versus SENTRY Database Information
12	IFR Database-Estimated Exempt Wells Subject to the Instream Flow Rule versus Well Logs and Water Rights
List	of Figures
1	Methow Watershed and Reach Boundaries

- 2 Methow Watershed Closed Basins from Chapter 173-548, WAC
- 3 Okanogan County Zoning in the Methow Watershed

List of Appendices

A Stream Management Reach Boundary Delineation Memorandum

1 Introduction

The Instream Flow Rule (Rule) for the Methow River was established in 1976 as Chapter 173-548 of the Washington Administrative Code (WAC). The Rule established a reservation of two cubic feet per second (cfs) of water in each of seven reaches of the Methow River watershed for future single domestic and stock water uses. The 2 cfs instream flow reservation in each reach is expressed as a reduction in streamflow associated with the consumptive use of aggregate instantaneous withdrawals authorized under the rule.

Developing estimates of total and consumptive use (total withdrawal minus return flow) of water to quantify the unallocated portion of the reservation and support a revision of the Rule is a high priority issue identified in the *Methow Basin (WRIA 48) Watershed Plan* (Methow Basin Planning Unit, 2005) and the *Final Detailed Implementation Plan* (Methow Watershed Council, 2009). Planned actions outlined in the *Final Detailed Implementation Plan* (Methow Teach (reach) since the two cfs instream flow reservation was established in December 1976 and developing a system to track remaining water in the reservation by reach as development continues in the Methow River basin.

Aspect Consulting, LLC (Aspect) received authorization from the Methow Watershed Council (MWC) under Washington State Department of Ecology (Ecology) Grant No. G0900100 to develop an Instream Flow Reservation tracking database (IFR Database). The primary objective of the IFR Database is to identify existing and potential future developable parcels in each reach subject to the Rule. The database will be used with estimates of water use from exempt wells presented in the *Water Withdrawal Study* (Aspect, 2011) to estimate remaining reservation quantities in each reach under current and potential future full build-out conditions.

This report documents development of the IFR Database including database framework, methodology, and underlying assumptions. The scope of work consisted of coordinating with agencies to compile and review information in available existing databases, setting up an IFR Database framework, developing protocols and assumptions for using data obtained from agency databases, and identifying potential limitations and data gaps. The Detailed Methodology section of this report contains a complete description of the work accomplished.

2 Purpose of the IFR Database

The purpose of the IFR Database is to provide the MWC with the necessary data and analysis tools to estimate the number of parcels in each reach whose domestic water supply source is a water right permit-exempt well (exempt well) – at the current level of buildout and at full (maximum) buildout based on existing zoning. Since this information is not tracked as part of any one existing database, the IFR Database brings together related data from a wide variety of existing public sources (e.g., Okanogan County parcel database, Ecology water rights and well log database) and uses that information to estimate whether a parcel is served by an exempt well. Using the compiled data, the IFR Database provides the MWC a tool to calculate and store these water source estimates (as well as key supporting data and assumptions), parcel-by-parcel, in a table of data that can be periodically updated to track exempt well use by reach.

The parcel-level estimates provided by the IFR Database are aggregated by stream management reach. These reach-by-reach tallies of the number of exempt well parcels will then be multiplied by the consumptive use per residential unit estimated in the *Water Withdrawal Study*, to determine the allocation of the two cfs instream flow reservation. This same analysis can be performed for future buildout under different assumptions (e.g., full buildout with or without subdividing existing parcel boundaries) to provide estimates of potential future water use under the Rule and identify reaches that have excess available water or may face future shortages.

3 Background

Previous efforts have been undertaken by the MWC and its predecessor the Methow Basin Planning Unit (MBPU) to evaluate allocation of the two cfs instream reservation since adoption of the Rule and to estimate potential future residential buildout subject to the Rule. Previous efforts include:

- *Recent Water Use in the Methow River Valley: An Estimate* (Ecology, 1991). This report estimated the number of new single domestic exempt wells installed between January 1977 (immediately after adoption of the Rule) and July 1990. Based on review of well log files, water right files, Okanogan County building permits, and a field verification of developed parcels Ecology estimated that about 1,150 new single domestic wells subject to the Rule were placed in use over the study period.
- *Phase II Level 1 Watershed Technical Assessment for the Methow River Basin* (Golder, 2002). This report, prepared as part of the Watershed Planning process, estimated that there were about 6,200 developed or developable parcels for residential use based on Okanogan County Assessor's data. This report did not identify the number of parcels developed at the time of the study, nor did it attempt to distinguish between pre- and post-Rule development dates or evaluate potential subdivision of parcels.
- An Estimate of Potential Single-Family Development in the Methow Valley (Highland Associates, 2003). This report, prepared for the MBPU, estimated the number of parcels developed for single-family use, the number of parcels that could be developed based on zoning limitations, the number of developed parcels that pre-date the Rule, and the number of parcels potentially subject to Rule. At the time of the report, about 1,300 parcels were estimated as being developed and subject to Rule, with an up to an additional 12,000 potentially developable parcels (assuming subdivision of larger parcels) that would be subject to the Rule at full buildout.
- Summary, Highland Associates Work on Tasks for Methow Watershed Council, Final Report (Highland Associates, 2008). This summary report updating the 2003 study estimated that, as of 2008, there were about 2,200 developed parcels subject to Rule.

Several limitations with these previous evaluations were identified through discussions with the MWC. The scope of work and development of the IFR Database was designed to specifically address these limitations and provide the MWC with a robust tool for evaluating and tracking water use against the two cfs instream flow reservation. Limitations in the previous work and how those limitations are addressed in the IFR Database include:

• The Rule did not provide a clear delineation of reach boundaries, making estimates of developed or developable parcels in each reach uncertain. Recent work by Aspect Consulting and the MWC to develop detailed reach boundaries is

provided in Appendix A and is used in this report as the basis for assigning individual parcels to the appropriate reaches.

- Documentation of data sources and methodology in some of the previous evaluations is limited. The current report is intended to provide a defensible, repeatable study to support evaluation of proposed revisions to the Rule.
- Previous evaluations were not provided in a database format that can be periodically updated and used as tool for tracking parcel development and allocation of the reservation over time. This report documents the database that will be provided to the MWC. This database relies on widely used, commercially available software and can be updated as new data become available.

4 IFR Database Overview

The IFR Database framework consists of two separate, but connected databases.

First Component: Access Database

The first component, the "main" database, which is strictly tabular in nature (i.e., the data are not tied to spatial information), is a Microsoft Access (Access) database. This database functions as the main user-interface for the system and stores the parcel-specific attributes that represent the basis for instream flow reservation estimates (see Table 1). Aside from providing a user-interface for exploring the data, the IFR Access Database contains many queries and routines that are run to parse input data tables against a set of assumptions (developed for this study) into parcel-specific estimates that are stored in the database.

Additional IFR Access

Database queries then parse these parcel-specific estimates into reach-by-reach tallies of current and future buildout estimates of parcels served by exempt wells and subject to the Rule.



Second Component: GIS Database

The second component is a geospatial database that stores relevant spatial datasets (such as parcel and reach boundaries) as well as resulting GIS analysis outputs (e.g., parcels assigned to the various reaches) that are critical inputs for the estimates compiled by the IFR Access Database (as described above). This geospatial database (IFR GIS Database) was developed as an ESRI Personal Geodatabase. Aspect also developed GIS analysis models (ArcGIS ModelBuilder) stored in an ESRI Toolbox to go with this spatial database. These models will allow the end-user to rerun complex spatial analysis workflows, as required when updating data, at the click of a button.

Technology Considerations

The formats of the two databases that comprise the IFR Database were chosen for a variety of reasons:

1. Both Microsoft Access (for the IFR Access Database) and ESRI ArcView (for the IFR GIS Database), though commercial software packages, are

widely-used and commonly understood programs. This familiarity eases longer-term system maintenance and increases the likelihood of interoperability and available support.

- 2. Microsoft Access allows the IFR Database to provide a user-friendly interface.
- 3. ESRI Personal Geodatabases are a type of Access database that stores spatial data. This format consistency between the IFR Access Database and the IFR GIS Database makes it easy to connect the two.. The IFR Access Database can link to the tabular attributes of the spatial features in the IFR GIS Database (a critical step in the analysis process), but the tables in the IFR Access Database can be easily joined into a GIS map.

A detailed accounting of the contents, data structure, relationships, tools, and workflows provided in the databases is available in the IFR Database Operation Manual.

A description of the methods and assumptions that drive the estimates generated by the IFR Database as well as known limitations and data gaps are provided in the following section: Section 5, Methods.

PIN:	3421011008		Owner:	MORTIMER, A	LAN & KELLY			
Reach:	Chewuch		Address:	00014 \SUN DO	G RD			
IFR Data	Assessor Data	Well Data	Public Water System Da	a Water Rights	Zoning and Easments	Links and Mapping		
WA7 Vate Vate Publi Ecolo Well V OS V W 12th Pearr IRRIG Ha	WATER: Water System Data Water System			DEVELOPMENT and LAND USE: Parcel Developed? Parcel Development Date: 06/01/2001 Data Source for Developed Designation: DOR/BP (Post94) Residential Parcel? Data Source for Determining that Parcel is Residential: DOR/BP (Post94) DOR "Base" Code: 11 DOR "Base" Code: 11 = ONE SINGLE FAMILY HOUSEHOLD DOR "Aux" Code:				
Source	ce of irrigation wa	ter (if know	n):		General Com	ments:		
Dat S	ource for Identific	ation of Irri	gation Information:					
📄 Flag	g This Record For Fu this record been m	urther Review anually edit	w Description of manual record and adjustmen	edits ts :				

Snapshot of the IFR Access Database User-Interface:

5 Methods

Introduction

To provide the MWC with the data and tracking tool necessary to make reach-by-reach estimates of the current and full buildout allocations against the two cfs instream flow reservation, design of the IFR Database was based on the following considerations and criteria:

- The IFR Database tracks data at the parcel level. Water use characteristics and the data stored in the IFR Database are tracked at the parcel level, to the greatest extent possible. Though estimates are intended to be aggregated within each stream management reach, tracking data at the parcel level allows for greater refinement of estimates. Currently, the IFR Database flags parcels as being served by an exempt well or not based on the best available data and the assumptions outlined in this document. This is only an estimate. However, by structuring the database to store estimates for each parcel, it is possible to refine the data, as new data is either collected or acquired by the MWC. Data in the IFR Access Database is tied to the parcel identification number (PIN) to allow the IFR Database to be linked back to Okanogan County parcel data.
- The IFR Database uses GIS analysis to aid reach-by-reach counting. Relevant spatial data that cannot be tied to individual parcels are associated to reaches through GIS analysis to allow reach-by-reach counting of that data for verification or comparative purposes.
- Water use estimates are conservative. To the extent possible, to meet resource management objectives, the estimates of water use against the two cfs instream flow reservation as captured by the IFR Database are conservative and when there is uncertainty err on the side of over-counting exempt well parcels. These estimates and the assumptions behind them are documented in Section 5, below.
- The IFR Database supports an updatable and repeatable analysis process. To meet this objective, methods and assumptions should be explicitly and clearly documented. Further, the Access database queries and routines as well as ArcView GIS analysis models that enact these methods should be delivered with the IFR Database.
- The IFR Database is collaboratively derived. Numerous entities were contacted to obtain and interpret data. IFR Database methods and assumptions have been vetted through the MWC technical subcommittee and have undergone MWC, Ecology, and public review.

General Methodology Overview

The basic process for making and interpreting the two cfs instream flow reservation tracking estimates in the IFR Database is summarized below:

- 1. Clarify instream flow rule issues.
 - a. Refine the delineation of reach (subbasin) boundaries and develop a convention for assigning parcels to reaches to support parcel-level estimates; and
 - b. To support buildout considerations, delineate closed basins identified in the Rule.
- 2. Estimate the number of developed parcels subject to the Rule.
 - a. For each parcel, make an attempt to determine:
 - Whether it has been developed;
 - Whether it has been developed as a single family residence;
 - Whether development post-dates the Rule (December 28th, 1976); and
 - Whether it receives water for domestic use from a self-supplied exempt source (exempt well).
- 3. Estimate other water use characteristics of parcels.
 - a. Determine whether a parcels uses an onsite-septic system (OSS); and
 - b. Determine whether a parcel uses a non-exempt water source for irrigation.
- 4. Estimate the number of parcels that could be subject to the Instream Flow Rule at buildout.
 - a. Determine whether each parcel is developable;
 - b. Determine current zoning for each parcel;
 - c. Determine minimum parcel size allowed under Zoning Code;
 - d. Determine maximum ERUs per parcel allowed under Zoning Code;
 - e. Determine developable acreage for each parcel;
 - f. Identify parcels in conservation easements and determine the future development allotment for those easements; and
 - g. For each buildout parcel, estimate if it would be served by an exempt well.

- 5. Conduct verification and error analysis
 - a. Compare results of parcel-level analysis to:
 - Other available data, summarized on a sub-basin level (water rights, census data, well logs); and
 - Results of previous studies.
 - b. Irrigation spatial analysis
 - The IFR Database was used to select a random sample of residential parcels thought to be served by exempt wells. Aerial photography of these parcels was reviewed to estimate irrigated acreage and assign an irrigation demand, as documented in the *Water Withdrawal Study*. Results of the aerial photo review were also used in this report to verify/analyze error for:
 - o Identification of developed/residential parcels
 - Identification of parcels receiving irrigation water from non-exempt sources.
 - c. Development dates
 - Comparison to Highlands Associates (2008).
 - d. Uncertainty analysis
 - Identify sources of uncertainty and how they may affect estimates of current or future exempt-well parcels. For example, how might assuming full development in closed basins affect buildout results?

These estimation methods are discussed in detail in the subsequent subsection, "Detailed Methodology." Verification and error analysis is discussed in Section 7.

