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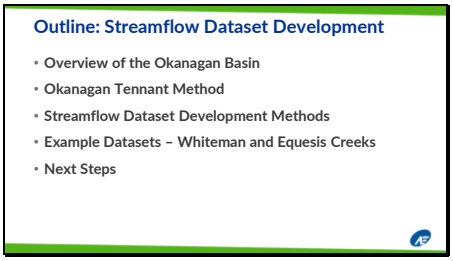

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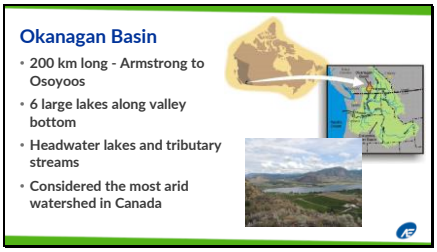

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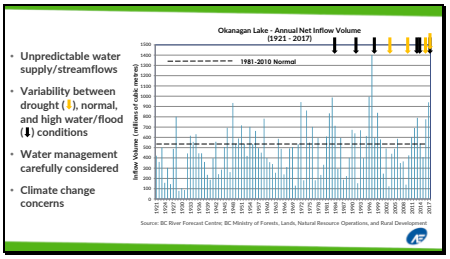

One of the biggest challenges in the Okanagan Basin is that we never know how much water we're going to get from one year to the next. The Okanagan's natural variability is as much a characteristic as its dryness. As a result, we have to plan for everything.

An example of this natural variability is reflected though annual net inflows into Okanagan Lake. Drought and floods occur and in more recent times droughts and floods are occurring in the same year.

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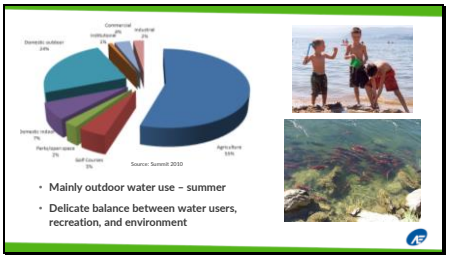

Balancing the often competing water requirements of the environment, basic human needs, irrigation, tourism, recreation, industry and cultural values has become increasingly difficult as more and more people live, work, and play in the Okanagan. There are currently about 325,000 residents in the valley, and the population grows and shrinks depending on whether it's ski season, boating season, or wine festival season. We expect to grow steadily for the foreseeable future.

In the Okanagan, 85% of our water is used outside for irrigation during the hottest and driest time of the year. There are about 20 water suppliers with more than 500 connections, and around 100 suppliers with less than 500 connections.

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In February 2016, the *Water Sustainability Act* (WSA) was implement to support water management in BC. Included within the WSA was the consideration of Environmental Flow Needs (EFNs) within water management decisions – to ensure aquatic resources were thoroughly considered in any/all decisions/plans.

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No specific EFN-setting methods were outlined within the WSA, so in 2016 the Okanagan Basin Water Board (OBWB) led a collaborative effort with BC Ministry of Forests, Lands, and Natural Resource Operations and Rural Development (FLNRORD), Okanagan Nation Alliance, and local consultants to develop EFN-setting methods for application in the Okanagan Basin. Two methods were developed – Okanagan Tennant Method (desktop) and Okanagan Weighted Useable Width Method (field based).

The Okanagan Tennant Method is to be used as an initial approach to EFN-setting and/or for lower risk watersheds (i.e., limited water use). Streamflow information is required to support the Okanagan Tennant Method.

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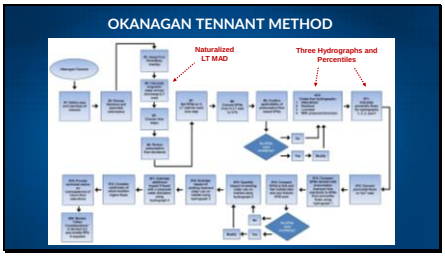

The following summarizes the 20-step Okanagan Tennant Method. Several streamflow values are required to support the method – Long-term mean annual discharge (LTMAD) and weekly streamflow values under naturalized, residual, and maximum licensed conditions.

