Abbotsford Mission
Water & Sewer Services

# Water Source Options

## 2012 Public Consultation Guide Booklet: A Starting Point for Discussions

May 2012

our water matters
Your **opinion** matters

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# Introduction

Abbotsford and Mission are growing communities. Eventually, the municipalities will require additional potable water beyond what can currently be provided by the existing water sources and infrastructure. In anticipation of such a time, the Abbotsford Mission Water & Sewer Commission (AMWSC) and its predecessor, the Central Fraser Valley Water Commission (CFVWC), have investigated future water source options over the past 20 years. With the lack of approval for the Stave Lake Water Supply project, as proposed in 2011, it is necessary to re-examine options.

Past source option reviews and recommendations have hinged upon the assumption that the AMWSC would provide a water supply solution that best meets long-term needs (i.e. for 50 to 100 years) at the lowest lifecycle cost. However, considering that such long term solutions come with significant up-front capital costs, the 2012 source option review will also contemplate shorter-term (5 to 20 year) interim steps that may be more immediately affordable.

This booklet is intended to introduce customers to the key factors that should be considered when selecting a new water source and then explains how various Fraser Valley sources hold up against those criteria.

It is important to understand that this exercise does not yet contemplate the timing for developing a new source and the associated infrastructure. AMWSC staff will simultaneously revisit future water demand projections and develop a water efficiency plan during 2012. Outcomes from these two activities will define when new water source development would need to begin.

# Existing Water System
## Facts & Map

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### History

Prior to the 1980s Mission was supplied with water from Cannell Lake, while Abbotsford (including former District of Matsqui) relied exclusively on groundwater. The Norrish Creek source was developed in the 1980s by the CFVWC. Ownership of the system transferred to Mission and Abbotsford in 2005. The AMWSC was formed, with the City of Abbotsford designated to oversee system capital projects, operations, and maintenance.

### Today's Customers

The regional system supplies water to the District of Mission and the City of Abbotsford.  Approximately 135,000 residents are serviced by the system. Industrial, commercial, institutional and agricultural customers account for an additional equivalent population of approximately 80,000 people.

### Main Components

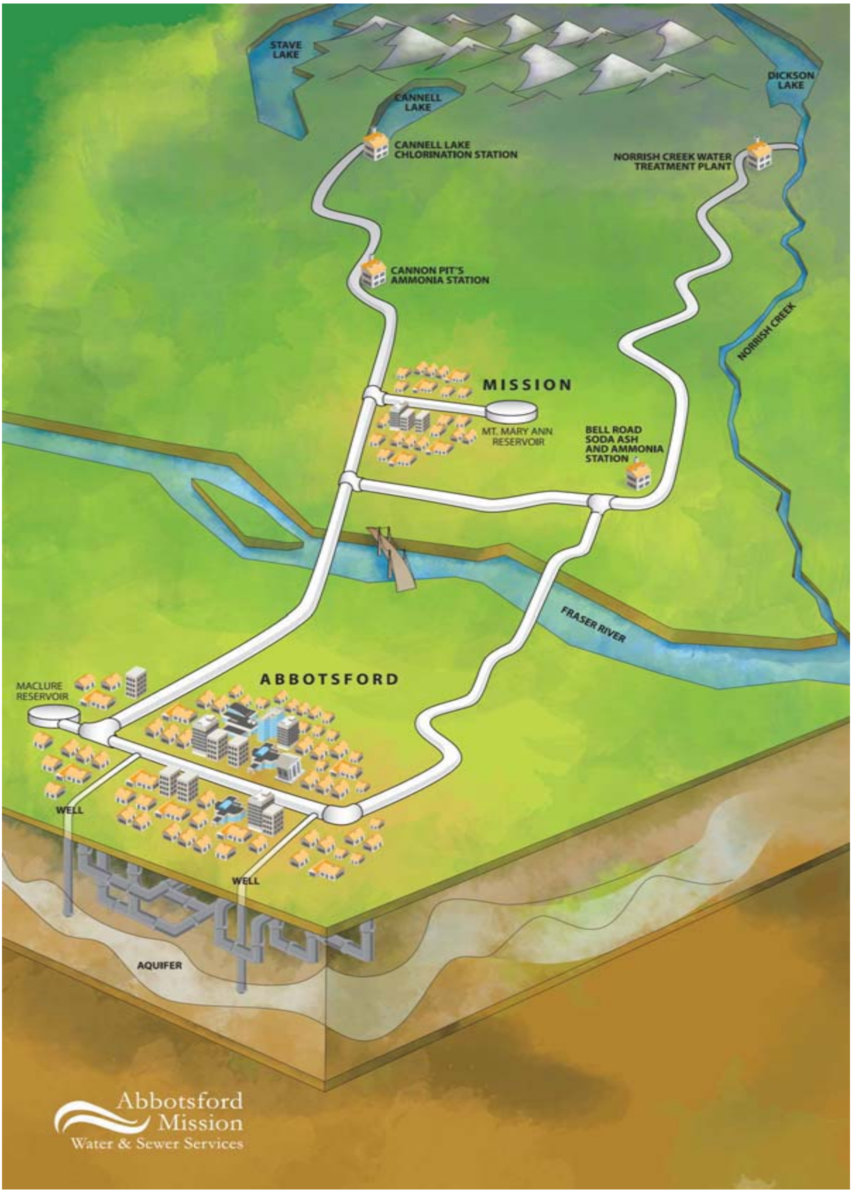
- 3 water sources:
  1) Norrish Creek: filtered & disinfected
  2) Cannell Lake: disinfected only
  3) 19 wells

- 86 km of transmission pipes

- 2 treated water storage reservoirs
  1) Maclure (in Abbotsford)
  2) Mt. Mary Ann (in Mission)

Abbotsford and Mission operate their distribution systems independently from the regional supply system.

