Date: June 25, 2018

From: Kurt Walker (Technical Unit)

To: Trevor Hutton, John Kirk, and the File

RE: Update to Ecology's 1991 Thompson Creek – Methow River Closed Tributary Report

Background & Purpose

Under WAC 173-548 (the Rule), 15 tributary streams and 17 lakes within the Methow River Basin are closed to further consumptive appropriations unless covered by a specified reservation. This closure included "all groundwaters hydraulically connected" to these streams and lakes. The Department of Ecology (Ecology) investigated the groundwater resources within the tributary basins from the headwaters to the main Methow River valley margin. In 1991, Ecology staff assembled broad technical findings into a collection of small reports. However, these reports failed to fully describe the stream reach behavior and controls from the mouth of each tributary bedrock canyon to the confluence with the Methow River. Ecology is now providing additional information in an effort to update the record and provide a more complete understanding of the hydraulic relationship between surface and groundwater in the Thompson Creek basin.

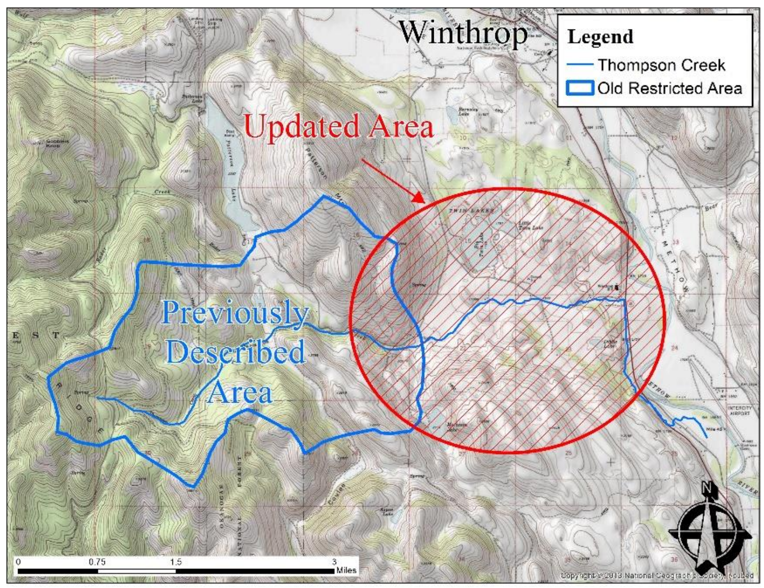

Figure 1 – Previously evaluated and described area of the Thompson Creek watershed in blue outline. Area of study and updated assessment within red hatched ellipse.

The occurrence and behavior of groundwater within the main Methow River Valley has been evaluated by many including Ecology and the U.S. Geologic Survey. The reader is directed to these works for a more holistic description of the hydrogeology of the main Methow River Valley. The focus of this report will be on the local hydrologic conditions and behavior in the lower Thompson Creek watershed primarily between the previously described restricted area and the Methow River.

Investigation

Among the key conclusions of the 1991 closed tributary reports, Ecology found that groundwater within the unconsolidated sediments outside the main Methow River Valley are, more likely than not, in hydraulic continuity with the tributary stream (Peterson and Larson 1991). Groundwater within the bedrock units was generally not considered to be in hydraulic continuity with the stream. There is currently no effort to re-investigate these conclusions. However, Ecology recognizes the need to extend our understanding beyond the previously described areas to also include the lower most reaches of some closed streams.

The Thompson Creek watershed is one of the smallest of the listed closed tributary streams under the Methow Rule. Historically, Ecology has not considered groundwater in the lowest portion of the watershed, approximately two stream miles above the main Methow River Valley, to be part of the restricted area under rule. As part of our current evaluation, Ecology staff performed field investigations and collected data within the Thompson Creek Basin on three occasions (September 2017, April 2018, and June 2018).

Geologic information was attained, well locations were identified, boundary conditions were observed, and the flow paths of Thompson Creek were identified.

