# Preliminary Temperature Source Assessment – South Fork Owyhee River

## February 2006

South Fork Owyhee River at Nevada-Idaho Stateline (Photo by M. Ingham, Idaho Department of Environmental Quality)

Prepared by:
Randy Pahl
Bureau of Water Quality Planning
Nevada Division of Environmental Protection

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## Background

In 2002, the South Fork Owyhee River was placed on the 303(d) List for exceedances of the temperature standard based upon BLM-collected data. With 303(d) listing comes the requirement to establish a TMDL. However, BWQP has concerns about standard appropriateness that need to be resolved prior to any TMDL effort. The purpose of this paper is to provide a summary of current knowledge about temperature levels and potential sources; and to use this document to support decisions for future actions – additional data, criteria revision, TMDL.

## Temperature Water Quality Standard

The current temperature standards for the South Fork Owyhee River were codified in 1990:

May through October Daily Maximum .....21 degrees C
November through April Daily Maximum ....13 degrees C

According to NDEP (1990), these criteria were set to protect spawning rainbow trout as recommended by the Nevada Department of Wildlife.

## Summary of Temperature Data

**BLM Data:** During the summer of 1999 through 2001, the BLM used continuous temperature logging devices to monitor water temperature at 2 locations on the South Fork Owyhee River referred to as: 1) Old USGS Gage (Sta. 13177800); and 2) Pipeline Crossing (See Figure 1). Graphs of the data are shown in Figures 2, 3 and 4 and summarized in Table 1. These data were the basis for NDEP's decision to initially place the South Fork Owyhee River on the 2002 303(d) List. As shown in the table and graphs, there were extensive exceedances of the temperature standard during 1999-2001. Unfortunately, no USGS gaging stations were in operation during this period so it is difficult to characterize the role that flows may have had on the temperature levels. However, an examination of flows recorded at another gaging stations in the area (13161500 – Bruneau River at Rowland, NV [1914-17, 1967-2004]) shows that 1999 annual flow volume was near the long term average, while the 2000-03 annual volumes were less than the long term average. It is possible that the South Fork Owyhee River experienced a similar level of flows during the 1999-2003 period.

