

Southern Lakes Enhanced Storage Concept

January 2012

**YUKON
ENERGY**



Overview

This presentation provides an overview of the Southern Lakes Enhanced Storage Concept. This concept generally consists of amending Yukon Energy's water license for regulating water levels in Marsh Lake (and Tagish & Bennett Lakes) during fall and winter months.

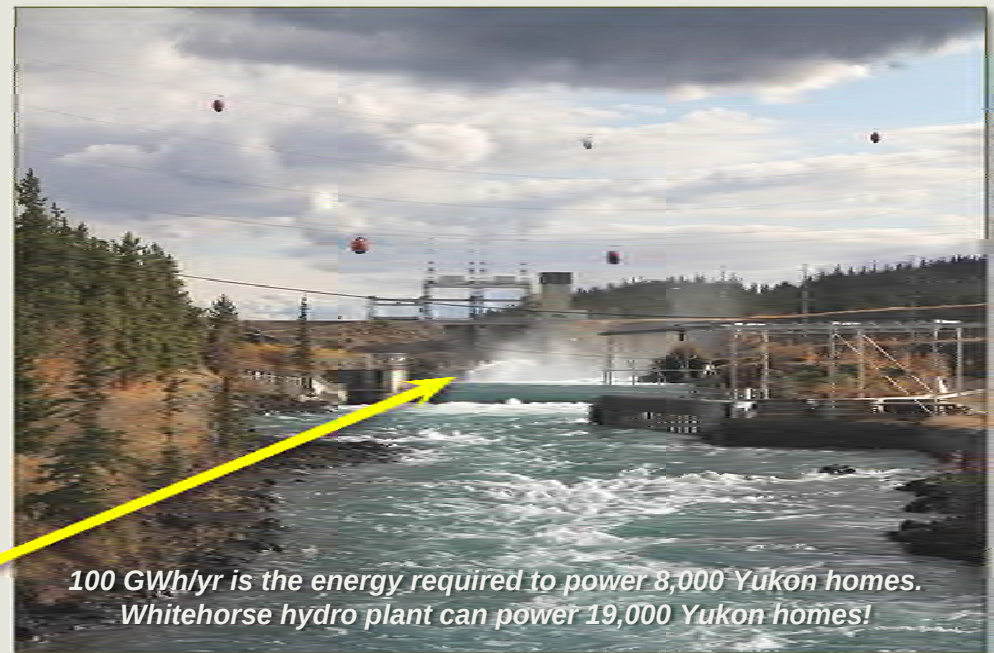
Presentation Overview

1. Existing Conditions
2. Proposed Change

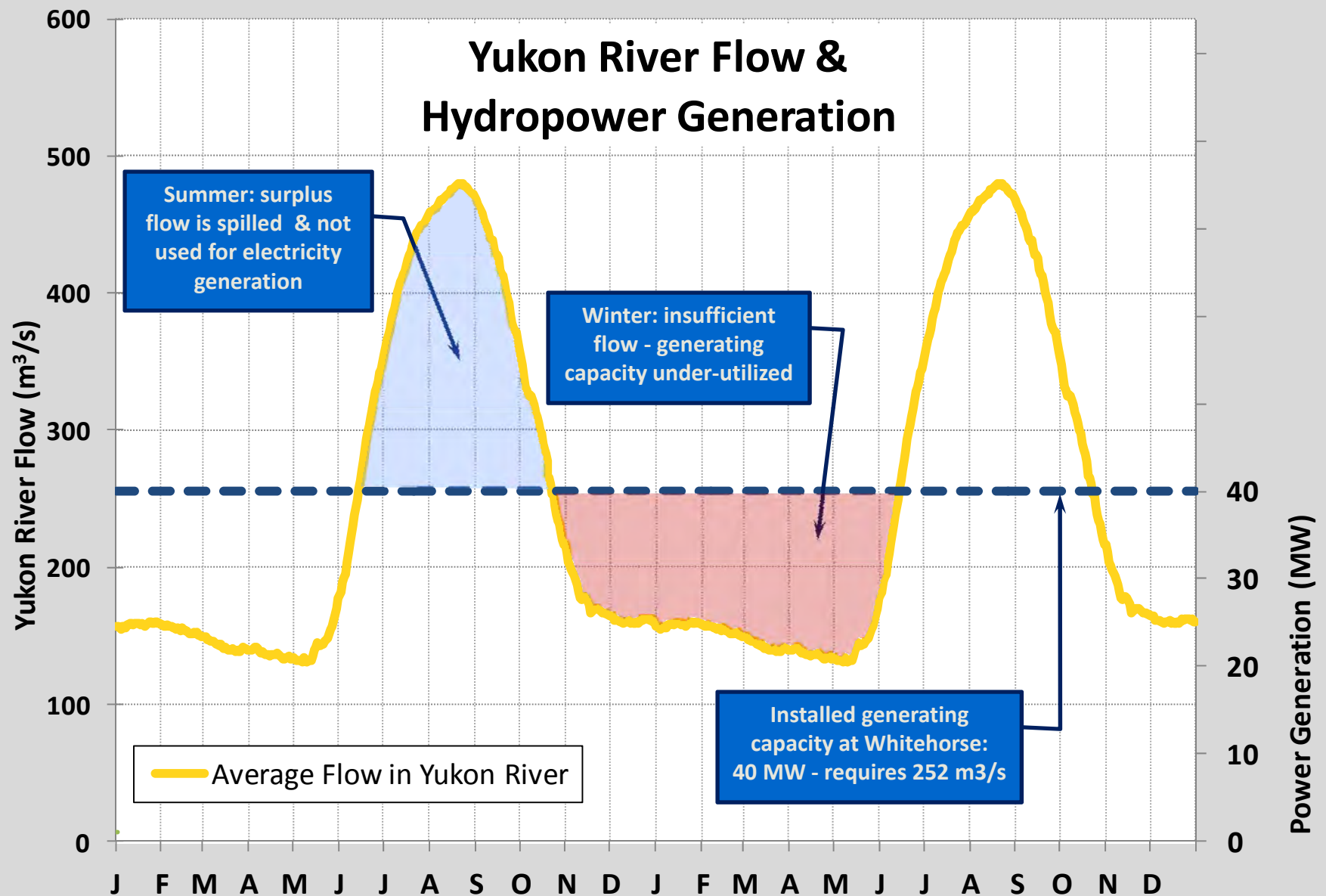


Producing Electricity at Whitehorse Rapids

- > Built in 1958, Whitehorse Rapids Hydroelectric Generating Station is the Yukon's largest renewable energy facility.
- > Hydropower is by far the most sustainable & resilient of all renewable energy technologies.
- > Whitehorse currently produces 240 GWh/yr, or 60% of the Yukon's renewable energy.
- > Whitehorse has an installed generating capacity of 40MW, but in winter months there is only enough water flow to produce 25 MW on average.
- > In summer months, there is excess water, which is "spilled"

