This document shows OWRD's comments and our responses to those comments. Most comments were addressed though there were a couple we chose not to address. For those comments not addressed, we explain our reasoning.

In addition to the OWRD's comments on this document, missing information was also highlighted as well as some inaccuracies that needed correcting. We addressed these overarching themes as well, which includes:

- Pages 11-15: Added a section on the economic, social, and cultural significance of surface water.
- Page 15, 18-19: Corrected sections related to water management and regulation which contained some outdated or inaccurate information.
- OWRD suggested that we utilize the SWARS database in this report to consider how surface water is managed. We feel that this is covered well in the Rivers and Streams Step 2 and 3 reports and don't want to be redundant. During the writing of the Surface Water Plan, we will make sure to mention and consider SWARS when writing about surface water management.
- OWRD suggested that we add a narrative on the expected impact of climate change and land use on future water use supplies in the Step 2 report. We feel such a narrative is more appropriate for Step 3 and have added it in that report.

Step 2 -Surface Water Appropriation and Management

Surface Water Appropriation

Surface water has generally been fully allocated for many decades for most of the Malheur-Harney Lake drainages. The Oregon Water Code was enacted in 1909, providing an exclusive centralized method for issuing new water rights and for determining existing ones. The most recent information compiled for surface water allocation was compiled by OWRD staff in a technical assistance report "Summary Memo of Water Rights within the Harney Place-Based Planning Area".

Surface water allocation for agricultural irrigation accounts for a significant use of surface water. Table 1 is from the OWRD data on the distribution of water

rights and estimated irrigation area by subbasin.

Table 1: Water Rights and Irrigated Acreage approved by Subbasin (from LovellFord and Mertz, undated)

Subbasin	Water Rights Approved (ac-ft)	Acreage Irrigated (acres)
Donner und Blitzen	10,894	7,586
Harney-Malheur Lakes	92,382	38,977
Silver Creek	39,285	27,589
Silvies River	89,051	42,336
Total	**231,612**	**116,488**

Most water rights have been adjudicated by court decree (Table 2; Figure 1).

Table 2: Adjudication Decrees in the Harney Basin (from LovellFord and Mertz, undated)

Subbasin (HUC-8)	Decree Name	SW Volume

Silvies (17120002)	Silvies River	74,800
Harney-Malheur Lakes (17120001)	Silvies River 1926	15,549
Harney-Malheur Lakes (17120001)	Cow Creek (Harney)	3,335
Harney-Malheur Lakes (17120001)	Rattlesnake Creek	2,077
Harney-Malheur Lakes (17120001)	Mill & Coffee Pot Creeks	4,051
Harney-Malheur Lakes (17120001)	Rock Creek (Harney)	3,182
Donner und Blitzen (17120003)	Donner und Blitzen River	7,860
Harney-Malheur Lakes (17120001)	Prather Creek	243
Harney-Malheur Lakes (17120001)	Riddle Creek	4,381

In total, there were 127,213 acre-feet of irrigation water rights issued under decrees within the study area. There still remain 20,310 acre-feet of irrigation water in the form of a claim, or unadjudicated registrations of use of water within the Harney-Malheur Lakes and Silver subbasins (Table 3). Some 104,399 acre feet /year includes non-irrigation permitted uses, unadjudicated rights (Table 3) and permits issued since adjudication.

Table 3:Total Volume of Unadjudicated irrigation water rights from WRIS (from LovellFord and Mertz, undated)

Subbasin HUC-8	**Acre-Feet**
Harney-Malheur Lakes	17,528
Silver	2,782

Irrigation water use from the Silvies River, and tributaries is concentrated in the Harney Valley, Silvies Valley, and Bear Valley. The use areas are separated by canyon reaches of the Silvies River. Irrigation diversions from Silver Creek are dominantly from the area around and above Riley. Further irrigation rights to the Double O area of the Malheur Refuge are dominated by rights held by USFWS for the Malheur Refuge. The tributary streams that don't usually get to Malheur Lake including Rattlesnake Creek, Cow Creek, Mill Creek, Coffee Pot Creek, Rock Creek, Prather Creek, and Riddle Creek have all been adjudicated (Figure 1). Donner und Blitzen River is dominated by water use by USFWS on the Malheur National Wildlife Refuge. It should be noted that Sage Hen Creek and Poison Creek were treated as tributaries to the Silvies River in the adjudication of Silvies River.

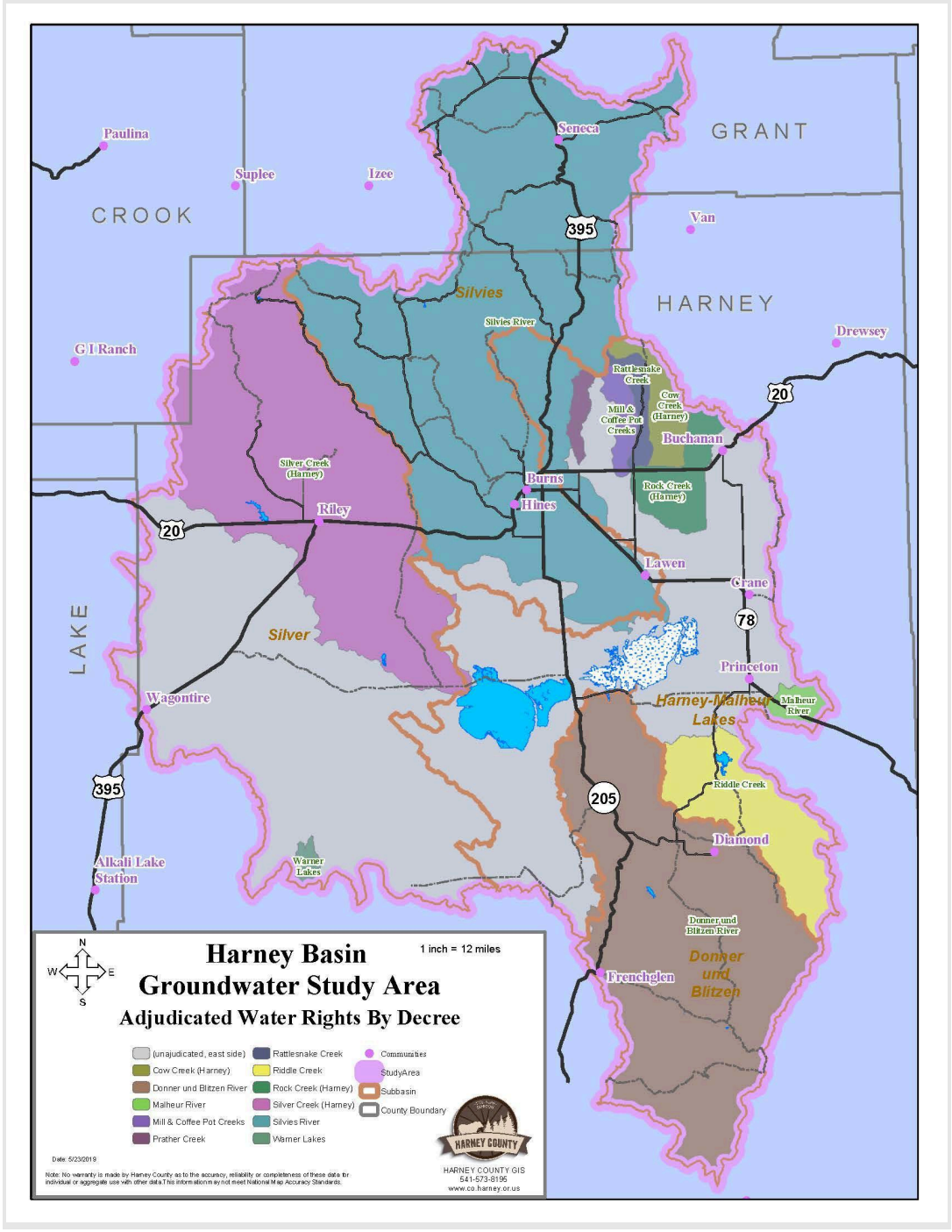


Figure 1: Adjudicated Water Rights by Decree (from LovellFord and Mertz, undated)

Water Availability and Timing in the Harney Basin

The unpredictable nature of surface water in the Harney Basin makes water management difficult. Management during years of heavy snowpack and rapid runoff is very different from managing during years of limited precipitation and early drought. The variability of runoff is also different among the tributary subbasins. The Blitzen River catchment is more groundwater driven and, while responsive to precipitation, has more predictable base flows (Figure 2 and 3).