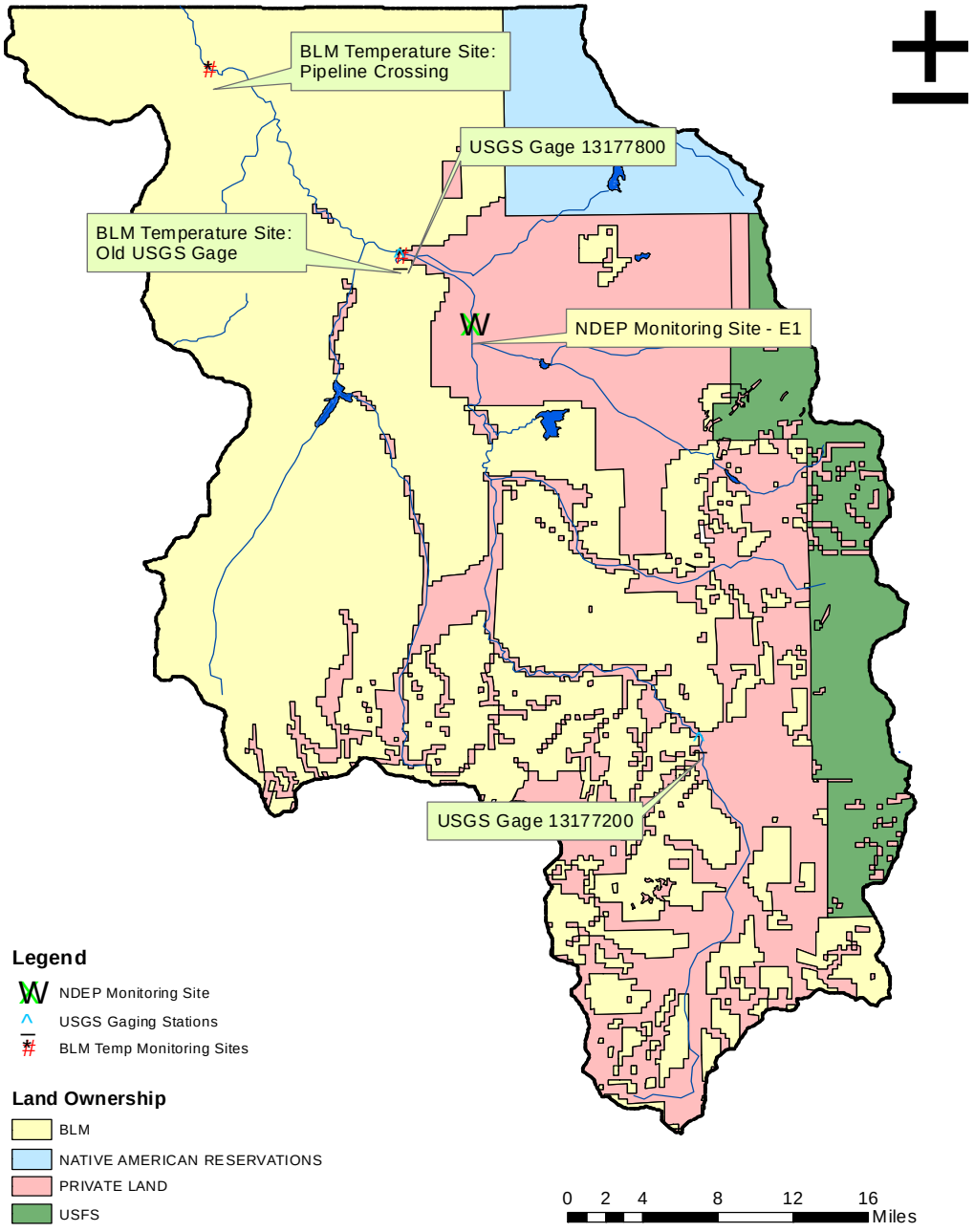


**Figure 1. South Fork Owyhee Basin – Monitoring Sites and Land Ownership**

**Figure 2. SF Owyhee River - Temperature Data from BLM (1999)**

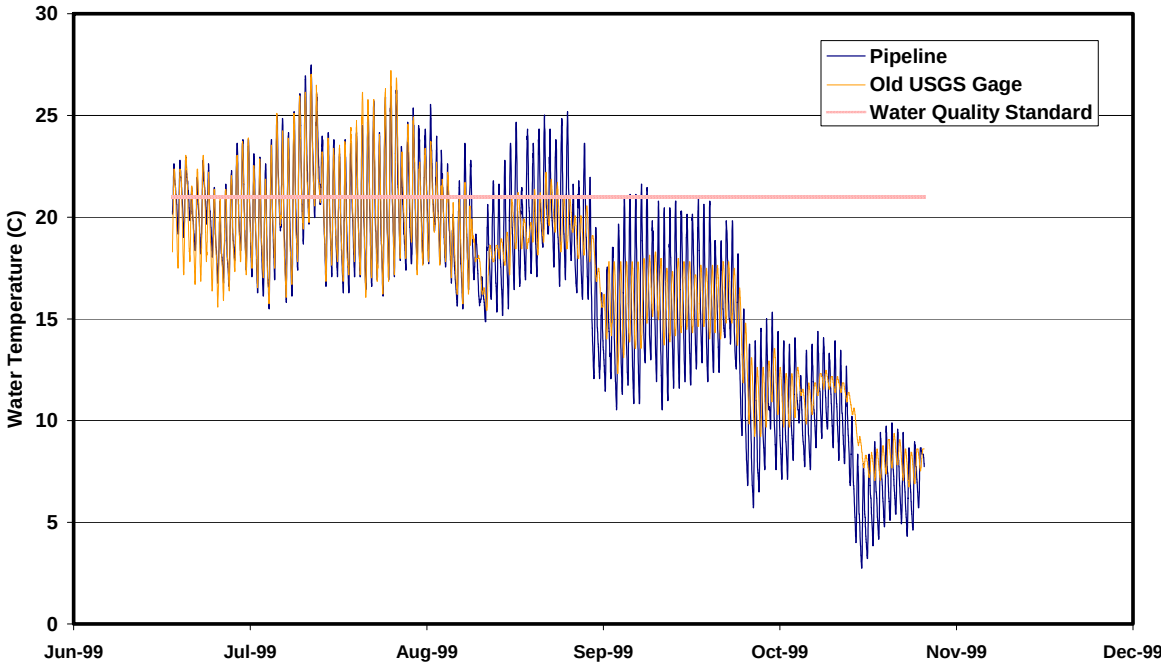


**Figure 3. SF Owyhee River - Temperature Data from BLM (2000)**

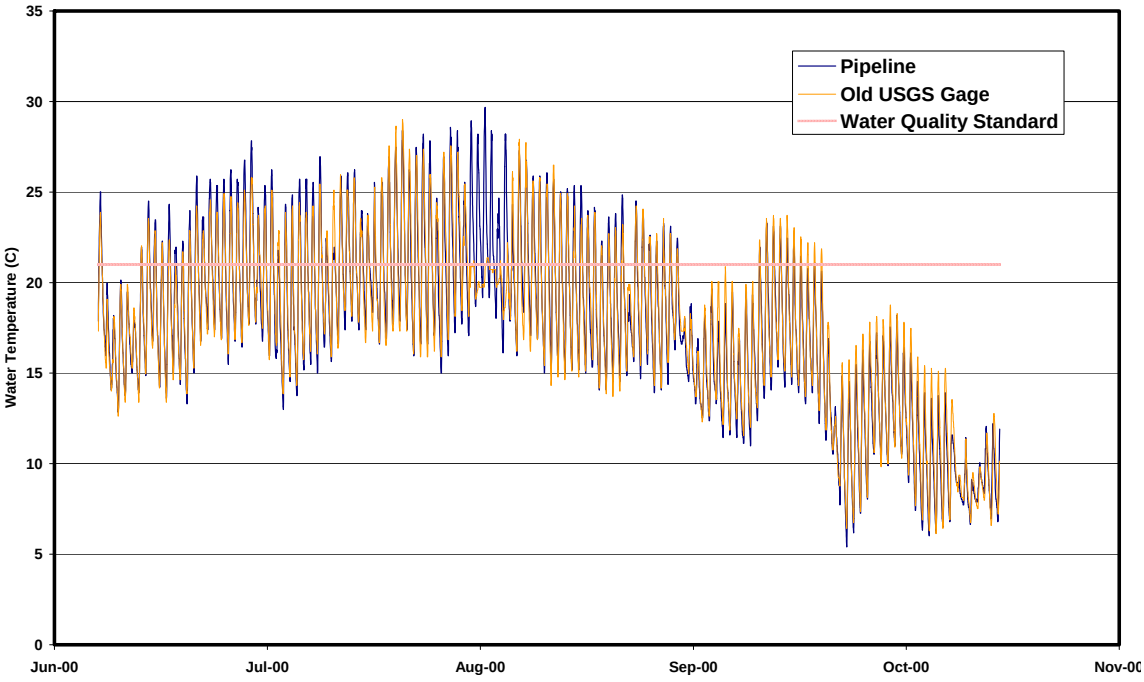

**Figure 4. SF Owyhee River - Temperature Data from BLM (2001)**

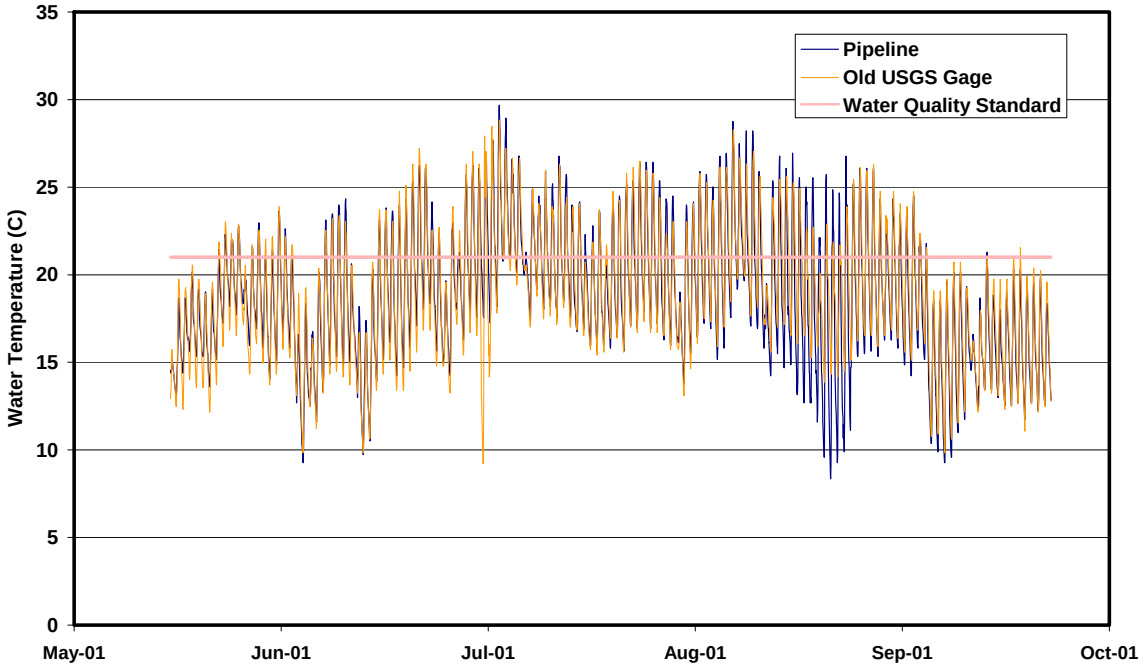


**Figure 5. SF Owyhee River - Temperature Data from BLM - Old USGS Gage (2002)**

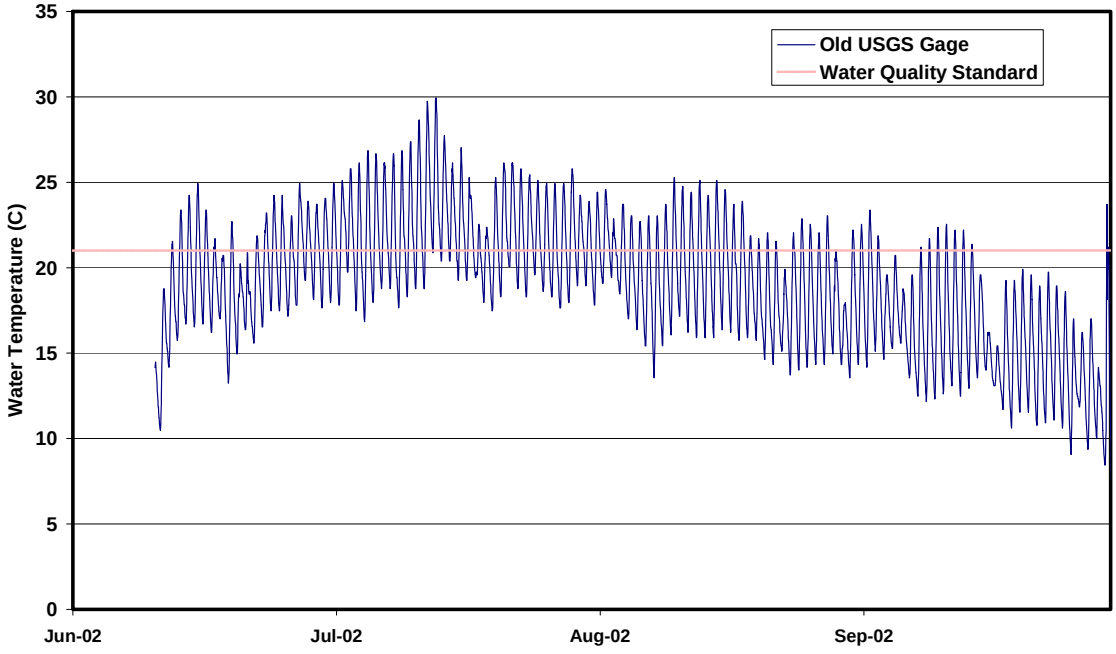

**Figure 6. SF Owyhee River - Temperature Data from BLM - Pipeline Crossing (2003)**

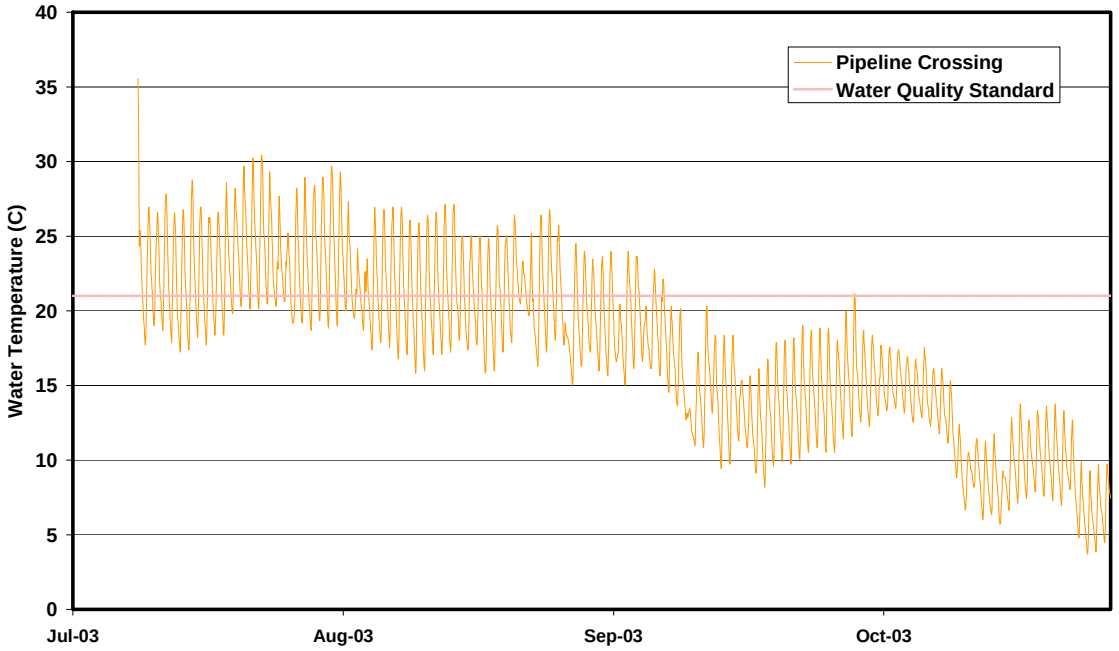


**Table 1. Summary of Temperature Data Collected by BLM, 1999-2001**

| Year | Statistic | Old USGS Gage (13177800) | Pipeline Crossing |
|---|---|---|---|
| 1999 | No. of days monitored | 133 | 133 |
| | No. of days criteria exceeded | 59 | 73 |
| | % Exceedance of standard | 44.4% | 54.9% |
| 2000 | No. of days monitored | 132 | 132 |
| | No. of days criteria exceeded | 89 | 87 |
| | % Exceedance of standard | 67.4% | 65.9% |
| 2001 | No. of days monitored | 133 | 133 |
| | No. of days criteria exceeded | 95 | 95 |
| | % Exceedance of standard | 71.4% | 71.4% |
| 2002 | No. of days monitored | 113 | Not collected |
| | No. of days criteria exceeded | 87 | |
| | % Exceedance of standard | 77% | |
| 2003 | No. of days monitored | Not collected | 112 |
| | No. of days criteria exceeded | | 65 |
| | % Exceedance of standard | | 58% |