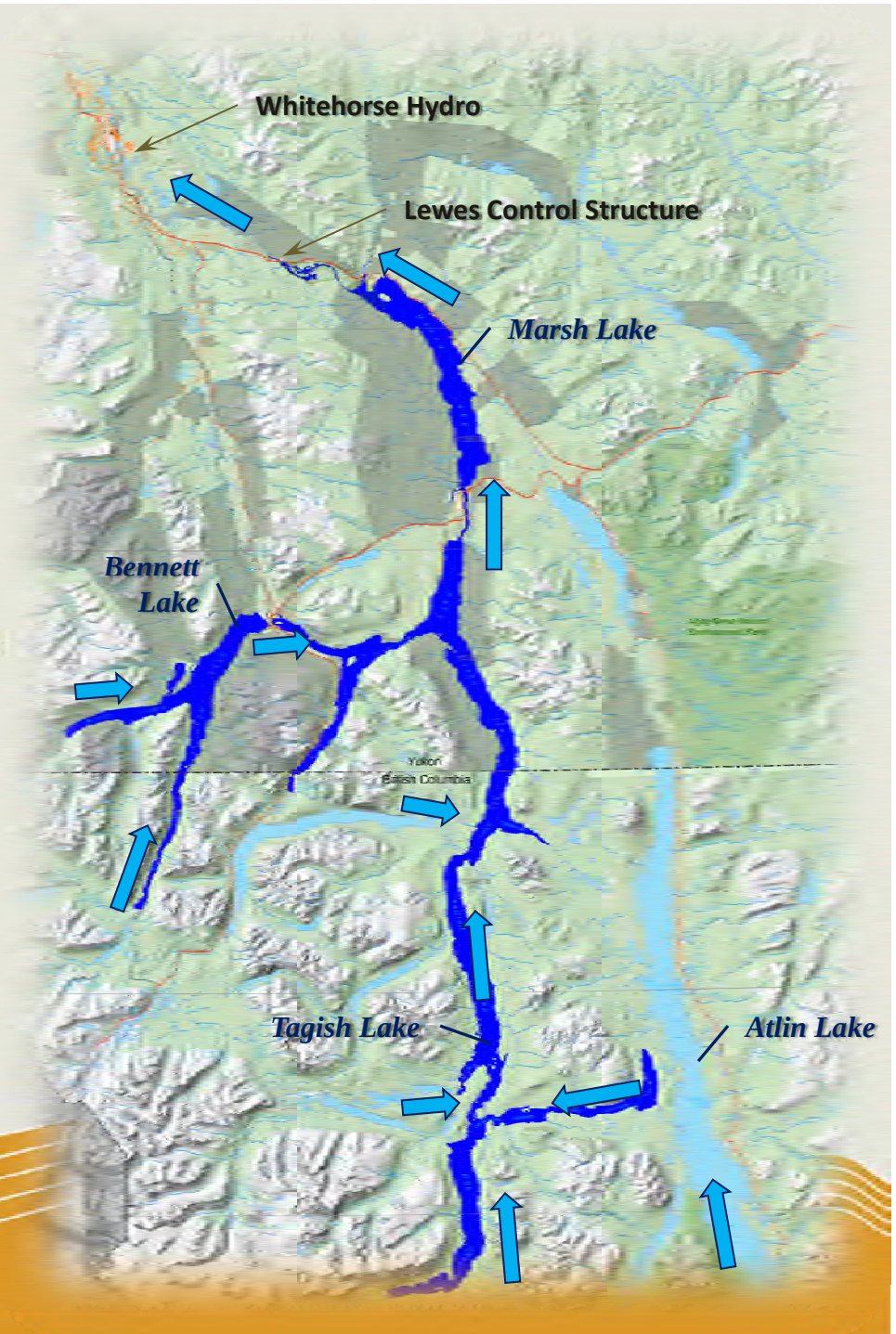


Yukon River Flow & Hydropower Generation

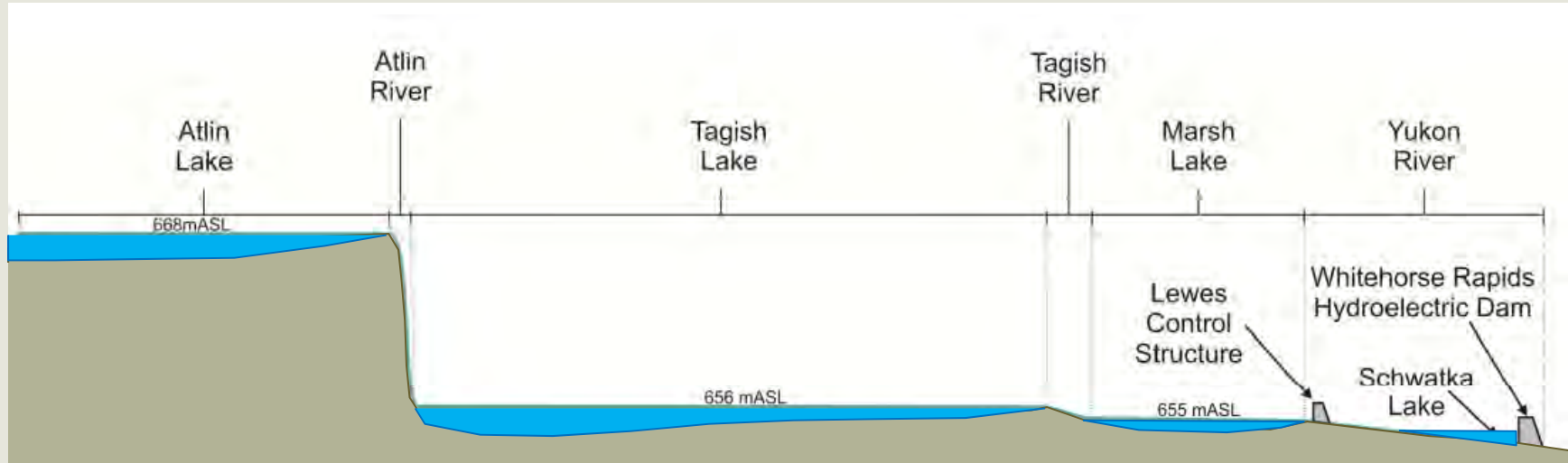


Water for Whitehorse Hydro comes from the Southern Lakes watershed

- > Marsh, Tagish & Bennett Lakes are hydraulically connected.
- > This means managing the outlet of Marsh Lake affects Tagish and Bennett Lakes, allowing storage of water in those lakes as well.
- > Water “stored” in the Southern Lakes is used for generating energy in the winter, when we need it the most.
- > Flow & lake levels are largely controlled by snow and glacier melt.
 - > Warmer years → higher lake levels;
 - > Cold years → lower lake levels.



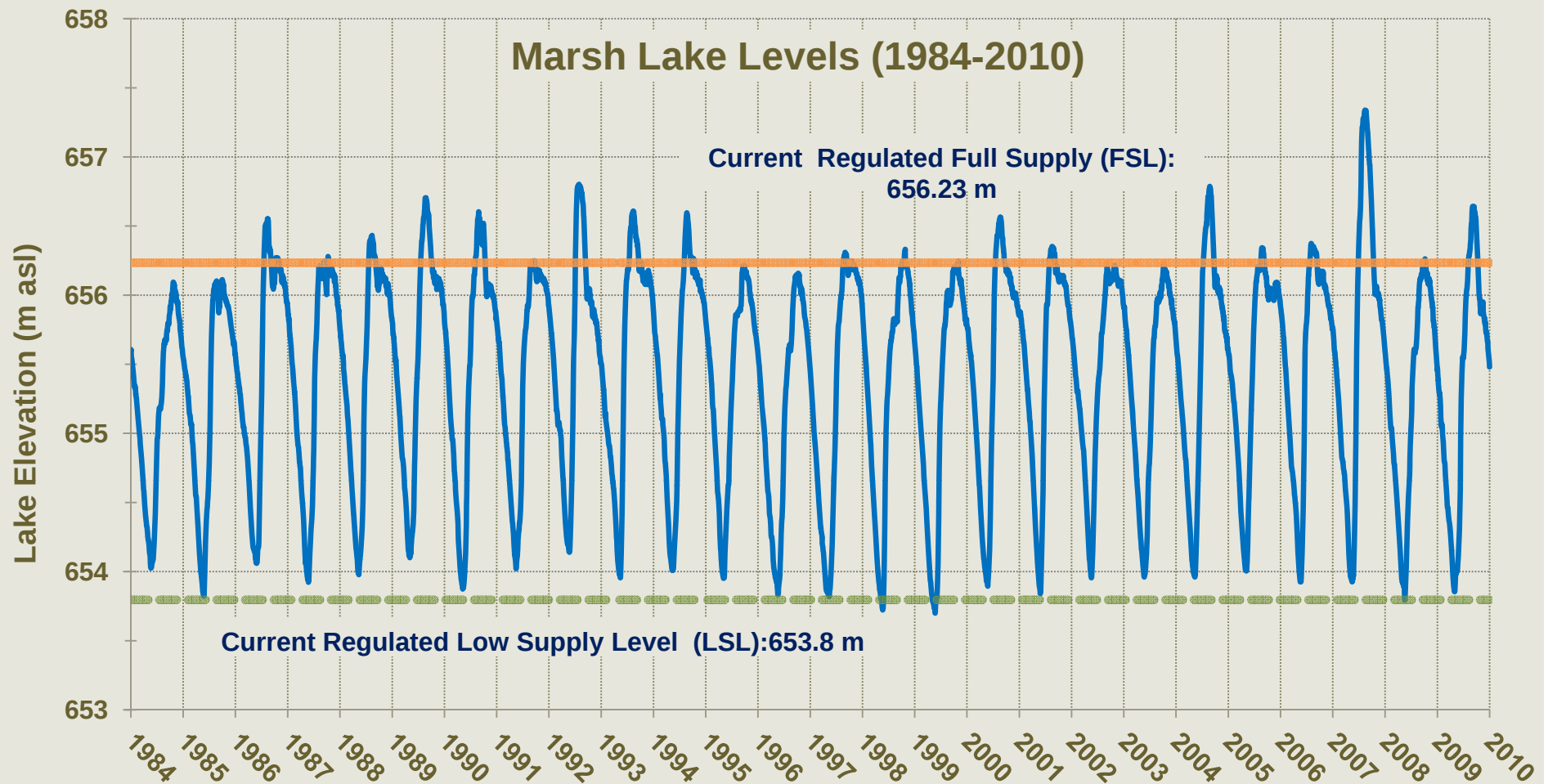
The Southern Lakes in Cross-Section



- > Water levels in Marsh, Tagish & Bennett Lakes are affected by Lewes River Control Structure

- > For 7 months of the year (mid-August to mid-February), Marsh, Tagish & Bennett effectively act as one lake.

- > Atlin, Tutshi and the other Southern Lakes are NOT affected by control of Marsh Lake levels because they are at higher elevations (their connecting rivers have rapids or waterfalls!)