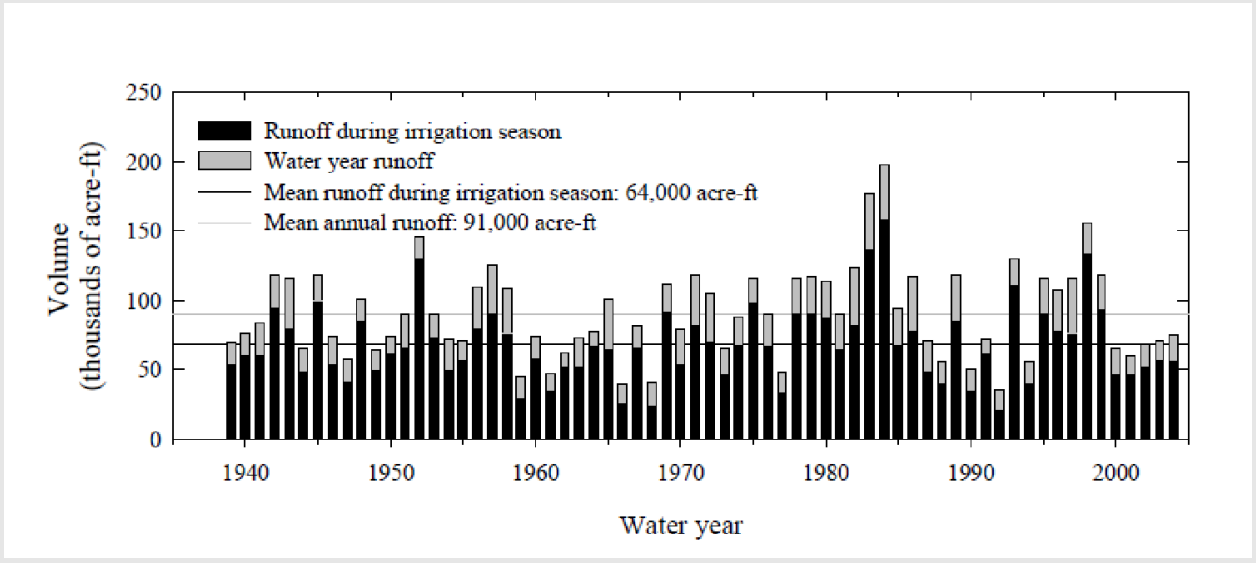
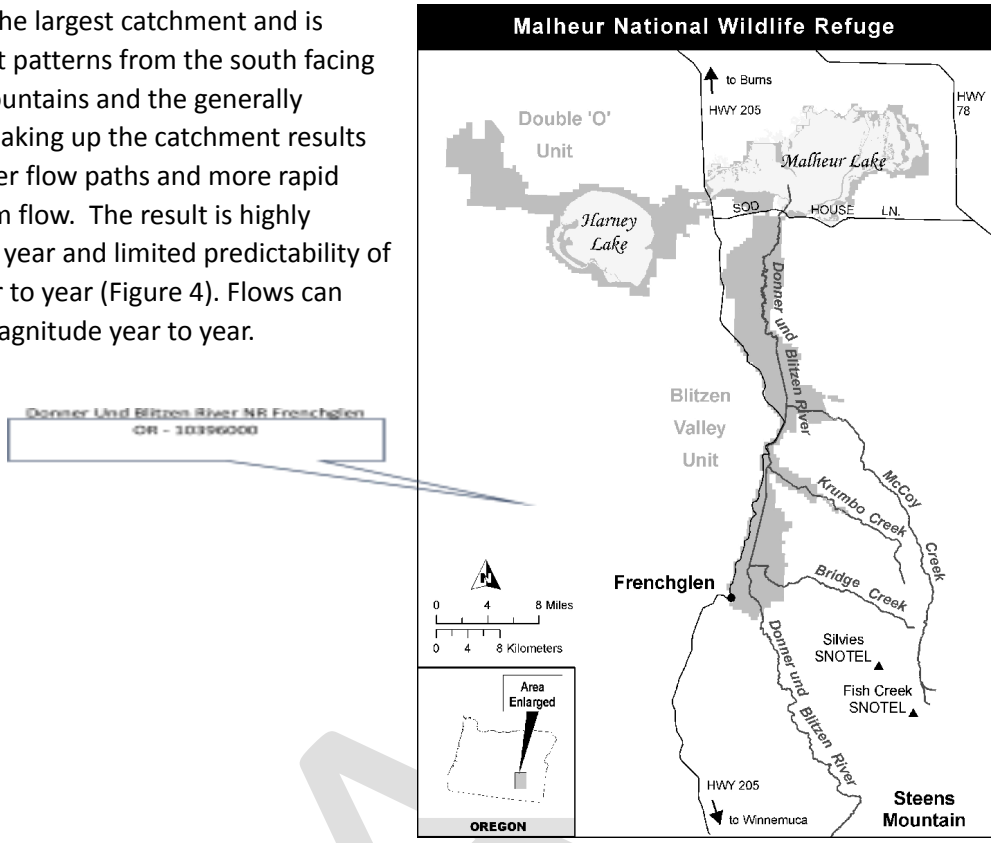


Figure 2: Blitzen River Runoff (from Mayer et al. undated)

The Silvies River has the largest catchment and is affected by snow melt patterns from the south facing slopes of the Blue Mountains and the generally impermeable rocks making up the catchment results in shorter groundwater flow paths and more rapid contribution to stream flow. The result is highly variable flows year to year and limited predictability of water availability year to year (Figure 4). Flows can vary over orders of magnitude year to year.



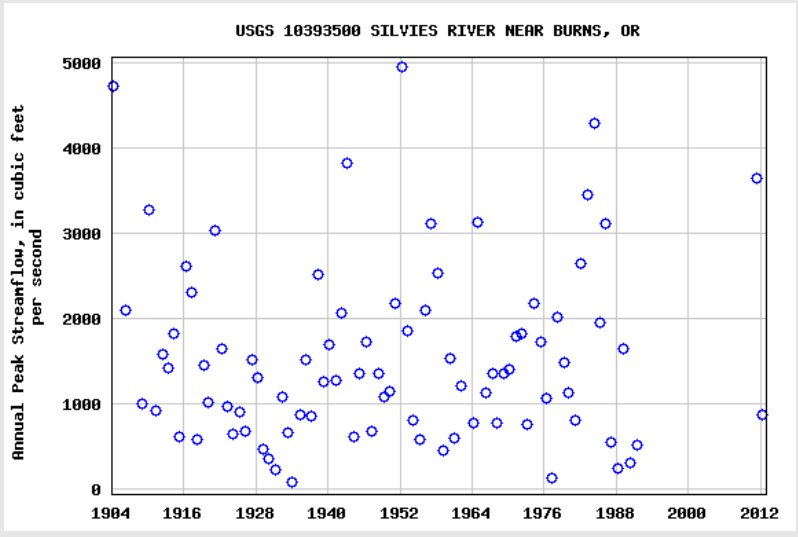


Figure 4:Silvies River Flow Variability (USGS data)

Silver Creek is similar to the Silvies but a significantly smaller catchment that accumulates less snowpack. Annual precipitation in the Silver Creek watershed ranges from 9.09 to 29.13 inches with an average of 11.51 inches. The highly variable runoff from the Silver Creek watershed, similar to the Silvies River creates a difficult water management situation. Springs in the lower Silver Creek catchment that align with the Brothers fault are important for water for the Malheur National Wildlife Refuge.

Timing of Peak Flows

The hydrograph showing the average timing of runoff that compares the Silvies River with the Donner und Blitzen River shows an earlier and higher peak from the Silvies River catchment and a lower but more prolonged peak for the Donner und Blitzen River (Figure 5).