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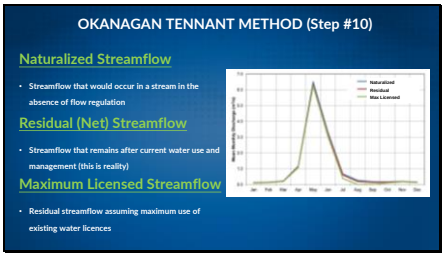

Summary of required streamflows needed to support the application of the Okanagan Tennant Method. The figure provides a graphical representation of the streamflows. Maximum licensed streamflows can be different than residual streamflows, since not all water suppliers currently use their full licensed volumes. For example, some water suppliers in the Okanagan Basin currently use 30-50% of their full licensed volumes.

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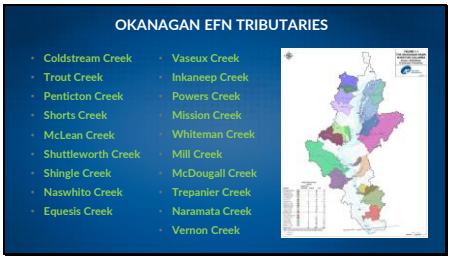

As part of the EFN-setting exercise led by the OBWB, 19 priority watersheds were identified by the OBWB, ONA, and FLNRORD. The watersheds cover the geographic variability of the Okanagan Basin, as well as include the watersheds with the heaviest water use and important historic and current fisheries values.

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The challenge with the application of the Okanagan Tennant Method within the Okanagan Basin (and the 19 priority EFN watersheds) is that there is limited historic and/or current streamflows recorded by the Water Survey of Canada and/or independent data collectors. Most of the EFN priority watersheds have streamflow records, but the records may be from historic periods, are short, are located at different points-of-interest, and record natural or residual streamflows. Thus, additional efforts are required to develop the necessary streamflow datasets for the Okanagan Tennant Method.

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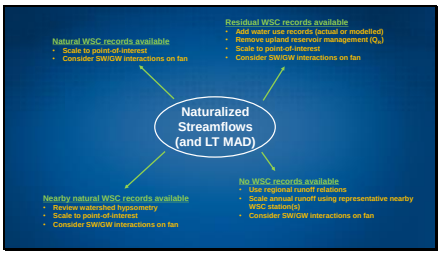

Within the Okanagan Basin, natural and/or residual streamflow records may be available for a watershed, but there are also situations where no streamflow records are available. Thus, there is a variety of methods (and largely watershed specific methods) that need to be applied to develop naturalized streamflows to support the Okanagan Tennant Method.

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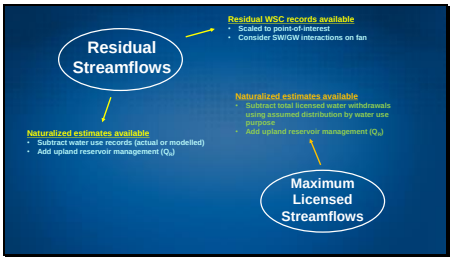

Similarly, different methods are also required to develop residual streamflow estimates due to limited information available. For the maximum licensed streamflow scenario, this is a calculated value using naturalized and/or residual streamflows records since the majority of watersheds do not experience full licensed withdrawals – yet.

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In addition to the challenge with limited historic and current streamflow records within the Okanagan Basin, a detailed understanding of water management is needed per watershed to apply the Okanagan Tennant Method. Okanagan Basin watersheds have varying levels of water management and limited water use, water transfer, and reservoir management records. Similarly, a limited understanding of groundwater / surface water interactions within watershed and across alluvial fans is known. All of this information is needed to be known/estimated to apply the Okanagan Tennant Method.