Data Sources

A general list of data sources/providers is below. For a detailed accounting of all external data sources (including contact info and internet links), see Table 2.

Data from United States Federal Agencies:

- Natural Resource Conservation Service (NRCS)
 - Watershed Boundaries Dataset (WBD)
- United States Geological Survey (USGS)
 - o National Elevation Dataset (NED) digital elevation model (DEM)

Data from Washington State:

- Washington State Department of Health (DOH)
 - o SENTRY Database (public water system table data)
 - o "ODWSources" GIS Database (public water system GIS data)
- Washington State Department of Ecology (Ecology)
 - o Well Log database
 - Water Rights GIS (GWIS)
- Washington State Department of Natural Resources (DNR)
 - Hydrography GIS

Data from Okanogan County:

- Office of Planning and Development
 - o Tax parcel GIS data
 - o Irrigation districts GIS data
 - o Town areas (GIS)
 - Zoning (GIS and regulations from County Code)
- Okanogan County Assessor's Office
 - Tax parcel assessment data (via GIS data from Planning Department)
 - DOR Code lookup table
- Okanogan County Building Department
 - o Building permit database
- Okanogan County Public Health
 - Water Adequacy Certificate database
 - Onsite Septic System database

Data from Local Agencies/Groups:

- City of Pateros, Town of Twisp, Town of Winthrop
 - Water service and sewer service data (service exceptions to town limits)
- Methow Conservancy
 - o Table of conservation easements and development restrictions

Clarify Instream Flow Rule Issues

Defining stream management reach boundaries:

The Rule established stream management reaches defined by control points on the Methow River that encompass drainage areas lying upstream of these control points. Because the Rule established a two cfs instream flow reservation for single domestic and stock watering purposes in each of the seven subbasins, it is necessary to account for the remaining reservation in each subbasin. Since the IFR Database attempts to track and estimate water source data at the parcel level, it is necessary to have a formal, citable definition and GIS delineation of the stream management reaches. This allows the underlying spatial information (parcels, water rights, well logs, etc.) to be aggregated by reach.

The Rule does not provide a detailed delineation of the subbasins defined by the seven stream management reaches. Previous GIS delineations of the subbasins are either too coarse, inaccurate, or otherwise unavailable. Therefore, Aspect developed a GIS dataset, based on the NRCS WBD, to serve as the working spatial definition of the reaches. This process is documented in a memo submitted to, and reviewed and adopted by the MWC and then submitted to Ecology (Appendix A).

The final, approved GIS dataset representing the seven stream management reaches is provided as a polygonal featureclass in the IFR GIS Database. Figure 1 illustrates these seven reach delineations in the Methow Basin.

Defining closed basin boundaries:

The Rule establishes several basins in WRIA 48 that are closed to further appropriation of surface waters and groundwater in continuity with these surface water bodies. Like the stream management reaches, no delineation of closed basins as defined in the Rule existed to sufficiently determine if a given parcel falls within one of these basins. This determination is necessary for future buildout analyses if it is assumed that parcels in closed basins cannot be further developed.

Paper maps provided by Ecology from the early 1990s do give a "spatial" representation of some closed basins. However, these maps were not part of any single report and do not define the closed basins in the Rule. Further, not all closed basins were represented in these maps. Because the Rule defined by named streams and lakes and "all ground waters hydraulically connected to these streams," Aspect developed a GIS representation of the closed basins with the best available data – using 12th digit hydrologic units from the WBD for the majority of the closed basins and NED DEM-delineated subdivisions of WBD polygons for the rest (see Figure 2).

This GIS dataset is provided as a polygonal feature lass in the IFR GIS database. The closed basin boundaries do not in any way represent MWC or Ecology's interpretation of the Rule and are used in the IFR Database only for the purposes of buildout analysis results sensitivity.

Assigning features to reaches/basins

Many parcels (and other polygonal features) can and do span multiple reaches/basins. However, to simplify the interpretation and assign parcels to only a single reach, it is assumed that a parcel is part of the reach in which it has its geometric centroid.

Estimate the number of developed parcels subject to the Instream Flow Rule

Identify parcels that are currently developed

This step identifies parcels that are currently developed regardless of the type and date of the development. Further refinements (described in subsequent steps) attempt to determine whether development is subject to the Instream Flow Rule. An identification of all parcels that are currently developed was also used for the buildout analysis.

The criteria used to determine if a parcel is currently developed are as follows:

- Assessor's Database: DOR Codes (Department of Revenue Codes; used to classify property for taxing purposes)
 - This is the primary means of determining whether a parcel is developed. The DOR code is an alpha numeric value that represents the current land use for each tax parcel as recorded by the Okanogan County assessor. To interpret this code, the IFR Access database stores a lookup table for determining if a given DOR code intrinsically implies that a parcel is developed.
 - Table 3 shows the DOR codes as they appear in the assessor's database and the interpreted understanding of whether or not each code implies that a parcel is developed.
 - The DOR codes in the Assessor's database are often multi-part and combined into this single field. This makes a succinct lookup based on Table 3 impossible without some pre-processing of the DOR codes. This processing step is managed by a series of queries in the IFR Access Database and involves parsing the original DOR code field into multiple values: a "base" code that conforms to the expected codes in the above table and auxiliary codes that modify or qualify that base code. The IFR Access database stores the processed DOR codes separately from the original. Examples of IFR Database interpretations of DOR codes can be found in Table 4.
 - The identification of developed parcels through this method assumes that the DOR codes are accurate and up-to-date. Discussions with County staff indicate potential for error in the DOR codes for some parcels because of irregular update frequencies and the "lower-priority" nature of the data (relative to other assessed information).

• Assessor's Database: Improvement Market Value:

- For agricultural and other open space base DOR codes (81, 83, 88, 94 and 95) that don't inherently imply that a parcel is developed, if that parcel's assessed improvement market value is greater than \$50,000 it is assumed that the parcel is developed. This \$50,000 threshold was also used by Highlands Associates in their 2008 report.
- This method hinges on the assumption that improvements greater than \$50,000 imply development. Although undeveloped parcels (those not occupied by a residence or business) might have improvements meeting this threshold, these are considered to be relatively few. Similarly, few parcels are likely developed for a home or business for values less than \$50,000.

Okanogan County Building Department Building Permit Database

- If a parcel has a building permit in the database of a variety that implies development, that parcel is flagged as having been developed.
- Because the Building Permit Database lacks clarity on the finality of a given permit, this approach conservatively over-estimates the number of developed parcels, and assumes that a building permit implies development. It is understood, however, that not all relevant building permits in the database were acted upon and the parcel developed.

The IFR Access database contains a field that stores an accounting of how the determination of development was made. This field contains a descriptor for all methods (as listed above) if a parcel is flagged as developed through multiple criteria.

IFR Database Developed Parcel Determination Source Matrix:							
I	D Me	etho	ł	Results			
DOR Code	Improvement Value > \$50K	Pre-1994 Building Permit	Post-1994 Building Permit	Number of Parcels Flagged as Developed	Percent of Total		
Χ				2590	45.4%		
X			Χ	1519	26.6%		
X		Χ		639	11.2%		
Χ		Χ	Χ	355	6.2%		
			Χ	161	2.8%		
Χ	Х			126	2.2%		
Χ	Х		Χ	114	2.0%		
		Х		79	1.4%		
Χ	Х	Χ	Χ	46	0.8%		
Χ	Χ	Χ		35	0.6%		
	Х		Χ	13	0.2%		
	Χ			11	0.2%		
		Χ	Χ	8	0.1%		
	Х	Χ		4	0.1%		
	Х	Х	Х	2	0.0%		

Identify parcels developed as residences

The criteria used to determine if a parcel is currently developed as a residence are as follows:

- Assessor's Database: DOR Codes:
 - Base (or auxiliary when following non-agricultural or open space) DOR codes 11-19 imply residential development.
 - A code of "0" after an agricultural or open space base DOR code implies that the parcel has a homesite and is thus flagged as residential.
- Okanogan County Building Department Building Permit Database

	IFR Database Residential Parcel Determination Source Matrix:				
ID	Meth	od	Res	ults	
DOR Code	Pre-1994 Building Permit	Post-1994 Building Permit	Number of Parcels Flagged as Residential	Percent of Total	
Х			2952	61.7%	
Х		Χ	1009	21.1%	
Х	Х		623	13.0%	
		Χ	86	1.8%	
	Χ		63	1.3%	
Χ	Χ	Χ	44	0.9%	
	Χ	Χ	5	0.1%	

• If a building permit record for a parcel has a type indicating the development of a residence, that parcel is flagged as residential.

Like the identification of developed parcels, the IFR Access database contains a field that stores an accounting of how the determination of a residential parcel was made. This field contains a descriptor for all methods (as listed above) if a parcel is flagged as residential through multiple criteria.

Identify development date of parcels

Critical to estimating the remaining reserve is insight into the development date of parcels within the basin. Only parcels developed after the Rule was in place (December 28th, 1976) are counted against the reserve. Unfortunately, only limited information is available to determine the development date of parcels.

• Okanogan County Building Department Building Permit Database

- The Building Permit Database represents the best available information tying a development date to an individual parcel.
- The Building Permit Database was provided in two parts/tables: pre- and post-1994 permits. In the pre-1994 table only one date is listed with each permit and it is assumed that this is the date of development. The post-1994 database, however, has multiple date fields. If the record has a date listed in the "Final" field, that date is used as the development date. However, it appears that this field has not been used by the building

department since 2002. Thus, if a parcel record does not have a date in the "Final" field the date from the field "Issue Date" is used instead.

- However, many parcels in the IFR Database that are flagged as developed do not have a corresponding record in the Building Permit Database or the permit record itself is missing the date. Further, data in the Building Permit Database drops off sharply in 1975, indicating that the database is incomplete (see Table 5).
- This approach also assumes that permits in the Building Permit Database all received a final inspection. This assumption was used because fields that suggest inspection finality were not available in the pre-1994 table and the final inspection date field in the post-1994 table seems to have not been used since 2002. This assumption/approach is conservative in that it likely overestimates the numbers of parcels developed since the Rule was enacted.

Other development date data considerations are as follows:

- Though the development date for each parcel is recorded in the IFR Access database when data exists, the majority of parcels flagged as developed are without known development dates. Of the 5,668 parcels in the IFR Database that are flagged as developed, 38 are listed as having a development date that predates the Rule, 1,830 have a development data after the Rule, and *3,800 do not have a known development date*. As such, it is necessary to augment the tally of parcels developed before and after the Rule with some general assumptions about the rate of development in the basin.
- The IFR Database stores a development rate factor for each reach that can be used to estimate the number of parcels without development dates that are subject to the Rule. Currently this value is set at 75 percent post-Rule development for all reaches. This number is based on consultation with long-time valley residents in the MWC indicating that, anecdotally, approximately 75 percent of all development has occurred since the Rule was enacted.

	Pre-Rule	Post-Rule	No Date
Headwaters	11 (4%)	255 (84%)	38 (13%)
Early Winters	1 (7%)	13 (93%)	0
Upper Methow	17 (3%)	511 (91%)	34 (6%)
Chewuch	21 (5%)	370 (86%)	40 (9%)
Middle Methow	15 (3%)	376 (87%)	41 (9%)
Twisp River	11 (4%)	212 (84%)	29 (12%)
Lower Methow	54 (5%)	961 (82%)	154 (13%)

• As a point of comparison, Aspect looked at the well completion dates in Ecology's Well Log Database, by reach:

The post-Rule development ratio suggested by the Well Log Database ranges between 82 percent (Lower Methow reach) and 93 percent (Early Winters reach). Though these numbers themselves suggest that the ratio of post-Rule development is greater than 75 percent, it is assumed that (like building permits) the completeness of the data falls off sharply going back in time. As such, it is likely that the ratio is somewhat lower than that suggested by the Well Log Database. Additionally, many wells have been drilled on parcels that have not yet been developed and some wells installed after adoption of the rule likely replaced wells on properties that were develop pre-Rule.

• Another relevant comparison can be made to the development ratios as suggested by Highlands Associates 2008 final tally of pre- and post-Rule residential developed parcels. Though Highland's methodology for categorization of pre- and post-Rule development is unknown, the numbers are as follows:

	Post-Rule Residential Developed Parcels
Headwaters	86 to 87%
Early Winters	100%
Upper Methow	83 to 85%
Chewuch	47 to 53%
Middle Methow	62 to 66%
Twisp River	62 to 66%
Lower Methow	46 to 52%
TOTAL	63 to 67%

• In general, the 25 percent / 75 percent approach used to estimate pre- and post-Rule development is limiting in that it is not a parcel-level assessment. However, the development date of individual parcels can be updated in the IFR Database as new information becomes available, thereby reducing the total number of parcels subject to this method of estimation.