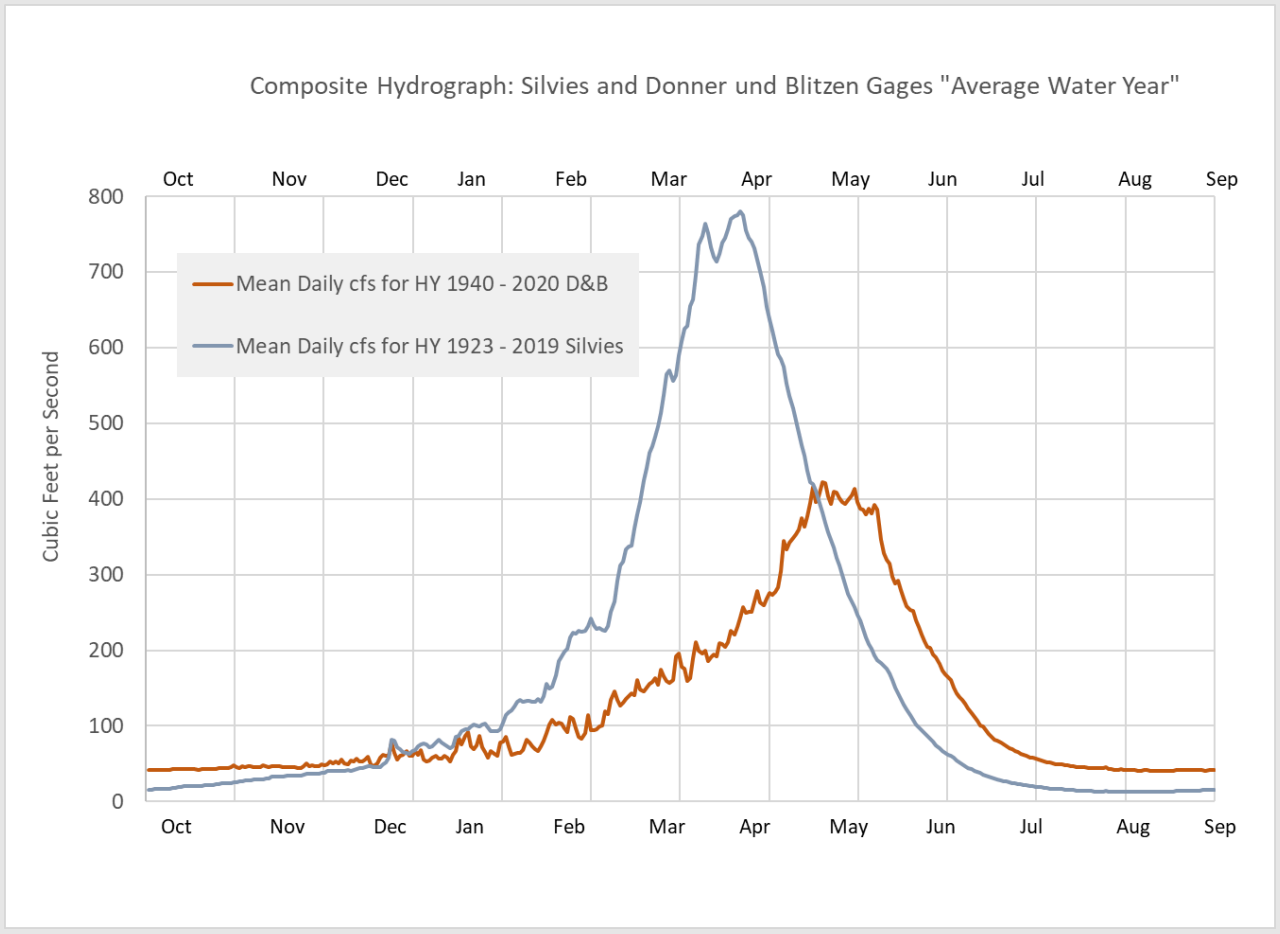


Figure 5: Comparative Average Hydrograph Silvies River and Donner und Blitzen River (from Svejcar 2022)

As climate changes the timing of runoff has changed. Runoff has come nearly a month earlier in the Silvies River (Figure 6) from the previous 50 years.

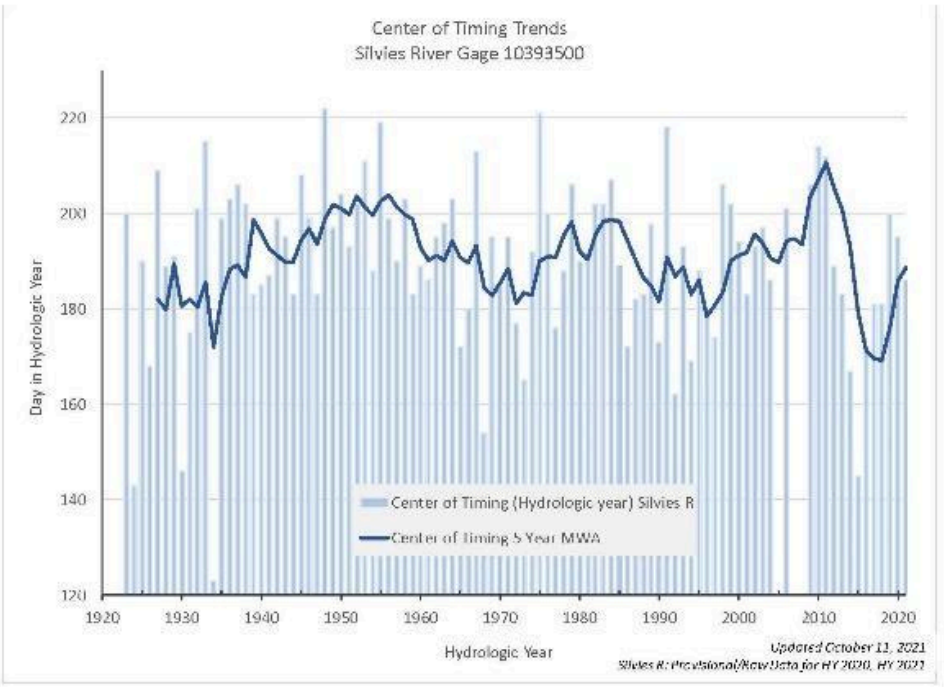


Figure 6: Runoff timing from the Silvies River (from Svejcar 2022)

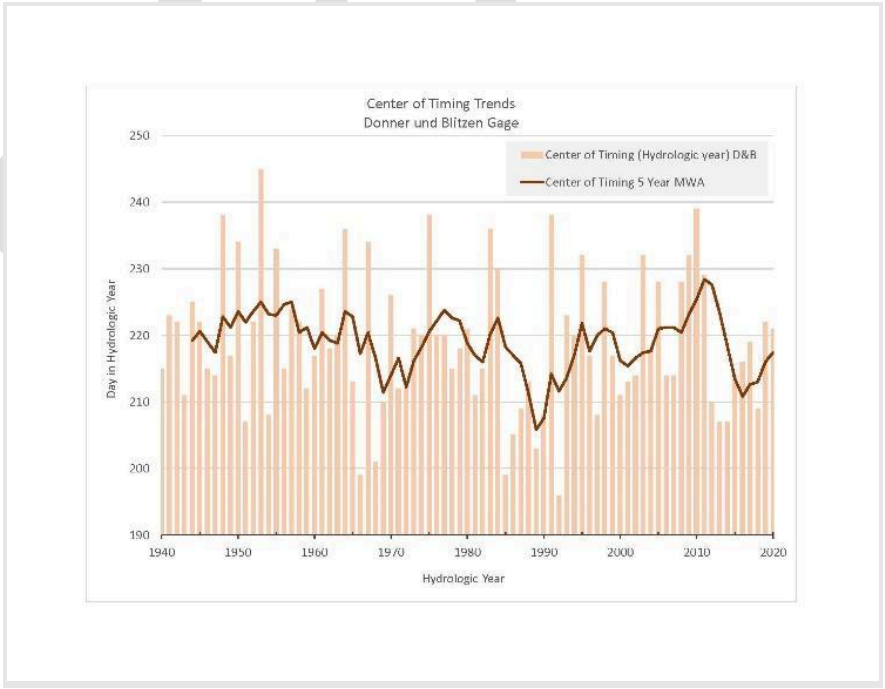
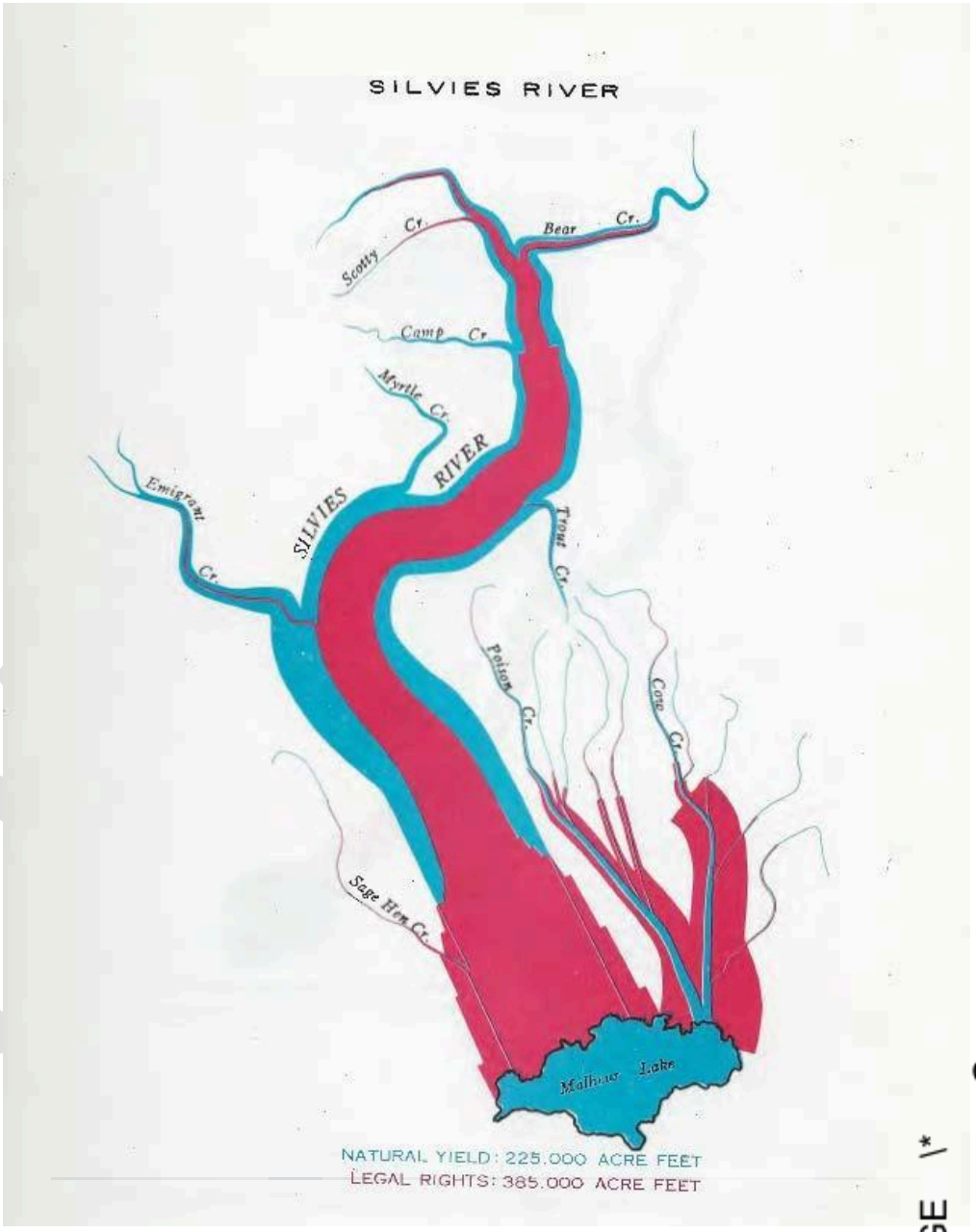


Figure 7 Runoff Timing from the Donner und Blitzen River (from Svejcar 2022)

Silvies River Appropriation

The Silvies River adjudication proceeding was thought to be completed except for the disposition of incomplete water rights. Investigations and surveys were completed to complete these rights. The proceeding was halted pending an anticipated judicial correction of some errors found in a 1923 court decree. The adjudication was approved by the Oregon Supreme Court in 1925 and modified in 1928. The adjudication allotted the right to significant diversions for some of the Pacific Livestock Company property (now part of Silvies Valley Ranch) with priority dates of primarily 1887 and 1888 with one for 1909. These rights are to the Silvies River, Camp Creek, Cottonwood Creek, Jump Creek, Flat Creek, Poison Creek, Trout Creek, Hall Creek and Payne Creek.



