Cowichan Water Use Plan

Public Advisory Group Meeting 4

May 8th, 2018

A community planning initiative in partnership with:

compass kwl ECOFISH RESEARCH

CVRD Cowichan Watershed BOARD Catalyst

Welcome

Partner Organizations

CVRD

Cowichan Watershed BOARD

Catalyst

Go Around…

What should the Cowichan Valley Citizen's front cover headline read for reporting out on the outcome of the Cowichan WUP?

Meeting Objectives

- To review and provide an update since the last meeting
- To review any changes to the current set of performance measures
- To review and discuss the rationale and performance of the new water use alternatives
- To discuss the characterization and significance of potential effects on lakefront properties
- **To review and assess a series of related recommendations for the Cowichan WUP**
- **To reach agreement on a preferred and recommended water use alternative**
- To discuss the next steps for the public engagement and planned public meeting
- To review the concluding steps of the planning process

Draft Agenda

8:30am	**Welcome and Update**
9:00am	**New Water Use Alternatives**
9:30am	**Characterizing Potential Effects on Lakefront Properties**
10:30am	**Break** – *15mins (light snacks)*
10:45am	**Assessing the Alternatives**
12:00pm	**Lunch** *(Provided) – 60mins*
1:00pm	**Other Related Recommendations**
1:45pm	**Reaching Agreement on a Preferred Alternative**
2:30pm	**Break** – *15mins*
2:45pm	**Reaching Agreement – Cont'd**
3:30pm	**Support for other Recommendations**
4:15pm	**Concluding Steps**
4:45pm	**Concluding Comments**
5:00pm	**Adjourn**

About Today

Ground Rules

- Come prepared
- Strive for Inclusion and Respect
- Challenge ideas, not people
- Speak in Terms of Interests, Not Positions
- Seek Common Ground
- Provide Rationale for Your Opinions
- Stay Focused
- Be Open-Minded, Participatory, and Concise

Update

- Aquatic & Riparian Technical Sub-Group
  - Post-WUP monitoring recommendations
- Characterizing potential effects on lakefront properties
- Developing final water use alternatives
- Hydrological Modelling and calculating PMs
- Public and Internal Websites
- Public Information Meeting (June 11)
- Other Updates?

Past Action Items

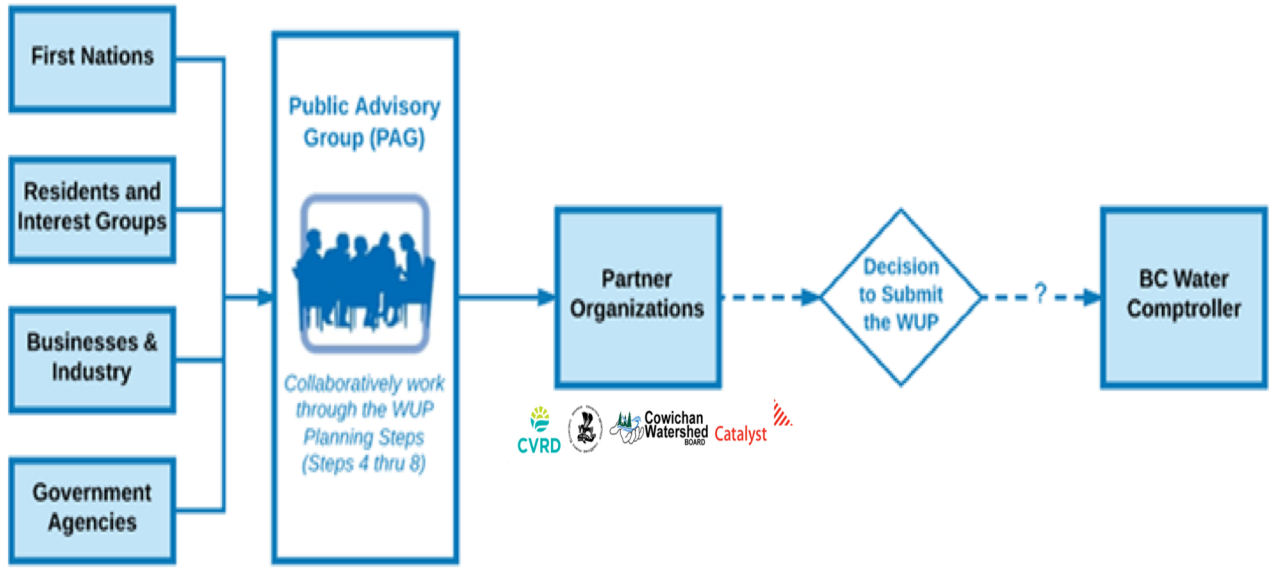
- Compass and KWL to better characterize the potential effect of increased lake levels on lakefront property owners in relation to property rights.
- Compass / CVRD to schedule the second public information meeting, as follows:
  - **Public Info Meeting 2 – June 11**
- Compass, KWL and Ecofish to develop a new round of alternatives (i.e., Round 3), complete the hydrology modelling, and assess against the performance measures.
- PAG members to review meeting notes and provide comments

Cowichan WUP Planning Process

Recap

Cowichan WUP Process

- A public planning process was initiated in the fall of 2017
- A **public advisory group** (PAG) was established and comprised of 20 community members representing First Nations, local governments, residents, businesses, industry, interest groups[1], and provincial and federal agencies
- The **PAG** has been meeting regularly over the past 6 months and will have their final meeting on May 8, 2018
- The **PAG**'s mandate is to identify and assess different water use alternatives and collaboratively develop recommendations for consideration by the Partner Organization



1. Lakefront property owners, agriculture, ENGOs, recreation, etc.

PAG Terms of Reference

5 Consensus Decision-Making

5.1 Consensus

Consensus is a goal but not a requirement of the WUP process. The Provincial Water Use Guidelines define consensus as a decision that participants can accept, without having to agree on all the details of the recommendations put forward. Meeting documentation will identify areas of agreement, areas of discord, and underlying trade-offs between alternative water uses.

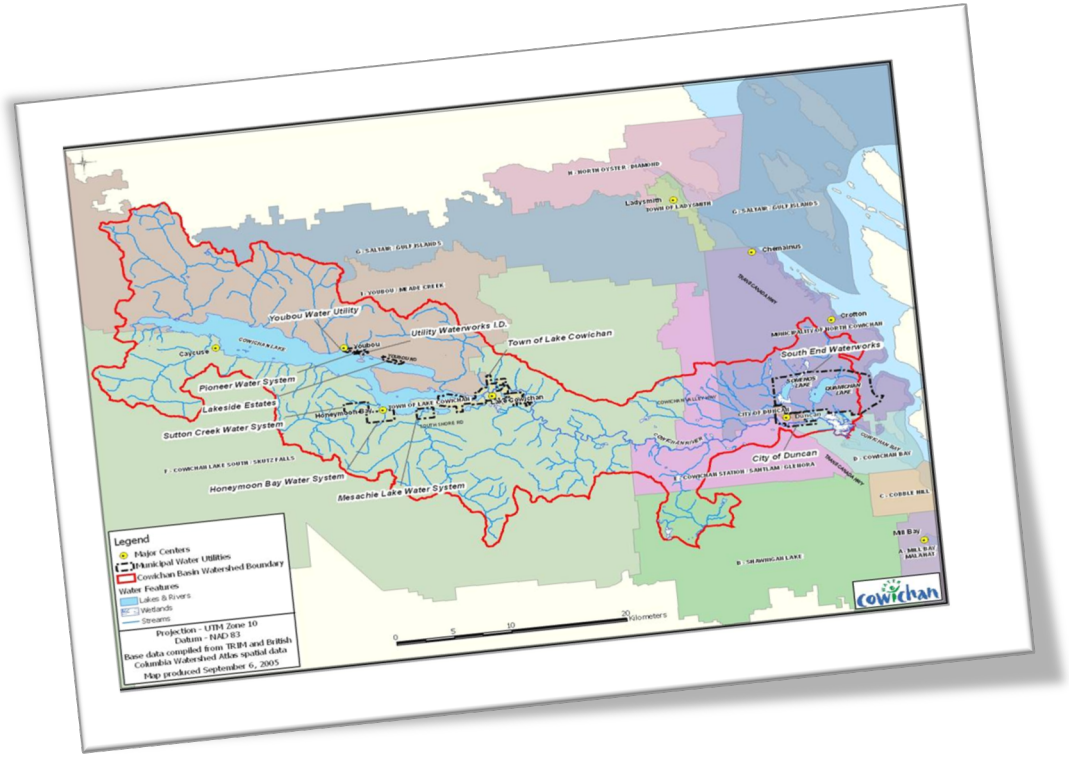
The decision making process to determine the PAG's position on a particular issue or when making a recommendation will not be by majority votes. In fact, there will be no voting per se, but there will be ranking exercises carried out at various points to gain insight of where broad agreement may lie.