It is interesting to note that the BLM data show little change in the maximum daily temperatures between the Old USGS Gage site and the Pipeline Crossing site, except for a few periods. The Idaho TMDL (discussed later) suggested that the black rock within the canyon area has increased average temperatures in that reach.

**NDEP Data:** Since 1966, NDEP has collected some miscellaneous temperature data for Sta. E1– South Fork Owyhee River at IL Ranch (Table 2, Locations on Figure 1). No corresponding flow measurements were taken. These temperature data show that the standard was exceeded a number of times during the months of July and August. However, these data may under represent the extent and level of temperature standard exceedances as many of the measurements were taken prior to the peak water temperature periods[1].

**USGS Data:** During the period 1977-81, the USGS collected some miscellaneous temperature and flow data for Sta. 13177800 – South Fork Owyhee River nr. Whiterock, NV (Table 3, Locations on Figure 1). These data show that the temperature standard was exceeded for periods of time during 1977-79, 1981 under a variety of flow conditions, e.g. near $10^{th}$ percentile flows, near $50^{th}$ percentile flows, above $50^{th}$ percentile flows. However, these data may under represent the extent and level of temperature standard exceedances as many of the measurements were taken prior to the peak water temperature periods[2].

[1] A review of the continuous temperature data collected by BLM suggests that the peak summer water temperature typically occurs between 3:00 PM and 5:00 PM.

[2] A review of the continuous temperature data collected by BLM suggests that the peak summer water temperature typically occurs between 3:00 PM and 5:00 PM.