Geologic – Hydrogeologic Conditions

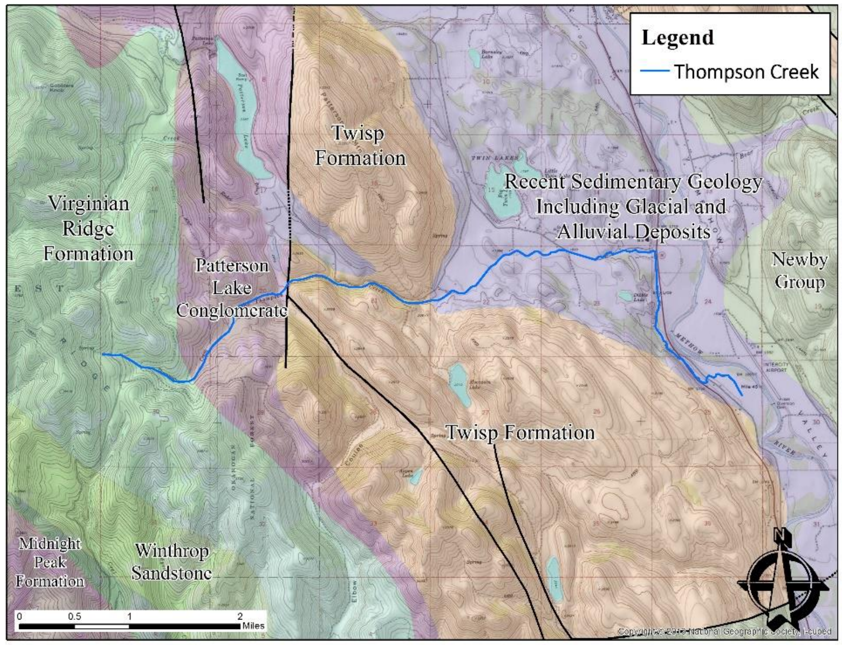

Figure 2 – WA Deptment of Natural Resources Geology of Thompson Creek area, major faults shown in black.

The Thompson Creek watershed drains a diverse area of rugged mountains, rolling hills, and narrow fertile valleys. The complex of bedrock strata that underlies the basin is exposed along numerous ridges and creek channels (Bunning, 1990)(see Figure 2). While the upper watershed is largely forested, the lowland stands of trees are sparse and less dense. Glacial-fluvial sediments and soils covering the land are often thicker than many Methow Valley tributaries, but are still typically thin (less than 200 feet) throughout the watershed. In contrast, the landscape of the main Methow River Valley consists of gentle slopes, broad terraces, and wide plains. Bedrock topography in the main valley has been extensively sculpted by glacial activity in to a U-shape profile with steep walls, smaller glacial side channels, and a deep floor (Barksdale, 1941). The main valley also hosts many large scale glacial deposits which are not found in the upper reaches of the Methow River tributary.

The upper Thompson Creek watershed is closely constrained by bedrock walls and floor (see Figure 2). Under this condition, groundwater within the glacial-fluvial sediments has a direct recharge/discharge relationship with Thompson Creek and other surface waters features within the watershed. At the margin of the main Methow River Valley the groundwater relationship with Thompson Creek changes. As the creek enters the main valley it is no longer constrained by near surface bedrock, but flows over an alluvial fan and thick glacial deposits before being fully captured by the Fog Horn Irrigation Ditch at Highway 20.

Well logs across the watershed were analyzed in order to better understand the local hydraulic conditions. Besides the Pine Forest Homeowners authorized under G4-24031, the few wells drilled on the upland slopes are completed exclusively into bedrock. In contrast, according to Ecology's well log data base, over 200 wells have been drilled into the glacial-fluvial sediments in the lower reaches of the watershed, mostly for domestic purposes. While glacial-fluvial wells are located throughout the lower watershed, they are concentrated around the Twin Lakes. The Twin Lakes are prominent, but shallow, kettle lakes which are part of a group of notable glacial deposit landforms found in the lower Thompson Creek watershed.

The ice carved channel between Highway 20 and Patterson Mountain is host to moraines, kettles, and eskers deposited by Cordilleran Ice Sheet occupation in the Methow Valley. The surface features including kettles and undulating topography are a result of rapid down-wasting of ice during the late phases of glaciation (Riedel, 2017). Collectively, these deposits establish a highly diversified, irregularly stratified package of glacial-fluvial sediments which host groundwater. A large number of groundwater users depend on this source. Additionally, the local kettle lake surface levels are directly correlated with groundwater elevation. For purposes of this report, this groundwater source will be called the Twin Lakes Aquifer (TLA). It is apparent from available geologic documents and reports that the TLA is a highly heterogeneous sediment aquifer that is horizontally restricted by bedrock to the east and west, and vertically constrained at an uncertain depth. An analysis of groundwater elevation data shows a clear pattern of where the TLA is recharged (higher elevations) and where it discharges (lower elevations). Figure 4 illustrates a generalized occurrence and movement of groundwater within the TLA.