When the PAG cannot identify a preferred final recommendation (non-consensus), the final summary report will record and indicate differences of opinion and reasons for non-consensus. Members in disagreement with a 'preferred option(s)' will be responsible for describing what part(s) of the agreement do not meet their needs and possible alternative and acceptable solutions.

Cowichan WUP Process

Scope of the Planning:

- Limited to water use related to potential changes in lake levels on Cowichan Lake and potential changes in flows down the Cowichan River.
- Based on future hydrology in the 2050s (under climate change)



- The scope of options to be explored is constrained by those issues that can be addressed under the *Water Sustainability Act*, i.e.,
  - Changes in flows released to the Cowichan River,
  - Changes in spring and summertime water levels (i.e., Rule Curve) for Cowichan Lake,
  - New infrastructure to store more water in Cowichan Lake (e.g., weir modifications, permanent pump station, etc.)

Cowichan WUP

Objectives and PMs

Objectives Areas

- **Culture and Heritage**
  - First Nations Salmon Harvesting Rights (FSC)
  - Traditional Knowledge Transfer & Generation
  - Ceremonial Bathing (Cultural Practices)
  - Archaeological Sites (Cowichan River)
- **Environment (Cowichan River)**
  - Geomorphology
  - Connectivity (lateral)
  - Water Quality
  - Fish Passage
  - Salmonid Rearing
  - Salmonid Spawning
  - Wildlife and Riparian
- **Environment (Cowichan Lake)**
  - Water Quality
  - Vancouver Lamprey
  - Lake Littoral Habitat
  - Wildlife and Riparian
- **Industry and Commercial**
  - Catalyst Paper
  - Agriculture (Irrigation / GW Wells)
  - Commercial Fisheries
- **Lakefront Properties**
  - Flooding and Inundation
  - Private Property Lakefront Areas
  - Docks / Wharves
  - Private water pump intakes
- **Municipal**
  - Waste Water
  - Water Supply - Lake
  - Water Supply - River
- **Recreation and Tourism**
  - Lake - Recreational Beach Use
  - Lake – Boat Access / Navigation
  - River – Boating and Tubing
  - Angling / Fishing
- **Water Management**
  - Infrastructure Capital and Operating Costs

Performance Measures

The PMs are largely unchanged since March's PAG mtg 3, except:

- **Lake Beach Use Areas – User Days PM**
- **Boating and Tubing – River PM**

Plus we reviewed some other potential issues:

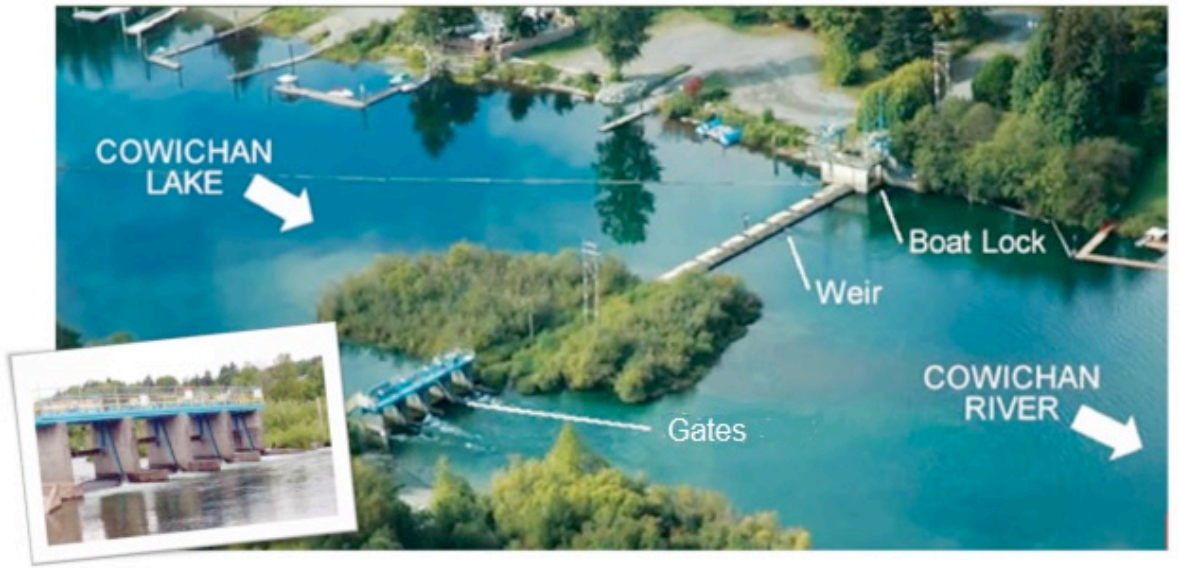
- Town of Lake Cowichan boat ramp cut off point
- River beach health adversaries – no reln to river flow data (n=4)
- Drinking water quality for Cowichan Lake – no impacts anticipated