- > On average, Marsh Lake levels are lowest in mid-May and peak in mid-August.
- > Lake levels fluctuate between elevation 653.7 and 657.34 m above sea level (ASL) – 3.64 m (12 feet)
- > 25% of years, peak lake level in Marsh Lake reach 656.6 m ASL or higher.
- > Yukon Energy's current water license allows for regulation of the lake between **656.23** and **653.8** m ASL (Full and Low Supply Levels respectively). 2.43 m (8 feet)

What does Lewes Control Structure Do?

- It regulates outflow from Marsh Lake during fall and winter.
- After August 15th, gates can be lowered to reduce flow in the river. Later in the winter, gates are raised to let more water out of the lake.
- Gates must remain open from May 15th to August 15th
- This structure effectively “stores” water in the Southern Lakes for use in the winter to generate hydropower at Whitehorse.



Lewes Control Structure in late winter with 12 gates closed

History of Lewes Control Structure

- Original wooden dam built in 1922 by British Yukon Navigation Co. (now White Pass) to hold water back until the spring to “flush” ice out of Lake Laberge for early-season steamship navigation on the Yukon River.
- Marsh Lake has been regulated for almost 90 years. Over the period of record, Marsh Lake has fluctuated within the same range.
- Dam rebuilt in the 1950s when Whitehorse hydro built.
- Current steel dam built in 1975. Innovative “sheet-pile” design



The first dam at Marsh Lake, with sternwheeler Gleaner in background

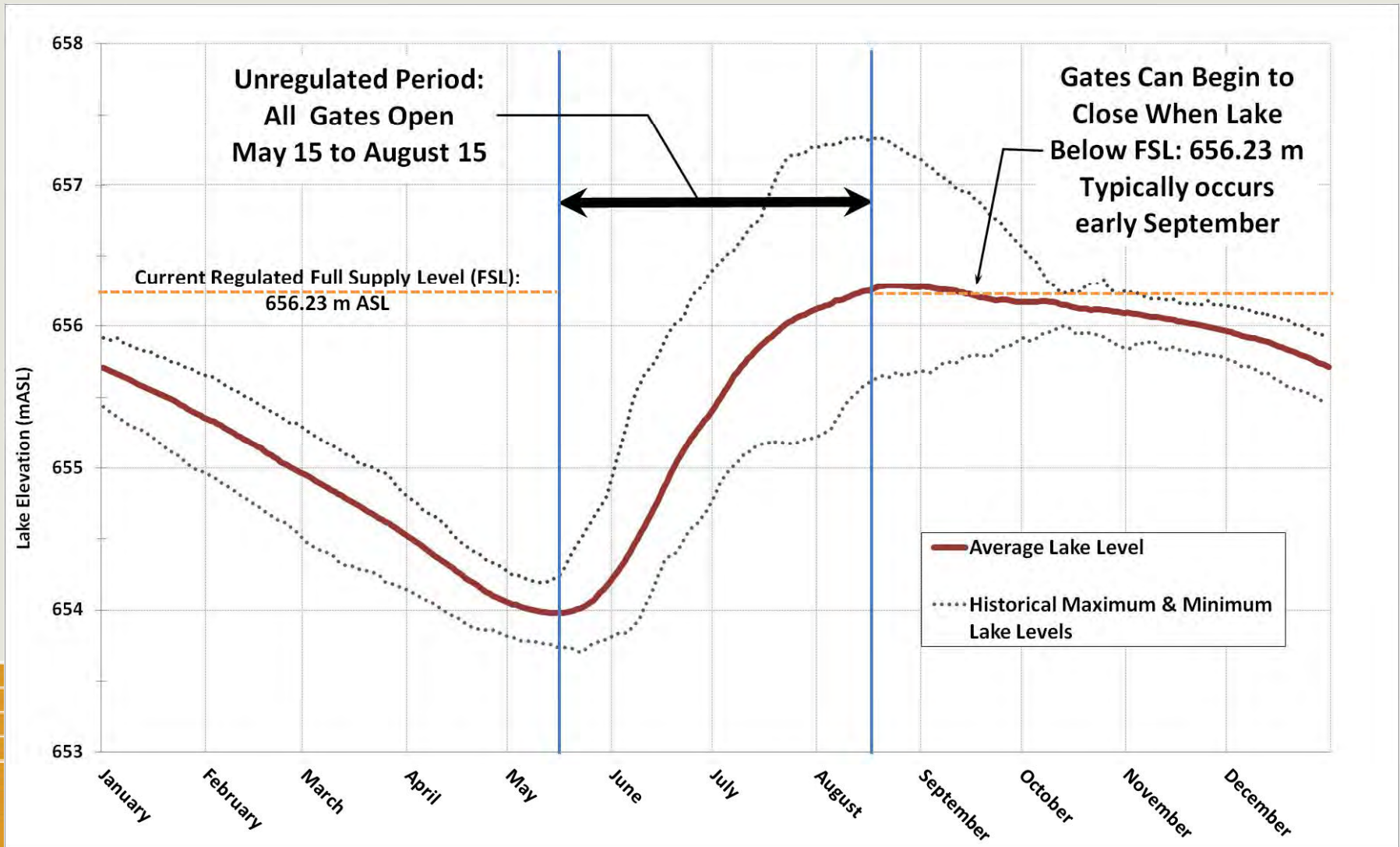
How is Marsh Lake Regulated?

- Marsh Lake is regulated according to Yukon Energy's water licence HY99-010
- License to be renewed in 2025 (14 years left in the current license).
- Conditions in the licence state that:
 - Structure must be fully open (no restriction to flow) from May 15th until lake levels recede to elevation 656.23 m ASL, or August 15th whichever comes later.
 - Gates cannot be closed until lake levels drop to "Full Supply Level" of 656.23 m ASL.
 - On average, gates start to be lowered in early September.
 - On low lake level years (such as 2011), gates start to be lowered on August 15th to raise the lake to (or near) the Full Supply Level

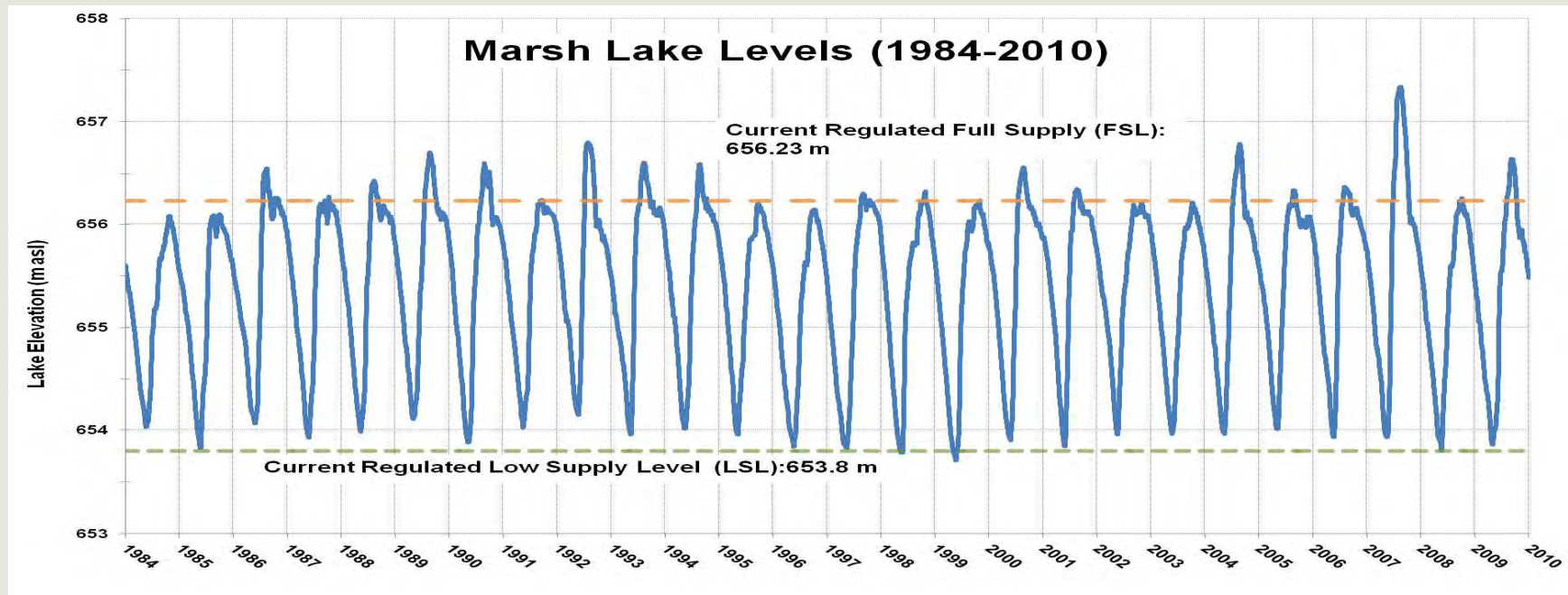


Lewes Control Structure in summer with all gates open.