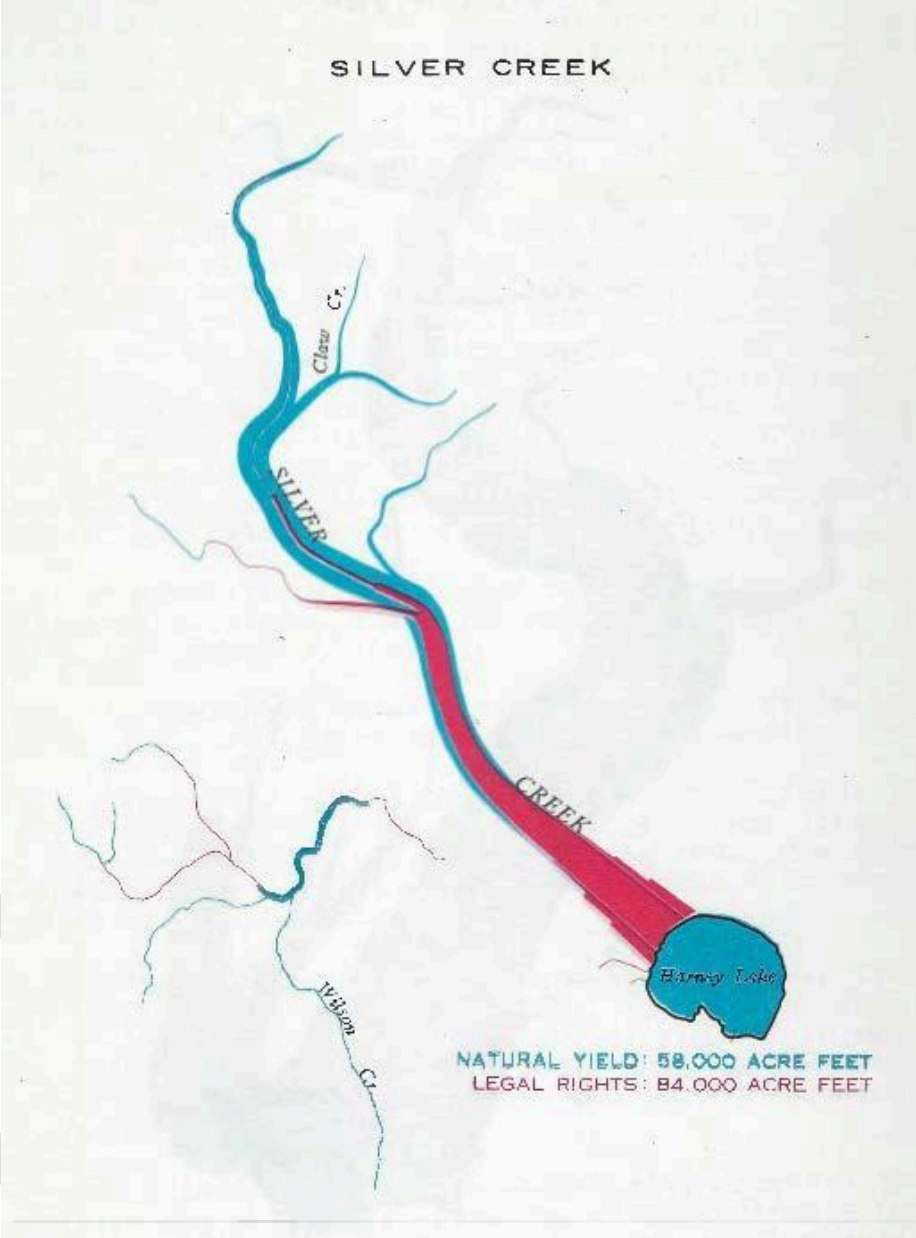
Above the Silvies Valley Ranch water rights have been allocated for Bear Creek, Scotty Creek, and others. Water rights of approximately 26,324 acre-feet have been appropriated for irrigation of 13,162 acres in the upper drainage in the Bear Creek, Emigrant Creek and Scotty Creek area.

Silvies Valley appropriations amount to an estimated 37,122 acre-feet to irrigate 18,561 acres. The Oregon Supreme Court decision on water rights to the Silvies River includes the statement; “There is no contest between any Harney Valley water users and the irrigators in Bear Valley, or Silvies Valley.”

The remaining 103,488 acre-feet of appropriated water to irrigate some 51,744 acres in the Harney Valley from the Silvies River. The 1967 Malheur Lakes Basin Plan documented an over appropriation of 160,000 acre-feet/year from the Silvies River system including Cow Creek and Poison Creek.