Cowichan WUP

Water Use Alternatives

Cowichan Weir

Constructed in 1957 – Operated by Catalyst Paper

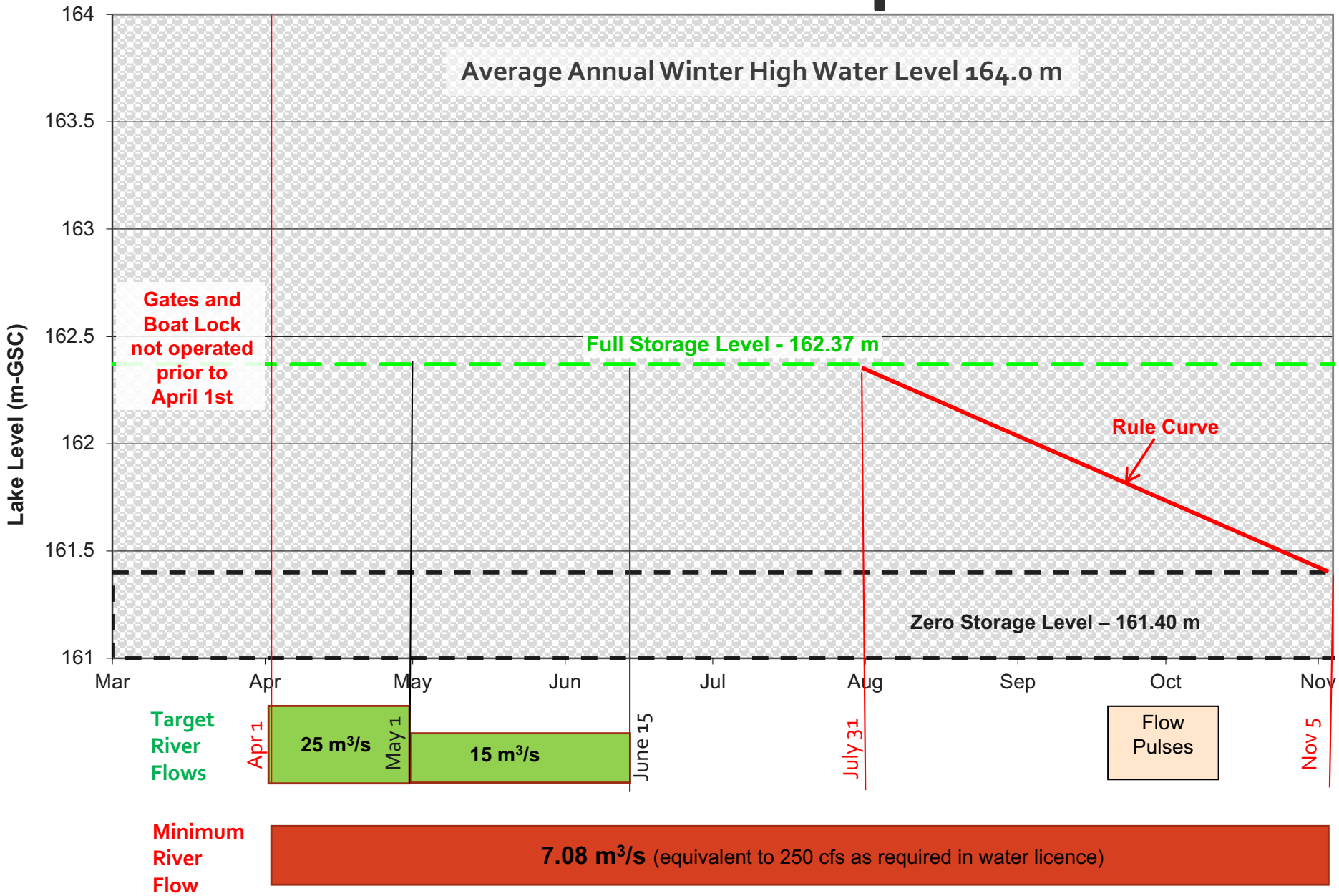


Stores 59.5 million m^3 of water in Cowichan Lake
(equivalent to 97 cm depth of water over lake surface)
(about 97 days of supply at minimum flow)

Original design

Design Intent	Water Licence Flow
Maintain min. flow in Cowichan River below weir	250 cfs (about 7 m^3/s)
Provide water for for Crofton Mill	100 cfs (about 2.8 m^3/s)
Maintain min. flow below the Crofton Mill Pump Station	100 cfs (about 2.8 m^3/s)

Cowichan Weir – Operation



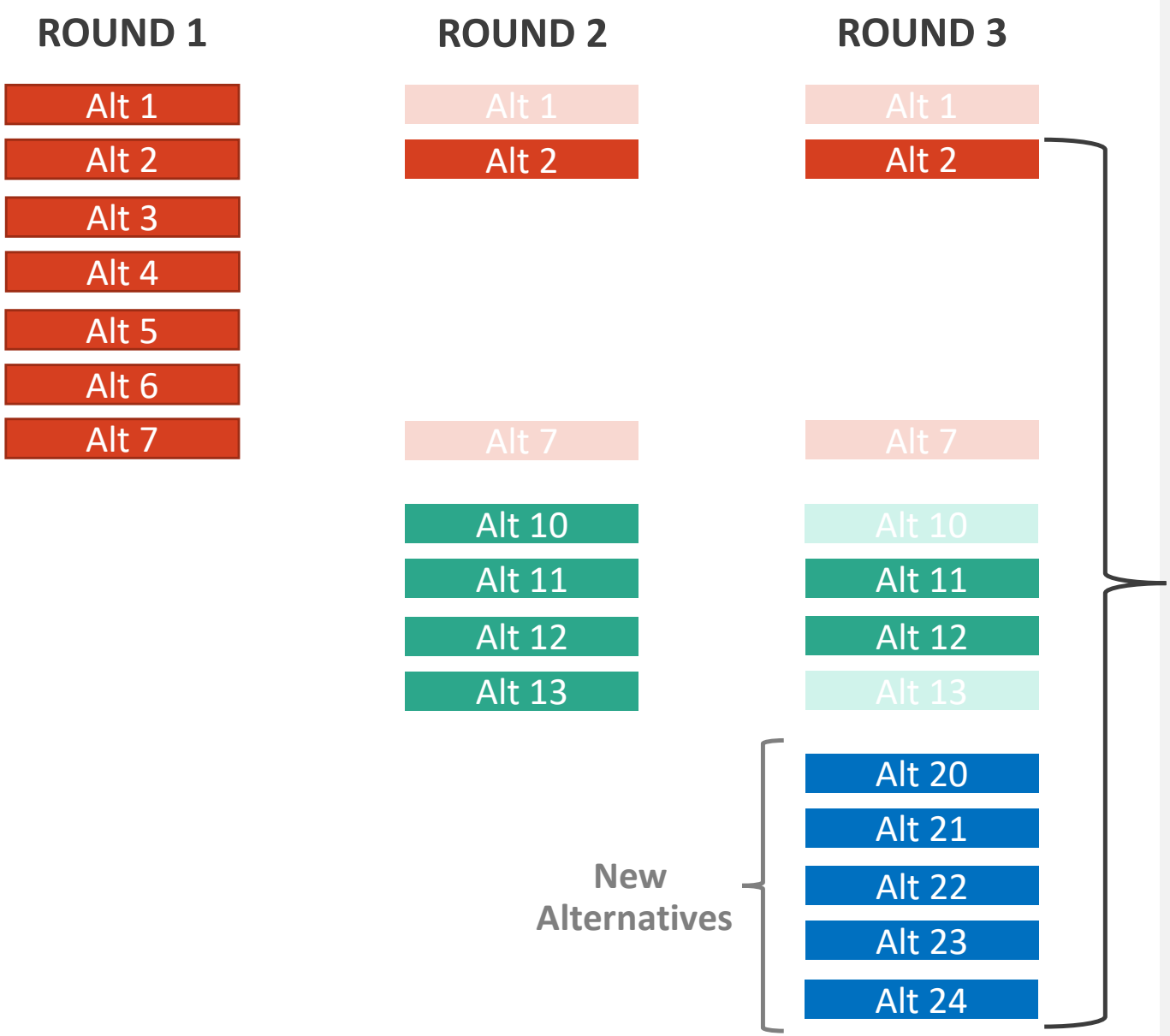
Water Use Alternatives

New Round 3

New alternatives attempted to:

- Target spring flows of 25cms and 15cms when inflows and storage targets allow;
- Target base flows of 7cms through the summer and early fall periods;
- Avoid any net incremental increase (i.e., 10cm or less) in lake levels during spring flooding events during the control period;
- Limiting the height of the weir to minimize inundation effects on lakefront property owners (i.e., a wider and shorter range of increases to the weir height were considered for this reason);
- Avoid base flows dropping below 5cms during summer droughts; and
- Avoid lake levels from dropping more than 15cm below the zero storage elevation (of 161.4m) with an absolute hard limit of no more than 30cm drop in the worst year (i.e., a reliance on negative storage was greatly reduced in this new round of alternatives based on PAG feedback at the March meeting).
- Avoiding a reliance of meeting base flows through pumping