Identify parcels served by Group A public water systems

Parcels whose domestic water supply is a Group A system are by definition served by a non-exempt source. The criteria used to make that determination are as follows:

- As identified though spatial analysis in GIS, parcels that fall within Group A public water system service area boundaries are assumed to be served by those sources.
- Since not all Group A service area boundary definitions were available in DOH's GIS dataset, Aspect attempted to generate service area boundaries for systems without this GIS data (where sufficient information existed) either through consultation with water system managers or by other lines of evidence based on spatial analysis as noted in the table below. The following table lists Group A public water systems in the Methow Basin and the service area boundary data source/delineation methodology:

PWSID	System Name	System Type	Has GIS Service Area Boundary?	Boundary Data Source
90050	TWISP, TOWN OF	Comm	TRUE	Twisp Town Limits (plus adjustment for few exceptions)
66450	PATEROS WATER DEPARTMENT	Comm	TRUE	Pateros Town Limits
97750	WINTHROP, TOWN OF	Comm	TRUE	Winthrop Town Limits (plus adjustment for few exceptions)

Group A	Water	System	Service	Area	Boundarie	s in	GIS:
---------	-------	--------	---------	------	-----------	------	------

PWSID	System Name	System Type	Has GIS Service Area Boundary?	Boundary Data Source
22340	EDELWEISS MAINTENANCE COMMISSION	Comm	TRUE	DOH GIS
67393	PINE FOREST WATER SYSTEM	Comm	TRUE	DOH GIS
19204	ALTA LAKE GOLF COURSE PLAT	Comm	TRUE	Grouped parcels guided by water right
				place of use
11476	WOLF CREEK PROPERTY OWNERS ASSN	Comm	TRUE	Approx. grouped parcels guided by water
				right place of use
54370	METHOW WATER SYSTEM INC	Comm	TRUE	Methow Town Limits from county GIS
				(checked against # of connections)
85135	SUN MOUNTAIN RESORT	NTNC	TRUE	Parcel Owner, source location
943	LIBERTY BELL HIGH SCHOOL	NTNC	TRUE	DOH GIS
SP660	PEARRYGIN LAKE STATE PARK - BOTH CG	TNC	FALSE	
48348	LOST RIVER AIRPORT ASSOCIATION	TNC	TRUE	DOH GIS
72751	RIVERBEND RV PARK	TNC	TRUE	water right place of use, source proximity
97744	Winthrop KOA	TNC	FALSE	
34195	SILVERLINE RESORT	TNC	FALSE	
SP010	ALTA LAKE STATE PARK	TNC	FALSE	
4280	WILSON RANCH PD WATER SYSTEM	TNC	TRUE	DOH GIS
31821	TWISP RIVER SKY RANCH WATER SYSTEM	TNC	TRUE	Grouped parcels guided by water right
				place of use
4109	EARLY WINTERS CABINS	TNC	FALSE	
30333	MAZAMA COUNTRY INN	TNC	FALSE	
7334	INDIAN CAMP - BUCKHORN MT ORCHARD	TNC	TRUE	DOH GIS
FS204	EARLY WINTERS WC - METHOW RD	TNC	FALSE	
7425	POIRIER ORCHARD	TNC	FALSE	
34838	RIVER RUN INN	TNC	FALSE	
AB604	Mazama Water Association	TNC	FALSE	
27684	BEAR CREEK GOLF COURSE	TNC	TRUE	DOH GIS
34216	MAZAMA STORE	TNC	FALSE	

• Parcels with water adequacy certificates listing a Group A system as the source were identified as being served by that system and are not counted as exempt well parcels.

Identify parcels served by Group B public water systems

• Some Group B water systems use non-permit exempt sources and development of these parcels does not count against the two cfs instream flow reservation. Group B water systems generally do not have service area boundaries, as such. However, by investigating a combination of parcel owner names, water systems names, water right places of use, plat names (lot legal descriptions), and water system source locations, Aspect was able to delineate pseudo "service area boundaries" for some Group B systems – essentially assigning parcels to the Group B systems that serve them. The following is a list of Group B systems for which Aspect delineated a boundary:

PWSID	System Name	Pseudo-Boundary Data Source
08037	FOSTER GUEST RANCH #3	APPROX. Grouped parcels by plat name, source proximity.
47127	LIBERTY WOODLANDS	Plat name, number of connections, water adeq. certs
AB365	Mazama Trailhead PUD	Grouped parcels by plat name
00158	Timberline Meadows PD #92	Grouped parcels by plat name
20006	STUD HORSE MOUNTAIN WATER	Plat name (some), water right place of use, number of
29900	SYSTEM	connections
AB802	Patterson Nilson	Plat name

Group B "Pseudo-Service Area Boundari

PWSID	System Name	Pseudo-Boundary Data Source	
00592	GOLD CREEK ACRES WATER SYSTEM	Street name and water system name, water adeq. certs., number of connections	
56610	WOLF RIDGE RANCH	Grouped parcels. Guided by water adeq. certs., plat names.	
51114	DEER RUN PUD WATER SYSTEM	Grouped parcels guided by water right place of use	
AB355	Mazama Springs	Grouped parcels by plat name, checked with connections	
07980	FOSTER GUEST RANCH #1	APPROX. Grouped parcels by plat name, source proximity.	
08036	FOSTER GUEST RANCH #2	APPROX. Grouped parcels by plat name, source proximity.	
03566	METHOW VALLEY ESTATES	Plat name, number of connections, water adeq. certs	
07426	ZAHN, DOUGLAS ORCHARDS	water right place of use, parcel owner name	
05185	TICE RANCH #1	Parcel owner name, number of connections	
01177	WALLEY SHORT PLAT WATER SYSTEM	Plat names, parcel owner names, water system name	
41090	GREENE & ROSSER WATER SYSTEM	Water system name and parcel owner/grantor name	
00463	HAWLEY/BEKENDAM WATER SYSTEM	Water system name and parcel owner name	
06169	CHAUNDY, SUSAN WATER SYSTEM	Water system name and parcel owner name	

- Since no single database groups Group B systems into categories of exempt sources (not having a domestic water right) and non-exempt sources (having a domestic water right) it is assumed that parcels identified as being served by Group B systems with more than six connections are served by a non-exempt source.
- Group B water systems in the basin with more than six connections that do not have representations of services areas in the IFR GIS Database (and thus have no parcels associated with them) represent a very small percentage of the total population, basin wide:

Group	PWSID	System Name	Residential
			Connections
В	30231	BURKE-LEHMAN WATER USERS ASSN	8
В	AB605	Bitterbrush PUD	7
В	05212	CHECHAQUO RANCH 3	9
В	05214	CHECHAQUO RANCH #4	9
В	05209	CHECHAQUO RANCH 1B	9
В	00266	TWIN LAKES 1	9
В	30236	KING-BOND WATER USERS	9
В	AC433	Bannick Wolf Creek	9
В	05211	CHECHAQUO RANCH 2	9

• Parcels with water adequacy certificates listing a Group B system as the source were identified as being served by that system when a specific system was listed in the Water Adequacy Certificate Database.

Other means of identifying a parcel's domestic water supply source:

- Ecology Well Log Database
 - The Well Log Database contains 3,164 wells in the Methow Basin. Of those, 341 have a tax parcel identification number listed with the well record. Parcels with a matching record in the well log database (231 of the 341) are assumed to be served by a permit exempt well. The IFR

Access database stores the Ecology Well ID number and well completion year for these matching records.

- Okanogan County Public Health Water Adequacy Certificate Database
 - This database contains parcels that have received a certificate for the purposes of obtaining a building permit or for subdividing a plat dating to the early 1990s. In most cases, the water source was only indicated as either "public" or "private." Parcels listed as having a "private" water source were counted as being self-supplied from an exempt well.
 - This approach assumes that parcels listed as having a private water source in the Water Adequacy Certificate Database are served by exempt wells. This could overestimate the number of exempt well parcels because some of these may be served by a private water right having a domestic use. The total number of private water rights having a domestic use (by subbasin) is shown below.

	Number of Domestic Use Water Rights		
Reach	Certs	Permits	Claims
Headwaters	17	5	45
Early Winters	3	0	2
Upper Methow	22	4	106
Chewuch	23	2	112
Middle Methow	22	1	94
Twisp River	43	1	73
Lower Methow	127	6	337
Total	257	19	769

Estimate Other Water Use Characteristics of Parcels

Estimate parcels served by an onsite septic system

- To identify parcels served by municipal sewer systems (not OSS) it is assumed that parcels within the limits of the Towns of Winthrop and Twisp, and City of Pateros (as identified in the Assessor's database tax code authority field) are served by those sewer systems.
- Town of Twisp provided a list of exceptions to this assumption, which have been recorded in the database. The City of Pateros and Town of Winthrop indicated there are few or no exceptions to this assumption within their respective service areas.
- Parcels with OSS certificates are flagged as such in the database.

Identify parcels receiving irrigation water from non-exempt sources The IFR Database identifies parcels served by exempt wells that also receive irrigation water form a non-exempt source (e.g., irrigation district). Data sources and interpretive methods to identify parcels that may be served by an exempt well but also receive irrigation water from a non-exempt source are as follows:

- The Okanogan County GIS coverage of parcels served by irrigation districts was imported into the IFR GIS Database. Parcels with a matching record in this dataset (the irrigation district GIS data include a PIN number) are assumed to be served by an irrigation district.
- A list of parcels identified by Highlands Associates (2008) as being served by irrigation districts was imported into the IFR Access Database. Parcels with matching records in this dataset are assumed to be served by an irrigation district. Highlands Associates worked with MWC and several irrigation purveyors to obtain detailed information on parcels receiving irrigation water.

IFR Database Irrigated Parcel Determination Source Matrix:				
Datas	Source	Results		
County GIS	Highlands Associates	Number of Parcels Flagged as Receiving Irrigation Water	Percent of total	
	Х	676	63.2%	
Х	Х	318	29.7%	
Х		76 7.1%		

Consideration was given to determine whether each exempt-well parcel receives irrigation water from a non-exempt source (water right or irrigation purveyor). Uncertainties in the mapped water right places of use in Ecology's WRTS and GWIS databases make it difficult to associate individual parcels with irrigation water rights. Typically the water right place of use does not list a parcel, and often covers a full quarter section that may include multiple parcels. Not accounting for private irrigation water rights likely underestimates the number of parcels that receive irrigation water from non-exempt sources. Efforts were made to determine whether each parcel receives irrigation water from an irrigation purveyor, however, review of information available from Okanogan County and consultation with the Methow Watershed Council indicate the irrigation status of many parcels frequently change with no mechanism available to update the database. Based on this, irrigation status was not assigned to individual parcels with sufficient certainty to estimate the impact irrigation water presents to lowering withdrawals by exempt wells.

Buildout Analysis

Beyond supporting and tracking current water use estimates, the IFR Database has been designed to estimate the number of parcels that, as currently zoned, could be developed as exempt well parcels and thus count against the two cfs instream flow reservation in the future. This estimate of potential future use is referred to here as a "buildout analysis." This buildout analysis should not be thought of as a forecast of future development, tied to a specific point in time or a development trajectory, but instead as an upper bound on the potential impacts of development on the instream flow reservations.

For the purposes of the IFR Database, two distinct buildout analysis methodologies are applied:

1) Full Buildout:

"Full" buildout assumes that each parcel will be *subdivided and developed to the greatest extent allowed by zoning regulations*. The general arithmetic is as follows:

For a developable parcel,

Developable Acreage ÷ Minimum Lot Size (from Zoning) = Number of Parcels at Buildout

In the above arithmetic, the division of the minimum lot size into the developable acreage ignores any remainders (i.e. there are no fractional numbers of parcels at buildout). For example, if a parcel has 55 developable acres in a 20-acre minimum lot size-zone, it is assumed that the existing parcel can be built out into two (not three) parcels.

The methodology for analyzing full buildout is outlined in this Section and relies on each processing step described below as steps A through H.

2) Buildout with no subdivision:

The assumption of subdivision of all parcels to the maximum number allowable by zoning regulations yields results that are potentially unrealistically high for the Basin, especially the Lower Methow reach (e.g., a 600-acre, developable parcel in a 1-acre minimum lot size zone likely would not be divided into a 600-parcel subdivision). As a point of comparison to the full buildout analysis, the IFR Database also tallies the current total number of developable parcels in each reach without subdividing them. This version of the buildout analysis does not account for zoning and only relies upon the identification of developable parcels (Step A) and conservation easement exceptions (Step F). Results of this analysis are comparable to the results presented in Highlands Associate's 2008 report.

The two buildout numbers (full buildout and buildout with no subdivision) represent an upper and lower limit to the potential future buildout. True buildout is likely something in between the two.

The following steps are involved in the IFR Database buildout analysis:

A. Identify developable parcels

Beginning with the assumption that all parcels are developable, the IFR Access Database flags parcels as not developable if they meet any of the following criteria:

If a parcel's PIN is non-numeric it can be assumed that that parcel is not developable. Non-numeric PINs in the database include those for right-of-ways ("ROW", "R/W", etc.); over-water areas ("RIVER", "METHOW RIV", "LAKE", "PEARRYGIN", etc.); planned development common areas ("COM AREA", "88135 CA", "CA", etc.); National Forests ("ONF", "WNF"); and other easements, structures, and government-owned areas otherwise not counted as a

traditional tax parcels and tracked in the Assessor's Database. These parcels are also identifiable by their lack of common attributation in the parcel GIS dataset.

- If a parcel is government-owned or tax-exempt (through State ownership) it is assumed that it is not developable. In the GIS parcel dataset these parcels can be identified by either a "G" or an "EW" in the property class field.
- Certain DOR codes are identified in the IFR Access Database as not developable in same lookup table as presented in Table 3 of this report. If a parcel's base DOR code matches a code in the table that is identified as not developable, that parcel is flagged as not developable. The following table lists parcel DOR codes that are taken to imply that a given parcel is not developable.

Code	Land Use
45	HIGHWAY & STREET RIGHT OF WAY ROW & EASEMENTS
77	DNR WA. ST. DEPT. OF NATURAL RESOURCES
89	OTHER RESOURCE PRODUCTION, PUD DAMLANDS
897A	PERPETUAL TIMBER
93	WATER AREAS

As with the process for determining if a parcel is currently developed, before the IFR Database can reliably interpret the DOR codes they must be parsed and standardized into "base" and "ancillary" codes. This methodology is described earlier in this report.

B. Identify current zoning for each parcel

During this study, Okanogan County was undergoing a revision of its Comprehensive Land Use Plan, which would include changes to zoning. Consultation with Perry Huston, Okanogan County Planning Director, indicated that zoning will generally remain the same for the Methow Review District (encompassing WRIA 48) – although some changes to names of specific zones could be implemented. Therefore, MWC elected to use *current County zoning* code for the buildout analysis.