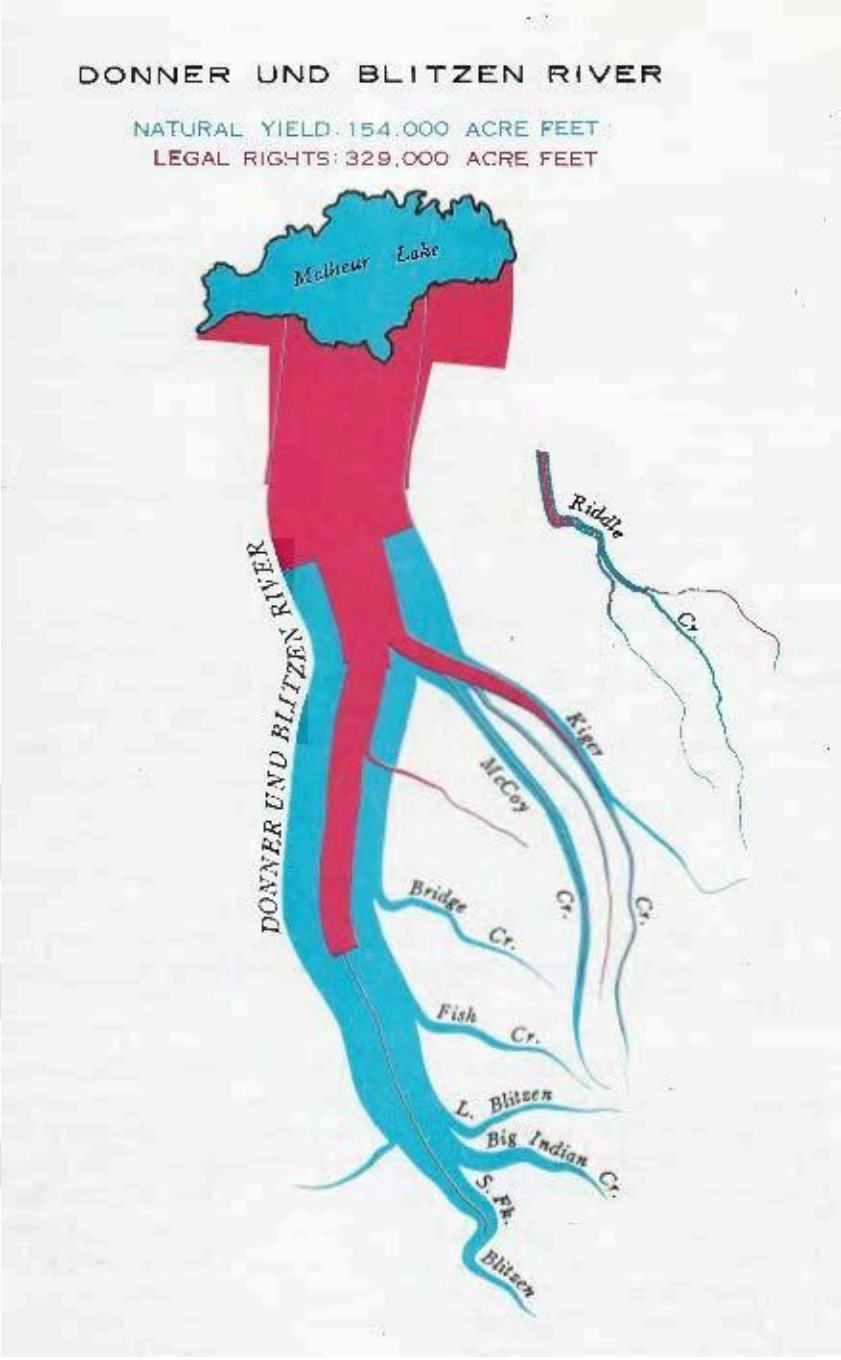
Silver Creek Appropriation

The Silver Creek adjudication was completed in 1928 and the court decree was finalized in 1934. Water rights date from 1877 to 1916. The adjudication recognizes an upper Silver Creek area and a lower area identified as Warm Springs Valley (below Moon Reservoir). Approximately 27,704 acres is irrigated in the upper Silver Creek area. An additional 12,375 acres is irrigated in the Warm Springs Valley. Some 23,287 acre-feet/year is appropriated to irrigate the Double O unit of the USFWS Malheur National Refuge but there is no delivery system for the flow and cooperative arrangements with upstream landowners are used to distribute the water on an annual basis. With the additional 2,782 acre-feet/year that is permitted but not adjudicated there is nearly 29,000 acre-feet/year over appropriated for Silver Creek. The USFWS Malheur National Wildlife Refuge has rights to divert some 37.5 cfs. from Harney Lakes spring area consisting of Double O Spring (Hibbard), Double O Spring Cold Spring, Barnyard Spring, Basque Spring, and Stinking Lake Spring. Spring flows are managed to fill ponds in the winter and flood fields in the spring and summer. The refuge is working on a spring monitoring program to track spring discharges.



Donner und Blitzen River Appropriation

The Blitzen River was adjudicated in 1938 and the court decree of 1942. Priority dates extend from 1872 to 1908. Much of the rights are held by the USFWS Malheur National Refuge. In 1999 the refuge applied to change the use of their appropriated water from irrigation to wildlife refuge management. The application was contested and finally approved in 2004. The approval to divert up to 820.4 cfs from the Blitzen River from 12 points of diversion. It remains that the Blitzen River is over appropriated by some 175,000 acre-feet/year. The Refuge use of Blitzen River water is described by Mayer and others (undated) as: "A system of dikes, canals, drains, and water control structures was developed in the early 1900s to facilitate grazing and farming. Twenty miles of the river was channelized and straightened at the same time. The water distribution system still exists and is used by the refuge to manage water in the Blitzen Valley".



The Refuge develops an annual irrigation strategy based on early spring water availability estimates (snow water content measured in February – March timeframe) (Mackay, 2023). Mayer and others (undated) have shown that the monthly streamflow by forecasts by NRCS improve from early in the year to later in the year. Using March or April forecasts are more likely to approximate water availability.

Northeast Side Streams

The smaller tributaries into the basin on the east side are intermittent and disappear into the alluvial fans of the surrounding uplands. Poison Creek and Cow Creek appropriations are shown in Figure 7. Cow Creek, Rattlesnake Creek, Mill Creek, Coffee Pot Creek, Prater Creek and Rock Creek (Harney) have all been adjudicated (Figure 1, Table 2). Poison Creek, Soldier Creek, Thousand Creek and Currey Gordon Creeks all drain towards the Harney Basin but are captured for irrigation and do not flow to the lakes. There is little information about the flows since there are no measurement devices (stream gages) on these streams. Springs are at the headwaters and contribute to these east side streams Rattlesnake, Poison, and Sage Hen creeks all have springs in their headwaters. Cow Creek originates from a series of springs including King Spring. There are some eight springs at the headwaters of Prater Creek. The east side streams do not currently reach Malheur Lake but may have in the past. The water used for irrigation is either evaporated or recharges the groundwater. Seepage measurements on Poison Creek and Rattlesnake Creek during late summer and early autumn low-flow periods provided evidence of groundwater recharge through channel losses in the Harney Basin lowlands (Garcia et al., 2022)

Southern Streams

Riddle Creek and tributaries to it (Paul Creek, Coyote Creek, Smyth Creek, etc.) flow off Steens Mountain to the east of the Donner und Blitzen River. Diamond Craters separates the Riddle Creek drainage from connecting with the Donner und Blitzen River and Malheur Lake. The rights to Riddle Creek were adjudicated in 1926 (Figure 1). Historically, the creek flowed into a series of playas (White Lake, Barton Lake and Dry Lake). Currently much of the flow is managed and diverted into the Highline Ditch, Feed Canal and other irrigation infrastructure.

Permitted Uses of Surface Water

Use in Acre-feet/year	Subbasin (HUC-8)			
	Donner und Blitzen	**Harney-Malheur Lakes**	**Silver Creek**	**Silvies River**
Irrigation	10,894	92,382	39,285	89,051
Recreation, Fish and Wildlife[1]	91,745[2]	397	37,833[3]	1,179[4]
Other (Domestic Livestock, Commercial etc.	54	299	128	2,928

[1] Duplication of storage rights for recreation and fish culture make the amounts higher than actual use.
[2] 25,807 ac-ft/year for fish culture and recreation, 40,182 ac-ft/year for Malheur Refuge
[3] 14,707 for Malheur Refuge
[4] 542 ac-ft/year for fish culture and recreation,

The Economic, Social, and Cultural Significance of Surface Water in the Harney Basin

The profusion of wildlife and plants associated with the Harney Basin wetlands has provided Native Americans with an abundance of food and resources for over 11,000 years. Relatively continuous occupation of sites around Malheur Lake varied with the fluctuation of lake levels. In September of 1872, President Ulysses S. Grant signed into law the 1,778,560 acres Malheur Reservation, centered on Malheur Lake. The reservation was terminated In January of 1883, the Reservation was made into public domain, open for settlers to claim under the Homestead Act. The Harney basin was settled by homesteaders and used for ranch expansion from California. The P Ranch in the Donner und Blitzen floodplain has a colorful history and was a dominant force in the settlement of the Harney basin. The ranch site is now part of MNWR. The MNWR was designated by Executive Order in 1908 by President Theodore Roosevelt. The refuge was established to protect the waterbird population from plume hunters at the time. The history of ranching, homesteader-rancher conflict, and public domain land use are reflected in Harney County today.

Current Land Uses

Land ownership in Harney County is approximately 25% private and 75% public. Land cover types are approximately 64% rangelands, 22% forest, 9% crop or pastureland, and 5% wetlands. Today, as in the past, cattle ranching, irrigated hay, and timber and wood products are the major economic enterprises in the county. Climatic characteristics of this semi-arid region of the northern Great Basin limit the types of crops that can be produced. For this reason, irrigated grass hay, pasture, and alfalfa hay dominate the agronomic operations (USGS, 2001).

Future Trends

Land use in Harney County has remained relatively static in recent years. However, there has been a significant increase in irrigated hay land, particularly alfalfa hay, using sprinkler irrigation from ground water. According to the 2012 Census of Agriculture (USDA-National Agricultural Statistics, 2012), irrigated land in Harney County increased by nearly 15,000 acres between 2007 and 2012. During that same time period, harvested irrigated cropland increased by nearly 25,000 acres, while irrigated pastureland decreased by nearly 10,000 acres. It is unclear, however, whether this trend will continue. In 2015, Oregon Water Resources Department announced that they would temporarily stop issuing irrigation well permits in the Harney Basin while the Department conducts monitoring and analysis of declining ground water levels in the basin.

Local Economy (Economic Data taken from ECONorthwest Memo of November 1, 2021)

Harney County has a long and colorful history of resource use and settlement. Fur trappers from the Hudson Bay Company visited the area in 1826 and called the lake “Malheur,” the French word for misfortune. The area was traversed by the Meeks Cutoff, an alternative on the Oregon Trail in 1845. Following the 1862 Homestead Act, the area was settled by California based cattle operations, eventually dominated by Pete French (the Cattle King) who amassed more than 140,000 acres of Harney County based on the Donner und Blitzen River (The P Ranch). Logging in the Malheur Forest north of Burns sustained a lumber mill until the 1980’s. Harney County covers approximately 10,000 square miles of high desert and forest land in southeast Oregon. These open spaces are the basis of a rural, outdoor lifestyle enjoyed by approximately 7,150 county residents. The towns of Burns and Hines with

approximately 4,240 residents are the hub of a hard-working ranching and agricultural community. The community has never quite recovered from the economic loss from the closure of the Hines Lumber Mill in 1980. With the majority of the county owned by the federal government, tax revenues necessary to maintain infrastructure are in short supply. One in four children in Harney County exists at or below the poverty level (compared to a 15% state average) and nearly 50% of children in public schools are eligible for free or reduced lunches. Harney County's economy is heavily weighted toward ranching and farming. The two largest private industries in the county are cattle ranching and farming and other crop farming (Table 4). Together, those two industries comprise $95.9 million in economic output, representing 19 percent of the total output ($494 million) in Harney County.