Water Use Alternatives



Alternatives

- Increased weir heights
  - ❑ 0m
  - ❑ +0.3m
  - ❑ +0.4m
  - ❑ +0.5m
  - ❑ +0.6m
  - ❑ +0.7m
  - ❑ +1.0m
- Decreased summer lake levels (below historical)
  - ❑ 0m
  - ❑ -0.15m
  - ❑ -0.3m
  - ❑ -1.0m
  - ❑ -1.5m
- Decreased fisheries flows
  - ❑ 15/25cms Spring flows
  - ❑ Summer min base flows
    - ➢ 5cms
    - ➢ <4.5cms
- Earlier date to fill lake
  - ❑ Mar 1
  - ❑ Feb 1

Water Use Alternatives

Round 3

Round 3 Alternatives			

Alt 20
Weir Ht +0.3m
	• Increased weir height +0.3m (i.e., 162.67m)	• Control Period: Starts on March 1. Uses 162.2m as low water level trigger to reduce flows. Off control when water levels are above 162.62m.
		• Target flows - **hard** targets:
		  ○ 15cms from March 1 to April 30
		  ○ 7cms from May 1 to May 15
		  ○ 5cms from May 16 to end of control period
		• Target flows - **soft** targets:
		  ○ 25cms from March 1 to April 30
		  ○ 15cms from May 1 to May 15
		  ○ 7cms from May 16 to end of control period
		• Pumping capacity = up to 5cms as required
			ALT20_W0.3

Alt 21 – **Weir Ht +0.4m**	• Increased weir height +0.4m (i.e., 162.77m)		ALT21_W0.4
Alt 22 **Weir Ht +0.5m**	• Increased weir height +0.5m (i.e., 162.87m)		ALT22_W0.5
Alt 23 **Weir Ht +0.6m**	• Increased weir height +0.6m (i.e., 162.97m)		ALT23_W0.6
Alt 24 **Weir Ht +0.7m**	• Increased weir height +0.7m (i.e., 163.07m)		ALT24_W0.7

Water Use Alternatives

Round 3

Alternative Name	Description	Short Name
Bookend Alternatives (PAG Mtg 2)		
Alt 1 **Status Quo**	• Status Quo • Current infrastructure • Current rule curve	ALT1_SQ
Alt 2 **Status Quo (with Pumps)**	Same as Status Quo (Alt 1) except: • Temporary pumps installed (as per Catalyst's proposed 10yr interim license) ○ Pumping capacity = up to 5cms when needed	ALT2_P5
Round 2 Alternatives (PAG Mtg 3)		

Alt 11
Weir Ht +1m, Fish Optimized Flows
	• Increased weir height +1m (i.e., 163.4m)
	• Control Period: Starts on February 1, but restricts water levels to no more than half the increased weir height (i.e., 162.9m) until Feb 28; on March 1 allow water levels to rise to the full weir height (163.4m)
	• Target flows – **hard** targets (every year):
	  ○ 7cms throughout control period
	  ○ 25cms from February 1 to March 31
	  ○ 15cms from April 1 to May 15
	• Target flows – **soft** targets (wet years with sufficient inflow – lake level within 30cm full storage):
	  ○ 25cms from February 1 to May 15
	• Pumping capacity = up to 7cms when needed
		ALT11_W1P7F

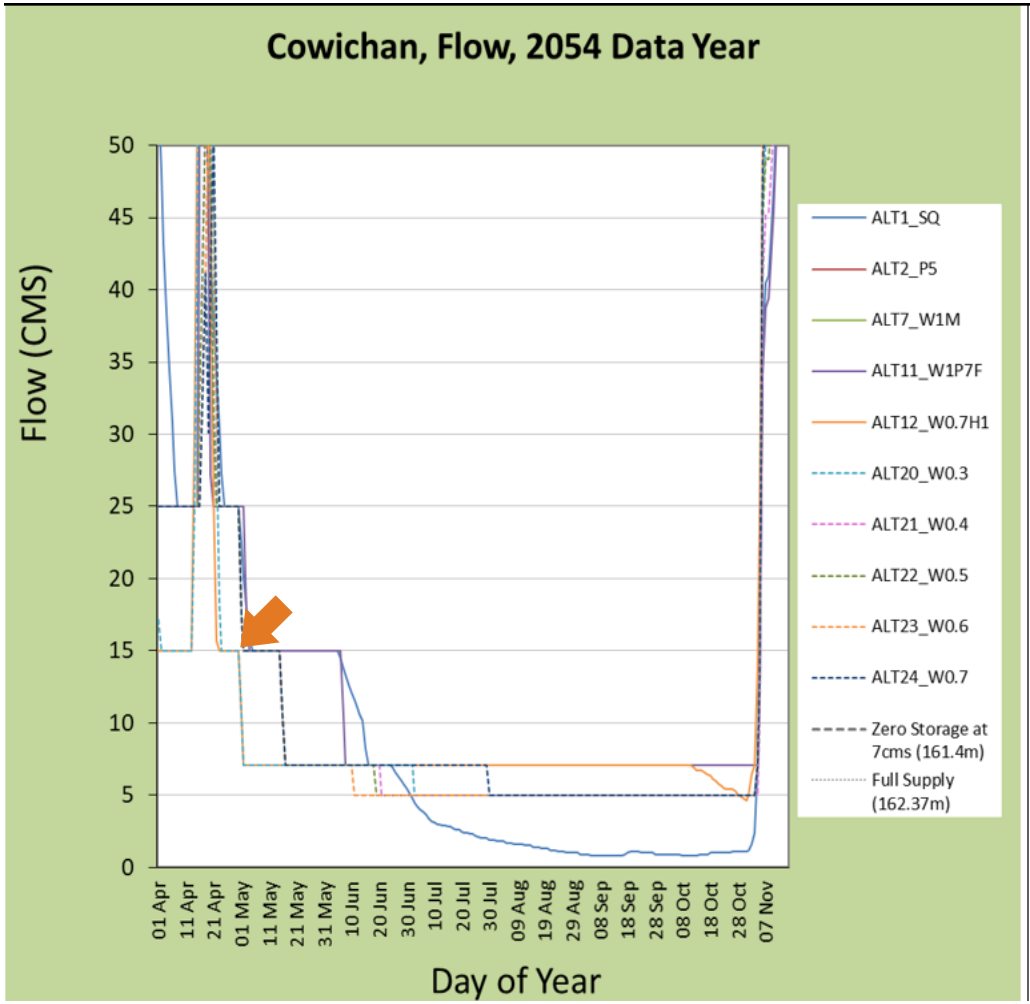
Alt 12
Weir Ht +0.7m, Hydrology Optimized Flows
	• Increased weir height +0.7m
	• Control Period: Starts on February 1, but restricts water levels to no more than the top of the existing weir height (162.4m); on March 1 allow levels to fill to the full weir height (163.1m)
	• Target flows:
	  ○ 7cms throughout control period
	  ○ 15cms February 1 to April 30
	• No pumps
		ALT12_W0.7H1