# Existing Water System
## Facts & Map



# Selecting a Source
## Factors to Consider

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A community should consider multiple factors when selecting a new municipal water source. The following is a list of key factors and describes ranking terminology used throughout this booklet.

## Source Capacity

First and foremost, the community needs to understand how much water it needs. This impacts the minimum size of sources that can be considered.

| | |
|---|---|
| **Large** | Source has more than 200 MLD available |
| **Medium** | Source has 50 to 200 MLD available |
| **Small** | Source has 10 to 50 MLD available |

MLD = million liters per day

## Capacity Risk

Related to above, one must also consider if the source is likely to have its capacity threatened in the future by such things as climate change or other causes.

| | |
|---|---|
| **Low** | Possible threats to current capacity exist, but not expected to be significant |
| **Moderate** | Possible threats to current capacity exist, but economic contingencies could be incorporated into planning |

## Distance

The further a source is from the customers, the longer the pipeline needed to convey the water. Pipe installation is often the most expensive aspect of a new water supply development.

Distances shown throughout booklet reflect the minimum length of pipeline (new and upsizing) needed to convey water from the source into the nearest tie-in point on the existing distribution system.

## Elevation

The relative elevation of the source to the customers impacts the amount of pumping needed to push the water to the customers. Pumping is one of the most expensive annual operating costs for a water supply.

Elevations shown throughout booklet reflect the sources' typical water levels.

The AMWSC must be able to deliver water as high as 123 m. (Abbotsford & Mission then pump to higher elevations as needed).

# Selecting a Source
## Factors to Consider

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## Normal Water Quality

The natural water quality of the source influences the complexity and cost of water treatment required to meet potable standards.

| | |
|---|---|
| **Excellent** | Likely requires disinfection only |
| **Good** | Likely requires direct filtration plus disinfection (e.g. minimum surface water treatment standard) |
| **Moderate** | Likely requires enhanced treatment in addition to filtration and disinfection (e.g. not unusual, but higher cost) |
| **Poor** | Untreatable or requires specialized technologies (e.g. very costly) |

## Contamination Risk

Further to the normal water quality, one must consider the likelihood that natural or man-made phenomena could contaminate the water source, rendering the source unusable or requiring increased water treatment processes.

| | |
|---|---|
| **Low** | Unlikely that any contamination will materialize. |
| **Moderate** | Possibility of contamination, but source is large enough to buffer impact. Sufficient land would be secured to provide space for additional treatment technologies if later needed. |
| **High** | Probability of contamination, but of a nature that is economically treatable. The water treatment plant would be equipped with processes that only operate during the emergency. |
| **Extreme** | Severe contamination probable and the necessary provisions to treat contaminants make the source an uneconomical choice. |

# Selecting a Source
## Factors to Consider

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## Permitting Complexity (including environmental assessment)

There are dozens of permits needed to develop a new water source. A water license and an environmental assessment (EA) certificate are often the most challenging ones to obtain. Both can require years of consultation with the general public, First Nations and multiple government agencies. Assuming there are no outright regulatory objections that would block development, one must then estimate how long and what work is needed to secure the permits. The cost of permitting studies may become significant or the time to obtain permits may be unreasonable considering timeline needed to secure additional water.

All water in BC is owned by the Crown on behalf of citizens. Authority to divert and use water is obtained by a license from the Ministry of the Environment in accordance with the Water Act.

| | |
|---|---|
| **Typical** | Permitting is expected to be achievable within 2 to 3 years * |
| **Challenging** | Permitting is expected to take 3 to 5 years and there will be significant costs to complete studies required to support permit applications |
| **Improbable** | One or more permits may not be possible to secure, preventing project from proceeding or requiring uneconomical alternatives |

* *Either a Provincial or Canadian EA would take a minimum of 2 years. Any option that diverts more than 27.3 MLD of surface water or 6.8 MLD of groundwater triggers a Provincial EA. If a major project is within 100 km of the Washington State border, US agencies have the option to participate in the review. A Canadian EA can be triggered for various reasons; if federal funding is received, it automatically triggers an EA.*

## Availability of Suitable Land

The infrastructure to treat and convey water requires land. One must contemplate if the necessary land and right-of-ways (ROWs) can be secured at reasonable costs. The land parcel must also have suitable geotechnical conditions.

| | |
|---|---|
| **Likely** | Most land required already belongs to Mission or Abbotsford or is Crown land. Cost of any acquisitions anticipated to be minimal. |
| **Challenging** | There are segments of required land that may be difficult and/or costly to procure. |
| **Improbable** | There are segments of required land that are likely impossible to procure and alternates are impractical. |