**Table 2. Miscellaneous Temperatures Readings at NDEP's Site E1 – South Fork Owyhee River at IL Ranch**

| Date | Time | Temperature, degrees C |
|---|---|---|
| **7/22/1966** | **unknown** | **23** |
| 8/17/1966 | unknown | 20 |
| 6/19/1967 | 18:00 | 21 |
| **7/11/1967** | **12:45** | **22.5** |
| **8/1/1967** | **10:30** | **21.5** |
| 8/22/1967 | 11:00 | 20.5 |
| 11/20/1967 | 12:00 | 5 |
| 1/23/1968 | 11:30 | 0.5 |
| 7/4/1968 | 11:30 | 21 |
| 8/26/1968 | 11:30 | 13 |
| 11/13/1968 | unknown | 2 |
| 8/26/1969 | 15:00 | 21 |
| 12/8/1969 | 17:00 | 1 |
| **8/10/1970** | **19:25** | **26** |
| 5/24/1971 | 18:10 | 17 |
| **8/30/1971** | **17:15** | **24** |
| **6/27/1972** | **17:15** | **24** |
| 11/28/1972 | 17:05 | 3 |
| 9/24/1973 | 17:20 | 11 |
| 10/15/1974 | 18:35 | 15 |
| 6/17/1975 | 16:00 | 11 |
| 9/29/1976 | 10:30 | 12.8 |
| 5/10/1978 | 10:50 | 13.5 |
| 3/30/1979 | 10:18 | 3.2 |
| 8/17/1982 | 11:15 | 18.3 |
| 9/28/1983 | 10:45 | 11.5 |
| 7/12/1988 | 15:20 | 20.5 |
| 6/20/1989 | 15:48 | 18 |
| 6/20/1990 | 16:15 | 12.5 |
| **7/31/1991** | **15:10** | **23.5** |
| 7/8/1992 | 16:20 | 18 |
| **7/13/1993** | **15:10** | **21.3** |
| **8/9/1994** | **15:30** | **22** |
| 3/28/1995 | 15:00 | 7 |
| 6/6/1995 | 16:00 | 12 |
| 9/19/1995 | 15:20 | 18 |

Shaded areas indicate exceedance of the temperature standard

**Table 3. Miscellaneous Temperature and Flow Readings at Sta. 13177800 – South Fork Owyhee River nr. Whiterock, NV (1977-81)**

| Date | Time[1] | Temperature, degrees C | Instantaneous Flow (cfs) |
|---|---|---|---|
| 4/12/77 | 11:55 | 8 | 70 |
| **7/8/77** | **12:00** | **22** | **8.7[2]** |
| **8/10/77** | **11:00** | **21** | **30[3]** |
| 9/8/77 | 12:10 | 17 | 4.9 |
| 11/16/77 | 13:20 | 5 | 26 |
| 1/6/78 | 13:10 | 2.5 | 34 |
| 2/17/78 | 11:10 | 0 | 44 |
| 3/15/78 | 11:40 | 5 | 51 |
| 4/5/78 | 11:20 | 7 | 112 |
| 5/4/78 | 13:45 | 7 | 287 |
| 6/16/78 | 11:30 | 17.5 | 881 |
| **8/3/78** | **9:35** | **21.5** | **39[4]** |
| 9/15/78 | 13:50 | 19 | 30 |
| 10/27/78 | 11:30 | 5.5 | 32 |
| 11/17/78 | 13:30 | 0.5 | 43 |
| 12/20/78 | 12:15 | 0 | 22 |
| 3/14/79 | 12:30 | 7 | 444 |
| 4/20/79 | 12:45 | 6.5 | 653 |
| 5/31/79 | 12:10 | 14.5 | 465 |
| **7/18/79** | **12:20** | **23.5** | **67[4]** |
| 9/6/79 | 10:40 | 17 | 44 |
| 3/12/80 | 13:10 | 4 | 184 |
| 4/2/80 | 10:50 | 5 | 164 |
| 5/9/80 | 9:30 | 11 | 542 |
| 7/10/80 | 13:10 | 19.5 | 81 |
| 9/2/80 | 13:50 | 20 | 26 |
| 10/15/80 | 13:10 | 5.5 | 31 |
| 12/10/80 | 13:15 | 0 | 33 |
| 2/17/81 | 13:00 | 8 | 67 |
| 4/16/81 | 12:45 | 13.5 | 49 |
| **6/19/81** | **14:20** | **21.5** | **85[5]** |
| **8/12/81** | **14:55** | **26** | **18[5]** |

Shaded areas indicate exceedance of the temperature standard

[1] All measurements were taken before typical time of peak temperature

[2] Flows were low (near the 10th percentile level for this day)

[3] Flows were near the median (50th percentile) for this day

[4] Flows were above the median (50th percentile) for this day

[5] Flow were between the 10th percentile and 50th percentile for this day

## Streamflows and Irrigation Use

A summary of the average annual flows for 2 USGS gaging stations are presented in Table 4. The average annual volume at 13177800 is about 2.5 times of that at 13177200. Figure 7 compares the median flows for the 2 gaging stations. Both gages experience high flows during the spring during snowmelt, followed by low flows in the late summer.

Another way of looking at these data are in terms of 10$^{th}$ percentile, 50$^{th}$ percentile (median) and 90$^{th}$ percentile flow statistics for the period of record (Figures 8 and 9). When investigating potential temperature problems, the summer flows are of great interest. Table 5 summarizes the percentile flows for selected days during the summer. These data show that the river flows can reach rather low levels during the late summer, contributing to temperature problems.

**Table 4. Summary of Gaging Stations and Flow Statistics**

| Station | Drainage Area (sq. mi.) | Period of Record | Average Discharge (AF) |
|---|---|---|---|
| 13177200 – South Fork Owyhee River at Spanish Ranch nr. Tuscarora, NV | 330 | Aug 1959 – Sep 1973 | 46,400 |
| 13177800 – South Fork Owyhee River nr. Whiterock, NV | 1080 | Oct 1955 – Sep 1981 | 116,600 |