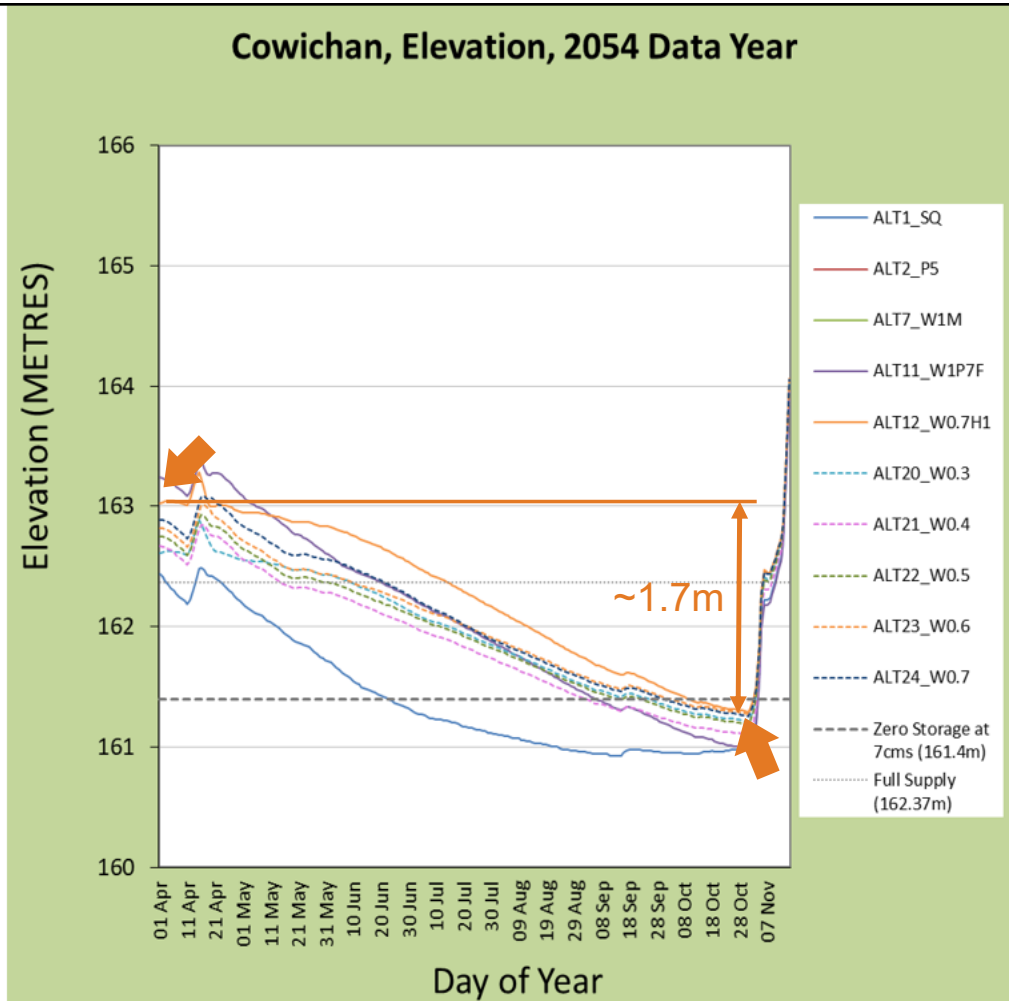
The challenges…

Period	Current (Alt 1)	Alt 11 Target	Alt 11 Min	Alt 12	New Alternatives (20-24) Target	New Alternatives (20-24) Min	ARTSG (Ref Min Flows)
Apr 1-15	25	25	15	15	25	15	20
Apr 16-30	25	25	15	15	25	15	20
May 1-15	15	25	15	7	15	7	15
May 16-31	15	7	7	7	7	5	15
Jun 1- 15	15	7	7	7	7	5	7
Jun 16-30	7	7	7	7	7	5	6
Jul 1-15	7	7	7	7	7	5	5
Jul 16-31	7	7	7	7	7	5	5
Aug 1-15	7	7	7	7	7	5	5
Aug 16-31	7	7	7	7	7	5	5
Sep 1-15	7	7	7	7	7	5	5
Sep 16-30	7	7	7	7	7	5	5
Oct 1 - 15	7	7	7	7	7	5	5
Oct 16-31	7	7	7	7	7	5	5
SUM	158	152	122	114	142	92	123

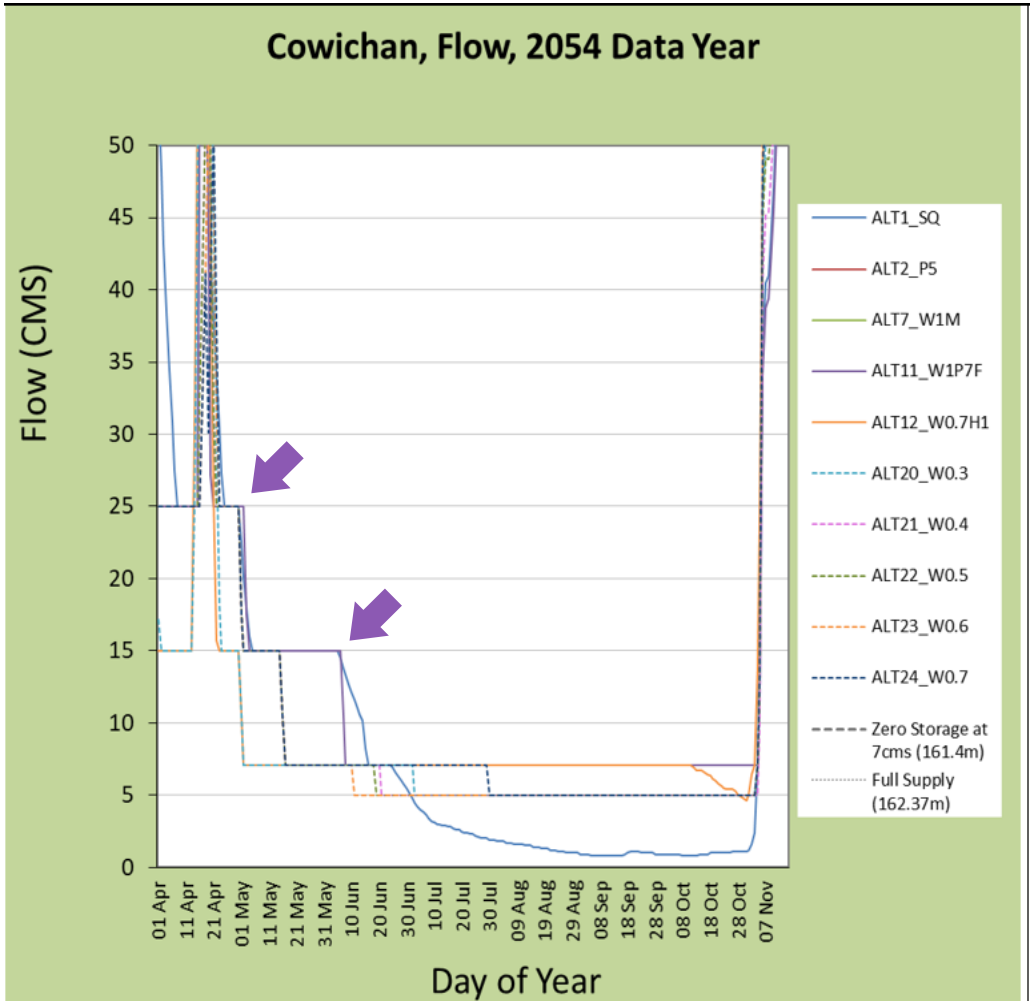
Note. This volume equivalent to ~1.7m of storage