# Selecting a Source
# Factors to Consider

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## Redundancy Contribution

System redundancy refers to having sufficient back-up infrastructure so that water demands can be met despite failure of any one component. With respect to the AMWSC system in particular, infrastructure in the Norrish watershed is subject to elevated natural disaster risks, which threatens 85% of the water currently supplied to Abbotsford and Mission. Similarly, the Fraser River crossings are vulnerable; loss would leave Abbotsford with only well water. Some new sources are better suited to mitigating these existing system risks.

| | |
|---|---|
| **Helps** | Minimizes critical system risk of losing supply during emergency |
| **No Benefit** | Does not minimize existing level of supply risk |

## Phasing Practicality (for large capacity options only)

Often when developing a new water source, one will develop it in phases to spread costs over time. The practicality of phasing is generally a factor of distance, water treatment technology implemented, geotechnical and environmental conditions.

| | |
|---|---|
| **Flexible** | Likely able to phase economically in 25 to 50 MLD increments |
| **Limited** | Economical phasing would be in at least 100 MLD increments |

## Cost

Assuming that multiple sources meet minimum requirements for all the above criteria, it then comes down to cost. One must consider the up-front investment (capital cost) and the funds necessary to keep the system running year after year (lifecycle costs). Page 26 provides a schematic that roughly illustrates how the costs of various options are likely to compare.

## Public Acceptance

Even if costs and all other criteria seem optimal, a given source may be perceived as unsuitable by the community.

**Tell Us What You Think of Each Source Option!**
(Contact info provided on the back cover of this booklet)

# Small Capacity Options (1 of 1) – Miracle Valley

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The Miracle Valley Aquifer is also referred to as the Hatzic-Stave Aquifer.

In 2007, a Miracle Valley hydrogeological investigation determined that there is potential for development of a well field that can produce an average of 17 MLD.

Aquifer Size = 10 $km^2$

## Capacity Risk → Low

- Recharge to the aquifer is from steams and precipitation, so climate change may have an impact.

## Distance → Unknown (suitable tie-in point to existing system to be determined).

## Elevation → 80 m


Pipeline route shown is merely an example of many possible options.

## Normal Water Quality → Good

- The AMWSC has not completed any water quality testing, but an independent 2005 study found water quality to be good.
- Since a well field could induce recharge from Stave Lake, filtration plus disinfection may be required.

## Contamination Risk → Low

- The aquifer is confined and in a remote location with few sources of contamination.

## Permitting Complexity → Typical

- The project would trigger a Provincial EA.

## Ability to Secure Land → Unknown

## Redundancy Contribution → Helps

- Another source would provide redundancy in the case of a Norrish system failure. However, the size of this source would not provide much redundancy.

# Medium Capacity Options (1 of 2) - Hayward Lake

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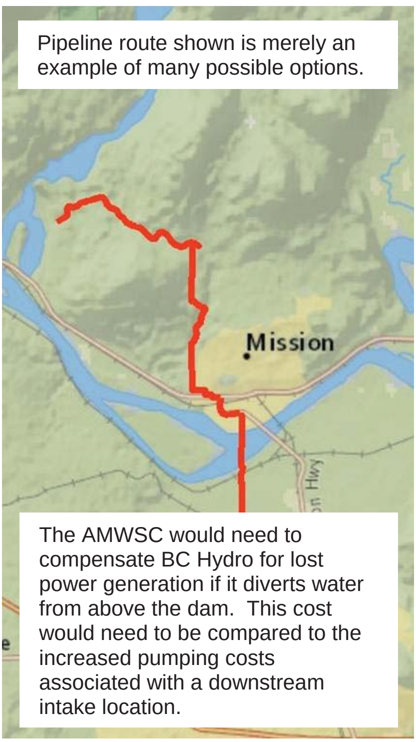
Past studies that considered Hayward Lake:

| Year | Author | Conclusion |
|---|---|---|
| 1995 | Dayton & Knight | Dismissed in favour of a Harrison option. |
| 2010 | AECOM | Lowest cost option, but threat of leachate from Mission Landfill made next lowest cost option (Stave) the recommended option. |




Pipeline route shown is merely an example of many possible options.

The AMWSC would need to compensate BC Hydro for lost power generation if it diverts water from above the dam. This cost would need to be compared to the increased pumping costs associated with a downstream intake location.

## Capacity Risk → Unknown

- A greater understanding of how BC Hydro operates its dams will be biggest influence upon this factor.

## Distance → 16 km
## Elevation → 45 m

## Normal Water Quality → Moderate

- Preliminary water monitoring was done by the AMWSC in 2008 and 2009.

## Contamination Risk → High

- The Mission Landfill is upstream; it has experienced leachate leak issues in the past.
- History of turbidity problems relating to fluctuating water levels and fine sediments along the lakeshore.

The 2010 study did not assume that treatment would need to include processes for addressing leachate contamination. This may increase cost estimates.

**Permitting Complexity → Challenging**
**Ability to Secure Land → Challenging**
**Redundancy Contribution → Helps**

Refer to Stave Lake comments on page 22; situation would be similar

# Medium Capacity Options (2 of 2) – Expand Norrish

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Understanding Norrish Water Licenses:

The AMWSC holds two types of water licenses for Norrish. The first is for ‘water withdrawal’, which allows water diversion up to 141.5 MLD from Norrish Creek, with a yearly average of 92 MLD. The second is for water storage in Dickson Lake, which the AMWSC must use to sustain fisheries flows below the intake. During the summer, water from Dickson Lake is released from the dam to replace what is diverted at the intake so that there are sufficient flows for fish in the creek.