Okanogan County Planning Department provides a GIS shapefile delineating the spatial extent of each current Zone. This shapefile was imported into the IFR GIS Database and reduced to only those Zones covering the Methow Basin. Further, inconsistencies existed in the zone code values in the GIS data from those listed in County ordinance. Aspect adjusted the GIS data to match the zone names/codes as listed in ordinance.

Overall, most parcels fit neatly into a single Zone. However, because of geometric/drawing inaccuracies between the zoning delineations and the parcel GIS dataset, a true GIS "overlay" analysis, to assign parcels to zones, is impossible without creating small "slivers" of parcels where the boundaries of the two datasets do not line up sufficiently. Though there are some instances where a given parcel may actually be split into multiple zoning designations (as currently delineated), an approach that divides up existing parcel geometry would be overly complex given the limitations and inaccuracies in the data. Therefore, like the assignment of parcels to reaches, it is assumed that a parcel's zoning designation is the zone that the parcel's geometric centroid falls within.



In the above example, parcel number 3521103006 would be assigned to the MRD 20 Zone and parcel number 3521100051 would be assigned to the MRD 5 Zone. The "sliver" areas of each parcel that cross into and adjacent zone would be ignored.

This analysis step is managed by an ArcGIS ModelBuilder tool.

C. Determine the minimum parcel size allowed under current Zoning Code

The Methow Basin encompasses 14 different zoning designations (see Figure 3). The majority of the Methow Basin falls within the "Methow Review District 20 (Uplands)" zoning designation – though most of this area covers the undevelopable Okanogan National Forest. Of the 14 zones in the Basin, five of them – "Methow Review District 20 (Uplands)", "Methow Review District 5 (Valley Floor)," "Minimum Requirement District," "Rural Residential District," and "Low Density Residential District" – make up 99 percent of the developable acreage in the Basin (see Table 6).

The minimum lot size was stored as an attribute in the source GIS database from the Planning department. These minimum lot size values were confirmed against County Code. Table 6 lists the 14 zones in the Methow Basin, the Code Chapter reference for each, the established minimum lot size, and a summary of each Zone's acreage in the Basin.

D. Determine maximum ERUs per parcel allowed under Zoning Code

Zoning in some areas allows for accessory dwelling units (ADU), such as an apartment above a garage. While there is potential an ADU could increase total water use by an exempt well parcel, it is outside of the scope of this study to estimate numbers of ADUs and water demand resulting from ADUs. This is in part, because the full buildout scenario forms an upper limit to future development that is sufficiently conservative and would far exceed water available under the reservation. Considering ADUs in the buildout would further increase water demand. Therefore, 1 ERU is assumed for each

parcel that might be developed as a single family residence.

E. Determine developable acreage for each parcel

It is understood that some geographic factors may render all or part of a "developable" parcel undevelopable. However, most of these factors, such as floodways and steep slopes/geologic hazard areas, are not accounted for in this analysis due to either lack of necessary geospatial data (floodways) or out-of-scope analytical complexity (steep slopes/geologic hazard areas).

The sole dataset used in the IFR GIS Database to adjust the developable acreage of each parcels is the 1:24,000-scale water body hydrography coverage from WA DNR. It is assumed that the acreage of a parcel that falls on over-water areas (the intersection between the parcel GIS features and the water body features) is not developable. Though imperfect, the DNR water body dataset is a serviceable way to account for wetlands (called "wet areas" by DNR), ponds, small lakes, etc. that are otherwise not segregated in the parcel dataset.

In the example to the right, a 159-acre parcel is shown to contain an eight-acre lake. As such, it is assumed that 151 of the parcel's 159 acres are developable.

F. Identify parcels in conservation easements and determine the future development allotment for those easements

Parcels currently part of conservation easement agreements that limit potential development are accounted for in two ways:

• Conservation easements stewarded by the Methow Conservancy were reviewed. These have established numbers of allowable residences at buildout that are intrinsic to the agreement. A shapefile was obtained from the Methow Conservancy that delineates these easements and lists the current number of residences and the allowable number of residences for each. Put simply, these easements are associated with the parcels that fall within them (via GIS). These easement parcels are then ignored when tallying buildout ERUs (as in the steps above) and the ERU allotment as defined in the Methow Conservancy dataset is used instead. The number of ERUs allowed at buildout for the easements that were reviewed ranges from 0 to 9.



This step is made complicated, however, by incongruities between parcel geometry and easements as delineated by Methow Conservancy (much like the Zoning, as described above). In this case, the following logic is used to associate a parcel with a Methow Conservancy easement in GIS:

- If the overlap between an easement delineation and a parcel is greater than or equal to 10 acres (regardless of percentages), that parcel is assumed to be part of that easement; or
- if the Assessor's DOR code contains the letters "CE" (indicating that the parcel is assessed as part of a conservation easement) and the easement delineation covers more than 10 percent of the parcels area, that parcel is assumed to be part of the conservation easement; or
- if there is no "CE" in a parcel's DOR code but the overlap between the parcel and the easement polygon is greater than or equal to four acres and 50 percent or more of the total parcel acreage, that parcel is assumed to be part of the conservation easement; or
- if there is no "CE" in a parcel's DOR code but the overlap between the parcel and the easement polygon is 90 percent more, that parcel is assumed to be part of the conservation easement.

These association criteria are applied by an ArcGIS ModelBuilder tool and can be adjusted by the user at the time of execution. The threshold criteria and the logic behind them are not based on any official interpretation, but are instead derived by trial and error.

Numbers of parcels containing easements are small compared to the total number of developable parcels. Easements tallied in this way include 86 parcels and 126 buildout ERUs.

• Conservation easements not represented in the Methow Conservancy dataset are assumed to be sufficiently captured by identifying any other parcels with a "CE" in their DOR codes that are not already associated with Methow Conservancy easements (by the criteria outlined above). These parcels are not grouped into contiguous easements and there are no specific development allotments for them. As such, a broad assumption must be made to estimate the buildout ERUs on these parcels. Here, it is assumed that at buildout each conservation easement parcel identified in this way will have *one more residence than is currently on the parcel*.

Easements tallied in this way include 37 parcels and 56 buildout ERUs.

This approach to buildout in regards to conservation easements assumes that no additional easement agreements will be established. Predicting numbers of future conservation easement agreements that might be entered established is beyond the scope of this study. Assuming no additional easements will be established is a conservative estimate.

G. For each buildout parcel, estimate if it would be served by an exempt well

- The IFR Database analysis assumes that a given buildout ERU will be served by an exempt well source if that parcel is either: (a) outside of a Group A water systems boundary or (b) not currently served by a Group B system with more than six connections (assumed to be a non-exempt source).
- For parcels that fall within a Group A service area or are served by a Group B system with more than six connections, the total number of buildout ERUs are summed up by each Water System matching these criteria. The IFR Database then looks up the number of approved connections for each of these water systems and compares that number to the estimated buildout ERUs. If a water system is determined to have a more buildout ERUs than DOH-approved service connections, the balance of buildout ERUs above the approved connections are assumed to be served by an exempt well. If a water system has more approved services than buildout ERUs it is assumed that no buildout ERUs in that water system service area will use an exempt well.
- This approach assumes, fundamentally, that all development occurring outside of a Group A water system boundaries (and Group B systems with more than six connections) will be served by exempt sources. This is conservative, potentially overestimating numbers of parcels that will be served by exempt sources. This assumption does not account for potential increases in allowable connections (and expanded service areas) for water systems that could be realized through water use efficiency measures, increased system capacities, or water rights and does not account for new water systems that could use water rights converted from other uses such as agriculture.

H. Other buildout considerations: Closed Basins per WAC

Closed basins established in the Rule (Figure 2) were evaluated and assumed to be developable to the full extent allowed by zoning (Figure 3). While the Rule prohibits further appropriations of surface waters and groundwater (including exempt wells) in hydraulic continuity with surface waters in these basins, it does allow for groundwater withdrawals that can be proven to be hydraulically disconnected.

An analysis of the Ecology Well Log Database for well log records located in closed basins suggests that development in these basins is happening and will likely continue.

	Well Completion Date:		
Closed Basin:	Pre-Rule	Post-Rule	No Date
Alder Creek	0	9	1
Bear Creek	1	50	4
Beaver Creek	4	88	23
Benson Creek	0	22	6
Black Canyon Creek	0	6	1
Cow Creek	0	10	3
French Creek	0	54	3
Gold Creek	1	37	5
Libby Creek	0	33	4

Wells in Closed Basins:

McFarland Creek	0	8	0
Squaw Creek	0	12	1
Texas Creek	0	23	3
Thompson Creek	0	44	7
Wolf Creek	0	24	3
TOTAL	6	420	64

The assumption that full buildout can occur in closed basins yields a conservative estimate, potentially overestimating the number of parcels that can be developed. For example, one means of proving a new well is not in hydraulic continuity with surface waters in closed basins (as required by the Rule) might be to complete the well in bedrock rather than in shallow, unconsolidated deposits. Bedrock wells in WRIA 48 tend to yield limited groundwater quantities and relatively dense development within the closed basins could be limited by the practicality of completing these wells in low-yield aquifers.

Each parcel that falls within a closed basin is flagged in the IFR Access Database, making it possible to refine/revisit this assumption in the future.

6 Results

Estimate of Existing Developed Exempt Well Parcels Subject to the Instream Flow Rule

Existing developed exempt well parcels subject to the Instream Flow Rule estimated using the IFR Database are shown in Table 7. These parcels are described as "existing" to indicate that they reflect a snapshot of parcel configurations at the time of this study. They were determined to be developed using methods described in Section 5 of this report that also describes the methodology for determining a development date (pre- or post-Rule). Because data indicating the date of development are incomplete, a conservative approach was used by assuming 75 percent of these parcels were developed after adoption of the Instream Flow Rule. As shown on Table 7, a total of 2,730 parcels served by exempt wells are estimated to have been developed after adoption of the Rule and therefore are subject to the two cfs instream flow reservation established in the Rule.

Buildout Exempt Well Estimates by Reach

Full Buildout with Parcel Subdivision

The full buildout scenario accounts for all existing developed residences and assumes every existing parcel will be subdivided into the smallest residential parcel allowed by current zoning code. This buildout estimate addresses only parcels that are identified in the IFR Database as having (current parcels) or needing (future buildout parcels) an exempt well water source. Results are shown in Table 8. The full buildout comprises an upper bound to the number of parcels that could be developed. No date is specified for any of the buildout estimates. Notable is that the number of parcels estimated at full buildout for the Lower Methow reach greatly exceeds the number of currently developed parcels. The Minimum Requirement District estimated at over 24,000 acres in the Lower Methow subbasin allows a minimum lot size of 1 acre. In considering the number of parcels at full buildout in the Lower Methow, it should be noted that although this estimate is based on current zoning code, other factors such as limitations on exempt well use for planned developments and steep topography make it unlikely this subbasin will develop to the full estimated extent.

Buildout with Current Parcel Size

The assumption of subdivision of all parcels to the maximum number allowable by zoning regulations yields results that are potentially unrealistically high for the Basin, especially the Lower Methow reach. As a point of comparison, a reduced buildout scenario was evaluated by tallying the current total number of developable parcels in each reach without subdividing them. This reduced buildout scenario, excluding the Lower Methow reach, results in about 33 percent fewer parcels at buildout of the other six reaches. The impact to the estimated buildout for the Lower Methow is much more significant, where the number of estimated exempt well parcels is reduced by nearly 90 percent. Results are shown in Table 9.

Full Buildout Excluding Closed Basins

During development of the IFR Database and while evaluating buildout scenarios, consideration was given to areas in WRIA 48 that are established in the Rule as closed basins, defined as areas closed to further appropriations to surface waters and groundwater (including exempt wells) in hydraulic continuity with the designated surface water bodies (see Figure 2). This restriction was not considered in the full or partial buildout scenarios because considerable development in closed basins has occurred since the Rule was adopted and will likely continue where new wells are tapping groundwater sources (primarily n bedrock) that while potentially not in continuity with surface water in the tributary, will nonetheless impact the Methow River. Recognizing that development in the closed basins faces additional restrictions due to typically low-yield from bedrock sources, a third buildout scenario was estimated assuming full buildout with parcel subdivision, but with no additional development in the closed basins. Predictably, this estimate lies in between the upper (full) and lower (reduced) buildout estimates and provides insight to the sensitivity of assuming closed basins are fully developable. Actual development in closed basins will likely proceed, but not to the extent that they might if physical water availability were not limited. Results are shown in Table 10. Assuming no development in closed basins has substantial impact to the full buildout estimate for the Lower Methow subbasin where over 9,000 exempt well parcels lie within closed basins. The buildout estimate for the Middle and Upper Methow subbasins is reduced by approximately 380 parcels while all other reaches remain nearly the same.

7 Verification and Error Analysis

The IFR Database and its underlying assumptions and methods have been designed when there is uncertainty to err on the side of overestimating the number of exempt well parcels. This approach is intentionally conservative to avoid underestimating current and future reserve allocation. Section 5 of this report describes the IFR Database methodology in detail and should be referred to for a description of individual assumptions and estimate implications..

Comparison of IFR Database Results to Other Subbasin-Level Data

Some agency database information cannot be tied to individual parcels but can be spatially associated with one of the defined subbasins. Examples are public water system connections from WDOH and water rights and well logs from Ecology. These data were summed by subbasin as a means to check and verify results of the IFR Database.

Table 11 shows tallies by subbasin derived from the IFR Database for total numbers of developed residential parcels served by Group A and larger Group B (with 7 or more connections) water systems. Because these tallies are from the IFR Database, they represent parcel-specific results derived from characteristics assigned to each parcel during database development.