Figure 3 – Photo taken June 2018 showing Big Twin Lake and Lower Thompson Creek area landscape, looking north.

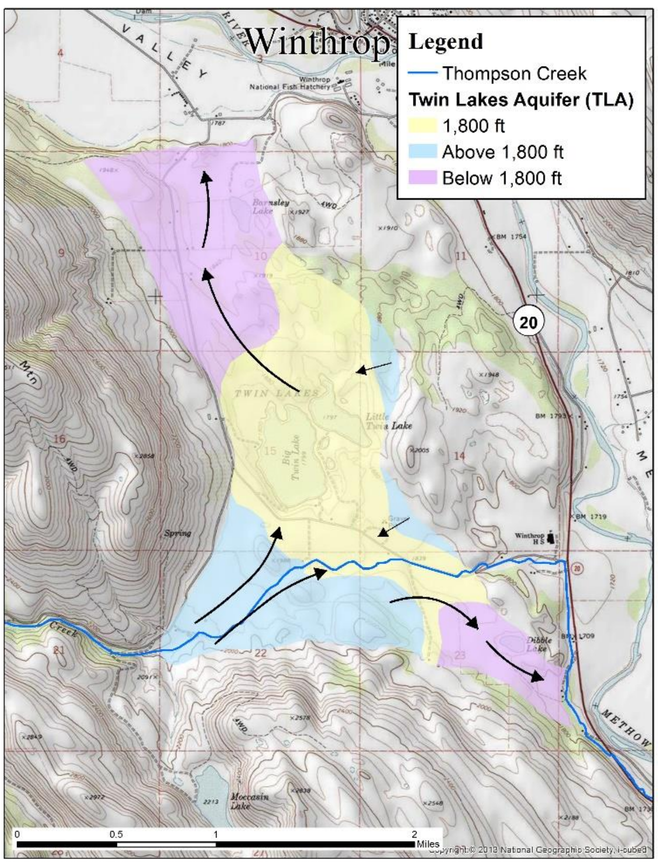

Figure 4 – Overview of groundwater occurrence and relative static water level of the Twin Lakes Aquifer. Arrows point in the area of generalized groundwater flow.

Recharge occurs primarily from Thompson Creek seepage losses, mountain front runoff, bedrock channel subsurface flow and direct precipitation. Lesser amounts of recharge occurs via return flow from intensively irrigated agriculture from the Thompson Creek water users and Wolf Creek Irrigation District. TLA discharge occurs to the glacial-fluvial sediments near the Methow River along the old ice channel (see Figure 4) and to the numerous glacial-fluvial constructed wells. Historic records shows groundwater elevations within the TLA, as evidenced by kettle lake elevations, may fluctuate many tens of feet due to prevailing climatic conditions. While it is possible that significant changes in land use or irrigation practices may also effect the groundwater level to a minor extent, it is unlikely to noticeably affect the recharge/discharge behavior of the TLA.

The glacial-fluvial aquifer within the main Methow River Valley has been thoroughly studied by the US Geological Survey, Ecology, and many others. For purposes of this report, it is referred to as the main valley aquifer (MVA). The MVA is distinguished in part due the limited amount of fine material, unlike the upland deposits which often contain more silts and clays (Konrad et al, 2003). It is broadly accepted that the glacial-fluvial MVA and the Methow River are in a high degree of hydraulic continuity. Exact exchange of water (gains and losses) between surface and groundwater will vary by location and season, but the condition is well documented. Near Winthrop, the TLA discharges as subsurface flow to the MVA along the upstream and downstream ends of the previously mentioned old ice channel that runs parallel to the current trace of river.

The hydraulic conductivity of the MVA is generally regarded as high with the river. Konrad and others (2003) show the river as gaining upstream of Winthrop but transitioning to seasonally variable between gaining and loosing from Winthrop to Twisp. While the MVA elevation may change seasonally, the aquifer and river condition results in a relatively flat groundwater water table that extends across the width of the main valley aquifer with a steady gradient down river. Groundwater elevation may be slightly elevated along the margins of the MVA as result of side drainage sub-surface recharge as is the case near the TLA outflow locations.