A 2009 hydrology study concluded that, in a drought year, the Norrish watershed would only be able to support a maximum day withdrawal of 155 MLD, with an annual average of 124 MLD. If the Dickson Lake storage volume were increased by approximately 20%, then withdrawals could be increased up to 176 MLD on peak days, with an annual average diversion flow of 141 MLD. Assuming that regulators would concur with these results, the various additional capacities available from Norrish would be:

| Units = MLD | Today’s Physical Limitations | Today’s Licensed Capacity | Unused Licensed Capacity | Unused Watershed Capacity | More Dickson Storage |
|---|---|---|---|---|---|
| | | | (relative to today’s 90 MLD) | | |
| Maximum | 90 * | 141.5 | +52.5 | +66 | +87 |
| Average | | 92 | +3 | +35 | +52 |

* the size of the pipeline from the treatment plant to the municipalities restricts flow to a maximum of 90 MLD. To optimize the amount of water that can flow from the plant, twinning of key pipe segments began in 2009. A twinned length along Maclure Road in Abbotsford was commissioned in June 2010 and construction along Gladwin Road is currently underway.

Requires:
1) Upsizing pipe between water treatment plant & Abbotsford.
2) Upsizing water treatment processes that can handle creek turbidity events.

Requires:
Raising the dam or getting regulatory permission for a lower minimum lake level.

# Medium Capacity Options (2 of 2) – Expand Norrish

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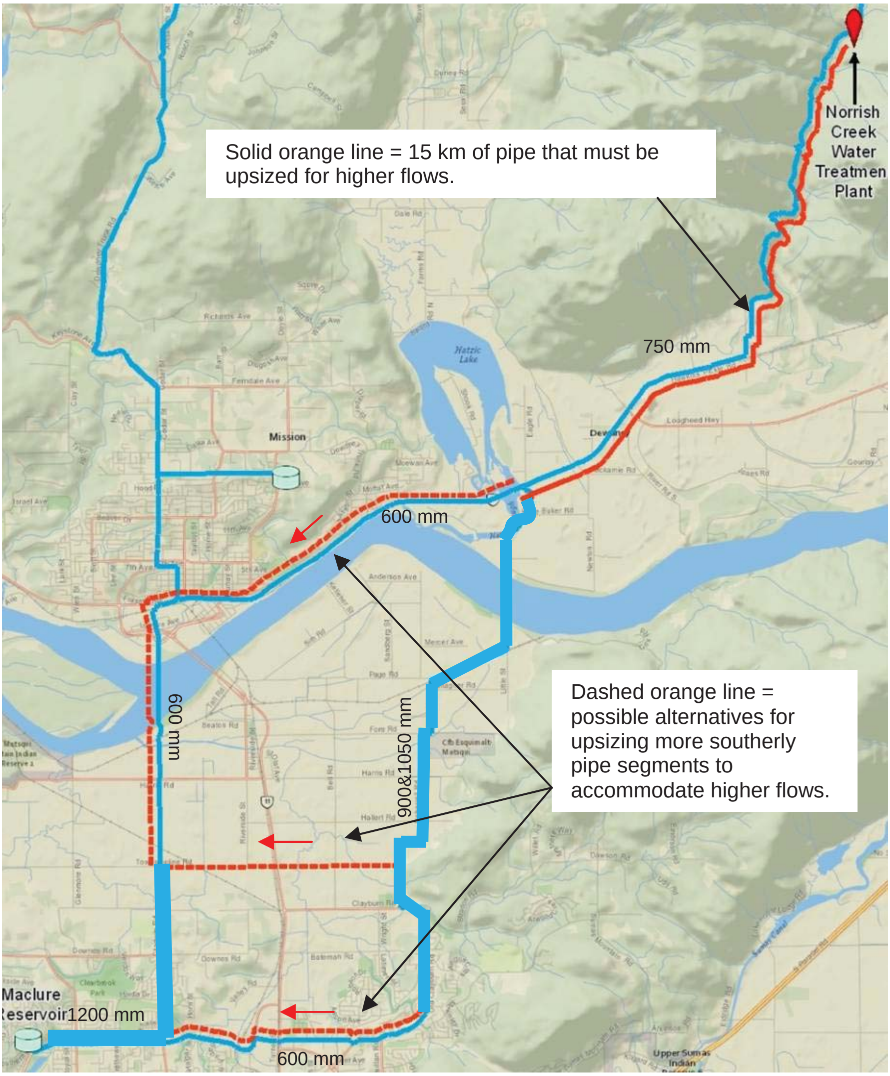

# Medium Capacity Options (2 of 2) – Expand Norrish

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## Capacity Risk → High

Watershed Size = 117 $km^2$

- The Norrish transmission pipeline, power line and access road is susceptible to landslides and downed trees. (Minor events, causing hours or days of downtime, occur monthly each winter).
- Norrish Creek is subject to storm-triggered turbidity events. During these times, the slow sand filters cannot operate. This reduces plant output to a maximum of 54 MLD. Turbidity events occur several times per month, primarily between October and April each year.
- Climate change is predicted reduce snowpack within the next 20 to 50 years, which would upset the watershed's current hydrology and impact the water volumes available for diversion.