**Figure 7. Median Flows per USGS Gaging Stations**

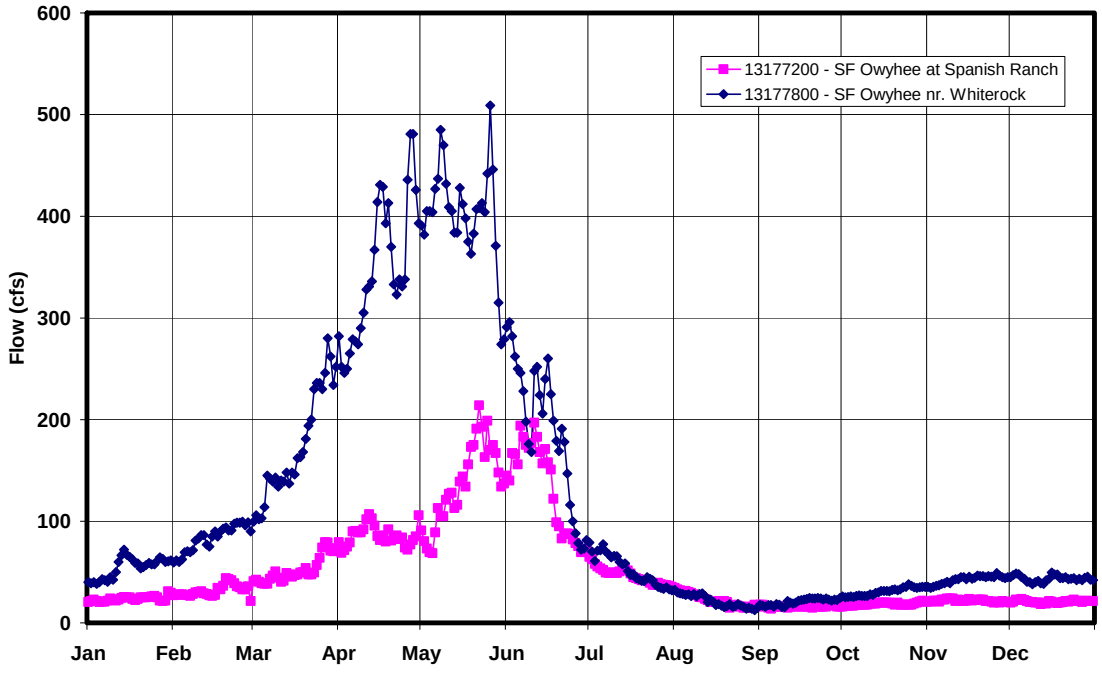

**Figure 8. 13177200 - South Fork Owyhee River at Spanish Ranch nr Tuscarora, NV - Daily Flow Statistics**

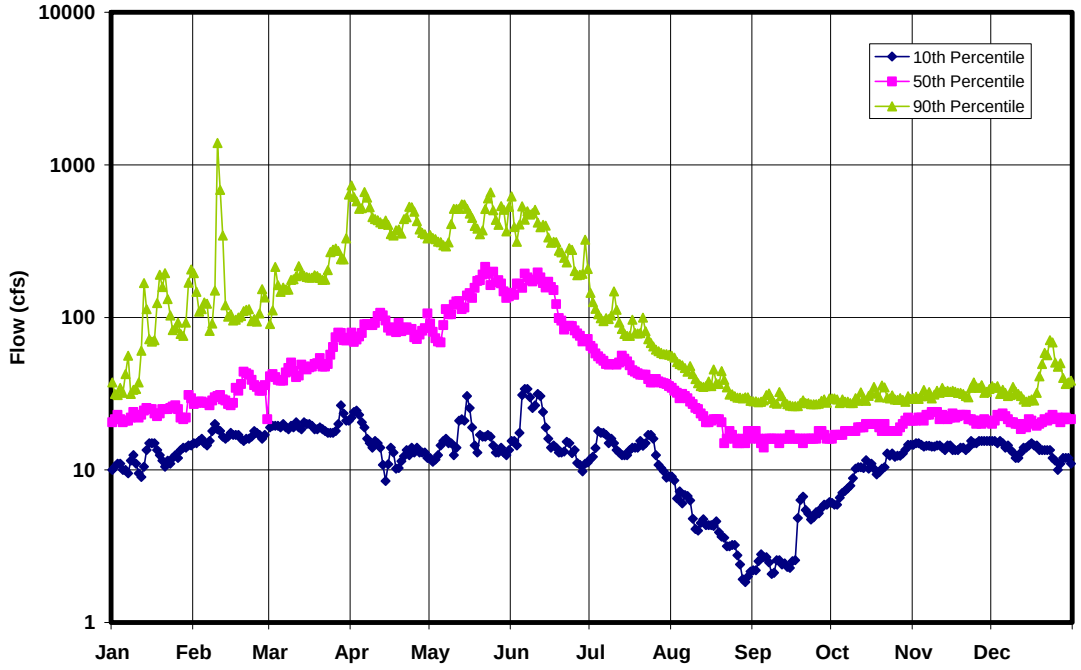


**Figure 9. 13177800 - South Fork Owyhee River nr Whiterock, NV - Daily Flow Statistics**

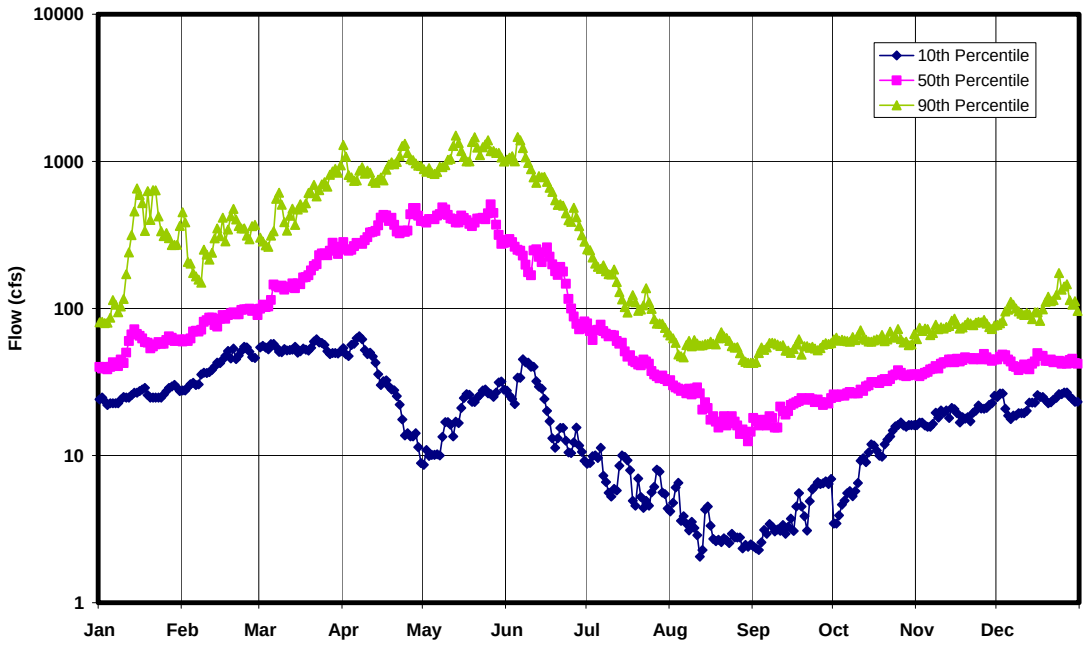

**Table 5. Summary of Percentile Flows during the Summer**

| Station | Date | 10th Percentile | 50th Percentile (median) | 90th Percentile |
|---|---|---|---|---|
| 13177200 – South Fork Owyhee River at Spanish Ranch nr. Tuscarora, NV | July 1 | 12 | 72 | 145 |
| | Aug 1 | 9 | 33 | 56 |
| | Sep 1 | 2 | 16 | 28 |
| 13177800 – South Fork Owyhee River nr. Whiterock, NV | July 1 | 9 | 79 | 252 |
| | Aug 1 | 4 | 30 | 66 |
| | Sep 1 | 2 | 15 | 43 |

The reduction in flows due to irrigation diversions contributes to the temperature problems on the South Fork Owyhee River. A preliminary examination of Landsat 7 images from 2000 indicate that nearly 30,000 acres of irrigated land exist within the South Fork Owyhee River watershed above Gaging Station 13177800 (Figure 10).