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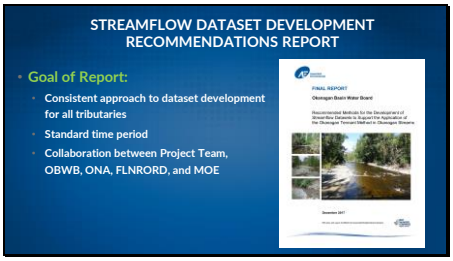

Due to the varying amount of streamflow records and water management information available throughout the Okanagan Basin, a report was commissioned by the OBWB to outline a consistent approach to streamflow dataset development in support of the Okanagan Tennant Method. The report was a collaborative effort between local consultants, OBWB, ONA, FLNRORD, and MOE to ensure that all parties were in agreement with the approach(es), standard time period for dataset development, and necessary assumptions.

The report provides a general approach to streamflow dataset development regionally within the Okanagan Basin, as well as individual methods for each of the 19 priority EFN watersheds.

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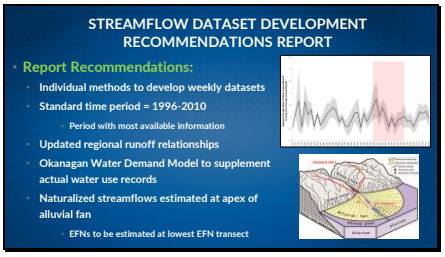

The recommendations report reviewed previous streamflow dataset development approaches (used within the Okanagan Basin) and available water management information. Several recommendations were outlined and included a standard time period, necessary hydrologic scaling approaches, and available models to be used to fill data gaps and/or supplement limited datasets.

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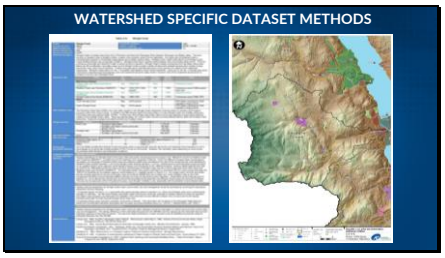

Example of recommended methods for Shingle Creek watershed (an EFN priority tributary). Similar deliverables were developed for each EFN priority watershed within the Okanagan Basin – which include a detailed approach for developing streamflow datasets, as well as a map delineating the watershed and highlighting all points-of-diversion, reservoirs, and other important watershed/data source characteristics.

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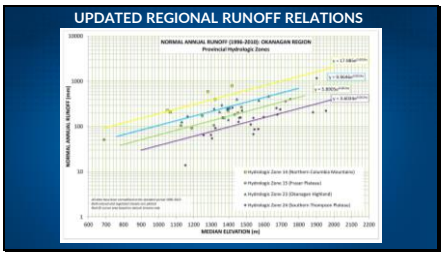

To develop streamflow datasets for application of the Okanagan Tennant Method, hydrologic scaling is necessary since limited historic and/or current hydrometric records are available at streamflow points-of-interest (i.e., apex of alluvial fan, EFN transects). Thus, median elevation - runoff relations previously established by MOE (i.e., Obedkoff 1998) were updated and normalized to the recommended standard time period (1996-2010).

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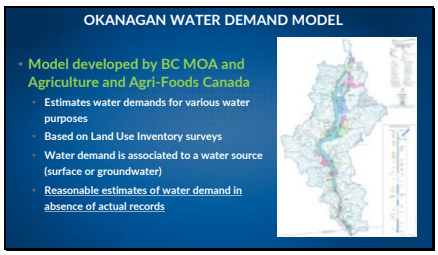

Limited information is available on water use in the Okanagan Basin. Some water suppliers have historic/current records of diversions to support user needs; however, many suppliers and private landowners do not. Thus, the Okanagan Water Demand Model (OWDM) was developed by the BC Ministry of Agriculture and Agriculture and Agri-Foods Canada to support the estimation of water demands in the Okanagan Basin for various water use purposes. For the Okanagan Basin, water use distribution areas have been defined (by water supplier) based on agricultural land use inventory surveys.

The OWDM provides reasonable estimates of water demand in the absence of actual records and are used to support the development of naturalized and residual streamflow datasets in the application of the Okanagan Tennant Method.