Table 4. Characteristics of the 10 Largest Private Industries in Harney County

IMPLAN Industry	Employment	Average Employee Compensation per Wage and Salary Employee	Value of Gross Output
Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	130	$36,740	$58,437,371
All other crop farming	767	$34,592	$37,479,401
Other real estate	102	$22,780	$14,308,488
Limited-service restaurants	124	$18,500	$11,616,663
Retail - Non-store retailers	84	$83,256	$8,412,346
Wholesale - Petroleum and petroleum products	6	$59,257	$8,394,090
Retail - Food and beverage stores	121	$32,773	$8,174,240
Monetary authorities and depository credit intermediation	30	$48,597	$7,922,416
Electric power transmission and distribution	5	$176,702	$7,718,536
Hotels and motels, including casino hotels	67	$20,939	$7,070,343

Source: IMPLAN 2019 Data Year for Harney County model region.

In addition to the direct employment, wages, and revenue from the agricultural sector, there are secondary economic contributions that the industry supports as their spending supports the suppliers that they and their employees purchase goods and services from. For every $1 million spent on crop farming in Harney County, there is an additional $345,553 in economic activity supported.27 On average, $1 million in spending by the industry supports a total of $286,200 in direct labor income and an additional $142,000 in labor income in secondary effects for things like farm suppliers, grocery stores, and other supply chain and household purchases.

There are approximately 166,501 irrigated acres of land in Harney County used for agricultural production – including both surface water and groundwater irrigation. Of those irrigated acres approximately 141,840 are used to grow hay or haylage. Table 5 summarizes acres for total and irrigated hay and haylage in the county. Approximately 42 percent of all irrigated agriculture in Harney County is for alfalfa production.

Table 5. Acres or Hay and Haylage in Harney County by Irrigation Status (2017)

Description	Acres - Total	Acres - Irrigated	Percent Irrigated
Hay, excluding Alfalfa	103,604	76,667	74.0%
Hay, Alfalfa	64,227	60,514	94.2%
Haylage	4,811	4,659	96.8%
Hay and Haylage	**172,642**	**141,840**	**82.2%**

Source: USDA National Agricultural Statistics Service. (2017). *QuickStats.*

Meadow hay is generally used as cattle feed and not exported out of the county. Meadow hay is less water intensive than alfalfa because it is limited to one cutting opposed to three to four cuttings for alfalfa (depending on weather conditions).

As of 2017 there was a total of $29.6 million in sales for crops and $52.7 million in sales for livestock in Harney County. On average, a farm in Harney County has a market value of agricultural products sold of $154,691 and a net cash farm income of $37,861. Most farms in the Harney Basin are either managed on a part-time basis or as part of a business that runs several farms. Annual gross revenue received per farm varies significantly in terms of the gross revenue received with approximately one-third receiving less than $2,500 per year and one-third receiving more than $100,000 per year (Table 6). Approximately 164 farms (30 percent of total) are larger than 1,000 acres (Table 7).

Table 6. Farms by Value of Sales, Harney County (2017)

Value of Sales	Number of Farms	Percent of Total
Less than $2,500	155	29%
$2,500 to $4,999	51	10%
$5,000 to $9,999	46	9%
$10,000 to $24,999	52	10%
$25,000 to $49,999	33	6%
$50,000 to $99,999	32	6%
$100,000 or more	163	31%
Total	**532**	**100%**

Source: USDA National Agricultural Statistics Service, 2017 Census of Agriculture. (2017). *County Profile: Harney County.* Available at: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Oregon/cp41025.pdf

Table 7. Size of Farm, Harney County (2017)

Size of Farm	Number of Farms	Percent of Total
1 to 9 acres	25	5%
10 to 49 acres	89	17%
50 to 179 acres	105	20%
180 to 499 acres	102	19%
500 to 999 acres	47	9%
1,000+ acres	164	31%
Total	**532**	**100%**

Source: USDA National Agricultural Statistics Service, 2017 Census of Agriculture. (2017). *County Profile: Harney County.* Available at: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Oregon/cp41025.pdf

The estimated gross revenue from surface water irrigated hayland is approximately $36.4 million.

In a recent review (Bairs et al., 2021) the economic benefit and contributions of surface water for flood-irrigated pasture and recreation was evaluated in the Harney Basin. The authors concluded "We estimate the economic benefit of surface water for flood irrigation to be approximately $160 per acre, translating to an annual average of $17.2 million in economic benefit. The grazing activity on the flood-irrigated pasture supports 718 jobs in the State of Oregon, most of which we predict are in Harney County, as well as $11.6 million in labor income, $40.1 million in economic output, and $22.1 million in value added."

Water was also valued for the economic effects related to recreation. Bairs and others (2021) concluded "The annual economic benefits of bird viewing and fishing are estimated to be $2.8 million and $526,000, respectively. These value estimates are conservative as they contain only direct use value, which is just one portion of total economic value, and do not include possible recreation on other public and private land. The visitor spending from bird viewing and fishing supports 85 jobs, $2.8 million in labor income, $7.2 million in economic output, and $4.1 million in value added. The vast majority of these contributions occur inside Harney County."

Looking at the combined economic effects of surface water use and recreational use of the bird habitat provided in the Harney Valley has been summarized by Blair and others (2021) as: "Together, these uses of surface water represent approximately $20 million in economic benefit and support 803 jobs and over $47 million in economic output in the State of Oregon. We estimate value and contributions from each of these uses separately, but the production of these goods and services are not independent from one another. Irrigated pasture and bird habitat are largely complementary surface water uses—the flood irrigation practice helps create and maintain the wet meadow habitat necessary for nesting birds. These two uses and their values and contributions are deeply intertwined. However, in very limited instances, irrigated pasture and bird habitat may represent a competing use to fish habitat, as the withdrawals necessary for wet meadow flooding leave less water instream."

Flood irrigation is seen by many water regulatory bodies as a "wasteful" practice. There is however, significant other benefits to flood irrigation in areas that provide migratory bird habitat. As noted by Sketch and others (2020): "Flood irrigation on western rangelands is important for diverse social and ecological reasons, providing forage for many agricultural operations and maintaining many critical wetlands across the region." This apparent conflict is critical in the Harney basin. The flood irrigated wet meadows of the Harney basin provide migratory bird habitat for millions of birds each year. Identified by the Audubon Society as an Important Bird Area, the Silvies floodplain and flood irrigated wet meadows provide critical habitat for both migratory and breeding birds. The Harney Valley wetlands associated with flood irrigated portions of the Silvies River, Silver Creek and Blitzen River floodplains are a critical portion of the Southern Oregon Northeastern California (SONEC) migratory bird focus area (IWJV, 2016).

Sketch and others conclude "Although irrigation efficiency is often evaluated narrowly in terms of amount of water used of the water applied, the decision of which irrigation system is most efficient and appropriate for a rancher's operation involves multifaceted social-ecological considerations that vary from operation to operation. For instance, across many landscapes of the Intermountain West, flood irrigation maintains critical habitat for birds in historically flooded wet meadows (Lovvorn and Hart 2001; Peck and Lovvorn 2001). These working wet meadows can be seen as social-ecological services (Huntsinger and Oviedo 2014) coproduced by humans and the environment…" The flood irrigation

practices in the Harney basin mimic and expand the wet meadow systems that they have replaced and provide significant ecosystem and economic benefits not measured in terms of "efficient water use".

Regulation of Irrigation Water

The best recent description of water regulation in the Harney Basin is from LaMarche (2011). While the descriptions quoted by LaMarche (2011) throughout this document are more than 10 years out of date, they provide the best available information. The description summarizes: "*Three major watersheds produce significant stream flow in the Malheur Lakes Basin (aka Harney Basin): Silvies River, Silver Creek, and Donner und Blitzen. These streams generate significant stream flow from snowmelt–runoff in the spring, which rapidly diminishes during summer. The lower valleys typically flood (both naturally and assisted by small dams) during spring runoff. However, in the Silvies River and Silver Creek watershed, summer base flows are small and irrigation demand far exceeds supply after the spring freshet. Base flows in the Donner und Blitzen River are higher and irrigation demand much smaller than the other watersheds. Therefore, most regulation and monitoring activity occurs in the Silvies and, to a lesser extent, Silver Creek watersheds. This activity is predominately complaint driven after spring runoff. However, regulation can occur during the winter and early spring of dry years as irrigators typically irrigate prior to the growing season to increase soil moisture content".* The summary adds: "*Due to the low gradient channels in both valleys, it is difficult to use measuring devices or stream gages as backwater conditions (either natural or due to check dams) are typical. As a result, complaint driven monitoring by manual discharge measurements is the norm. Complaints are numerous because the basin is highly fully appropriated and the users unorganized".*

Silvies River

LaMarche describes: "There is water use in the Silvies Valley (upstream of Harney Valley), but it is comparatively small and confined to the alluvial filled valley next to the river. There are few complaints for regulation in this valley, and the valley has always been regulated separately from the lower valley".