For comparison, Table 11 also contains tallies from the WDOH SENTRY database, which is not available on a parcel-specific basis, but contains data that can be assigned to a given subbasin based on spatial location. In Table 11, residential connections for Group A and Group B (more than 7 connections) from SENTRY are tallied by subbasin and compared to the comparable tallies from the IFR Database. For water systems that span multiple reaches, the connections were divided in proportion to the number of developed parcels in each water system in each reach.

Table 12 presents the estimated current number of exempted wells per reach subject to the Rule, well logs by reach from Ecology's well log database, and groundwater rights with a domestic component by reach from Ecology's WRTS/GWIS/Well Log databases.

Results from the IFR Database are generally consistent with or somewhat overestimate numbers of exempt wells and water service connections estimated based on other agency databases. These positive comparisons to estimates based on other sources of data provide an additional degree of confidence in the accuracy of the IFR Database. Some examples follow:

• As shown on Table 11, Washington Department of Health data indicate the number of connections served by water right-permitted public water systems (Group A and larger Group B) is slightly higher (1,551) than the number

estimated using the IFR Database (1,493), indicating that the IFR Database's identification of parcels served by non-exempt water systems is accurate.

- Further, the favorable comparison between the number of residential parcels in Group A systems as identified by the IFR Database and the number of Group A residential connections per WDOH SENTRY validates the IFR Database's methods for identifying residential parcels.
- Looking at Table 12, ideally the number of well logs (3,164) minus the number of domestic groundwater rights (673) should represent something close to the number of exempt wells in the watershed (2,491). The estimated 2,730 exempt wells from the IFR Database is about 10 percent higher than what would have been estimated based solely on well logs and water rights. This indicates that the IFR Database has captured additional apparent exempt wells, providing a more reliable estimate than other approaches.
- For Aspect's companion *Water Withdrawal Study Plan*, the IFR Database was used to select a random sample of residential parcels thought to be served by exempt wells and not receiving water from a non-exempt irrigation water source. Aerial photography of these parcels was reviewed to estimate irrigated acreage and assign an irrigation demand (as documented in the *Water Withdrawal Study*). Of the original 240 Database-selected parcels matching the criteria referenced above, less than 10 were rejected for not appearing to be residential developed parcels. The small percentage of parcels rejected for this reason suggested that the IFR Database is yielding fairly accurate estimates.
- Appendix E of the *Methow Basin (WRIA 48) Watershed Plan* contains tables showing at least two previous estimates for numbers of developed parcels subject to the two cfs instream flow reservation including a table from Highlands Associates (2003) that estimates there are 2,552 total developed parcels that are subject to the Rule. Although the total numbers of developed parcels subject to the Rule in Appendix E are similar to the total estimated number of exempt wells in Table 12, the numbers differ substantially when presented by subbasin. These differences can be partially assigned to previous studies that used older source data and subbasin boundaries that were not clearly delineated.

References

- Aspect Consulting, LLC (Aspect), 2011, Water Withdrawal Study, Water Resource Inventory Area 48, Twisp, Washington. June 16, 2011.
- Golder Associates, Inc., 2002, Phase II-Level 1 Watershed Technical Assessment for the Methow River Basin, Final Draft. June 26, 2002.
- Highlands Associates, 2003, An Estimate of the Potential for Single-Family Development in the Methow Valley. Okanogan. Washington. October, 2003.
- Highlands Associates, 2008, Work on Tasks for Methow Watershed Council, Final Report. July 25, 2008.
- Methow Basin Planning Unit, 2005, Methow Basin (WRIA 48) Watershed Plan. June 20, 2005.
- Methow Watershed Council, 2009, Final Detailed Implementation Plan, Methow River Basin (WRIA 48). October 29, 2009.
- Washington State Department of Ecology (Ecology), 1991, Recent Water Use in the Methow River Valley: An Estimate. December 1991.
Limitations

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Methow Watershed Council for specific application to the referenced property. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

Table 1 - Parcel-Level Attributes Tracked by the IFR Database

WRIA 48 Water Use Study Project No. 080180

Field Name	Data Type	Description
PIN	Text	Parcel ID Number
Reach	Text	Methow River Reach that parcel is associated with
DOR_BASE	Text	First two digits of Assessor DB DOR code
DOR_AUX	Text	Ancillary digits of Assessor DB DOR code
Developed_YN	Yes/No	Is the parcel developed? (yes or no)
Developed_YN_Source	Text	How was it determined that the parcel is developed?
Developed_Date	Date/Time	Date that the parcel was developed
Residence_YN	Yes/No	Is the parcel a residential parcel?
Residence_YN_Source	Text	What is the source of data for determining status as residential
		parcel?
Developable_YN	Yes/No	Is the parcel developable? (yes or no)
Water_Source_Type	Text	Water source type (Group A, Group B, or self-supplied)
Water_System_Name	Text	Name of public water system that the parcel is understood to
		connect to
ExemptWell_YN	Yes/No	Does the parcel have/use an exempt well?
PWS_ID	Text	ID # of public water system (if applicable) that the parcel falls
		within. Does not imply connectivity.
Well_ID	Long Integer	Ecology well ID of self-supplied well on parcel
Well_Year	Long Integer	Year of well installation from well log
Municipality	Text	Name of incorporated municipality the parcel falls within (if
		applicable)
Sewer_YN	Yes/No	Is the parcel on a sewer system? (yes or no)
Sewer_Sys_Name	Text	Name of the sewer system (if applicable/known)
Irrigation_YN	Yes/No	Does the parcel receive irrigation water from a non-exempt source?
Irrigation_YN_DataSource	Text	How was the parcel flagged as receiving irrigation water from a non-
		exempt source?
IrrigationWaterSource	Text	Source of irrigation water for the parcel (district name, etc.)
ClosedBasin_YN	Yes/No	Is the parcel in a closed basin (yes or no)?
ClosedBasinName	Text	Name of the closed basin
SubBasinName	Text	Name of the hydrologic basin the parcel falls within (from WBD)
Comments	Memo	IFR Tracking Database Comments
Flag_For_Review	Yes/No	Yes/No field indicates whether a parcel records requires further
		review and analysis
Lat_Center	Double	The Latitude (Northing) of the centroid of the parcel part (WGS84)
lang Contar	Double	The Longitude (Facting) of the controld of the percel part (M/CS24)
Long_center	Double	The Longitude (Easting) of the centroid of the parcel part (WGS84)
CE_TF	Yes/No	Is the parcel in a conservation easement (per DOR code)?
HOMESITE_YN	Yes/No	Does have a homesite (per DOR code - for Ag parcels)?
AUX_RES_YN	Yes/No	Does the parcel have an auxiliary residence (per DOR code)?
OSS_YN	Yes/No	Does the parcel have on-site septic?
OSS_Date	Date/Time	When did the parcel get an OSS certificate?
WAC_YN	Yes/No	Does the parcel have a water adequacy certificate?

Aspect Consulting

Table 1 - Parcel-Level Attributes Tracked by the IFR Database

WAC_Date	Date/Time	What is the date of the water adequacy certificate?
PhotoLink	Text Link to photos of the property on Okanogan County web	
MapSifterLink	Text Link to County's online map of parcels	
ManualEditFlag Yes/No Has the record been updated manually?		Has the record been updated manually?
EditDesc	Text	How has the record been adjusted?

Table 2 - IFR Database Data SourcesWRIA 48 Water Use Study Project No. 080180

GIS/Spatial Data (as Imported into the IFR GIS Database)								
Data Set	Featureclass Name in IFR GIS Database	Souce	Source Data Date	Source Data Format	Processing Steps/Modifications	Link or Contact Info		
Parcels	parcels	Okanogan County Assessor (GIS)	3/29/2011	shapefile (polygons)	Extracted parcels in Methow Basin, added field that identifies the source shapefile (032911.shp)	http://www.okanogancounty.org/planning/gis.htm		
Public Water System Service Areas	PWS_ServiceAreas	WA DOH (via S. Leibenguth) + Aspect Additions(1)	9/15/2010	file geodatabase featureclass (polygons)	Extracted service areas in Methow Basin, reprojected data from NAD83 HARN State Plane Washington South to NAD27 State Plane Washington North, simplified attribute table, added field "DataSource", added service area polygons for water systems not in source DOH dataset (where possible)	http://www.doh.wa.gov/ehp/dw/sentry.htm		
Public Water System Source Locations	PWS_Sources	WA DOH (via S. Leibenguth)	9/15/2010	file geodatabase featureclass (points)	Extracted source locations in Methow Basin, reprojected data from NAD83 HARN State Plane Washington South to NAD27 State Plane Washington North	http://www.doh.wa.gov/ehp/dw/sentry.htm		
Well Logs	WellLogs	WA Ecology	10/26/2010	shapefile (points)	Extracted well log locations in Methow Basin, reprojected data from NAD83 HARN State Plane Washington South to NAD27 State Plane Washington North, added field that identifies the source shapefile (Water Well Logs 10-26-10.shp)	http://www.ecy.wa.gov/services/gis/data/data.htm		
Water Right Places of Use	WR_POUs	WA Ecology (GWIS)	3/9/2011	file geodatabase featureclass (polygons)	Extracted POUs in Methow Basin, reprojected data from NAD83 HARN State Plane Washington South to NAD27 State Plane Washington North, joined in geodatabase table "WR_DOC" to add full water right attributation	ftp://www.ecy.wa.gov/wr/GWIS_Data/		
Water Right Points of Diversion/Withdrawal	WR_Points	WA Ecology (GWIS)	3/9/2011	file geodatabase featureclass (points)	Extracted points in Methow Basin, reprojected data from NAD83 HARN State Plane Washington South to NAD27 State Plane Washington North, joined in geodatabase table "D_Point_WR_Doc" and "WR_DOC" to add full water right attributation	ftp://www.ecy.wa.gov/wr/GWIS_Data/		
Stream Management Reaches	Reaches	Aspect Consulting	2/1/2011	shapefile (polygons)	See Appendix A, Reach Boundary Memo for full description of this dataset and it's development. For the IFR GIS database, reprojected data from NAD83 State Plane Washington North to NAD27 State Plane Washington North	ΝΑ		
Irrigation Districts	OtherOKCountyData >> IrrigationDistricts	Okanogan County Assessor (GIS)	10/14/2003	shapefile (polygons)	Extracted features in Methow Basin	http://www.okanogancounty.org/planning/gis.htm		
Town Areas	OtherOKCountyData >> TownAreas	Okanogan County Assessor (GIS)	1999	shapefile (polygons)	Extracted features in Methow Basin	http://www.okanogancounty.org/planning/gis.htm		
Current Zoning	OtherOKCountyData >> Zoning	Okanogan County Assessor (GIS)	3/7/2005	shapefile (polygons)	Extracted features in Methow Basin, reduced attribute table to "ZoneCode" and "ZoneName", cleaned-up and made consistent Zone Codes and Zone Names	http://www.okanogancounty.org/planning/gis.htm		
Water Bodies	DNRHydro >> Water Bodies	WA DNR	11/8/2008	ArcINFO Coverage (polygons)	Extracted POUs in Methow Basin, reprojected data from NAD83 HARN State Plane Washington South to NAD27 State Plane Washington North	http://fortress.wa.gov/dnr/app1/dataweb/dmmatrix.html		
Methow Conservancy Conservation Easements	MethowConservancy_CEs	Methow Conservancy (via Dawn Woodruff)	3/18/2011	shapefile (polygons)	Reprojected data from NAD83 to NAD27 State Plane Washington North, added numeric fields for current homesites (HS_Num), possible homesites (PHS_num), and possible wells (PossWells)	dawn@methowconservancy.org		

Table 2 - IFR Database Data SourcesWRIA 48 Water Use Study Project No. 080180

Table Data (as Imported into the IFR Access Database)								
Data Set	Table Name in IFR Access Database	Souce	Source Data Date	Source Data Format	Processing Steps/Modifications	Link or Contact Info		
Pre-1994 Building Permits	BuildingPermits_pre94	Okanogan County Building Department (via Gene Wyllson @ Planning)		Microsoft Access Database Table	Imported data into the IFR Access database. Developed lookup table for permit types and whether those types imply new development and/or residential development.	ghwyllson@co.okanogan.wa.us		
Post-1994 Building Permits	BuildingPermits_post94	Okanogan County Building Department (via Gene Wyllson @ Planning)		Microsoft Access Database Table	Imported data into the IFR Access database. Developed lookup table for permit types and whether those types imply new development and/or residential development.	ghwyllson@co.okanogan.wa.us		
DOR Code Lookup Table	Codes_DOR	Okanogan County Assessor	Unknown	Website	Entered data into table form	http://www.okanogancounty.org/Assessor/DOR%20Use%20Codes.htm		
Highlands Associates Data	HighlandsData	Highlands Associates, Reserve Use Since 1976, Final Report.	2008	Various Shapefile Attribute Tables	Combined the DBF attribute tables of shapefiles (previously separated by reach)	Highlands Associates, Omak, WA (509) 422-5030		
On-Site Septic Parcels	OSS_parcels	Okanogan County Public Health Department (via Dave Hilton)	1/6/2010	Microsoft Excel Table	None	dhilton@co.okanogan.wa.us		
Parcels with Water Adequacy Certificates	Water_Adeq_Certs	Okanogan County Public Health Department (via Dave Hilton)	1/6/2010	Microsoft Excel Table	Parsed field "Water System" in field "Group" to make values more consistent, fewer in number	dhilton@co.okanogan.wa.us		
Zoning Codes	ZoningCodes	Okanogan County Planning Department and Aspect Consulting	NA	NA	Table was developed from Okanogan County Code (available online) and matched to Zoning designations in the GIS polygon dataset	http://nt5.scbbs.com/cgi- bin/om_isapi.dll?clientID=450788553&depth=2&infobase=okanco.nfo&record={5C57}&soft page=PL frame		
Public Water System Data	Public_Water_Systems	WA DOH (SENTRY)	2/28/2011	Microsoft Access Database Table	Imported data for public water systems that fall within the Methow Basin	http://www.doh.wa.gov/ehp/dw/sentry.htm		