## Summary of Idaho TMDL

In December 1999, the State of Idaho completed the *South Fork Owyhee River Subbasin Assessment and Total Maximum Daily Load* which targeted sediments and temperature. As part of this document, information was collected at locations within Nevada. Following is a summary of their key findings and conclusions as pertains to the Nevada reach:

- According to a report by Idaho Department of Fish and Game, approximately 65 miles of the South Fork and tributaries have been channelized in Nevada. (NOTE: A quick examination of 1999 Orthophotos on NDEP fileserver verify significant channelization has occurred on the South Fork and some tributaries.) From River Mile 56 (west boundary of YP Ranch) downstream there is little evidence of alteration of river flow or stream bank modification.
- Little shading due to large woody vegetation exists. The flashy nature of flows appears to be the limiting factor for the presence of large woody vegetation. Young willow shoots cannot become a dominate feature on point bars within the floodplain. It is also stated that the lack of a valley-wide floodplain [in the canyon area below YP Ranch in Nevada] may explain the lack of mature woody species. (applies to canyon area below YP Ranch)
- Little information is available for fisheries in the subbasin.
- Geothermal input is limited and is not a source in the South Fork Owyhee River
- Redband trout appear to have the capability to adapt to adverse conditions, such as low or intermittent flows, and water temperatures greater than 28 degrees C.

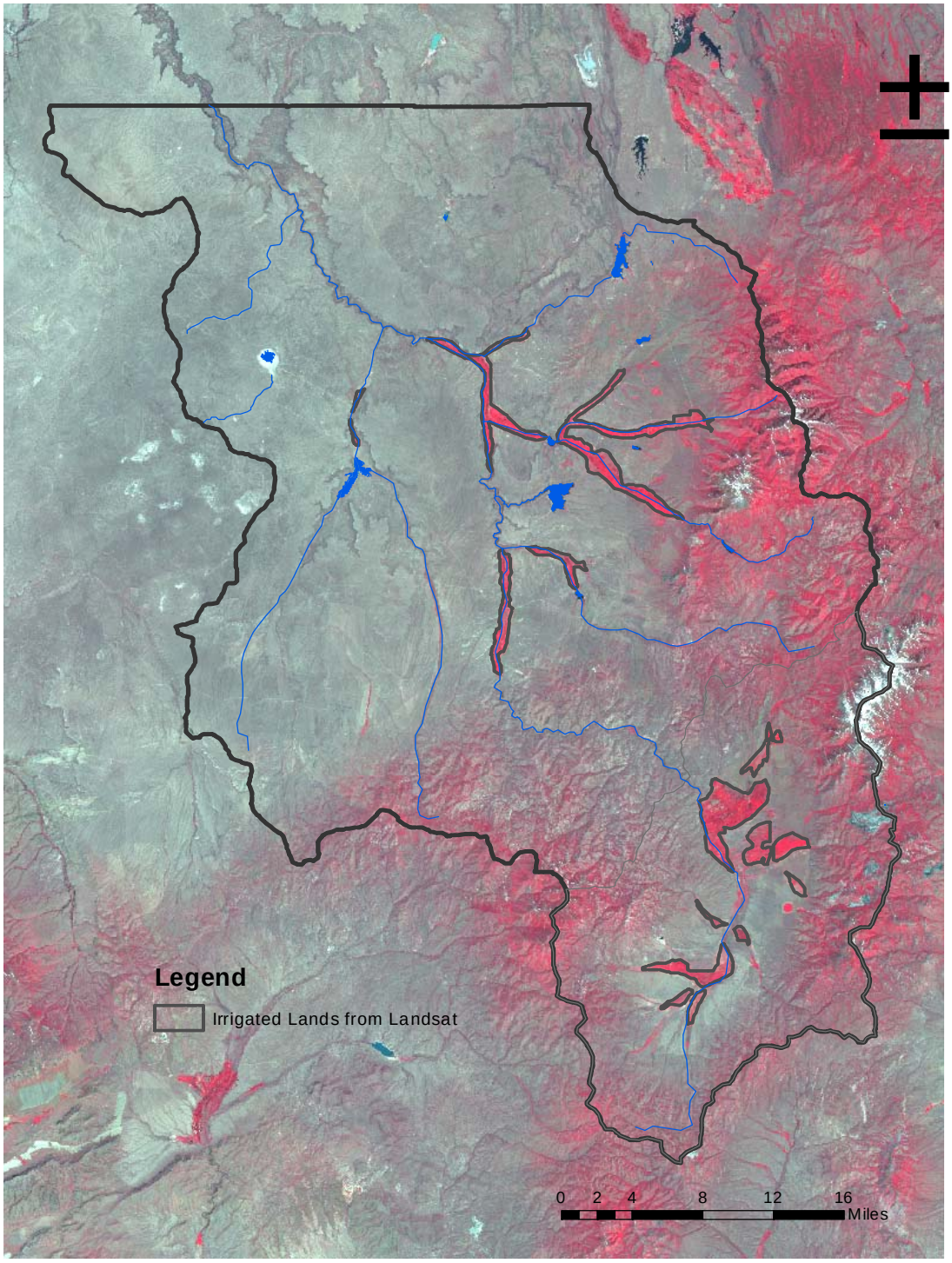


**Figure 10. Approximate Irrigated Lands In South Fork Owyhee River Basin**

## Summary of *DRAFT Owyhee Subbasin Plan*

In 2004, a voluminous (over 1000 pages) draft document was produced by the Shoshone-Paiute Tribes and the Owyhee Watershed Council (2004) for the Northwest Power and Conservation Council. Much of the focus is on redband trout. The desired outcomes for this effort are: 1) a professional, comprehensive and science-based fish and wildlife assessment/plan; and 2) a comprehensive, locally-supported management plan for fish and wildlife resources. Following is a summary of their key findings and conclusions as pertains to the Nevada-portion of the South Fork Owyhee River:

- Redband trout are found in 1,623 miles of streams in the Nevada portion of the Owyhee Subbasin (includes South Fork Owyhee basin and Jarbidge basin). Figure 1.3 in the Owyhee Subbasin Plan shows redband trout within the entire South Fork Owyhee River and some of the tributaries.
- Proper Functioning Condition (PFC) surveys were performed. The SF Owyhee below USGS Gage 13177800 was identified as "Functioning at Risk Downstream". Other small reaches were identified as either "Functioning at Risk - Trend Not Apparent" or "Non-functioning".
- According to the Bruneau Subbasin Assessment (another related document produced for the Northwest Power and Conservation Council), redband trout are adapted to fluctuations in stream flow and water temperature typical of desert streams and are more tolerant of modifications in flow and temperature than other salmonids.
- With input from Nevada area experts, Qualitative Habitat Assessments (QHAs) were performed for streams within the South Fork Owyhee watershed. Four reaches (see Figure 11) plus numerous tributaries were scored for 11 different characteristics thought to be the main "drivers" of fish (redband trout) production and sustainability:

    - Riparian condition
    - Channel stability
    - Habitat diversity
    - Fine sediment load
    - High flow
    - Low flow
    - Oxygen
    - Low temperature
    - High temperature
    - Pollutants
    - Obstructions

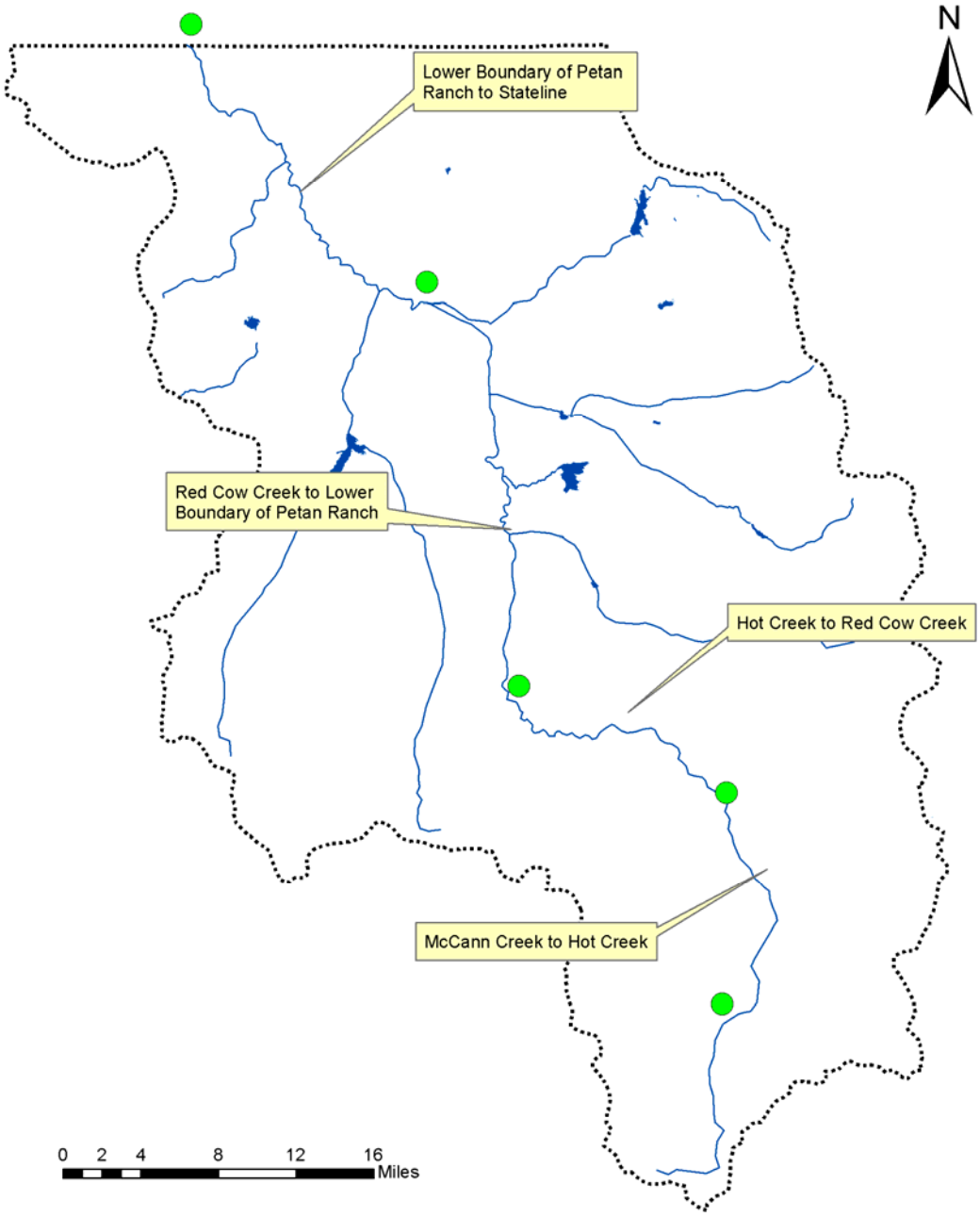


**Figure 11. Qualitative Habitat Assessment Reaches**

Each characteristic was assigned a score from 0 (0% of potential without disrupting existing infrastructure that is vital to society and that is likely to remain in place for the foreseeable future) to 4 (100% of potential without disrupting existing infrastructure that is vital to society and that is likely to remain in place for the foreseeable future).

Table 6 summarizes the results of the QHA for the South Fork Owyhee River. It is interesting to note that obstructions (irrigation diversions,etc.) were considered the most limiting factor for redband trout in the system. "High temperature" scored 3.0 (75% of potential without disrupting existing infrastructure that is vital to society and that is likely to remain in place for the foreseeable future) throughout the entire South Fork. "Low flows" were scored at the highest value (4.0). Riparian conditions ranged from 2.0 to 2.5. The worst "channel stability" scores (2.0) were for the 2 reaches with the most irrigation activity (McCann to Hot Creek; Red Cow Creek to lower boundary of Petan Ranch. The best "channel stability" score (4.0) was for the reach below Petan Ranch through the canyon. All four reaches scored 2.5 for "habitat diversity".

**Table 6. Summary of Qualitative Habitat Assessment for South Fork Owyhee River**

| Reach | Comments | Lowest Scores | "High Temperature " Scores | Limiting Factor |
|---|---|---|---|---|
| 1) McCann to Hot Creek | Brook trout present in spring heads, Redband trout are seasonal, mountain whitefish present year around. | Obstruction (1.0) | 3.0 | Obstruction |
| 2) Hot Creek to Red Cow Creek | Redband trout present year around, low density | High flow (2.0)<br>Obstruction (2.0) | 3.0 | Obstruction |
| 3) Red Cow Creek to lower boundary of Petan Ranch | Redband trout present seasonally (spring) during good water years when suitable temperatures exist. | Riparian condition (2.0)<br>Channel stability (2.0)<br>High flow (2.0)<br>Obstruction (2.0) | 3.0 | Obstruction |
| 4) Lower boundary of Petan Ranch to Stateline | | High flow (2.0)<br>Obstruction (2.0) | 3.0 | Obstruction |

Numerous tributaries were also scored during the QHA. "Obstructions" was the most common limiting factor for tributaries. "High Temperatures" scores ranged from 3.0 to 4.0 for the tributaries. "Riparian condition" scores ranged from 1.5 on Sheep Creek to 2.0 on Deep Creek to 3.0 on Harrington Creek.

## BLM Assessments

A portion of the South Fork Owyhee River lies within the Owyhee Allotment managed by the Elko Bureau of Land Management Field Office. Following is a summary of their habitat conditions assessments for 5 different reaches (Figure 12) (Elko BLM 2000):

Reach 1 (Surveyed in 1977, 1986, 1995)

1. Reach 1 has the best potential for improvement within the Owyhee Allotment. Floodplain width is significantly greater here than for Reaches 3 and 4. Cattle have access to all stations within this reach.
2. Lack of clean streambottom substrates remains a significant problem.
3. Improvement in the riparian zone has improved from 1977 to 1995, however mature willows remain lacking. The scouring action of the river may limit willow establishment, however, grazing is also an important influence.