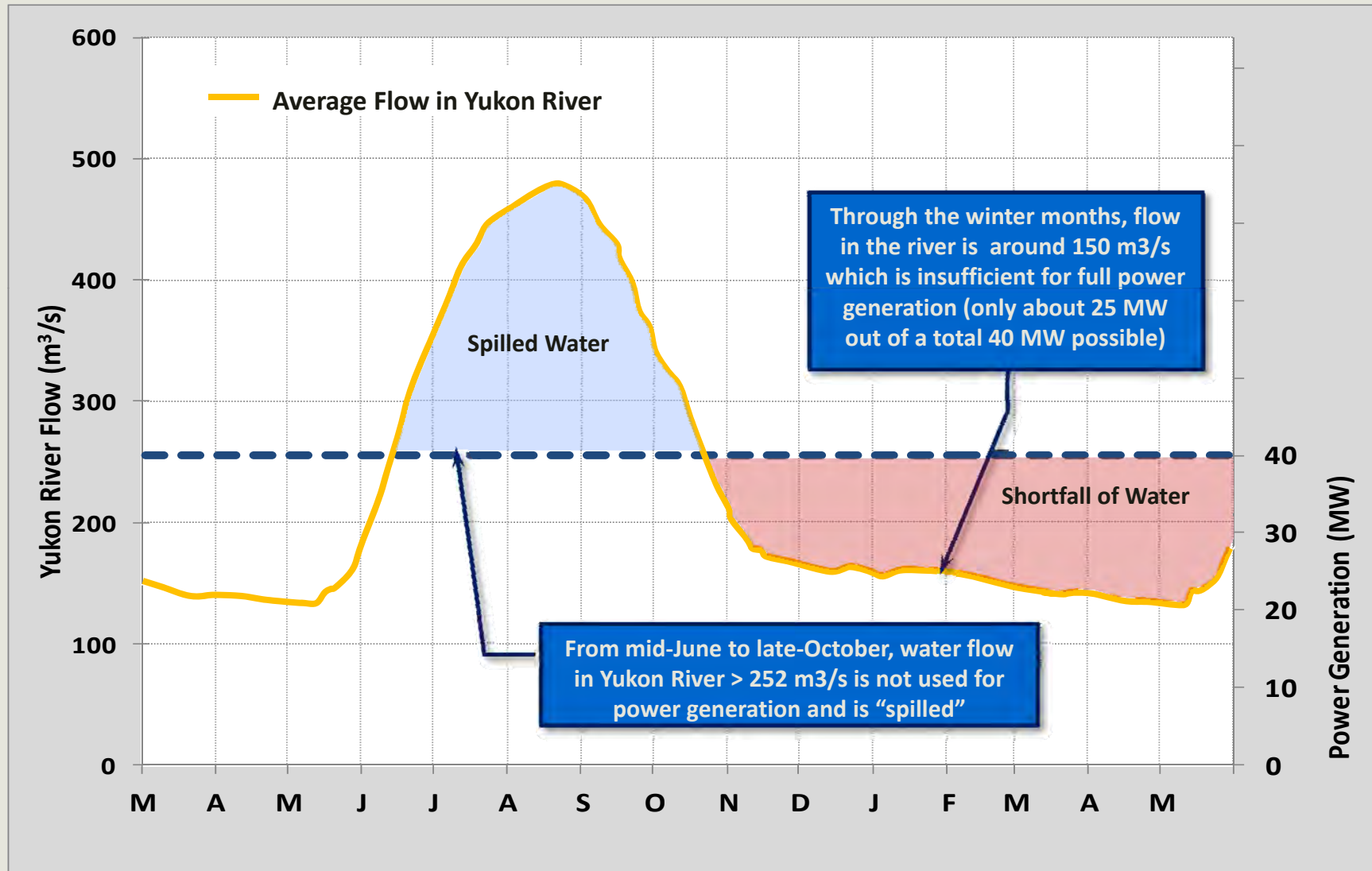
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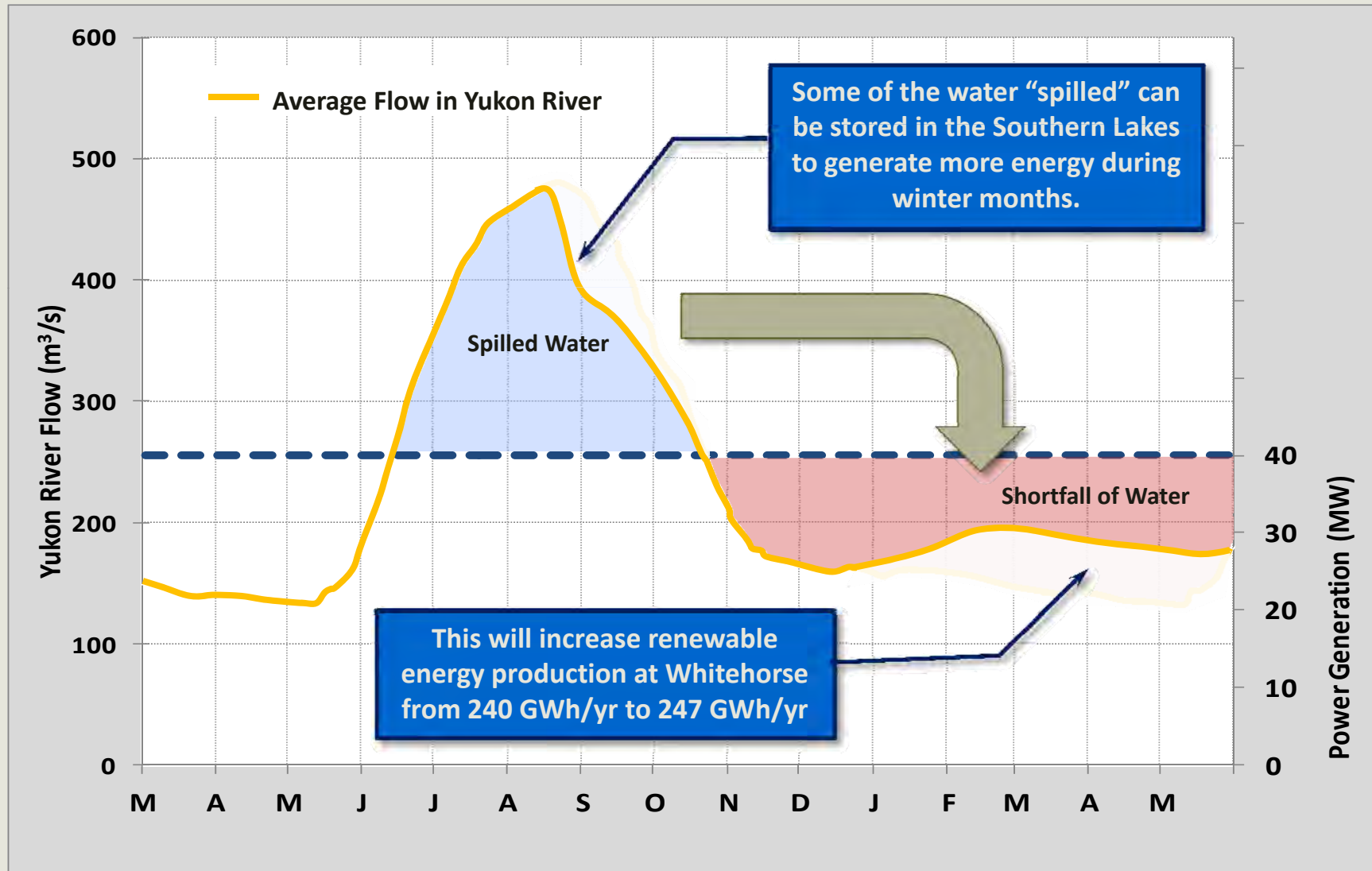
Any questions about how Marsh Lake is currently managed?



How can more hydropower be generated at Whitehorse?