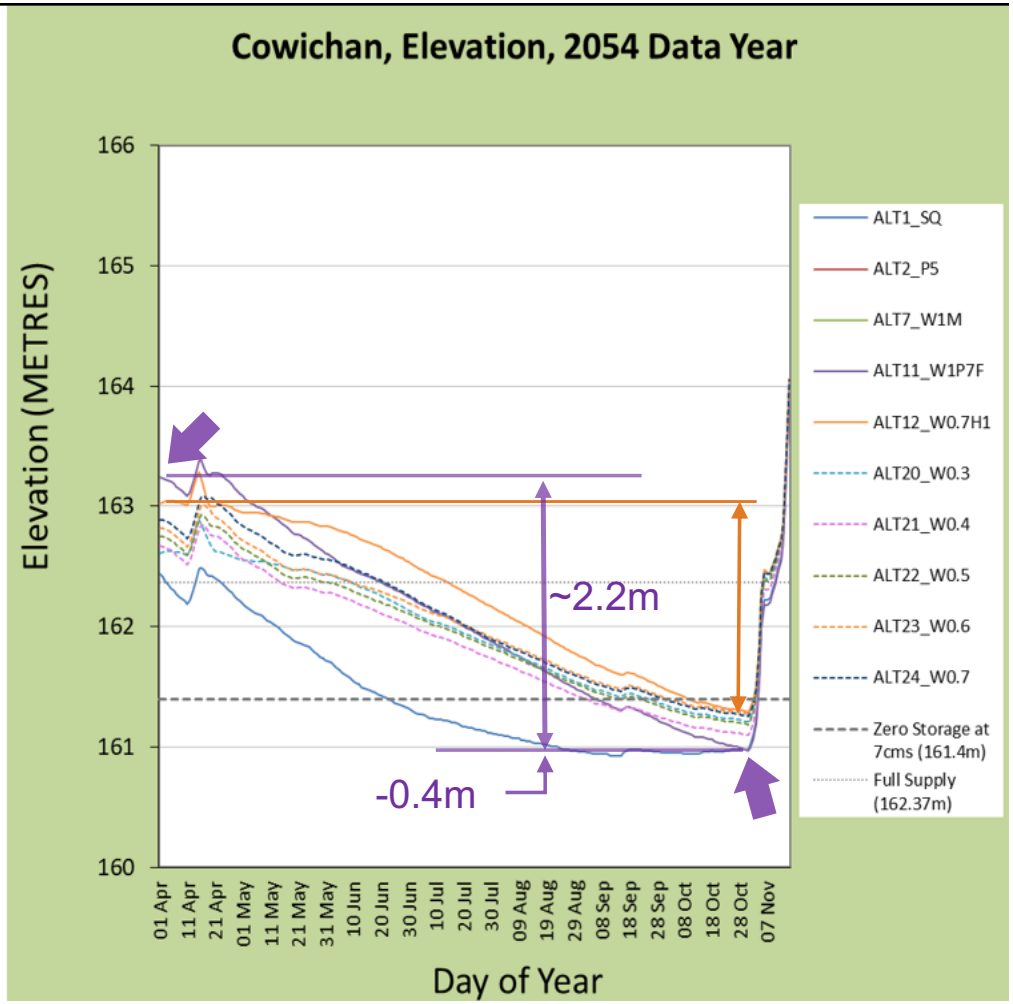
The challenges…



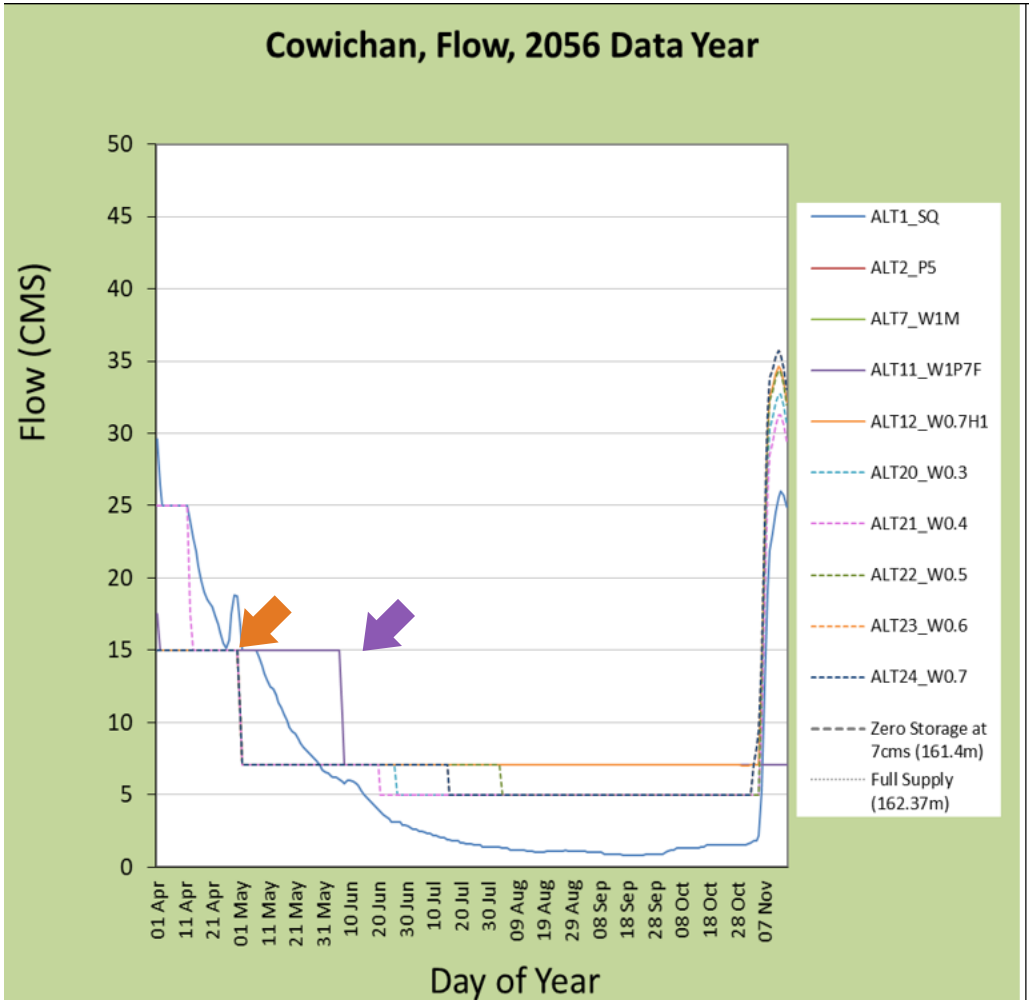


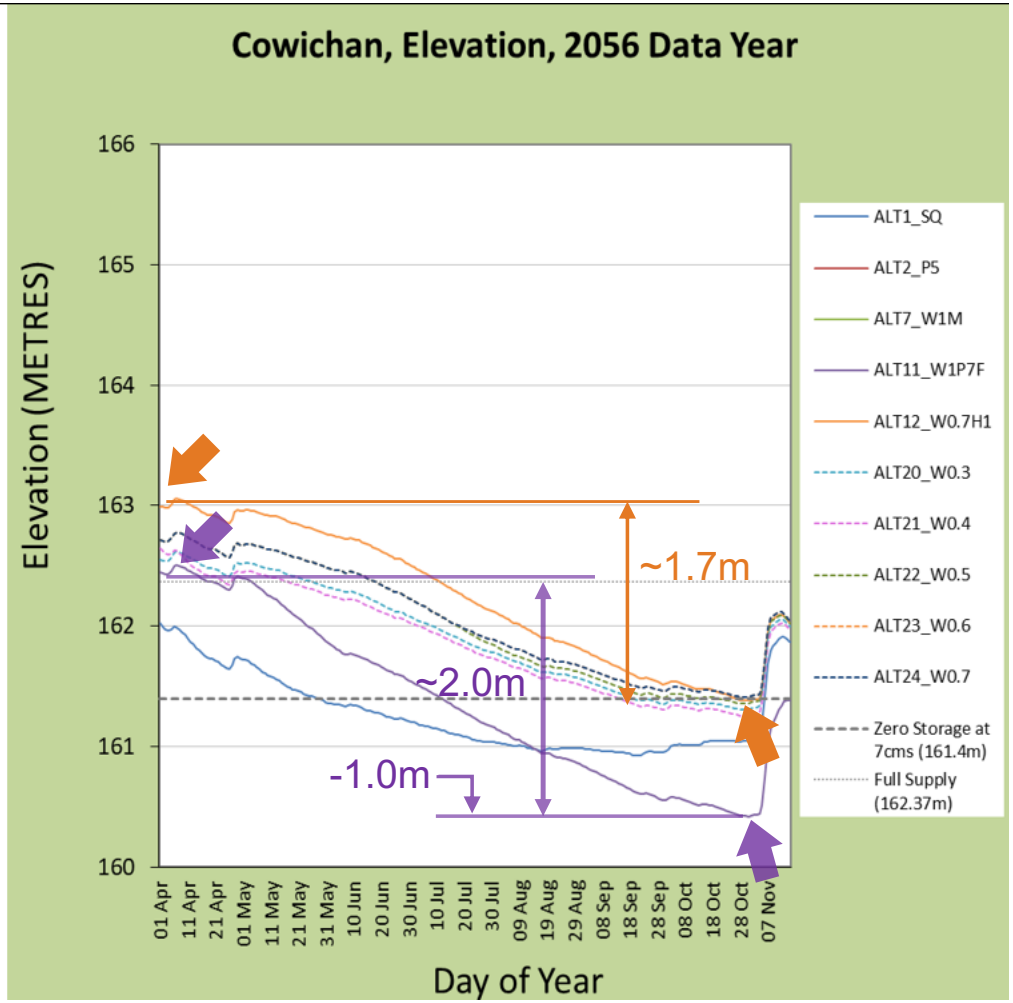
The challenges…





The challenges…





Cowichan WUP

Characterizing Potential Effects on Lakefront Properties


BUY
WORK
MIND
JOB
BILL
FAIL
MOVE
SMS

Potential Effects on Lakefront Properties

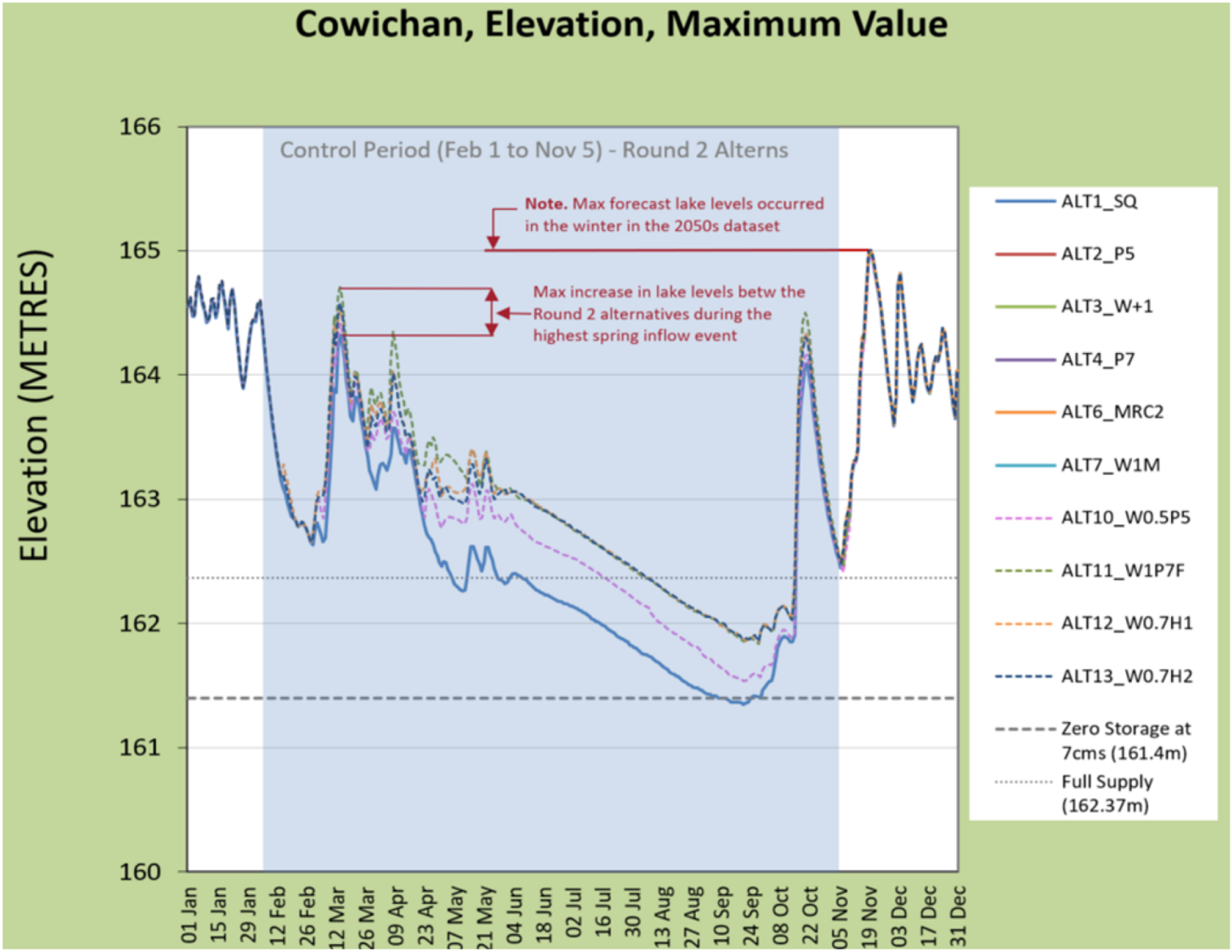
Summary of our review includes 3 potential effect areas during the control period:

1. Characterizing Potential Incremental Flooding Risks to Lakefront Homes
2. Characterizing Inundation of Lakefront Properties and the Natural Boundary
3. Potential Risk of Increased Erosion

NOTE this information was not for the development of new PMs but rather as supplemental information to be used to help characterize the performance of the alternatives

Potential Incremental Flooding Risks on Homes

Why did we review this?