## Distance → see map on previous page
## Elevation → 236 m

- The possibility of harvesting Norrish for power generation has been investigated multiple times over the last 30 years. A 2010 study suggested that it was not a feasible idea without using existing transmission pipe as a power station 'penstock' (which can be an expensive component of a power project). If Norrish system expansion again becomes part of the future water strategy, power generation opportunities could be revisited.

## Normal Water Quality → Good
## Contamination Risk → Moderate

- As mentioned above, Norrish Creek is subject to storm-triggered turbidity events.
- Watershed above intake is gated. Logging occurs and recreational access is allowed by permit.

# Medium Capacity Options (2 of 2) – Expand Norrish

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## Permitting Complexity → Challenging

- Obtaining permission to twin the pipeline down the Norrish Creek valley may be difficult. Fisheries & Oceans Canada (DFO) may require a Canadian EA under the Fisheries Act. Even without an EA requirement, it recently took two years to obtain a DFO permit to install a new intake in Norrish Creek.
- Increasing the water license volumes may be a lengthy process or, at worse, not be possible. Requesting any more than 27.3 MLD will trigger a Provincial EA. Even prior to EA legislation, it took more than five years to secure the last water license volume increase in the mid-1990s. That license was issued by the Province under continued objections by the DFO.
- The MOTI no longer allows high-pressure pipelines to be built along its highway ROWs. Five km of twinned pipeline would need to follow the Lougheed Highway.

## Ability to Secure Land → Unknown

- If MOTI will not issue an exemption to its policy, then dozens of ROWs would need to be secured adjacent to the highway. It can take years to complete such land negotiations.

## Redundancy Contribution → No Benefit

# Large Capacity Options (1 of 4) – Chilliwack Lake

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Past studies that considered Chilliwack Lake:

| Year | Author | Conclusion |
|---|---|---|
| 1995 | Dayton & Knight | Viable option, but there are other preferred options. |
| 2004 | EarthTech | One of the more expensive of options studied. |
| 2010 | AECOM | Most expensive of options studied. |

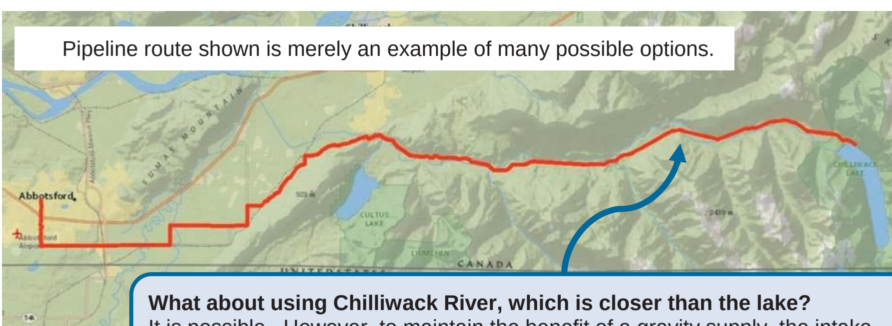
## Capacity Risk → Moderate

Watershed Size (above lake) = 350 km$^2$

- There are several water license holders downstream of the lake.
- The watershed relies on recharge from glaciers, snow & rainfall, so climate change may have an impact.

## Distance → 80 km
## Elevation → 620 m

- Furthest large capacity source option.
- Highest large capacity source option and the only one that could potentially operate fully by gravity. There may be opportunity to recapture operating costs through power generation.




**What about using Chilliwack River, which is closer than the lake?**
It is possible. However, to maintain the benefit of a gravity supply, the intake would still need to be located quite far up the river. (e.g. at best, only 15 to 20 km closer)

# Large Capacity Options (1 of 4) – Chilliwack Lake

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## Normal Water Quality → Good

- Preliminary lake water quality monitoring occurred in 2008 and 2009. Results suggest that quality is as good as or better than other large capacity options.

## Contamination Risk → Moderate

- While area geotechnical conditions are largely unknown, landslides may be possible, which can upset water quality.
- The watershed is open to recreation and to logging.
- Part of watershed is within U.S.; it may be difficult to manage watershed activities south of the border

## Permitting Complexity → Challenging

- In addition to potentially long water licensing and EA processes, the fact that a portion of watershed is within the United States may necessitate international discussions.

## Ability to Secure Land → Unknown

- There have been no in-depth investigations into sites or pipeline routing.

## Redundancy Contribution → Helps

- The location of the lake south of the Fraser River would offer Abbotsford greater reliability of supply should there be a Norrish Creek system failure.

## Phasing Practicality → Limited

- Phasing practicality is limited due to the distance, which would make it uneconomical to install a pipe size that serves needs for less than 50-years.