Reach 2

1. Reach 2 is within private land and no habitat condition information was collected during 1995. However, visual observation in 1998 and 1999 indicate aquatic and riparian habitat conditions are poor.

Reach 3 (Surveyed in 1977, 1987, 1995)

1. Reach 3 is entrenched and is laterally confined between canyon walls.
2. A lack of overhanging vegetation indicates willows are not becoming established as a result of late season grazing and/or hydraulic scouring.

Reach 4 (Surveyed in 1977, 1987, 1995)

1. Located in a very rugged canyon area. Floodplain development is limited by steep canyon walls.
2. Although livestock grazing impacts are evident in accessible areas, riparian zone development is limited by scouring associated with concentrated flood flows within an entrenched channel.
3. Willows in excess of 2 feet are absent where cattle have access. In areas inaccessible to grazing, a moderately dense corridor of older willow are present.

Reach 5 (Fourmile Pasture) (Surveyed in 1977, 1987, 2000)

1. As with other segments of the SF Owyhee River within the Owyhee Allotment, this segment is situated within a narrow, rocky canyon.
2. In 2000, a proper functioning (PFC) assessment was completed on about a two mile stretch of this reach. The entire reach was rated as nonfunctional due to channel entrenchment, excessive sedimentation, unstable streambanks, and the nearly complete absence of a riparian zone. All plant growth that had occurred during the previous year had been cropped down to a one inch or less stubble height by livestock.

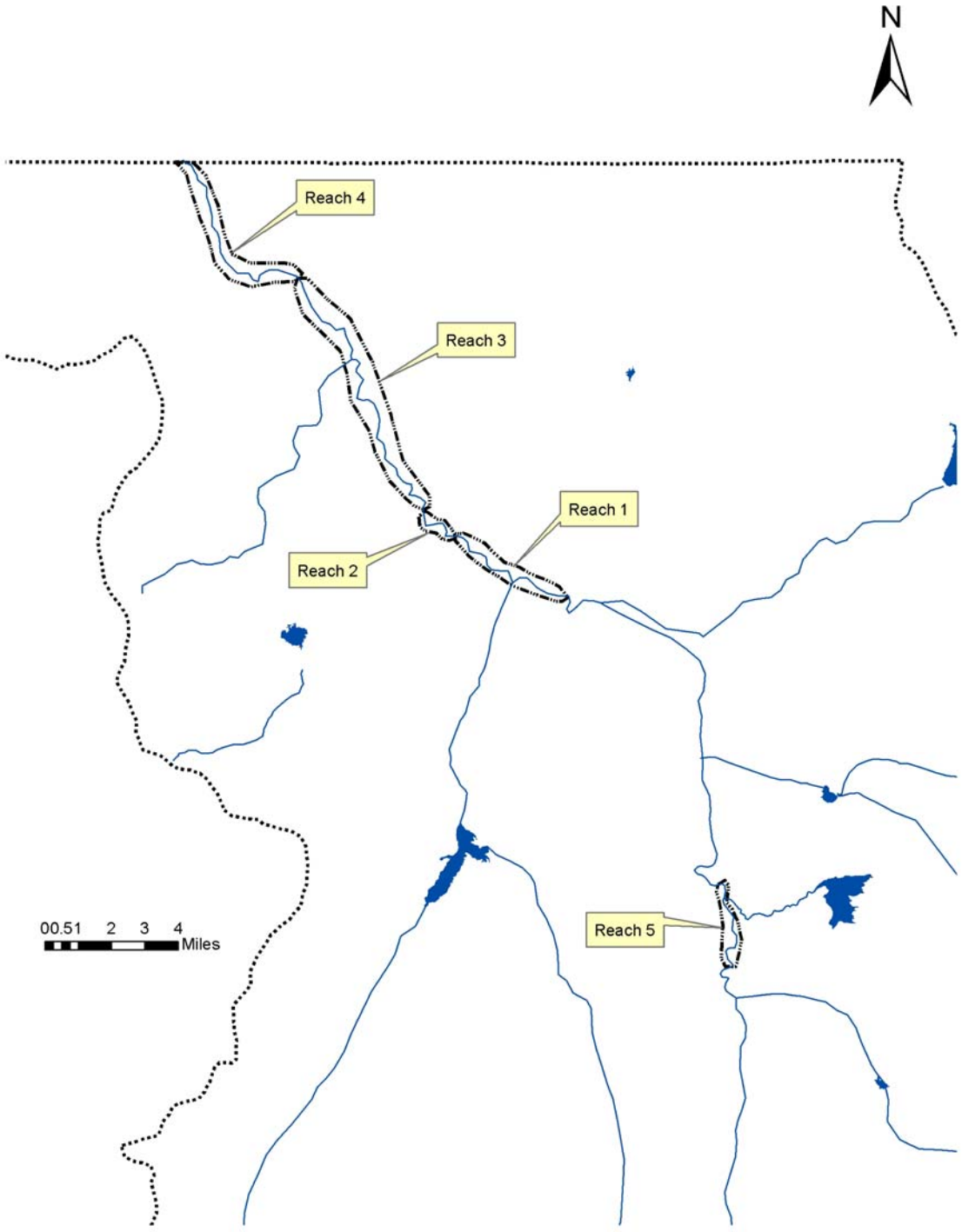


**Figure 12. BLM Habitat Assessment Reaches**

## Summary

Some observations:

- The data show that the temperature standard (21 degrees C) is exceeded for extended periods of times during various flow conditions. Major factors leading to the elevated temperatures are likely: channelization, limited riparian vegetation in areas, and flow diversions for irrigation. One question to ask ourselves is "Can measures be taken to meet the temperature standard in the river?" Unfortunately, it is not possible to accurately determine what temperature levels could be achieved under various restoration scenarios (or could be expected under natural conditions) ***without spending significant funds for monitoring and model development.*** Until such work could be done, it becomes difficult for us to develop appropriate temperature standards and/or a TMDL that appropriately defines source mitigation needs. Another problem is that significant stretches of the river are on private land and have been channelized. Not surprising, the QHA ranked channel stability as low in the irrigated lands areas. It is likely that obtaining access permission to these areas would be difficult.
- A condition of TMDL approval is that the Load Reduction would result in compliance with water quality standard. To accurately define that linkage is $$$$$$$$. We could probably come up with some BTU loading reduction, but what would it really mean in terms of channel/corridor improvements?
- BIG QUESTIONS: What is the property owners motivation for wanting to improve the channel/riparian condition? Where would the funds come from for such an expensive endeavor? Would water rights need to be purchased to maintain higher flows?
- We don't need any huge monitoring/modeling effort (or a TMDL) to tell us that a good goal would be to return the river to a more natural state with meanders and riparian vegetation. We could spend millions of dollars on studies and basically arrive at the same conclusion (but with more details).
- According to NDEP files, the current temperature standard was set to protect rainbow trout. Under the current standards review process, the needs of the redband trout should be considered.
- Some constraints:
    - If we wanted to pursue more detailed work:
        - Numerous locations and tributaries would need to be monitored – temperature and flow
        - Much of the property is on private land likely making access difficult.

## References

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