Table 3 - Assessor's Database DOR Codes and Development Assumptions

Code	Land Use	Group	Developed?	Developable?
11	ONE SINGLE FAMILY HOUSEHOLD	RESIDENTIAL	Yes	Yes
12	2-4 HOUSEHOLD UNITS	RESIDENTIAL	Yes	Yes
13	5 OR MORE HOUSEHOLD UNITS	RESIDENTIAL	Yes	Yes
14	RESIDENTIAL HOTEL OR CONDOMINIUM	RESIDENTIAL	Yes	Yes
15	MOBILE HOME COURTS OR PARKS	RESIDENTIAL	Yes	Yes
16	MOTELS/HOTELS	RESIDENTIAL	Yes	Yes
17	INSTITUTIONAL LODGING NURSING HOMES, ALZHEIMER'S	RESIDENTIAL	Yes	Yes
18	STRUCTURES ON LEASED LAND P.P. ON REAL	RESIDENTIAL	Yes	Yes
19	CABIN	RESIDENTIAL	Yes	Yes
21	FOOD AND KINDRED PRODUCTS	MANUFACTURING	Yes	Yes
22	TEXTILE MILL PRODUCTS	MANUFACTURING	Yes	Yes
23	APPAREL & OTHER FINISHED PRODUCTS (MADE FROM	MANUFACTURING	Yes	Yes
24	LUMBER & WOOD PROD. EXCEPT FURNITURE	MANUFACTURING	Yes	Yes
25	FURNITURE & FIXTURES	MANUFACTURING	Yes	Yes
26	PAPER & ALLIED PRODUCTS	MANUFACTURING	Yes	Yes
27	PRINTING & PUBLISHING	MANUFACTURING	Yes	Yes
28	CHEMICALS	MANUFACTURING	Yes	Yes
29	PETROLEUM REFINING & ALLIED INDUSTRIES	MANUFACTURING	Yes	Yes
30	RUBBER & PLASTIC PRODUCTS	MANUFACTURING	Yes	Yes
31	LEATHER & LEATHER PRODUCTS	MANUFACTURING	Yes	Yes
32	STONE, CLAY & GLASS PRODUCTS	MANUFACTURING	Yes	Yes
33	PRIMARY METAL PRODUCTS	MANUFACTURING	Yes	Yes
34	FABRICATED METAL PRODUCTS	MANUFACTURING	Yes	Yes
25	PROFESSIONAL, SCIENTIFIC, AND CONTROL INSTRUMENTS,		Mar	Mar
35	PHOTOGRAPHIC, CLOCKS, ETC.	MANUFACTURING	Yes	Yes
36	NOT ASSIGNED	MANUFACTURING	Yes	Yes
37	NOT ASSIGNED	MANUFACTURING	Yes	Yes
38	NOT ASSIGNED	MANUFACTURING	Yes	Yes
39	MISCELLANEOUS MFG.	MANUFACTURING	Yes	Yes
41	RAIL/TRANSIT TRANSPORTATION	TRANSPORTATION, COMMUNICATION, AND UTILITIES	Yes	Yes
42	MOTOR VEHICLE TRANSPORTATION	TRANSPORTATION, COMMUNICATION,	Yes	Yes
43	AIRCRAFT TRANSPORTATION HANGERS		Yes	Yes
44	MARINE CRAFT TRANSPORTATION	TRANSPORTATION, COMMUNICATION,	Yes	Yes
45	HIGHWAY & STREET RIGHT OF WAY ROW & EASEMENTS	TRANSPORTATION, COMMUNICATION,	No	No
46	AUTOMOBILE PARKING	AND UTILITIES	No	Yes
47	COMMUNICATIONS	TRANSPORTATION, COMMUNICATION, AND UTILITIES	Yes	Yes
48	UTILITIES	TRANSPORTATION, COMMUNICATION, AND UTILITIES	Yes	Yes
49	MISC. TRANSP., COMMUNICATION, AND UTILITIES	TRANSPORTATION, COMMUNICATION, AND UTILITIES	Yes	Yes
50	CONDOMINIUMS / NON RESIDENTIAL USE	TRADE	Yes	Yes
51	WHOLESALE TRADE	TRADE	Yes	Yes
52	RETAILING - BLDG. MATERIALS, HARDWARE, AND FARM EQUIPMENT	TRADE	Yes	Yes
53	RETAILING - GENERAL MERCHANDISE	TRADE	Yes	Yes
54	RETAILING - FOOD GROCERY MEAT CUTTING	TRADE	Yes	Yes
55	RETAILING - AUTOMOTIVE, MARINE CRAFT, AIRCRAFT & ASSESSORIES. GAS STATIONS	TRADE	Yes	Yes
56	RETAILING - APPAREL & ACCESSORIES	TRADE	Yes	Yes
57	RETAILING - FURNITURE, HOME FURNISHINGS & EQUIPMENT	TRADE	Yes	Yes

Table 3 - Assessor's Database DOR Codes and Development Assumptions

Code	Land Use	Group	Developed?	Developable?
58	RETAILING - EATING & DRINKING RESTAURANTS	TRADE	Yes	Yes
59	OTHER RETAIL TRADE MINI MARTS	TRADE	Yes	Yes
61	FINANCE. INSURANCE. REAL ESTATE.	SERVICES	Yes	Yes
62	PERSONAL SERVICES	SERVICES	Yes	Yes
63	BUSINESS SERVICES	SERVICES	Yes	Yes
64	REPAIR SERVICES	SERVICES	Yes	Yes
65	PROFESSIONAL SERVICES FUNERAL HOMES, HOSPITALS	SERVICES	Yes	Yes
66	CONTRACT CONSTRUCTION SVCS	SERVICES	Yes	Yes
67	GOVERNMENTAL SERVICES	SERVICES	Yes	Yes
68	EDUCATIONAL SERVICES	SERVICES	Yes	Yes
69	MISCELLANEOUS SERVICES MINI-STORAGE	SERVICES	Yes	Yes
		CULTURAL, ENTERTAINMENT &		
71	CULTURAL ACTIVITIES	RECREATIONAL	Yes	Yes
74.4		CULTURAL, ENTERTAINMENT &	N.	
71.1	NATURE EXHIBITS	RECREATIONAL	Yes	Yes
		CULTURAL, ENTERTAINMENT &		
72	PUBLIC ASSEMBLY	RECREATIONAL	Yes	Yes
		CULTURAL. ENTERTAINMENT &		
73	AMUSEMENTS	RECREATIONAL	Yes	Yes
		CULTURAL. ENTERTAINMENT &		
74	RECREATIONAL ACTIVITIES	RECREATIONAL	Yes	Yes
		CULTURAL. ENTERTAINMENT &		
75	RESORTS & GROUP CAMPS, DUDE RANCH	RECREATIONAL	Yes	Yes
		CULTURAL ENTERTAINMENT &		
76	PARKS	RECREATIONAL	Yes	Yes
		CULTURAL ENTERTAINMENT &		
77	DNR WA. ST. DEPT. OF NATURAL RESOURCES	RECREATIONAL	No	No
		CULTURAL ENTERTAINMENT &		
78	NOT PRESENTLY ASSIGNED	RECREATIONAL	No	Yes
		CULTURAL ENTERTAINMENT &		
79	OTHER CULTURAL, ENTERTAINMENT, ACTIVITIES	RECREATIONAL	Yes	Yes
		CULTURAL ENTERTAINMENT &		
80	RESOURCE PRODUCTION & EXTRACTION	RECREATIONAL	No	Yes
	AGRICHTURE (NOT CLASSIFIED IN CURRENT USE	CULTURAL ENTERTAINMENT &		
81		RECREATIONAL	No	Yes
810	HOMESITE	AGRICULTURAL LAND USE CODES	Yes	Yes
811	OBCHARD LAND		No	Yes
812	IRRIGATED ALEALEA	AGRICULTURAL LAND USE CODES	No	Yes
813	DRYLAND ALFALFA	AGRICULTURAL LAND USE CODES	No	Yes
814	VINEYARDS / GRAPES	AGRICULTURAL LAND USE CODES	No	Yes
815	IRRIGATED PASTURE	AGRICULTURAL LAND USE CODES	No	Yes
816	GRAZING LAND	AGRICULTURAL LAND USE CODES	No	Yes
817	DRYLAND GRAIN	AGRICULTURAL LAND USE CODES	No	Yes
818	OTHER FARMING, GARLIC, BABIES BREATH, ROW CROPS, ETC.	AGRICULTURAL LAND USE CODES	No	Yes
819	UNIMPROVED. UNUSED LAND	AGRICULTURAL LAND USE CODES	No	Yes
		CULTURAL. ENTERTAINMENT &		
82	AGRICULTURE RELATED ACTIVITIES	RECREATIONAL	No	Yes
820	HOMESITE	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
821	FRUIT	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
822	REFRIGERATED STORAGE	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
823	C.A. FACILITY	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
824	AGRI CHEM FACILITY	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
825	C.A. SALES & REPAIR	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
826	NURSERIES	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
827	FRUIT STANDS	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
828	IRRIGATION SALES & SERVICE	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
829	TRUCK FARMS & SEEDS	RESOURCE PRODUCTION & EXTRACTION	Yes	Yes
	AGRICULTURE CLASSIFIED UNDER CURRENT USE	CULTURAL, ENTERTAINMENT &	NI -	¥
83	AGRICULTURE RCW 84.34	RECREATIONAL	NO	Yes

Table 3 - Assessor's Database DOR Codes and Development Assumptions

Code	Land Use	Group	Developed?	Developable?
830	HOMESITE	OPEN SPACE CUA LAND USE CODES	Yes	Yes
831	ORCHARD LAND	OPEN SPACE CUA LAND USE CODES	No	Yes
832	IRRIGATED ALFALFA	OPEN SPACE CUA LAND USE CODES	No	Yes
833	DRYLAND ALFALFA	OPEN SPACE CUA LAND USE CODES	No	Yes
834	VINEYARDS / GRAPES	OPEN SPACE CUA LAND USE CODES	No	Yes
835	IRRIGATED PASTURE	OPEN SPACE CUA LAND USE CODES	No	Yes
836	RANGE LAND	OPEN SPACE CUA LAND USE CODES	No	Yes
837	DRYLAND GRAIN	OPEN SPACE CUA LAND USE CODES	No	Yes
838	OTHER FARMING, GARLIC, BABIES BREATH, ROW CROPS, ETC.	OPEN SPACE CUA LAND USE CODES	No	Yes
839	UNIMPROVED, UNUSED LAND	OPEN SPACE CUA LAND USE CODES	No	Yes
84	FISHING ACTIVITIES & RELATED SERVICES	CULTURAL, ENTERTAINMENT &	No	Yes
85	MINING ACTIVITIES & RELATED SERVICES	RECREATIONAL	No	Yes
86	REFORESTATION UNDER RCW 84.28	CULTURAL, ENTERTAINMENT &	No	Yes
		RECREATIONAL	-	
87	NOT PRESENTLY ASSIGNED	CULTURAL, ENTERTAINMENT &	No	Yes
		RECREATIONAL	_	
88	DESIGNATED FOREST LAND UNDER RCW 84.33	CULTURAL, ENTERTAINMENT &	No	Yes
		RECREATIONAL	_	
89	OTHER RESOURCE PRODUCTION, PUD DAMLANDS	CULTURAL, ENTERTAINMENT &	No	No
	,	RECREATIONAL		
897A	PERPETUAL TIMBER	CULTURAL, ENTERTAINMENT &	No	No
		RECREATIONAL		
91	UNDEVELOPED LAND	UNDEVELOPED LAND	No	Yes
92	NON COMMERCIAL FOREST	UNDEVELOPED LAND	No	Yes
93	WATER AREAS	UNDEVELOPED LAND	No	No
94	OPEN SPACE PER RCW 84.34	UNDEVELOPED LAND	No	Yes
95	TIMBER LAND PER RCW 84.34	UNDEVELOPED LAND	No	Yes
96	NOT ASSIGNED	UNDEVELOPED LAND	No	Yes
97	P.P. ON REAL (TREES)	UNDEVELOPED LAND	No	Yes
98	PIT SITES	UNDEVELOPED LAND	No	Yes
99	OTHER UNDEVELOPED LAND	UNDEVELOPED LAND	No	Yes

Table 4 - Example IFR Database Interpretations of Multi-part DOR Codes in the Okanogan County Parcel Database

WRIA 48 Water Use Study Project No. 080180

Original DOR Code	Base Code	Aux Code(s) ¹	Homesite? ²	Auxiliary Residence? ³	Conservation Easement?	Interpreted Land Use	Developed?
11 CE	11		NO	NO	YES	Residential in conservation easement	YES
5564	55	64	NO	NO	NO	Automotive retail and repair services	YES
62 11	62	11	NO	YES	NO	Professional services with auxiliary residence	YES
81 01 5	81	1,5	YES	NO	NO	Ag land with orchard, irrigated pasture and homesite	YES
81 10	81	1	YES	NO	NO	Ag land with orchard and homesite	YES
816	81	6	NO	NO	NO	Ag land (Grazing)	NO
816CE	81	6	NO	NO	YES	Ag land (grazing) on a conservation easement	NO
83 26	83	2,6	NO	NO	NO	Open space Ag with irrigated alfalfa and range land	NO
94 11 CE	94	11	NO	YES	YES	Open space per RCW 84.34 with aux residence on a conservation easement	YES

Notes:

¹Codes following base codes other than 81, 82,83 and 91 (agriculture and open space) are assumed to be secondary codes that add to or modify the base codes. Aux codes following agriculture and open space codes describe characteristics of the land/land use.