# Large Capacity Options (2 of 4) – Fraser River

Abbotsford Mission Water & Sewer Services

Past studies that considered the Fraser River:

| Year | Author | Conclusion |
|---|---|---|
| 1995 | Dayton & Knight | Viable option, but there are other preferred options. |
| 2010 | AECOM | One of lower cost options, but rejected since better large capacity options (e.g. Stave Lake) available at similar cost. |

## Capacity Risk → Low

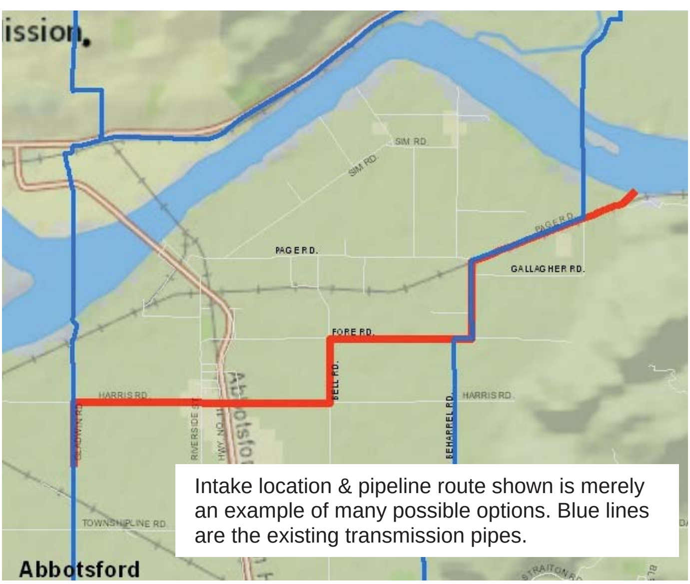
Watershed Size = 215,000 km$^2$

- The Fraser River watershed is extremely large and even at its lowest flows, diversion of 100 MLD constitutes 0.001% of the water in the river.

## Distance → 2 - 10 km *
## Elevation → 0.5 - 7 m

* Distance depends on intake location and tie-in point to existing system.

- Closest large capacity source option.
- One of lowest source options. However, proximity to existing infrastructure may open up opportunities to minimize pumping costs by dividing system into low and high elevation supply zones.




Intake location & pipeline route shown is merely an example of many possible options. Blue lines are the existing transmission pipes.

# Large Capacity Options (2 of 4) – Fraser River

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## Normal Water Quality → Moderate

- Preliminary water monitoring was done by the AMWSC in 2008 and 2009. Results suggest lower quality than all other large capacity options, but it is better quality than many North American sources. Technologies exist to reliably treat it to potable standards.

## Contamination Risk → High

- The possible impact of climate change upon the back-up of brackish water into the Abbotsford-Mission segment of the river would need to be investigated.
- Fraser River basin is an enormous watershed with unlimited potential for contamination, both natural and man-made. Municipal wastewater plants discharge to the Fraser River upstream of Abbotsford & Mission.
- The nature of a river flow is that many contamination plumes will pass.

## Permitting Complexity → Unknown

- No discussions with regulators have yet occurred to gain an understanding of the potential permitting challenges.

## Ability to Secure Land → Likely

- The fact that all water supply components could be located within Abbotsford or Mission's municipal boundaries increases the ease of finding suitable sites.

## Redundancy Contribution → Helps

- Another source with large capacity would provide redundancy in the case of a Norrish system failure.
- Opportunity exists to locate intake and water treatment plant on the south side of the Fraser River, reducing Abbotsford's reliability on the river crossings.

## Phasing Practicality → Flexible

- Close location provides more economical opportunity for smaller incremental phased capacity increases.
- It may be possible to leverage existing transmission mains to spread capital costs over a longer term.

# Large Capacity Options (3 of 4) – Harrison Lake

Abbotsford Mission Water & Sewer Services

Past studies that considered Harrison Lake:

| Year | Author | Conclusion |
|---|---|---|
| 1995 | Dayton & Knight | Recommended that Harrison be developed as next Abbotsford-Mission water supply. * <br>* The CFVWC did some preliminary engineering and permitting between 1997 and 2003. |
| 2003 | Dayton & Knight | Recommended that other options be reviewed since costs higher than originally anticipated in 1995. |
| 2004 | EarthTech | Ranked Harrison as one of more expensive options. |
| 2010 | AECOM | 2nd most expensive of options studied. |

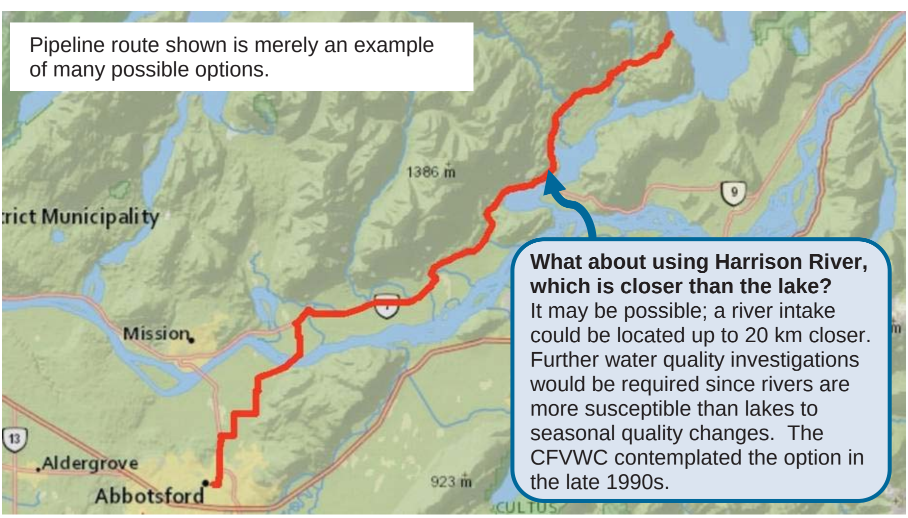
## Capacity Risk → Low

Watershed Size = 5700 km$^2$

- While there are many small water license holders already using the lake and climate change may alter hydrology, the watershed size makes it unlikely that the capacity of an AMWSC water supply from Harrison would ever be at risk.