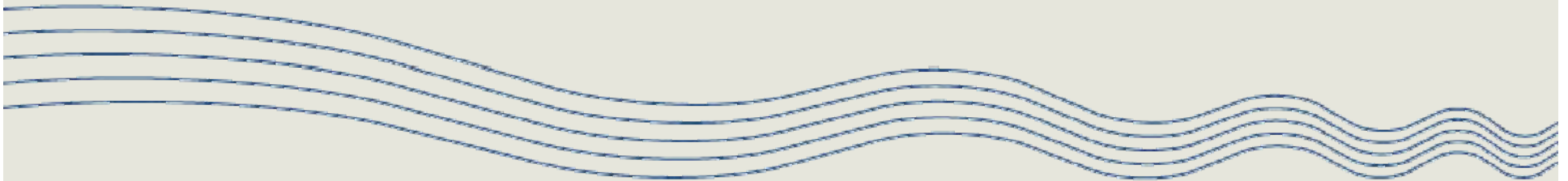
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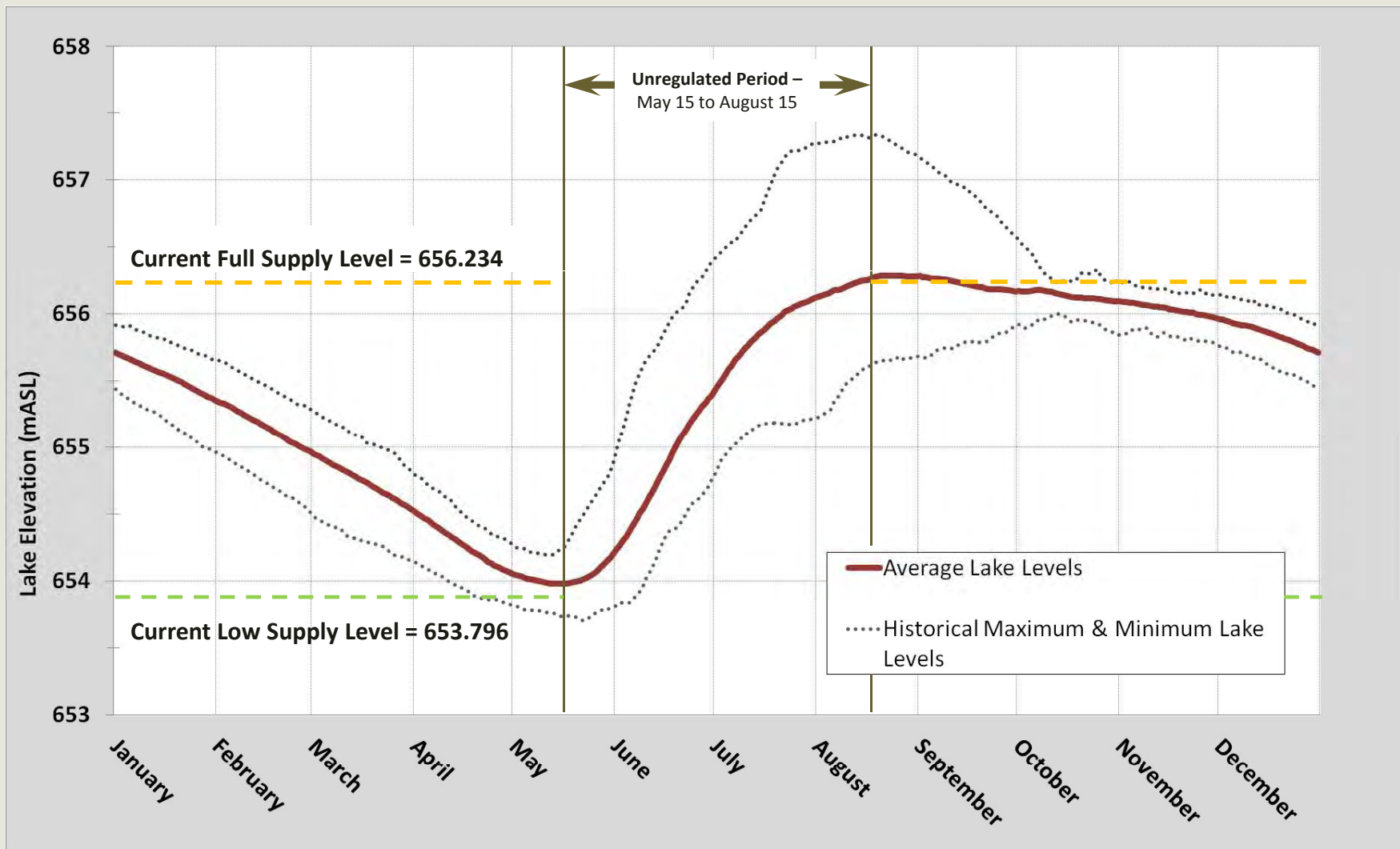
Southern Lakes Enhanced Storage – Proposed Change

Summary of proposed changes to water licence :

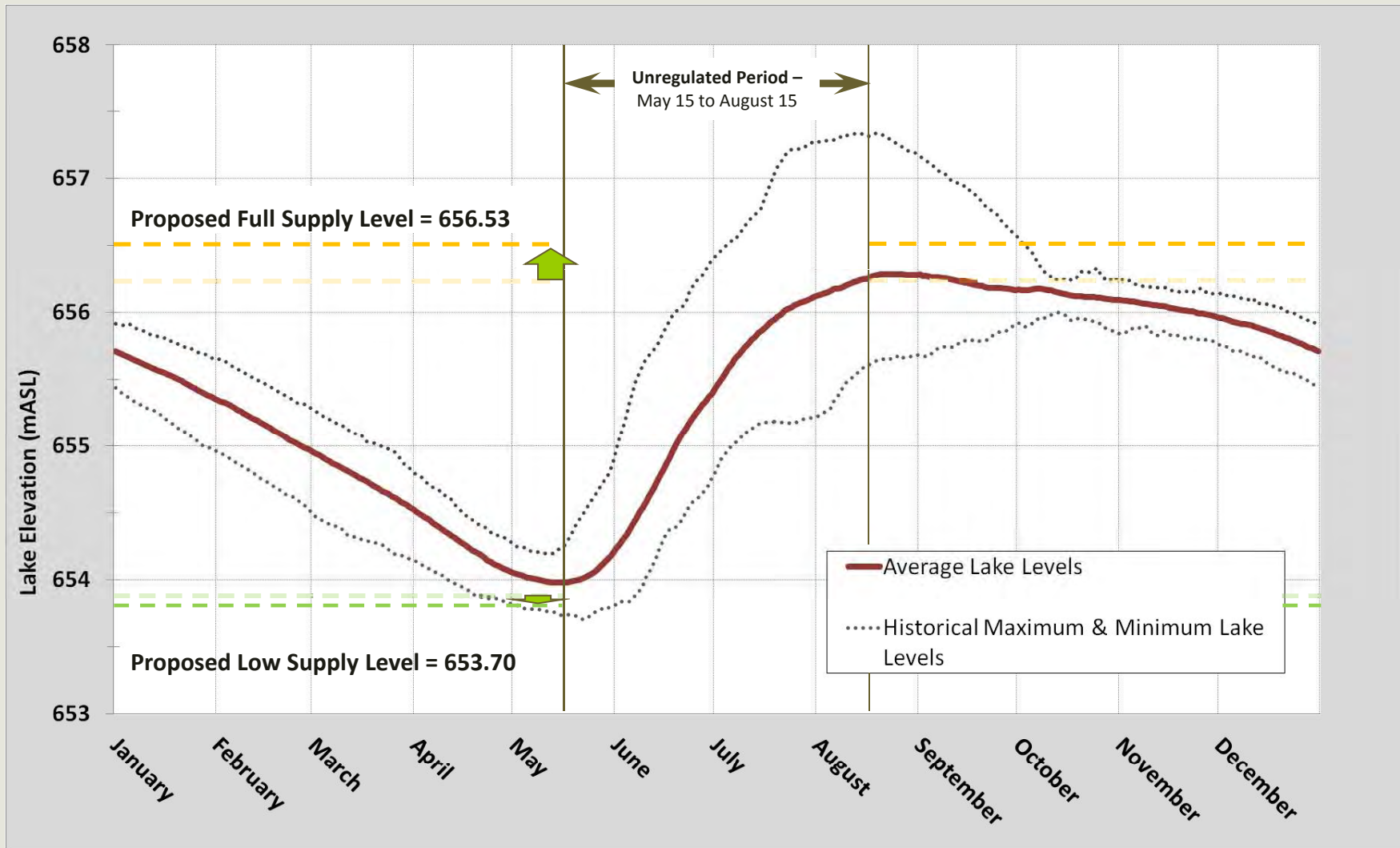
- Increase regulated full supply level (FSL) by 0.3 m from 656.234 to 656.53 m ASL
- Lower low supply level (LSL) by 0.1 m from 653.796 to 653.70
- Gate closure rules may not need to change, but there may be environmental benefits to manage flows by adjusting gate closure rules.