² "Homesite" is used to flag agricultural and open space DOR codes (81, 82, 83 and 91) that have a zero after the base code. This zero implies that the parcel, while agricultural, has a homesite on it.

³ "Auxiliary residence" parcels are those parcels whose DOR code includes a residential DOR code after the base code.

Table 5 - Development Years from Building Permit Database by Subbasin WRIA 48 Water Use Study Project No. 080180

	REACH									
Year	Chewuch	Headwaters	Early Winters	Lower Methow	Middle Methow	Twisp River	Upper Methow	Total		
1975	1	6	0	4	0	1	2	14		
1976	5	2	0	11	6	0	3	27		
1977	1	2	0	13	1	6	1	24		
1978	3	2	0	13	6	4	7	35		
1979	1	3	0	10	6	3	3	26		
1980	3	3	0	10	9	1	6	32		
1981	3	1	0	6	6	2	4	22		
1982	2	1	0	12	6	3	6	30		
1983	6	2	0	14	9	2	1	34		
1984	6	2	0	10	12	1	5	36		
1985	11	2	0	15	8	4	11	51		
1986	5	4	0	13	10	1	8	41		
1987	4	2	0	10	3	3	6	28		
1988	3	0	0	9	4	5	10	31		
1989	3	2	0	16	3	7	12	43		
1990	5	3	0	19	12	2	12	53		
1991	16	5	0	17	10	6	18	72		
1992	15	3	0	19	15	5	15	72		
1993	6	5	0	20	14	12	11	68		
1994	6	11	0	11	12	3	22	65		
1995	8	9	0	16	15	6	19	73		
1996	13	7	0	17	14	6	18	75		
1997	11	9	0	14	9	5	17	65		
1998	7	10	0	11	8	7	15	58		
1999	13	14	0	15	10	6	31	89		
2000	10	14	0	11	16	6	27	84		
2001	9	13	0	16	16	7	31	92		
2002	5	10	0	20	6	9	14	64		
2003	8	9	0	16	14	4	30	81		
2004	21	13	0	16	10	1	29	90		
2005	7	26	0	32	16	6	38	125		
2006	11	15	0	23	15	7	26	97		
2007	6	16	0	38	11	3	27	101		
2008	7	12	0	25	18	8	19	89		
2009	4	11	0	19	6	7	12	59		
2010	6	9	0	14	8	4	23	64		
No Date	11	12	0	18	6	10	13	70		
Total	262	270	0	573	350	173	552	2180		

Table 6 - Okanogan County Zoning Codes in Methow Basin WRIA 48 Water Use Study Project No. 080180

County Code Chapter	Zone Name	Zone Code	Minimum Lot Size	Allows Primary Residence?	Allows ADU?	Total Acres in Basin	Developable Acres in Basin	Percentage of Total Developable Acreage
17.05	MINIMUM REQUIREMENT DISTRICT	MD	1 acre	Yes	No	245,173	27,235	26.39%
17.07	AGRICULTURE DISTRICT	AD	20 acres	Yes	No	67	66	0.06%
17.10	COMMERCIAL DISTRICT	С	5000 sqft	No	Yes	17	12	0.01%
17.11	INDUSTRIAL DISTRICT	I	10000 sqft	No	No	7	7	0.01%
17.12	AIRPORT DEVELOPMENT DISTRICT	AP	10000 sqft	No	No	177	66	0.06%
17.14A	RURAL RESIDENTIAL DISTRICT	RR	5 acres	Yes	Yes	17,486	10,686	10.35%
17.14B	LOW DENSITY RESIDENTIAL DISTRICT	LDRD	20 acres	Yes	Yes	4,610	2,670	2.59%
17.14	METHOW REVIEW DISTRICT 12,500	MRD 12,500	12500 sqft	Yes	Yes	28	14	0.01%
17.14	METHOW REVIEW DISTRICT 1	MRD 1	1 acre	Yes	Yes	602	561	0.54%
17.14	METHOW REVIEW DISTRICT 5 (VALLEY FLOOR)	MRD 5	5 acres	Yes	Yes	27,488	18,902	18.31%
17.14	METHOW REVIEW DISTRICT 20 (UPLANDS)	MRD 20	20 acres	Yes	Yes	867,713	42,943	41.61%
17.15	URBAN RESIDENTIAL DISTRICT	UR	5000 sqft	Yes	No	32	15	0.01%
17.16	NEIGHBORHOOD USE DISTRICT	NU	5000 sqft	Yes	No	14	11	0.01%
17.17	SPECIAL REVIEW COMMERCIAL	SRC	5000 sqft	No	Yes	38	18	0.02%

Table 7 - Estimated Existing Exempt Well Parcels Subject to the Instream Flow Rule

WRIA 48 Water Use Study Project No. 080180

Reach	Exempt Well Parcels with Known Post-Rule Development Date	Exempt Well Parcels with Unknown Development Date	Estimated Percent Developed After 1976	Total Estimate of Developed Exempt Well Parcels
Headwaters	137	111	75%	220
Early Winters	0	0	75%	0
Upper Methow	271	261	75%	467
Chewuch	213	270	75%	415
Middle Methow	220	248	75%	406
Twisp River	122	188	75%	263
Lower Methow	380	772	75%	959
TOTAL	1343	1850		2730

Notes:

Does not account for permit-exempt stock watering wells on otherwise undeveloped parcels.

Table 8 - Estimated Exempt Well Parcels Subject to the Instream Flow Rule at Full Buildout

WRIA 48 Water Use Study Project No. 080180

Reach	Total Exempt Well Parcels at Full Buildout ¹	Exempt Well Parcels not in Public Water System Service Areas or Conservation Easements at Full Buildout	Current Buildout Residences Agreed to in Conservation Easements ²	Estimated Self-Supplied Parcels in Public Water System Service Areas ³
Headwaters	953	739	48	166
Early Winters	4	1	3	0
Upper Methow	1948	1811	25	112
Chewuch	1291	1162	30	99
Middle Methow	1618	1280	34	304
Twisp River	678	644	31	3
Lower Methow	26133	25834	10	289
TOTAL	32625	31471	181	973

Notes:

¹ Assumes existing zoning applies.

² Only existing conservation easements were addressed as the number and nature of future easements was not predicted.

³ Self-supplied parcels within water system service area boundaries address conditions when the number of parcels in a service area exceed the number of connections currently approved by WDOH. This conservatively assumes that water systems will not expand their number of approved connections leaving the balance to be self-supplied.

Table 9 - Estimated Exempt Well Parcels Subject to the Instream Flow Rule at Buildout with Current Parcel Size (Reduced Buildout)

WRIA 48 Water Use Study Project No. 080180

Reach	Total Exempt Parcels at Reduced Buildout (no parcel subdivision) ¹	Exempt Well Parcels not in Public Water System Service Areas or Conservation Easements at Reduced Buildout	Current Buildout Residences Agreed to in Conservation Easements ²	Estimated Self-Supplied Parcels in Public Water System Service Areas ³
Headwaters	697	483	48	166
Early Winters	4	1	3	0
Upper Methow	1069	932	25	112
Chewuch	937	808	30	99
Middle Methow	1131	793	34	304
Twisp River	512	478	31	3
Lower Methow	2913	2614	10	289
TOTAL	7263	6109	181	973

Notes:

¹ Assumes existing zoning applies.

² Only existing conservation easements were addressed as the number and nature of future easements was not predicted.

³ Self-supplied parcels within water system service area boundaries address conditions when the number of parcels in a service area exceed the number of connections currently approved by WDOH. This conservatively assumes that water systems will not expand their number of approved connections leaving the balance to be self-supplied.

Table 10 - Estimated Exempt Well Parcels Subject to the Instream Flow Rule at Full Buildout - Assuming No Additional Development within Closed Basins

WRIA 48 Water Use Study Project No. 080180

Reach	Total Exempt Wells at Buildout ¹	Exempt Well Parcels not in Public Water Service Areas or Conservation Easements at Buildout	Current Buildout Residences Agreed to in Conservation Easements ²	Estimated Self-Supplied Parcels in Public Water System Service Areas ³
Headwaters	953	739	48	166
Early Winters	4	1	3	0
Upper Methow	1887	1766	25	96
Chewuch	1290	1161	30	99
Middle Methow	1300	992	34	274
Twisp River	678	644	31	3
Lower Methow	16912	16622	10	280
TOTAL	23024	21925	181	918

Notes:

¹ Assumes existing zoning applies.

¹ Only existing conservation easements were addressed as the number and nature of future easements was not predicted.

² Self-supplied parcels within water system service area boundaries address conditions when the number of parcels in a service area exceed the number of connections currently approved by WDOH. This conservatively assumes that water systems will not expand their number of approved connections leaving the balance to be self-supplied.

Table 11 - IFR Database-Identified Residential Water System Connections versus SENTRY Database Information

Reach	IFR Database- Identified Residential Parcels Served by Group A Systems	Group A Residential Connections from SENTRY Database	Database-Identified Residential Parcels Served by Non- Exempt Group B Systems	Group B (with >6 Connections) Residential Connections from SENTRY Database	Group A Database Over/Under- Estimate	Group B Database Over/Under- Estimate	Residential Connections from Group A Systems without Service Area Delineations	Residential Connections from Group B Systems (with >6 Connections) without Service Area Delineations
Headwaters	145	110	23	76	35	-53	4	42
Early Winters	0	0	0	0	0	0	0	0
Upper Methow	231	216	14	31	15	-17	2	18
Chewuch	97	79	4	9	18	-5	4	0
Middle Methow	309	244	0	0	65	0	1	0
Twisp River	156	171	0	17	-15	-17	0	17
Lower Methow	508	584	6	14	-76	-8	20	7
Total	1446	1404	47	147	42	-100	31	84

Table 12 - IFR Database-Estimated Exempt Wells Subject to the Instream Flow Rule versus Well Logs and Water Rights

WRIA 48 Water Use Study Project No. 080180

					Domestic ⁺ Grou	undwater Right	s		
Reach	Total Estimated Exempt Wells from IFR Database	W Rec E D	Vell Logs cords from Ecology Jatabase	Certificate Issued	Permits	Claims	Total Domestic Groundwater Water Rights	Well Logs Minus Domestic Groundwater Rights	Difference between IFR database estimate of exempt wells vs. well logs- minus-water rights
Headwaters	220		304	9	4	35	48	256	-36
Early Winters	0		14	0	0	1	1	13	-13
Upper Methow	467		562	10	3	74	87	475	-8
Chewuch	415		431	12	2	76	90	341	74
Middle Methow	406		432	13	1	75	89	343	63
Twisp River	263		252	13	1	41	55	197	66
Lower Methow	959		1169	57	3	243	303	866	93
Total	2730		3164	114	14	545	673	2491	239

Notes:

¹ From Washington Ecology WRTS Database. Domestic water rights are those with a purpose field containing "DS" (domestic single), "DM" (domestic multiple), or "DG" (domestic general)







	MAY-2011	BY: PPW	FIGURE NO.
CONSULTING	PROJECT NO. 080180	REV BY:	1







	MAY-2011	BY: PPW	FIGURE NO.
CONSULTING	PROJECT NO. 080180	REV BY:	2



10/201



Aspect	MAY-2011	BY: PPW	FIGURE NO.
CONSULTING	PROJECT NO. 080180	REV BY:	3

APPENDIX A

Stream Management Reach Boundary Delineation Memorandum



MEMORANDUM

Project No.: 080180

February 17, 2011

To:	Greg Knott, Chair - Methow Watersh	ned Council
cc:	Greg Schuler, Watershed Lead - Was	shington State Department of Ecology
	Hydrogeologist 2736 William M. Sullivan 2//7=/11	Ale of Washing Ale of Washing
From:	William M. Sullivan, LHG	Timothy J. Flynn, LHG, CGWP
	Project Hydrogeologist	Principal Hydrogeologist
Re:	Stream Management Reach Bound	ary Delineation – WRIA 48, Washington

Background and Objective

This memorandum presents the methodology for delineation of stream management unit boundaries in the Methow River watershed, as established by the 1976 Methow Instream Flow Rule (Chapter 173-548, Washington Administrative Code [WAC]), codified in December 1976. The Instream Flow Rule (Rule) established base flows for seven stream management units (stream management reaches). The Rule also established a reservation of 2 cubic feet per second (cfs) of water in each stream management reach for future single domestic and stock water uses.

The Methow Watershed Management Plan (WMP), approved by the Okanogan County Commissioners in June 2005, recommended several modifications to the Rule to make water under the 2 cfs reach reservations available to beneficial uses in addition to the single domestic and stock water allowed in the Rule. Recommended Rule revisions also included developing mechanisms to allow transfer between individual reaches of unallocated portions of the 2-cfs reservation under certain conditions. The Detailed Implementation Plan (DIP), adopted by the Methow Watershed Council (MWC) in October 2009, identified the proposed Rule changes as the highest priority action for implementation.

To support the Rule revision process, it is necessary to estimate for each stream management reach how much of the 2-cfs reserve has been utilized by single domestic and stock water uses since adoption of the Rule in 1976, how much remains for future uses, and what quantity is required to meet future needs assuming build-out of undeveloped parcels under the current zoning. To support this effort, a water tracking database is being developed to estimate within each reach the number of parcels that are currently served by exempt permit wells covered under the reservation and the number of parcels that could potentially utilize the reservation in the future under full build-out assumptions.

The existing delineation of stream management reach boundaries has not been adequately defined to accurately identify parcels within each reach. The objective of the effort documented in this memorandum is to more precisely define boundaries of subbasins that comprise the seven stream management reaches established in the Rule. The boundary delineation is intended to observe the properties of stream management reaches as stated in the Rule (see Table 1 below). The boundary delineation is based on the highest-fidelity data available across the entire watershed, and utilizes prior delineation efforts where feasible and sufficiently accurate. The intent is to develop a methodology that is documented and repeatable, and provides reach boundary delineations in an electronic, geospatial format to support the watershed analysis.