## Distance → 60 km
## Elevation → 10 m

- 2nd furthest large capacity source option.
- 2nd lowest large capacity source option.



# Large Capacity Options (3 of 4) - Harrison Lake

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## Normal Water Quality → Good

- Preliminary lake water quality monitoring occurred in 2008 and 2009. Results suggest that quality is as good as other large capacity options.

During the CFVWC era, it was assumed that Harrison water would require disinfection only. The Fraser Health Authority verbally advised in 2012 that filtration would also be required based on their experience with smaller water suppliers currently using the lake.

## Contamination Risk → Moderate

- Landslides into lake have occurred, which can upset water quality.
- The watershed is open to recreation and to logging.

## Permitting Complexity → Challenging

- Potentially long EA process, particularly since pipeline routing would pass several First Nation lands and its potential impacts upon their lands would need to be respected.

## Ability to Secure Land → Challenging

- Pipeline segments would need to follow Lougheed Highway; the BC Ministry of Transportation & Infrastructure (MOTI) no longer allows high pressure pipelines traveling along their ROWs. This may mean that ROWs would need to be secured for a large number of properties adjacent to the highway.

## Redundancy Contribution → Helps

- Another source with large capacity would provide redundancy in the case of a Norrish system failure.

## Phasing Practicality → Limited

- Phasing practicality is limited due to the distance, which would make it uneconomical to install a pipe size that serves needs for less than 50-years.

# Large Capacity Options (4 of 4) – Stave Lake

Abbotsford Mission Water & Sewer Services

Past studies that considered Stave Lake:

| Year | Author | Conclusion |
|---|---|---|
| 1995 | Dayton & Knight | Rejected Stave due to competing use by BC Hydro. |
| 2004 | EarthTech | Recommended Stave as most economical long-term option. |
| 2006 | Dayton & Knight | Supported earlier recommendation to pursue a Stave Lake option. |
| 2010 | AECOM | Recommended proceeding with Stave Lake. |

Stave Lake is by far the most studied large capacity option, with more than two years of initial engineering, permitting investigations and land studies completed up until November 2011. The following table lists the preliminary engineering work done; refer to page 22 for information on permitting work completed to date.

| Consultant | Work |
|---|---|
| AECOM | Stave Lake Water Supply Conceptual Designs. |
| Opus DaytonKnight | Preliminary engineering for transmission mains. 80% of work needed to proceed to detailed design completed. |
| CH2M Hill | Preliminary engineering for lake intake and pump station. Able to proceed to detailed design at any time. |
| CH2M Hill | Preliminary engineering for water treatment plant. Significant further work, especially water quality monitoring and pilot-scale treatment testing, required prior to detailed design. |

*Engineering Design Stages*

CONCEPTUAL
Develop general ideas about the infrastructure to be designed.

↓

PRELIMINARY
Complete geotechnical, environmental, archeological and other studies to develop initial design drawings.

↓

DETAILED
Prepare the structural, mechanical & electrical drawings needed for construction.

# Large Capacity Options (4 of 4) – Stave Lake

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Pipeline route shown is that envisioned in 2011. Other options could still be considered.

## Capacity Risk → Moderate

- Water diversion from Stave Lake by the AMWSC would need to align with the 'Stave River Water Use Plan', which stipulates minimum downstream flow and water level requirements for fisheries. This means, in the case of a drought, fisheries has priority use of the water.

> A 100 MLD withdrawal from Stave Lake is less than 1% of the water that flows through the Stave Falls dam. BC Hydro has completed reservoir modeling, which predicts that a 400 MLD diversion by the AMWSC could almost always be supported without compromising competing needs.

- BC Hydro varies the lake level throughout the year to optimize power generation. The intake location proposed in 2011 would be within a deep pool of the original Stave River, allowing it to function within BC Hydro's full range of water levels. That said, a BC Hydro dam failure would impact the planned intake operations. The risk of dam failure is low; seismic upgrades were recently completed at the Stave Falls dam.

- The intake location envisioned in 2011 is just upstream of the BC Hydro dam. Another location that was once considered and could be revisited, is at the north end of Miracle Valley. This location would allow the intake to be positioned be deep within the original lake (i.e. pre-reservoir flooding), where neither lake level fluctuations nor a Stave Falls dam failure would impact the water quantity available to the AMWSC.

# Large Capacity Options (4 of 4) – Stave Lake

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**Distance → 20 km**
**Elevation → 80 m**

- 2nd closest large capacity option.
- 2nd highest large capacity option.

## Normal Water Quality → Good

- Preliminary water quality monitoring was done by the AMWSC in 2008 and 2009. An online water quality monitoring station operated briefly in 2011. Results suggest that quality is as good as or better than other large capacity options.
- An intake located deep in the original lake (i.e. rather than in an area flooded by reservoir), as described under the 'Capacity Risk' section, may have better raw water quality.