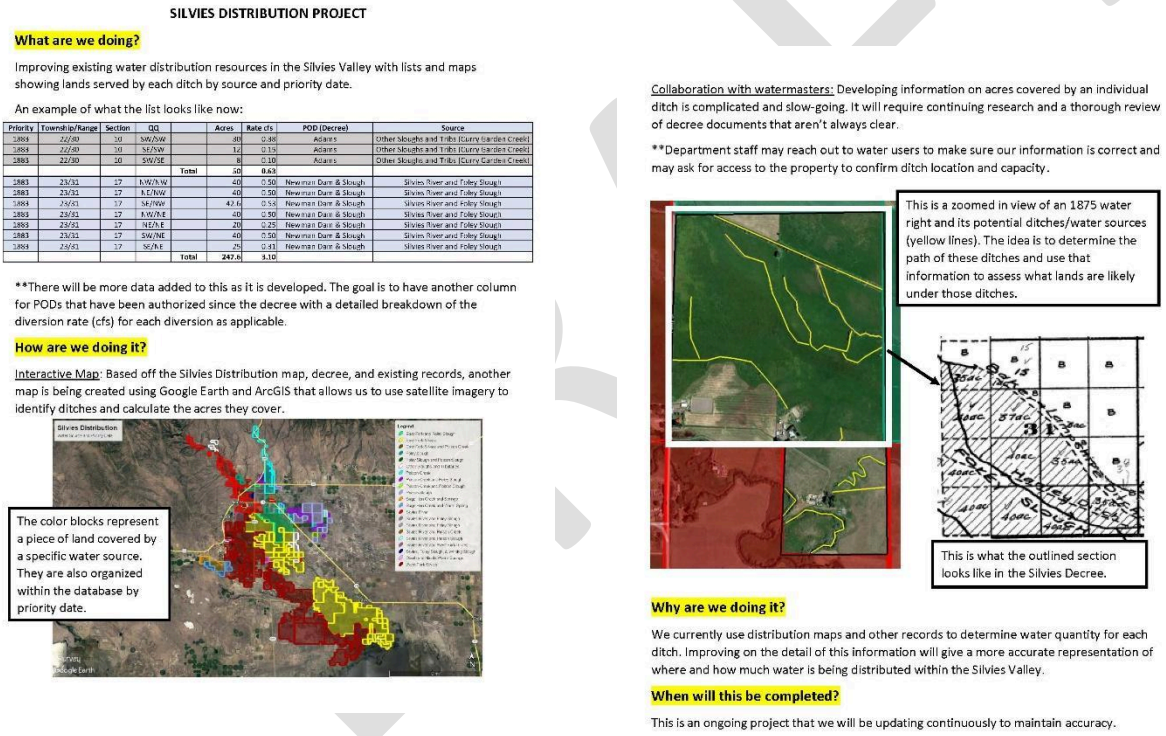
La Marche describes: *"The Silvies River naturally bifurcates as it enters Harney Valley. Numerous sloughs carry water to individual or groups of irrigators, the largest being Foley Slough. Legally, stream flow is to be divided between the main stem Silvies and Foley Slough at a ratio of approximately 10 to 1, based on the water rights on each system (This ratio actually varies somewhat based on the priority date and acreage of the rights being fulfilled from each channel, which in turn depends on the available flow above the bifurcation point). Historically, this division in flow occurred somewhat naturally due to the channel configuration and associated hydraulic properties in each channel. This is no longer true due to either natural or anthropogenic changes in the Silvies channel and some controversy exists on how to remedy this issue. Currently, the division of flows is routinely checked manually without benefit of a staff gage or rating curve. Given the site conditions it may be difficult to develop a stage discharge relationship at this location in either channel".* Over the past 15 years, water in excess of adjudicated amounts going down Foley Slough has been managed at the Wheel Dam further down the system.

The Silvies River decree requires headgates and measuring devices, however there are few measuring devices on headgates and distributaries of the Silvies. Since the LaMarche (2011) report a number of headgate and measuring devices have been installed, particularly in the Silvies basin. While there is no complete inventory, the issues of measurement devices has not been completely resolved however, key diversion measurement devices have been required.

OWRD identified the following issues from their perspective in managing water from the Silvies River (Gall and Spriet, 2021).

- Excessive water diversion at Point of Diversion
- Excessive water diversion from shared ditch
- System wide: inefficient conveyance (flat, brushy ditches)
- 20 feet of fall over 20 miles; the whole basin is flat
- Assertive use of dams; not passing water down to other users
- Flooding across junior lands to get to senior lands

Recent discussions between the community and OWRD has led to a start to Improve public information to explain existing water distribution resources in the Silvies Valley with lists and maps showing lands served by each ditch by source and priority date. An Interim product (Figure 10) has been shared with the public. The map showing Silvies distribution needs to accurately reflect the legal rights and court decrees of points of diversion associated with places of use.



SILVIES DISTRICT PROJECT

What are we doing?

Improving existing water distribution resources in the Silvies Valley with lists and maps showing lands served by each ditch by source and priority date.

An example of what the list looks like now:

Priority	Township/Range	Section	QQ		Acres	Rate cfs	POD (Decree)	Source
1869	22/30	20	NW/NW		40	0.88	Adams	Other Sloughs and Tribs (Curry Garden Creek)
1884	22/30	20	SE/SW		12	0.15	Adams	Other Sloughs and Tribs (Curry Garden Creek)
1883	22/30	20	SW/SE		8	0.10	Adams	Other Sloughs and Tribs (Curry Garden Creek)
				Total	60	0.63		
1883	23/31	17	NW/NW		40	0.50	Newman Dam & Slough	Silvies River and Foley Slough
1883	23/31	17	NE/NW		40	0.50	Newman Dam & Slough	Silvies River and Foley Slough
1884	23/31	17	SE/NW		42.6	0.53	Newman Dam & Slough	Silvies River and Foley Slough
1883	23/31	17	NW/NE		40	0.50	Newman Dam & Slough	Silvies River and Foley Slough
1883	23/31	17	NE/NE		20	0.25	Newman Dam & Slough	Silvies River and Foley Slough
1883	23/31	17	SW/NE		40	0.50	Newman Dam & Slough	Silvies River and Foley Slough
1884	23/31	17	SE/NE		25	0.31	Newman Dam & Slough	Silvies River and Foley Slough
				Total	247.6	3.10		

**There will be more data added to this as it is developed. The goal is to have another column for PODs that have been authorized since the decree with a detailed breakdown of the diversion rate (cfs) for each diversion as applicable.

How are we doing it?

Interactive Map: Based off the Silvies Distribution map, decree, and existing records, another map is being created using Google Earth and ArcGIS that allows us to use satellite imagery to identify ditches and calculate the acres they cover.

The color blocks represent a piece of land covered by a specific water source. They are also organized within the database by priority date.

Collaboration with watermasters: Developing information on acres covered by an individual ditch is complicated and slow-going. It will require continuing research and a thorough review of decree documents that aren't always clear.

**Department staff may reach out to water users to make sure our information is correct and may ask for access to the property to confirm ditch location and capacity.

This is a zoomed in view of an 1875 water right and its potential ditches/water sources (yellow lines). The idea is to determine the path of these ditches and use that information to assess what lands are likely under those ditches.

This is what the outlined section looks like in the Silvies Decree.

Why are we doing it?

We currently use distribution maps and other records to determine water quantity for each ditch. Improving on the detail of this information will give a more accurate representation of where and how much water is being distributed within the Silvies Valley.

When will this be completed?

This is an ongoing project that we will be updating continuously to maintain accuracy.

*Figure SEQ Figure * ARABIC11: Silvies Distribution Project handout (OWRD, 2022)*

The other large bifurcation on the Silvies River critical for water management is the East Fork/West Fork split. At most flows, stream flow is to be almost equally divided between the two forks based on the water rights priority date and acres associated with each branch. However, most of the very senior water rights receive water from the West Fork, which means that at low flows upwards of roughly 70% of the

water should be sent down the West Fork channel. Dams are present on both the East and West Forks and are used to manage the distribution of flows between the two branches. Again, flows in each fork are routinely checked manually, without benefit of a staff gage. The site conditions may make it difficult to develop a stage–discharge relationship.

Diversions to the main water users in the valley have measuring devices.

Management Needs for the Silvies River

There is no headgate on the Foley Slough as it is legally considered a distributary of the Silvies River. A headgate at this location would enable better management of water of the Silvies River. A number of design solutions have been evaluated but all have exceeded cost benefit considerations. Management of flows in Foley Slough occurs at the East Fork Silvies River. There is also a need for a telemetry equipped stream gage on the Foley Slough in order to closely monitor and manage flows at this critical location in real time. The gage would probably be a velocity–index gage, given the site conditions. In addition, as mentioned previously, some type of control structure needs to be installed to manage the division of flow.

At the bifurcation of the East and West Forks of the Silvies River there are dams without measurement devices. There is a need for infrastructure changes and a telemetry equipped stream gage on each fork, in order to closely monitor and manage flows and this critical location in real time. The gages may have to be a velocity–index gage, given the site conditions.

Since 2010 a significant number of headgate and measurement devices have been installed. NRCS has cost shared on water control structures in the Silvies floodplain under the Working Lands for Waterbird Habitat Conservation - Harney County initiative. Some 96 structures have been completed and some 68 additional are in progress affecting irrigation to some 4,150 acres.

In addition to a new gage on the West Fork Silvies near the bifurcation, a weir on the West Fork Silvies at the Highway 205 pcrossing (near Island Ranch) would greatly aid in monitoring and water management for these users.

It is important to highlight that cost-share programs for infrastructure improvement, like water control devices that regulate irrigation, exist. The installation of monitoring devices capable of monitoring rate and/or duty aids management of surface water.