Updates to Restricted Area Map

It appears the historic restricted groundwater use area map contained some small inaccuracies. A small portion of Elbow Coulee south of Thompson Creek had been incorrectly included within the Thompson Creek watershed. Alternatively, the drainage that includes Moccasin Lake has been included since it directly contributes to Thompson Creek. Corrections were made to the restricted area maps to clarify the issue (see Figures 5 and 6).

The updated restricted area map (Figure 5) reflects a best estimate of where withdrawal of groundwater within the glacial-fluvial sediments may impact Thompson Creek flows. An evaluation of the available geologic information clearly implies that the groundwater within the glacial-fluvial sediments are hydraulically connected to Thompson Creek within the headwaters to a point slightly east of the axial trace of Patterson Mountain (see Figure 5). At this point Thompson Creek flows over an alluvial fan and areas of increased depth to bedrock and the creek becomes disconnected from groundwater. While substantial flow and subsurface flow from the upper reach of Thompson Creek is lost to the TLA, the majority is ultimately returned to MVA and contributes to the Methow River. Therefore, groundwater withdrawn from the TLA is not expected to negatively affect Thompson Creek flows, but will impact water availability in the MVA and Methow River.

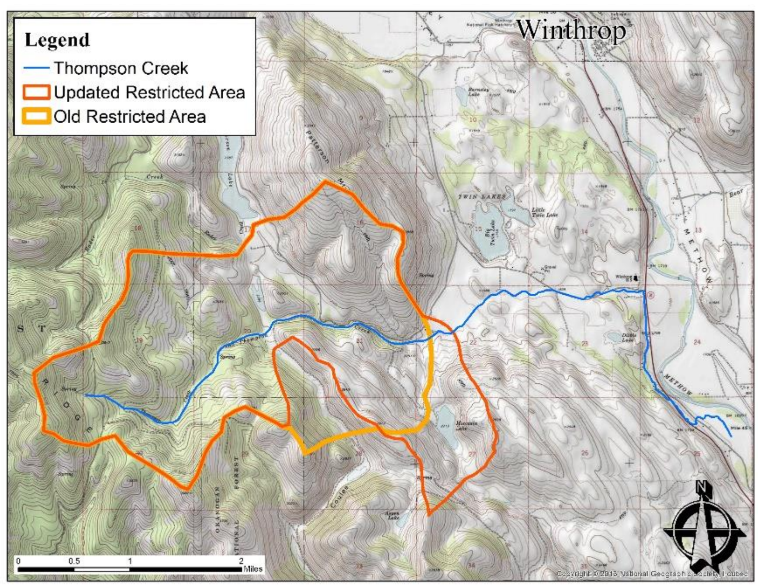

Figure 5 – Thompson Creek restricted groundwater area with update. Entire watershed shown. See Figure 6 for close up view of changes to historic delineation.

Findings

Ecology previously found and continues to recognize that groundwater in the glacial-fluvial sediments from the uplands to the west margin of the TLA are hydraulically connected to Thompson Creek as depicted in Figure 5. Considering the geologic setting, recorded static water levels, recent field observations, and previous technical reports, it is strongly evident that groundwater in approximately the lowest two miles of Thompson Creek becomes disconnected and hydraulically separated from the deeper groundwater of the TLA. While disconnected from the streamflow of Thompson Creek, groundwater within the TLA ultimately discharges to the MVA which is undoubtedly hydraulically connected to the Methow River.

Limitations

Ecology has conducted this work with the intent of providing a general description and interpretation of the subsurface stratigraphy and hydraulic behavior within the aforementioned study area containing Thompson Creek. While we hope this work will be useful to Ecology managers and other parties considering water management decisions, we caution that additional investigation may be warranted depending on the degree of certainty needed and the information available in site specific cases.

This technical analysis has been prepared in effort to update our understanding of groundwater and surface water interactions in the Thompson Creek drainage, WRIA 48, Okanagan County, Washington. Because each hydrogeologic study is unique, each hydrogeologic analysis is unique and is based on conditions that existed at the time the investigation was performed. The findings and conclusions of this analysis may, however, be affected by the passage of time as a result of either manmade or natural events.