Stream Management Unit Name	Control Station	River Mile	TRS	Affected Stream Reach (includes tributaries)
Lower Methow	Methow R. nr. Pateros (12.4499.50)	6.7	T30N R23E - 20	Methow River confluence with Wells Pool to confluence with Twisp River
Middle Methow	Methow R. nr. Twisp (12.4495.00)	40.0	T33N R22E - 17	Methow River from Twisp River to confluence with Chewuch River
Upper Methow	Methow R. nr. Winthrop (12.4473.89)	50.2	T34N R21E - 2	Methow River from confluence with Chewuch River to confluence with Little Boulder Creek and including Little Boulder Creek
Methow Headwaters	Methow R. at Little Boulder Cr. (12.4473.83)	65.3	T36N R19E - 25	Methow River from confluence with Little Boulder Creek to headwaters
Early Winters Creek	Early Winters Cr. near Mazama		T36N R19E - 27	Early Winters Creek from confluence with Methow River to Headwaters
Chewuch River	Chewuch R. nr. Boulder Creek (12.4475.00)	8.7	T36N R21E - 35	Chewuch River confluence with Methow River to headwaters
Twisp River	Twisp R. nr. Twisp (12.4489.98)	0.3	T33N R22E - 7	Twisp River from confluence with Methow River to headwaters

Table 1 Stream	Managamont	Init Information	Chapter 172-5/9	W/AC
	wanayement	Juit mormation,	Chapter 175-540	WAG

Previous Work

Demarcation of the seven management reaches in the supporting documentation for the Rue is inadequate to support a parcel-scale evaluation of current and future allocation of the reservations. The stream management reaches established in the Rule (Table 1) are presented in Department of Ecology River Basin Program Series Publication No. 4 (Kauffman and Bucknell, 1976) that contains a map showing generalized subbasin boundaries. The map is too coarse-scaled to support watershed planning objectives and was drafted before the use of GIS systems. Three loosely-compiled GIS boundary delineations have been completed within the past 10 years. The first was during the watershed planning *Phase II- Level I Watershed Technical Assessment* (Golder Associates, 2002), and a second was made by Highland Associates in 2008. Both sets of delineations were of coarse scale (and therefore not entirely consistent with topographic features), and are not available in electronic format.

A third subbasin delineation dataset (GIS shapefile), developed in 2005, was provided to Aspect by Washington State Department of Ecology (Ecology). The source of this data was not well documented and Ecology staff confirmed it did not represent an official delineation of the subbasins established in the Rule. In fact, it was very similar to the other two datasets and is not entirely consistent with the stream management reaches described in Table 1. Therefore, it was determined by the MWC that a more precise, accurate, and citable dataset would be required to support the Rule revision and analysis on existing and future allocation of the 2-cfs reservation.

Reach Boundary Delineation Methodology

In the absence of more site-specific hydrogeologic information, topographic divides (e.g., ridges) are assumed to represent both surface water and groundwater divides between drainages. This simplifying assumption is the basis for the reach boundary delineation methodology as it allows drainages to be delineated using only topographic data. Specific exceptions to this assumption are described below.

Since very high-resolution elevation data (such as LiDAR) is not available for the entire Methow River watershed (see Figure 1), the next most precise source for topographic subbasin delineations are 10-meter pixel digital elevation models (DEM), based on 1:24,000 USGS topographic maps. This 10-meter data is commonly available and can be acquired from many public sources. It is also of a sufficient resolution to delineate reach boundaries with reasonable accuracy. It also has advantages over LiDAR, as 10-meter DEM datasets are much smaller and more manageable and illuminate the intermediate-scale drainage features that are most likely to form watershed boundaries.

Watershed Boundary Dataset

Drainage delineations based on the 10-meter DEM data already exist for the Methow River watershed. The National Resource Conservation Service (NRCS) developed the Watershed Boundary Dataset (WBD) GIS coverage for the Methow River watershed. The WBD is a national dataset developed delineating surface water drainages. The NRCS describes the WBD as follows:

"Watershed boundaries define the aerial extent of surface water drainage to a point. The intent of defining hydrologic units (HU) for the Watershed Boundary Dataset is to establish a baseline drainage boundary framework, accounting for all land and surface areas. The selection and delineation of hydrologic boundaries are determined solely upon science-based hydrologic principles, not favoring any administrative or special projects nor particular program or agency. At a minimum, they are being delineated and georeferenced to the USGS 1:24,000 scale topographic base map meeting National Map Accuracy Standards (NMAS)."

The WBD is organized into drainages of hierarchical order (Table 2). These ordered levels, or "hydrologic units" (HU), are numbered up to the 12th-digit, which is the most detailed delineation available in the WBD. Within the WBD, the entire Methow River drainage is classified as a "subbasin", or 8th-digit HU.

February 17, 2011

Project No. 080180

Name	Digit	Example
Subbasin	8	Methow River
Watershed	10	Twisp River
Subwatershed	12	Eagle Creek

Table 2 – Hierarchy of WBD Hydrologic Units

The WBD's Methow River 8th-digit HU (subbasin) is comprised of seven 10th-digit HUs (watersheds), which in turn are comprised of 51, 12th-digit HUs (subwatersheds). Though coincidentally matching in number (seven), the 10th-digit HUs are not consistent with the seven reaches defined by the Rule. By definition, each HU is delineated to a single outlet point. In the case of the 10th-digit HUs from the WBD, these outlet points are not the same locations as the control stations referenced in the Rule, as would be required for the two HUs and stream management reaches to match.

Starting from the 51 constituent 12th-digit HUs, it is possible to group them such that they reasonably match the reaches in Table 1. This approach yields delineations for four of the seven reaches (Lower Methow River Reach [Figure 2], Twisp River Reach [Figures 3 and 4], Middle Methow River Reach [Figures 3 and 4], and Chewuch River Reach [Figure 5]) that are based on the high-quality WBD delineations and require no further modification (Table 3).

Reach	10th-Digit HU	12th-Digit HU	Reach	10th-Digit HU	12th-Digit HU
		Boulder Creek Early Winters	Linner Methous Diver	Cedar Creek	
		Cub Creek	Creek	upper wietnow River	Early Winters Creek
		Doe Creek-Chewuch River			Alta Coulee-Methow River
	Lower Chewuch	Eight Mile Creek			Black Canyon Creek
	River	Falls Creek			French Creek
		North Fork Boulder Creek			Gold Creek
Chowyooh Biyor		Pearrygin Creek-Chewuch River		Lower Methow River	Libby Creek
Chewach River		Twenty Mile Creek			McFarland Creek-Methow River
		Andrews Creek	Lower Methow		South Fork Gold Creek
	Upper Chewuch River	Headwaters Chewuch River	River		Squaw Creek
		Kay Creek-Chewuch River			Texas Creek-Methow River
		Lake Creek			Alder Creek-Methow River
		Thirtymile Creek-Chewuch River		Middle Methow	Benson Creek
		Windy Creek			Lower Beaver Creek
		Buttermilk Creek		River	South Fork Beaver Creek
		Eagle Creek			Upper Beaver Creek
		Headwaters Twisp River			-
		Little Bridge Creek			
Twisp River	Twisp River	Lower Twisp River			
		Middle Twisp River			
		South Creek			
		Upper Twisp River			
		War Creek			

Table 3 – Stream	Management Reaches	Delineated based on WB	3D 12 th Digit Hl	J without Modification
------------------	--------------------	------------------------	------------------------------	------------------------

The three remaining reaches (Headwaters, Upper Methow, and Middle Methow) are nearly approximated by grouping the remaining 12th-digit HUs, except that the Fawn Creek and Thompson Creek 12th-digit HUs straddle the control stations between the Headwaters and Upper Methow River reaches and the Upper Methow River and Middle Methow River reaches, respectively (Table 4). The

WBD-based delineations for these reaches were modified so that the reach delineations correspond to the control stations specified in the Rule. Additional modifications were made to the boundary between the Headwaters and Upper Methow River reaches to incorporate detailed site-specific hydrogeologic information in the Twin Lakes area. These modifications are discussed in the following section.

Reach	10th-Digit HU	12th-Digit HU	
		Diamond Creek	
	Lost River	Eureka Creek	
		Lower Lost River	
Headwaters		Upper Lost River	
		Rattlesnake Creek-Methow River	
	Upper Methow River	Robinson Creek	
		West Fork Methow River	
Headwaters/Upper Methow River	Middle Methow River	Fawn Creek-Methow River	
Unner Methew Diver	Middle Methow River	Goat Creek	
opper methow River	Middle Methow River	Wolf Creek	
Upper Methow River/Middle Methow River	Middle Methow River	Thompson Creek-Methow River	
Middle Methow River	Middle Methow River	Bear Creek	

Table 4 – Stream Management Reaches Delineated based on WBD	0 12 th Digit HU requiring Modification
---	--

Modifications to the NRCS Watershed Boundary Dataset

Modifications to the WBD delineation was necessary at two locations on the Methow River to match existing control stations established in the Rule (Tables 1 and 4) at two locations on the Methow River. These locations include: 1) at the mouth of the Chewuch River in Winthrop (WBD 12th-digit HU Thompson Creek-Methow River); and 2) at the mouth of Little Boulder Creek in Mazama (WBD 12th-digit HU Fawn Creek-Methow River). Utilizing the established control stations in the Rule is important to preserve historical stream flow data and avoid the need to establish new gauge locations.

In the case of the Headwaters and Upper Methow reaches (Mazama area), if the WBD delineations were used, the Looney Creek and Thiese Creek drainages would fall into the Middle Methow reach (Figure 7). However, to be consistent with the control station established in the Rule, these drainages were included in the Upper Methow reach. Aspect performed a GIS-based basin delineation, using the 10-meter DEM as input, for surface waters draining to an outlet point at the confluence of Little Boulder Creek and the Methow River (but not including Little Boulder Creek).

A boundary was delineated to an outlet point at the control station at the mouth of Little Boulder Creek along the topographic divide to the north until it intersected the existing WBD boundary. The same methodology was used to connect the outlet point/control station with the WBD boundary to the south, except in the valley bottom where topography is too flat to definitively delineate February 17, 2011

topographic divides. To address this, a straight line method was used. A straight line was drawn across the valley floor extending from the control station to the nearest distinguishable topographic feature on the south valley wall, while accounting for the influence of known watercourses which drain from the northwest to Little Boulder Creek.

A second modification to the WBD delineations was required in the Winthrop/Twin Lakes area (Figure 6). The control station established in the Rule that separates the Upper and Middle Methow River reaches corresponds with the confluence of the Chewuch and Methow Rivers. In the WBD, the Thompson Creek-Methow River HU spans this control point. Again, a GIS-based 10-meter DEM delineation was performed to identify the area in the Thompson Creek-Methow River HU that drained to an outlet point at the confluence of the Chewuch River and the Methow River. This area, topographically, is included in the Upper Methow River reach.

The boundary between the Upper Methow River and Middle Methow River reaches were further modified to account for site-specific hydrogeologic conditions in the Twin Lakes area. Hydrogeologic studies conducted by Aspect for Ecology and the Twin Lakes Aquifer Coalition (Aspect, 2009) indicate a groundwater divide in the vicinity of Twin Lakes that does not correspond to the topography-based surface water divide. The known groundwater divide was given precedence over the surface water divide, as it more accurately delineates which reach would be affected by groundwater withdrawal on each side of the divide.

Limitations

Hydrologic drainages in the Methow River are subject to manmade and other influences (such as ditches, canals, diversions, groundwater flow, overbank flow, etc.) that when more fully understood, may necessitate adjustment to reach boundaries as additional information becomes available.

Work for this project was performed and this memorandum prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

Future Refinement

At such a time as higher-resolution elevation data (such as LiDAR) is available for the entire Methow River watershed, refined topographic drainage delineations will be possible. However, these delineations will be subject to the same non-topographic uncertainties and necessary modifications mentioned above. The progress of data stewards such as NRCS and ever-improving datasets such as the WBD should be monitored as data sources for future reach boundary refinement.

References

Aspect Consulting, LLC (Aspect), 2009, Hydrogeologic Evaluation Report Water Right Application G4-34915, Twin Lakes Aquifer Coalition, Cost Reimbursement Project, prepared for Washington State Department of Ecology. Bainbridge Island, Washington. Unpublished Work. December 29, 2009.

Golder Associates, Inc., 2002, Phase II-Level 1 Watershed Technical Assessment for the Methow River Basin, Final Draft. June 26, 2002.

Highlands Associates, 2008, Reserve Use Since 1976, Final Report.

Kauffman, K.G. and Bucknell, J.R., 1976, Water Resources Management Program Report of the Methow River Basin. Washington Department of Ecology River Basin Program Series Publication No. 4, December 1976.

Attachments

- Figure 1 Methow Instream Flow Rule Revision Reach Boundary Delineations
- Figure 2 WRIA 48 Reach Boundaries: Pateros/Alta Lake Area

Figure 3 – WRIA 48 Reach Boundaries: Twisp Area

Figure 4 – WRIA 48 Reach Boundaries: Twisp Detail

Figure 5 – WRIA 48 Reach Boundaries: Winthrop Area

Figure 6 - WRIA 48 Reach Boundaries: Winthrop Detail

Figure 7 – WRIA 48 Reach Boundaries: Mazama Area

W:\080180 WRIA 48\Deliverables\Reach Boundary Memo\Memo 2-17-2011.doc



NAD 1983 State GIS Path: T:\projects_8\WRIA48\MWC\Delivered\Rea



Methow Instream Flow Rule Revision Reach Boundary Delineations

Aspect	FEB-2011	BY: PPW	FIGURE NO.	
	PROJECT NO. 080180	REV BY:	1	