Overview of proposed change to Marsh Lake water levels



Overview of proposed change to Marsh Lake water levels



Effect of proposed change on average Marsh Lake levels

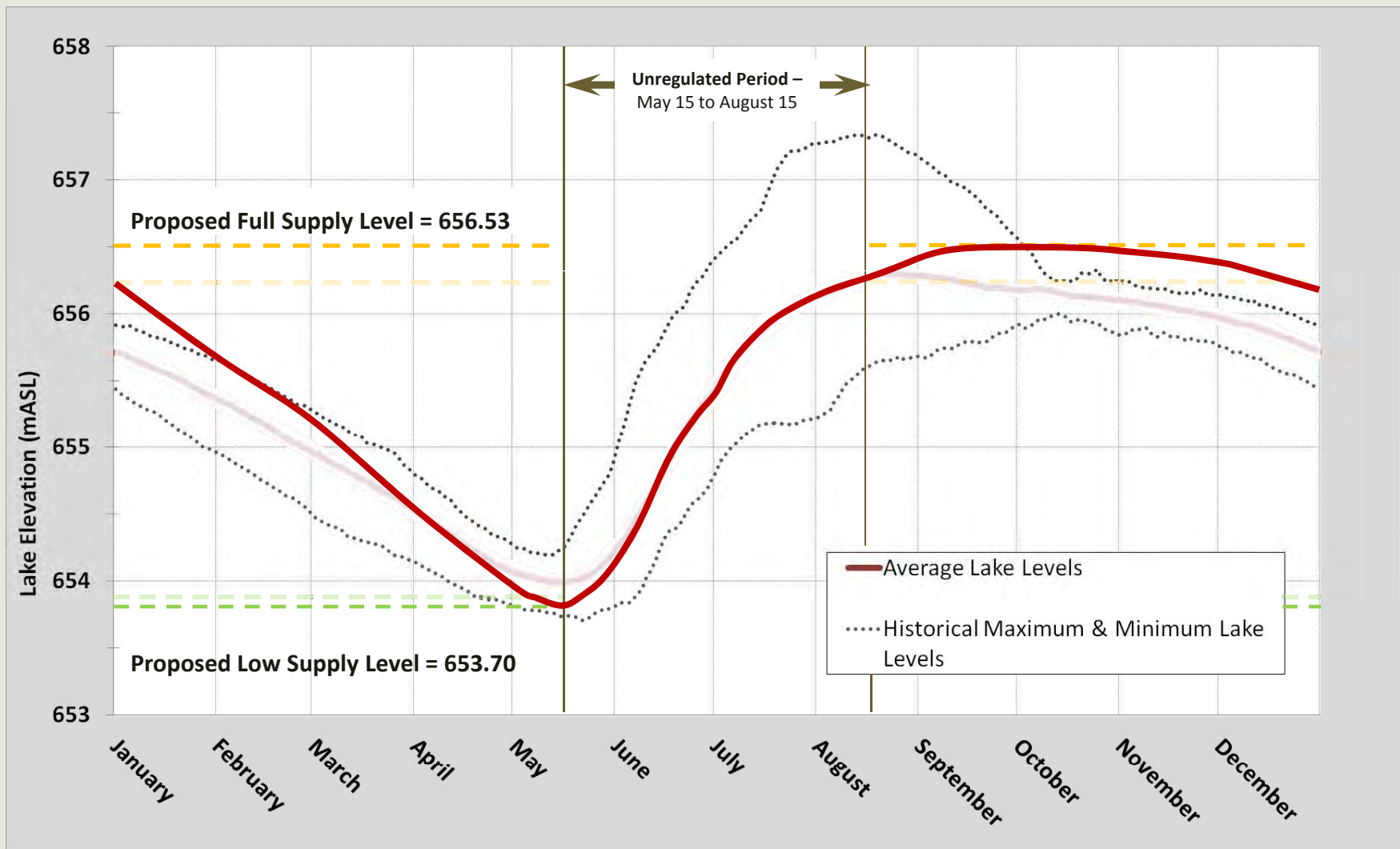
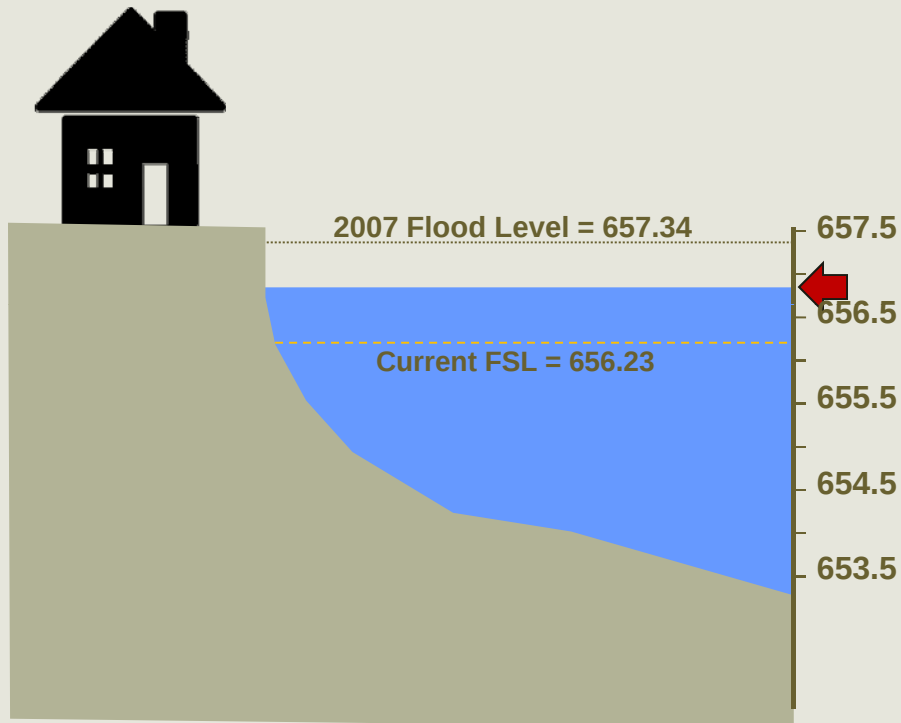


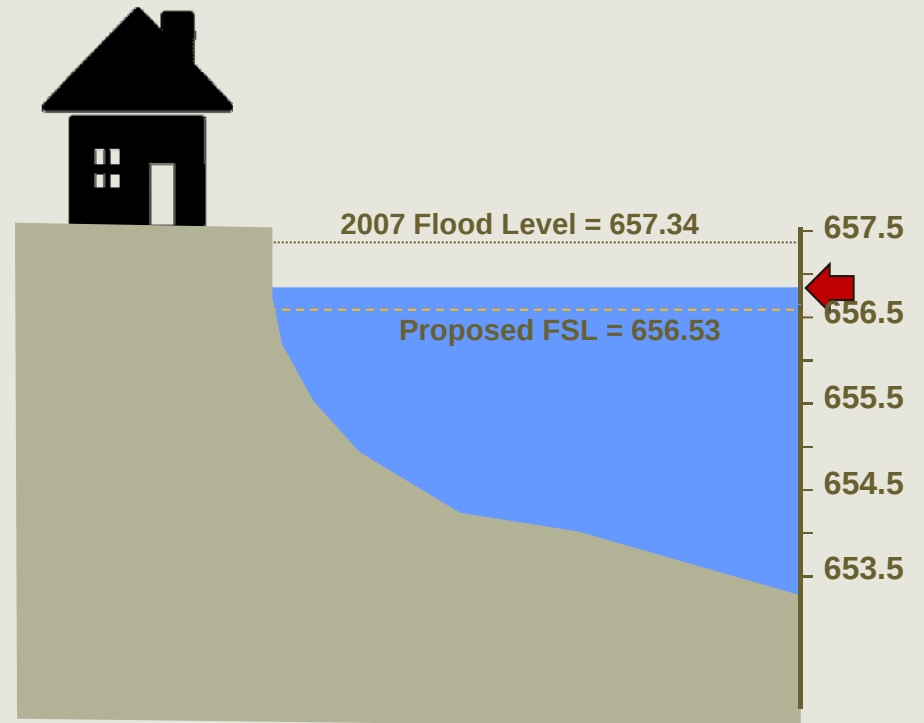
Illustration of proposed change in high water year

2004/05 selected as representative year for illustration purposes – peak lake level: 656.79 m

Current Conditions:



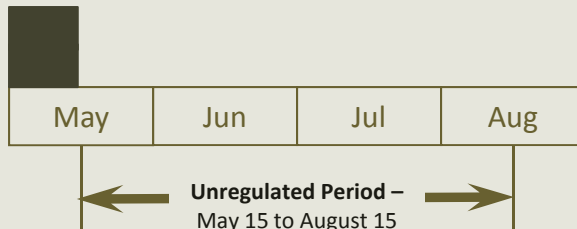
Proposed Change:



Gate Position
Open/Closed:

Current

Proposed



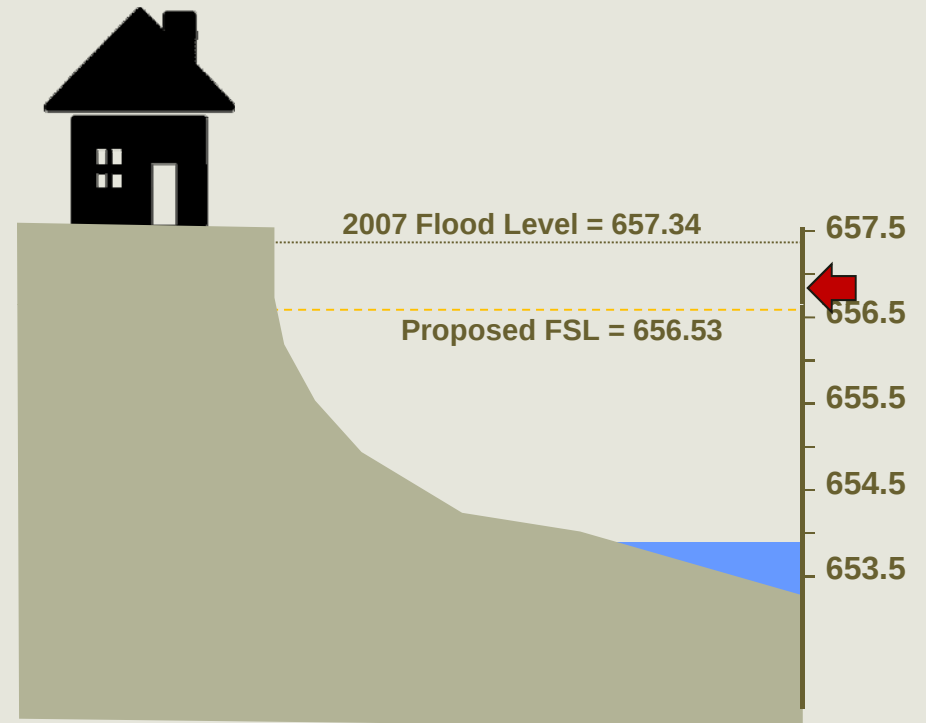
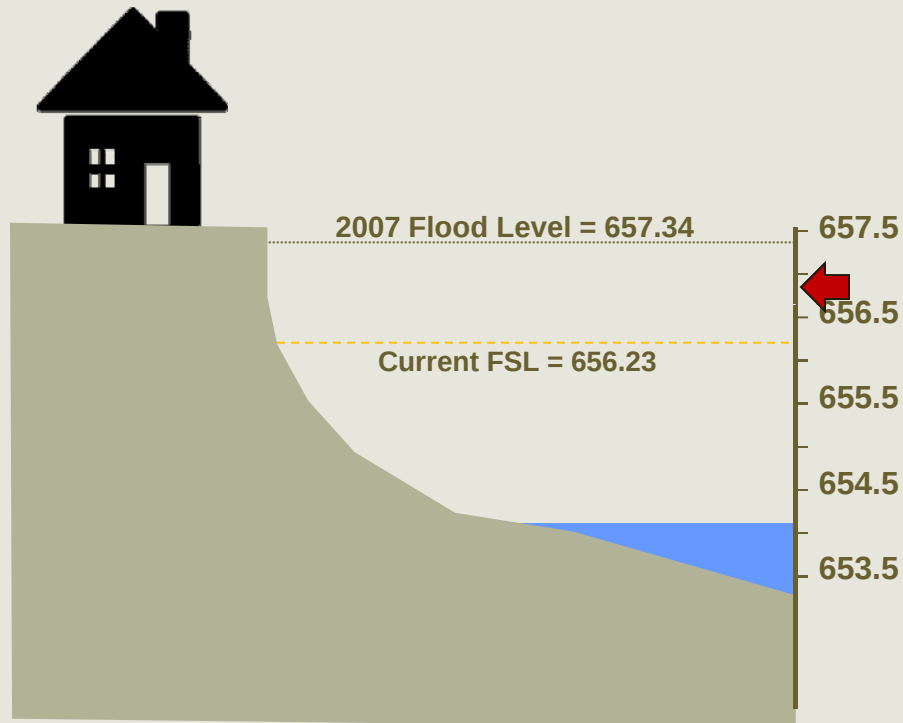
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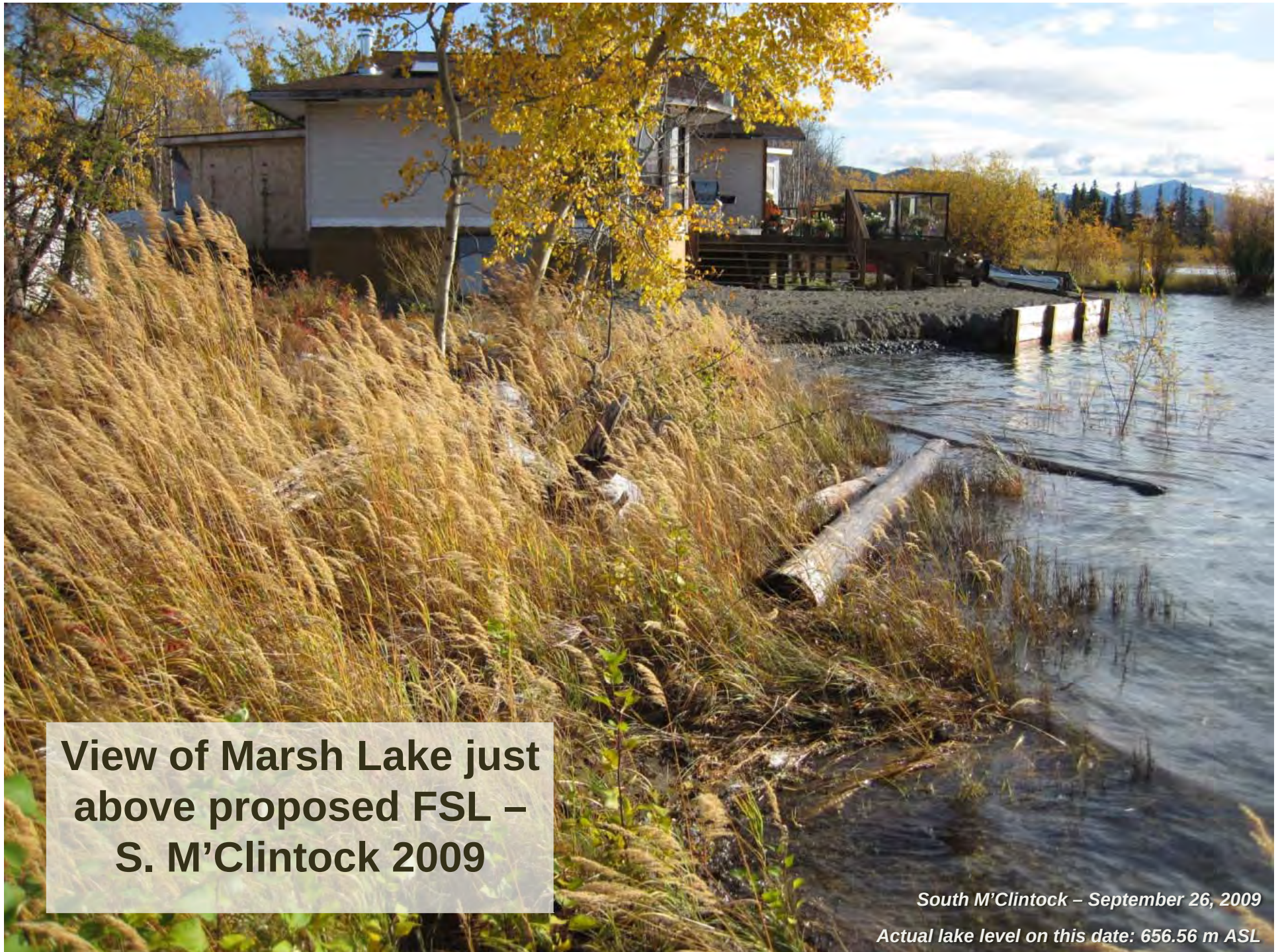
Proposed