The practice of geology, geological engineering and hydrogeology are far less exact than some engineering or natural science disciplines. Interpretations of subsurface conditions presented in this report are based on available data. Professional judgment was applied to form an opinion about subsurface conditions throughout the area of interest. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Thus, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

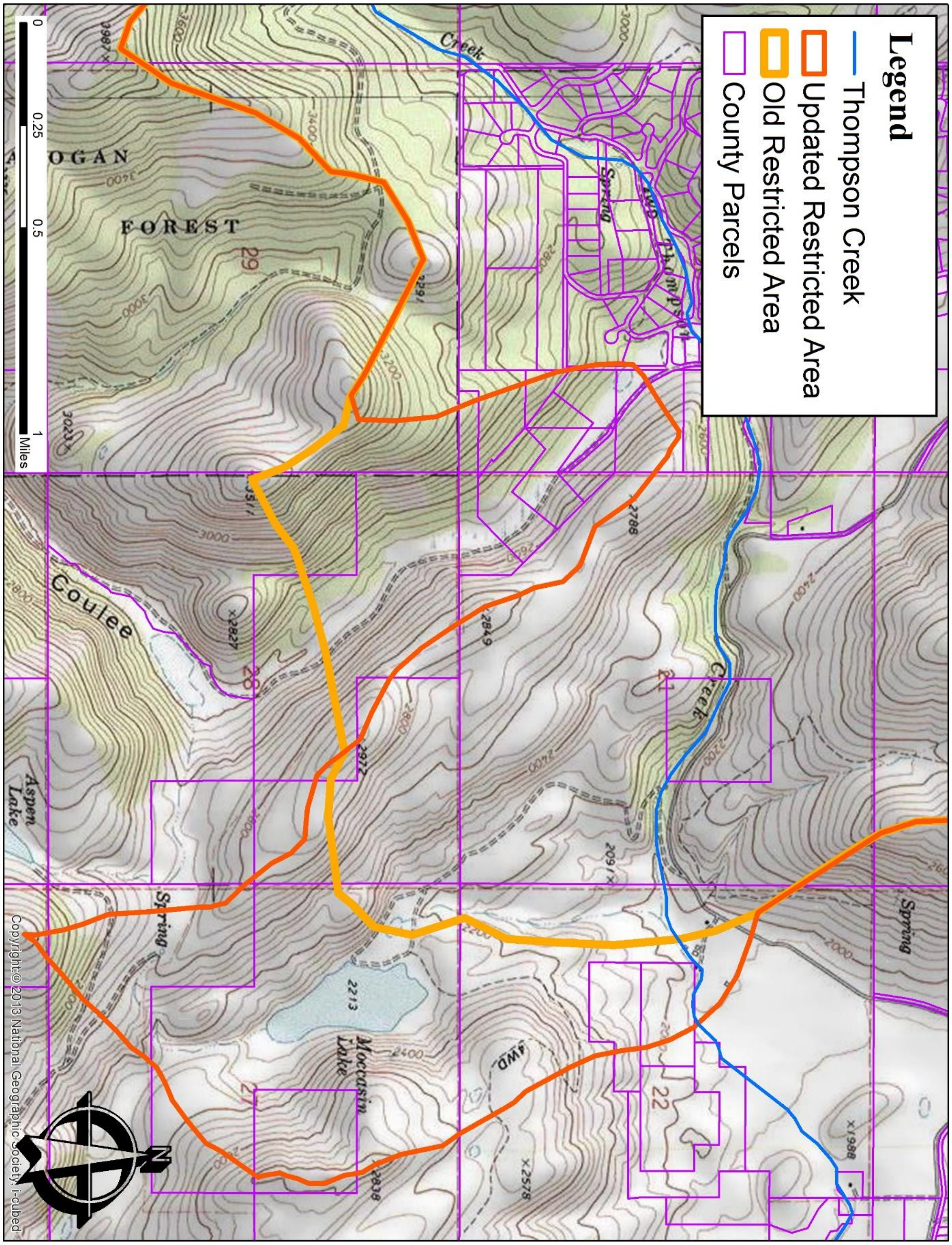

Figure 6 – Close up view of Thompson Creek restricted groundwater area. County parcels in purple included for convenience.

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