Silver Creek

LaMarche describes: "*Silver Creek is smaller than the Silvies River in terms of watershed size, stream flow, and irrigation use. Typical of the major streams in the basin, Silver Creek also bifurcates in its' valleys: Silver Creek Valley (west of Burns) and the Warms Springs Valley just upstream of Harney Lake— the ultimate terminus for all three major watersheds in the basin. The Silver Creek decree puts most users in the upper valley on par, and there are better irrigation rotation agreements and landowner cooperation in the Silver Creek watershed than the Silvies River. As a result, there are fewer complaints for regulation and monitoring in the Silver Creek watershed compared to the Silvies watershed*".

La Marche explains: "*For the Silver Creek Valley, monitoring and regulation are complaint driven. Most of the users have established irrigation rotations and diversions are checked by occasional manual discharge measurements when there are complaints".*

Management in the lower Silver Creek is described as: "*For the Warm Springs Valley (downstream of Silver Creek Valley), regulation activity and monitoring are also complaint driven and more routine due to higher frequency of complaints, plus storage in Moon Reservoir. The channel gradient is much lower in this valley and as a consequence, diversions are monitored by manual stream flow measurements. The presence and hydraulic configuration of Moon reservoir also causes some regulation complexity. Senior live flow users are located below the reservoir, which should pass live flow to these users when required. The outlet of the dam, however, is of insufficient size to pass runoff at higher flows. Routine monitoring of outflows and storage by manual measurements are typical regulatory activities in the valley"*.

LaMarche explains regulation in the Silver Creek as: "*There is regulation of junior irrigation users on Silver Creek in favor of the refuge. Monitoring of inflows to the refuge from the Silver Creek distributaries is very difficult due to channel gradients, presence of springs near the refuge which comingle water with the Silver distributaries, water control dikes on the refuge, and the numerous channels which drain into the refuge"*.

Management Needs for Silver Creek

La Marche has identified the following needs for improved management of water in the Silver Creek subbasin:

1. *A stream gage with telemetry above the valley near the historic "Silver Creek near Riley, Oregon" gage site (near the road crossing at the bottom of the "upper valley") would help with regulation efficiency and distribution in the valley. The installation of measurement devices on the main channels/diversions in the Silver Creek valley would also help with regulation.*
2. At Moon Reservoir he suggests: "*A staff plate on the reservoir plus and stage/capacity curve are needed to better manage the storage and distribution of water below the reservoir. In addition a measuring device downstream of the dam (to measure outflows) would also be very beneficial to distribution and regulation in the valley"*.
3. Diversion regulation could be improved at major diversions: "*Hotchkiss Cattle Company is the largest water user in the upper Silver Creek watershed. The installation of measurement devices on the associated diversions would help with regulation"*.
4. A staff gauge on Poison Creek where the creek enters the Harney Valley would aid in regulation.

Donner und Blitzen River

LaMarche describes that: "*There is very little regulation and monitoring in the Donner und Blitzen watershed due to the late season runoff and the small amount of irrigation use. There are some large diversions related to water distribution in the Malheur National Wildlife Refuge, which encompasses most of the Blitzen Valley as well as Harney and Malheur Lakes. There is a stream gage just upstream of the refuge which records the inflows to the refuge from the Donner und Blitzen River"*.

Recent activity in the Donner und Blitzen includes flow monitoring by USGS and exploration of removal of the Page Springs weir.

Flooding in Burns and Hines

The area between the Five Mile Dam to below Hines (Figure 11) is subject to flood damage on the occasions when the Silvies River rises to flood stage. Flooding has resulted in damage to homes and infrastructure and with remapping of the floodplain has the potential to significantly rise the cost of flood insurance for a significant portion of the Burns Paiute reservation, the communities of Burns and Hines. A number of flood studies have been conducted to identify and assess the flood risk in the Burns-Hines area. In 1968 the State Water Resources Board published a Flood Plains Study of the Burns-Hines Area (SWRB, 1968). The 1989 flood study followed the 1964 flood which resulted from a rain on snow event. In 1989 FEMA published a Flood Insurance Study for the City of Hines (FEMA, 1989). In1998 the Federal Emergency Management Agency (FEMA) published a flood insurance study for the city of Burns (FEMA, 1998) and Unincorporated areas of Harney County (FEMA, 1998a). The flood insurance studies were an update to flood studies completed in 1984.

With the advent of LiDAR technology (aerial laser facilitated elevation measurement) more detailed topography can be evaluated. FEMA and others initiated discussions with Harney County residents between 2011 and 2016 and published a preliminary flood insurance study on June 28, 2019. The preliminary mapping for the City of Burns is shown in Figure 11.

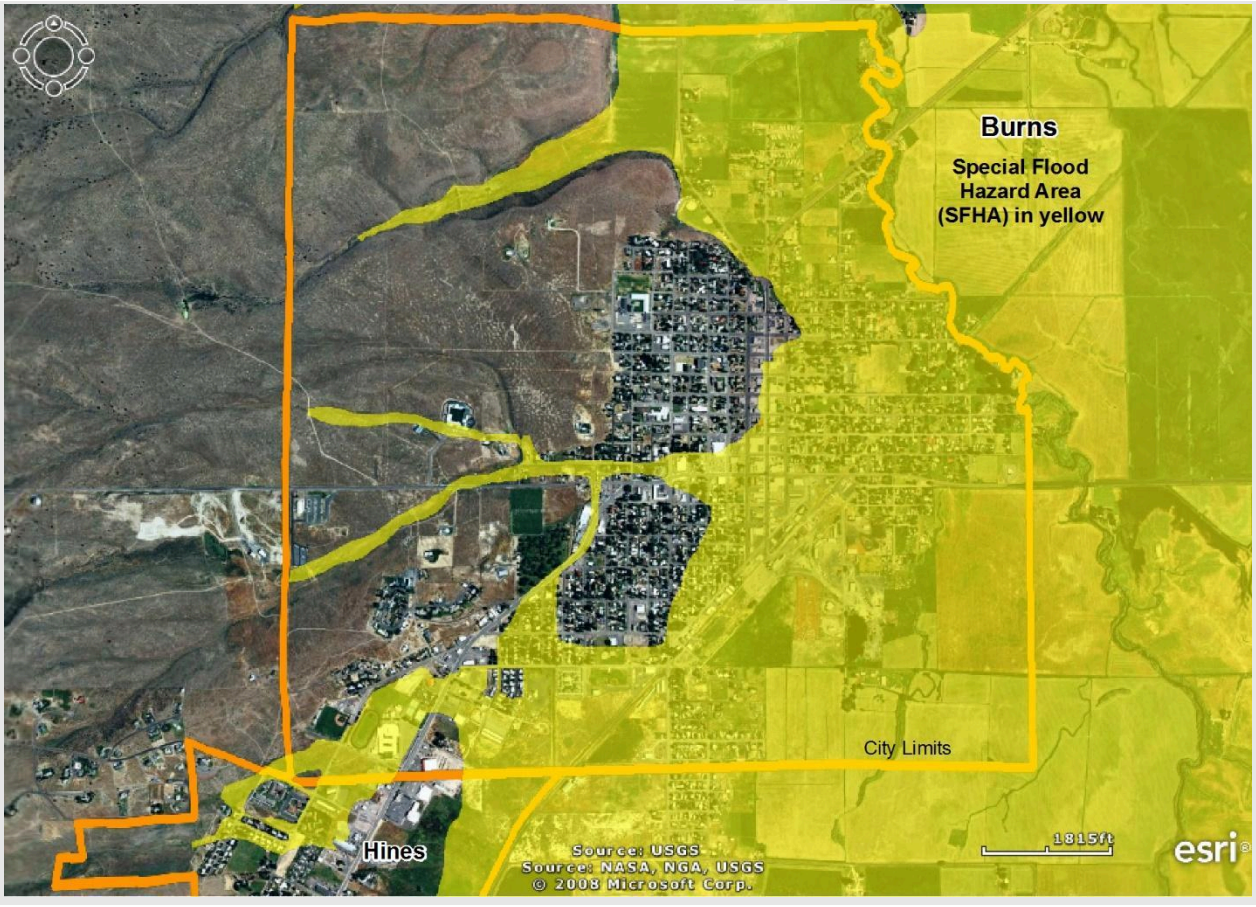


Figure 12: Preliminary floodplain mapping for the Burns area (FEMA, 2019)

In response to the startling area of inclusion in flood hazard zones, the County Court explored potential opportunities to mitigate the flooding and reduce the flood hazard area. The County contracted with an

engineering firm (Kleinschmidt Associates and Ecological Engineering LLC, 2022) to explore opportunities to reduce the impact of flooding on properties in the area. The report identified ten alternative approaches to mitigate flooding in the area. The consultants recommended two high priority actions and recommended no consideration for three alternatives. Four alternatives were recommended for further study and analysis and one alternative was recommended to be built into short-term planning.

Managing flood impacts to the citizen so Harney County is being explored. Some of the alternatives identified by the engineering study (Kleinschmidt Associates and Ecological Engineering LLC, 2022) could remove between 367 and 370 structures from the flood hazard area. There are currently some 469 structures that are flooded by less than 0.1 foot during a 100 year flood and 270 structures that are flooded more than 1.0 foot during a 100 year flood. The choice of mitigation strategy will be based on funding, permitting, and community acceptance. There is an effort to chose an alternative that has flood irrigation wet meadow benefits along with flood mitigation benefits.

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