## Contamination Risk → Moderate

- The Stave watershed is open to recreation and logging.
- There is an upstream Allouette Lake fertilization program.
- Landslides are possible, which may upset water quality.

There are economical water treatment plant designs that can address all of these potential contamination impacts.

## Permitting Complexity → Challenging

- Both a Provincial and Canadian EA would be required. (The latter by DFO for the pipeline crossing of the Fraser River). By November 2011, both EA processes were well underway with many supporting studies (e.g. archeological & environmental) completed and interested First Nations engaged in consultation.
- The water in Stave Lake is licensed to BC Hydro; a water sharing agreement with BC Hydro would be required in addition to a water license issued by the Province. By November 2011, agreement term negotiations were nearing completion.
- The MOTI no longer allows high-pressure pipelines along their highway ROWs. It would be necessary to obtain an exemption for a short length of pipeline along the Lougheed Highway. By November 2011, discussions with the MOTI were nearing a successful resolution.

# Large Capacity Options (4 of 4) – Stave Lake

## Ability to Secure Land → Likely

- Preferred sites for a water intake, raw water pump station and water treatment plant were identified in 2011 for a Stave Lake project. All are within Crown land.
- Pipeline routing was also identified in 2011. Few new ROWs would be needed for the preferred route.

## Redundancy Contribution → Helps

- Another source with large capacity would provide redundancy in the case of a Norrish system failure.
- Stave is the only new source option that would offer the benefit of allowing its new water treatment plant to also filter Cannell Lake water. (Fraser Health is expecting the AMWSC to enhance Cannell Lake water treatment).

## Phasing Practicality → Limited

- Phasing practicality is limited due to distance. In 2011, it was envisioned that a Stave Lake Water Supply would be staged in 100 MLD increments up to an ultimate capacity of 400 MLD. Sufficient land would be secured for the ultimate capacity. Similarly, an intake tunnel and raw water pump station building would be sized up for the ultimate capacity. The pumps and water treatment processes would be installed in 100 MLD increments. Most of the pipes would be sized for at least the first two phases (i.e. 200 MLD). Those segments through environmentally sensitive areas (e.g. across Fraser River) may be sized to meet additional flows.

# Sources with Insufficient Capacity

Abbotsford Mission Water & Sewer Services

## More Abbotsford-Sumas Wells

The Bevan Well Field, installed in 2007/08, is the newest water source in the AMWSC water system. Its four wells have a combined capacity of 25 MLD, which exceeds the threshold for a BC EA.

> The Bevan Wells were the first phase in a 2004 water planning strategy aimed to ensure sufficient supply while a longer-term solution was developed.

As part of the required EA process, the AMWSC developed a groundwater model to determine the effects of increasing the draw from the aquifer by 25 MLD. This exercise determined that the base flow of two local streams would be affected and that there would be negative impacts to the existing Clearbrook Waterworks District (CWD) well field. Ultimately, after four years of studies and consultation, the Province issued an EA Certificate in May 2011. However, the Certificate restricts well operation to May through September, imposes an upper limit on the annual volume extracted and requires that the AMWSC construct mitigation works for the streams and Clearbrook Waterworks District. Numerous other notification, consultation, and monitoring commitments are also stipulated. After December 2015, the wells are to be used only for emergency and maintenance purposes unless the AMWSC requests that the Province amend the EA Certificate terms.

Due to the challenges with permitting the Bevan Wells, the aquifer may not be the best choice to meet future water needs. There is too much uncertainty surrounding approvals and the potential impacts. The aquifer is highly vulnerable to contamination and nitrate concentrations do not meet acceptable levels for drinking water in parts of the aquifer.

## Cannell Lake Expansion

Cannell Lake resides in a small (2.1 $km^2$) watershed. A 2009 watershed assessment investigated if withdrawal amounts higher than the licensed 9.1 MLD would be possible. Based on study outcomes and after two years of further supporting work, the Province granted the AMWSC with an amended license. It allows an annual average withdrawal of 11.8 MLD with daily maximums up to 69 MLD, contingent upon the time of year and lake water level. There is little value in investing more time or money into further Cannell Lake supply expansion.

# Sources with Insufficient Capacity

Abbotsford Mission Water & Sewer Services

## Negligibly-Sized Water Sources

The following are examples of water sources within the Fraser Valley that are too small to consider, have already been allocated to other users, or are at extreme risk of capacity reduction during drought:

- Abbotsford's Mill Lake
- Mission's Mill Lake
- Hatzic Lake
- Vedder Canal
- Sumas River
- Albert Dyck Lake
- Lost Lake
- Sumas Mountain Groundwater

**Putting AMWSC water demands into perspective:** On an average day, Abbotsford and Mission use enough water to fill more than 25 Olympic sized-pools. During the summer, this can increase to more than 40.

## Not Previously Considered for Various Reasons

While there are some water sources of seemingly suitable size for AMWSC consideration, they have not been considered for various reasons. For example, the Chehalis and Wahleah watersheds' available capacities relative to their distance from Abbotsford and Mission make them uneconomical. Cultus Lake is a relatively small (100 $km^2$) watershed that is used intensively for recreation; the competing uses and the fact that approximately 40 km of piping would be needed to deliver water to the existing water system eliminated it early in previous source option investigations.