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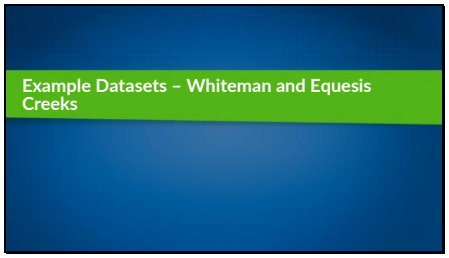

Examples of resultant streamflow datasets to support the application of the Okanagan Tennant Method – following the streamflow dataset development methods outlined within recommendations report.

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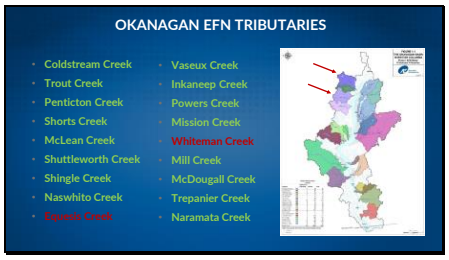

Example streamflow datasets developed for Whiteman and Equesis Creek watersheds – both watershed located within the northern part of the Okanagan Basin. These watersheds are examples of the variability of water management within the Okanagan Basin – Whiteman Creek (limited water use and no managed upland reservoirs) and Equesis Creek (upland managed reservoir and water use on alluvial fan).

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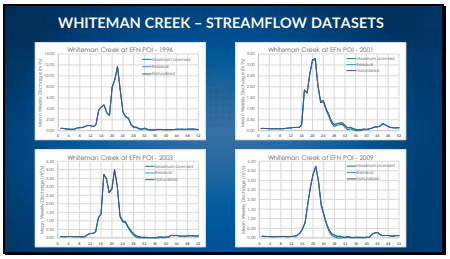

Example Whiteman Creek watershed streamflow datasets for selected years within the standard period (1996-2010). Note limited water use within the watershed, so all naturalized and residual/maximum licensed streamflows are not largely different.

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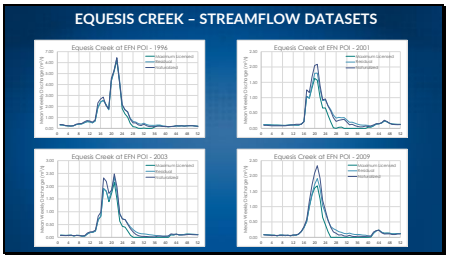

Example Equesis Creek watershed streamflow datasets for selected years within the standard period (1996-2010). Note watershed has a moderate sized reservoir in the headwaters and sizeable water use on the lower reaches (i.e., alluvial fan). Difference in streamflow pattern(s) than Whiteman Creek – higher streamflows in the summer due to reservoir supplementing streamflows and water licensing resulting in low streamflows (under maximum licensed streamflow scenario).

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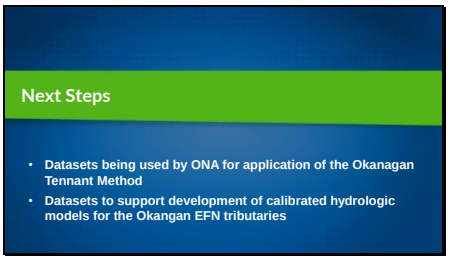

For the Okanagan EFN-setting project, streamflow datasets are being developed to support the application of the Okanagan Tennant Method by the ONA. The Project Team developing the streamflow datasets are currently working with the ONA to finalize the datasets to ensure that all site specific and anecdotal watershed information/knowledge is captured appropriately to reflect historic/current conditions.

The finalized streamflow datasets will also be used to support the calibration of hydrologic models being developed for the 19 priority Okanagan EFN watersheds. This is a new OBWB project to be completed in late-2019 to support water management decisions and drought and flood planning in the Okanagan Basin.

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Acknowledgements
• Okanagan Basin Water Board
• Okanagan Nation Alliance
• BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
• BC Ministry of Environment