Unregulated Period –
May 15 to August 15

Ice cover forms mid-November

Southern Lakes Enhanced Storage – Proposed Change

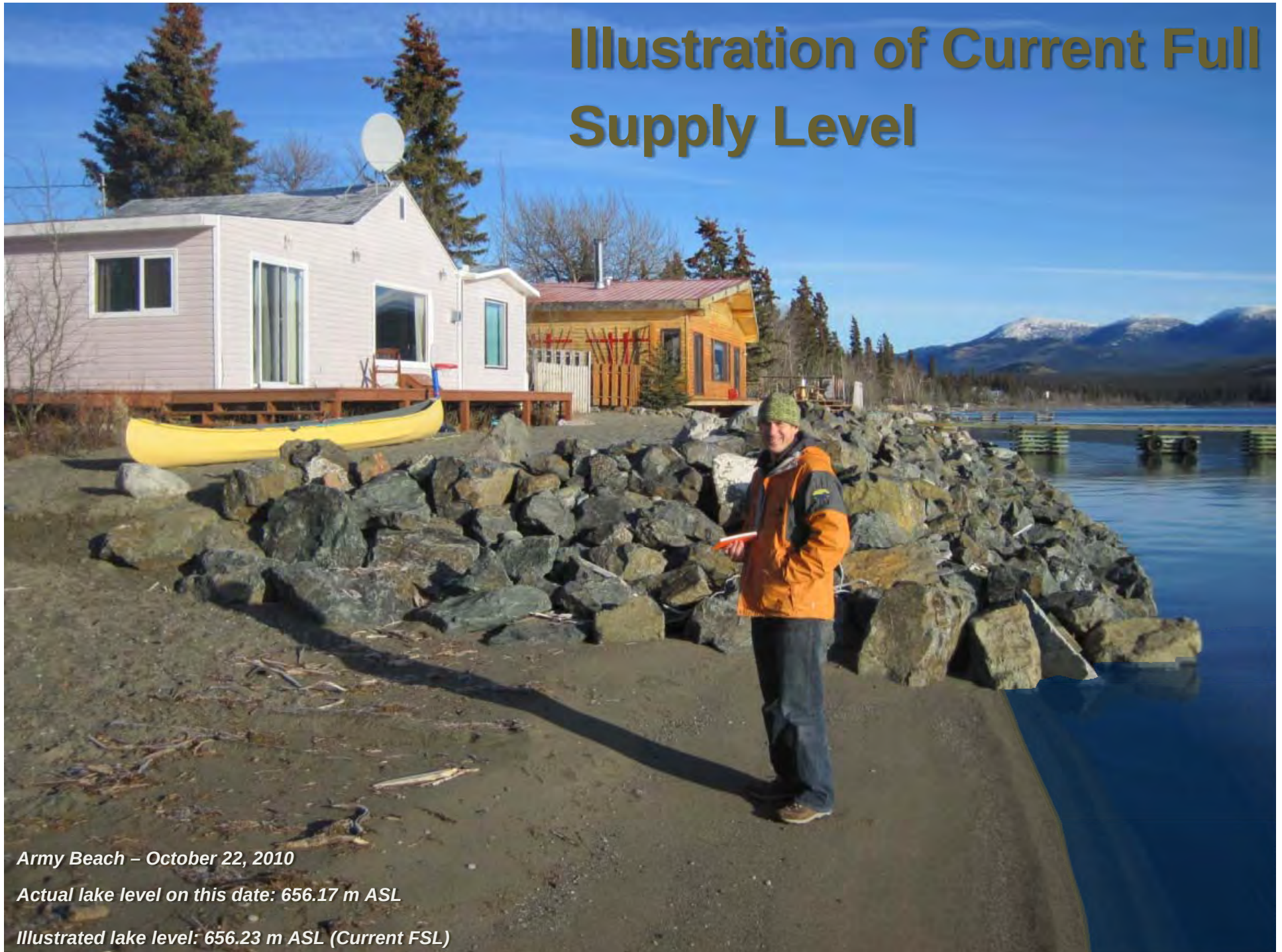


**View of Marsh Lake just
above proposed FSL –
S. M'Clintock 2009**

South M'Clintock – September 26, 2009

Actual lake level on this date: 656.56 m ASL

Illustration of Current Full Supply Level



Army Beach – October 22, 2010

Actual lake level on this date: 656.17 m ASL

Illustrated lake level: 656.23 m ASL (Current FSL)

Illustration of Proposed Full Supply Level



Illustrated lake level: 656.53 m ASL (Proposed FSL)

Illustration of Current Full Supply Level



South M'Clintock – August 30 2011

Actual lake level on this date: 656.14 m ASL

Illustrated lake level: 656.23 m ASL (current FSL)

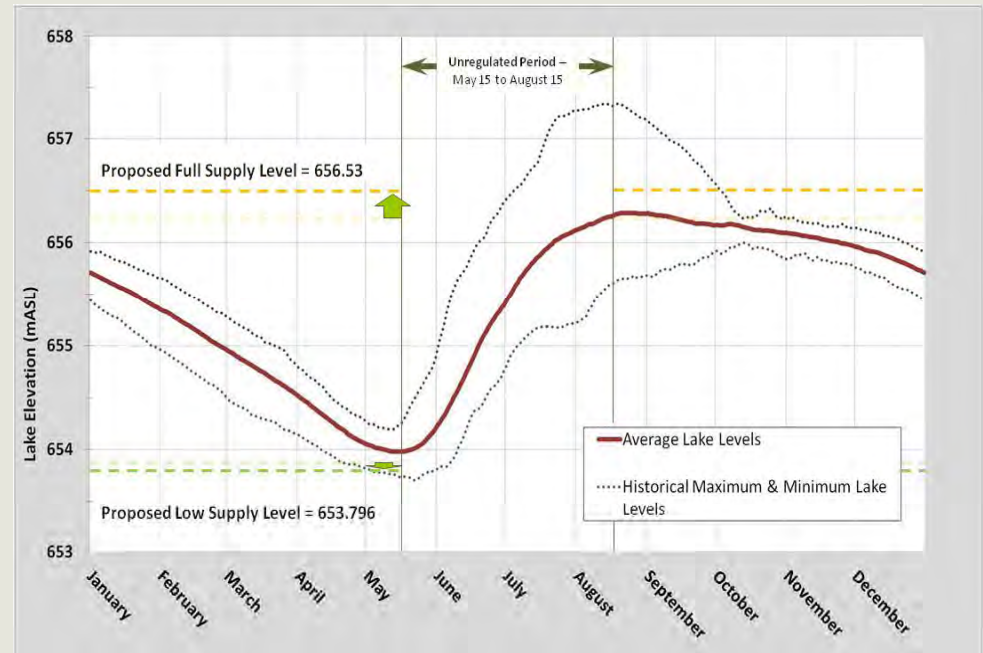
Illustration of Proposed Full Supply Level



Illustrated lake level: 656.53 m ASL (Proposed FSL)

Scope of Proposed Changes to Lewes Control Structure Water Licence

- > Increase regulated full supply level by 0.3 m
 - > Lower low supply level by 0.1 m
 - > No change to gate closure dates necessary, but may be optimal.
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- > Water level changes extend to Marsh, Tagish & Bennett Lakes during the regulated period
 - > Water level changes in mid-August through March in most years.
 - > No change to water levels from June to mid-August



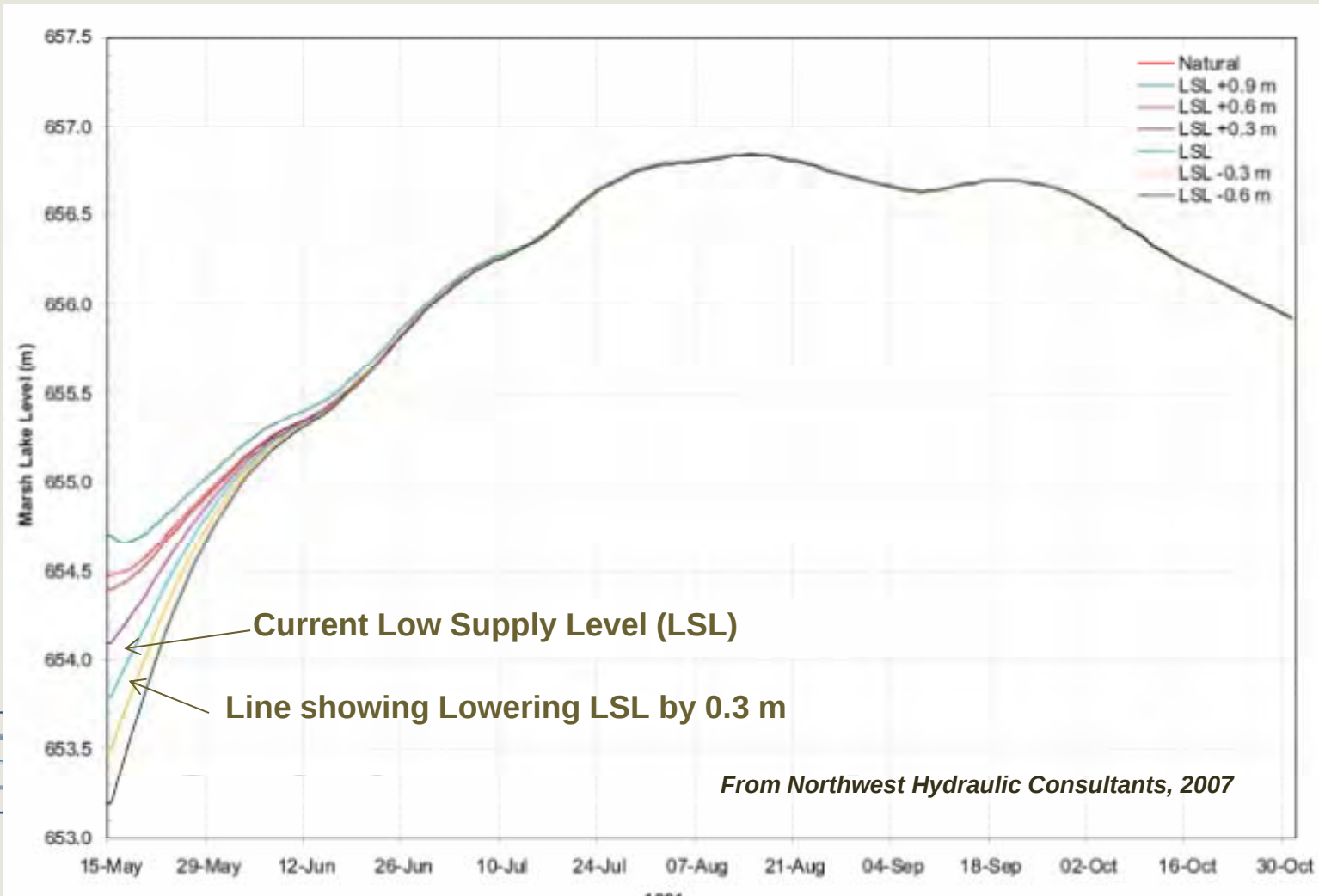
Questions?

End



Effect of proposed change to Low Supply Level by 0.1 m

- Affects only Marsh Lake and does not extend to other Southern Lakes
- Lake refills very quickly and effect only lasts a couple of weeks in May





Army Beach – October 22, 2010

Lake Level: 656.17 m ASL



Army Beach – August 5, 2010

Lake Level: 655.92 m ASL