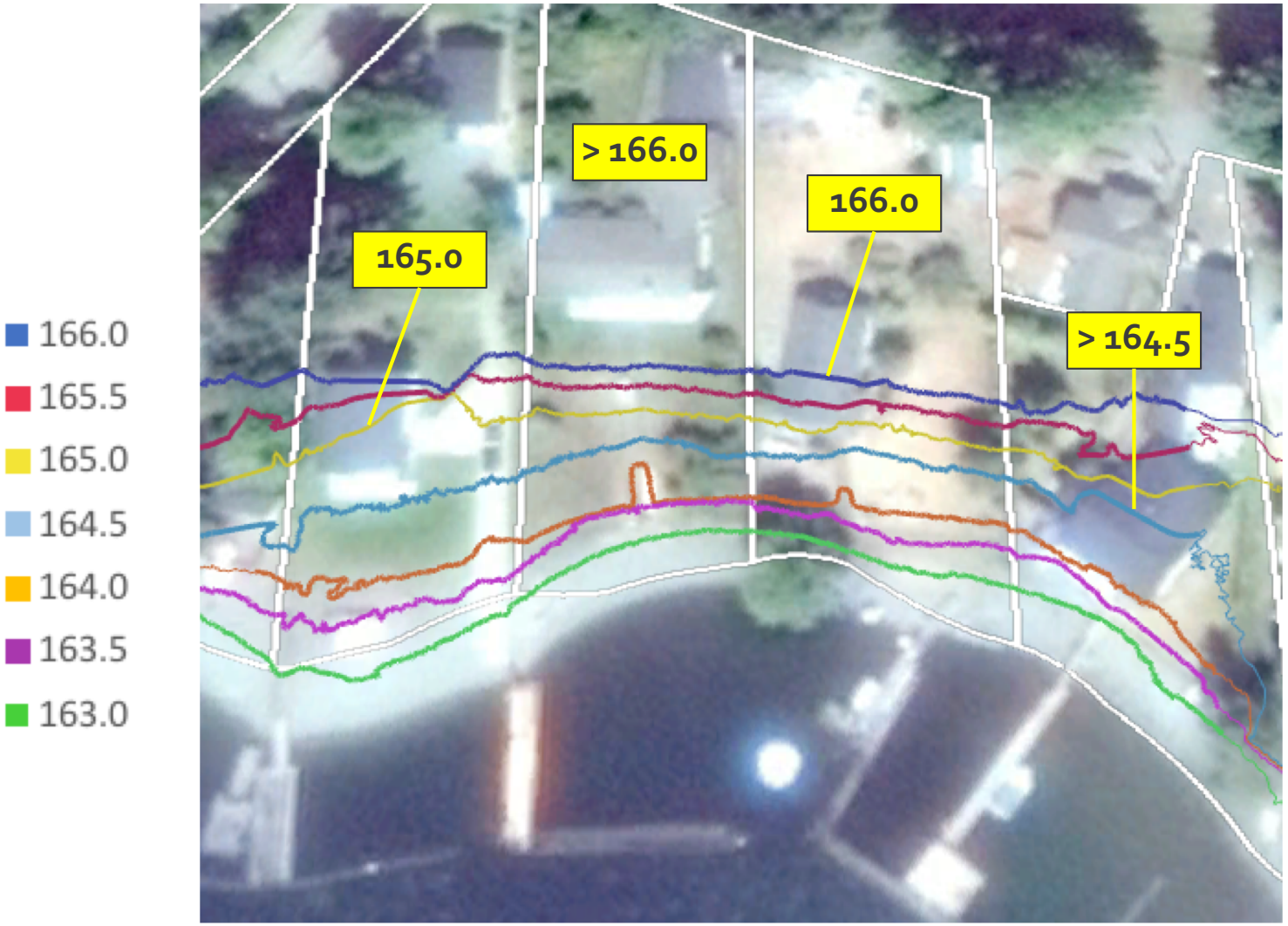


Potential Incremental Flooding Risks on Homes

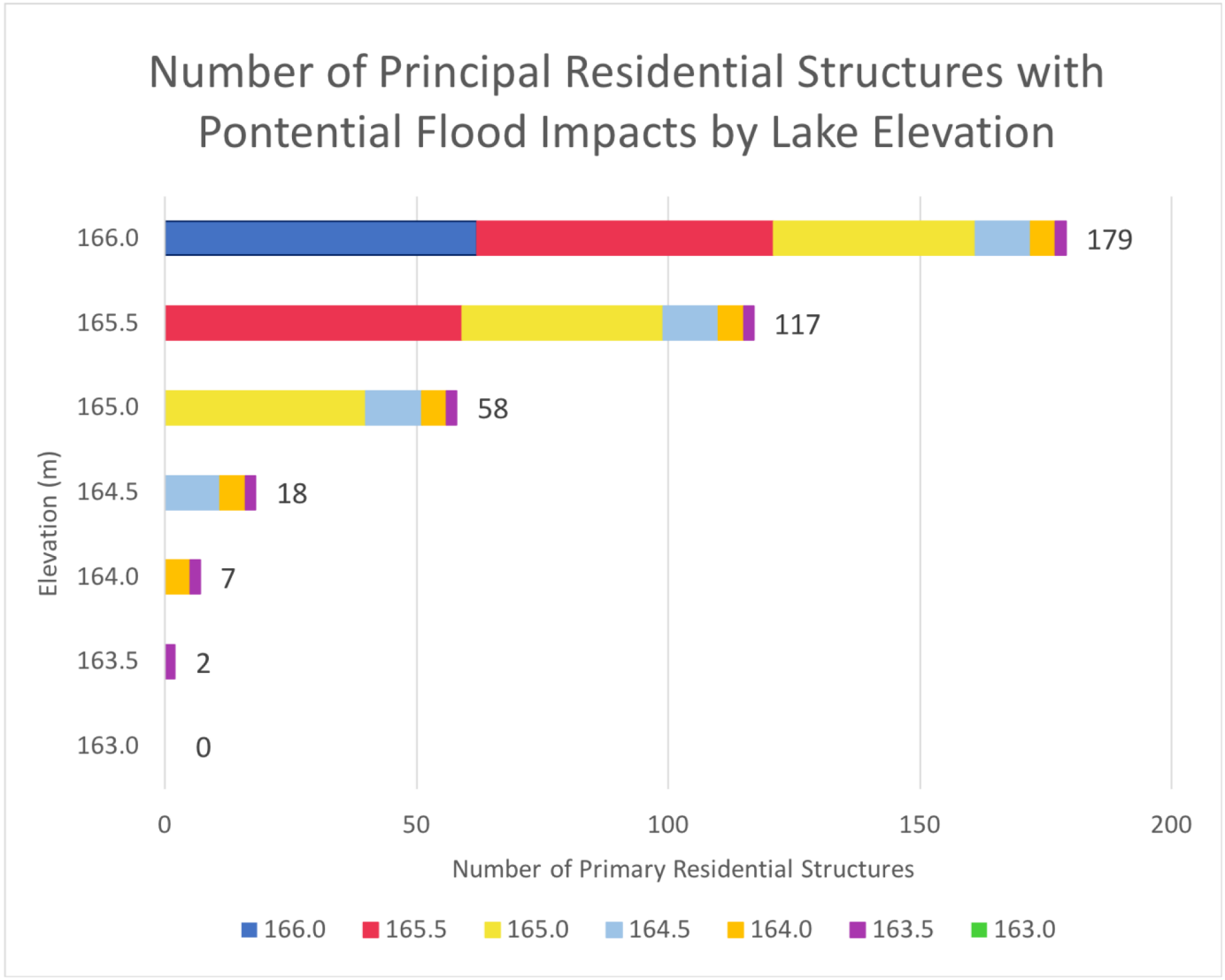
Our cursory review,

- Used an existing CVRD spatial elevation dataset to generate 0.5m interval lake elevation contours ranging from 163.0 to 166.0 for the entire lake.
- Assessed the lake elevation contours using Google Earth satellite imagery to count the number of times each elevation level intersected with a principal residential structure.
- A total of **490 structures** were clearly identified and assessed in lakefront properties or adjacent land parcels which would be inundated at higher lake levels.
- Results are summarized as the cumulative number of structures for each lake elevation level.

Potential Incremental Flooding Risks on Homes



Potential Incremental Flooding Risks on Homes



% Total Primary Structures Identified (490)

36.5%

23.9%

11.8%

3.7%

1.4%

0.4%

0.0%

Note: these results are intended to provide additional context for evaluating impacts of peak flood events at varying magnitudes and do not correspond to specific alternatives.

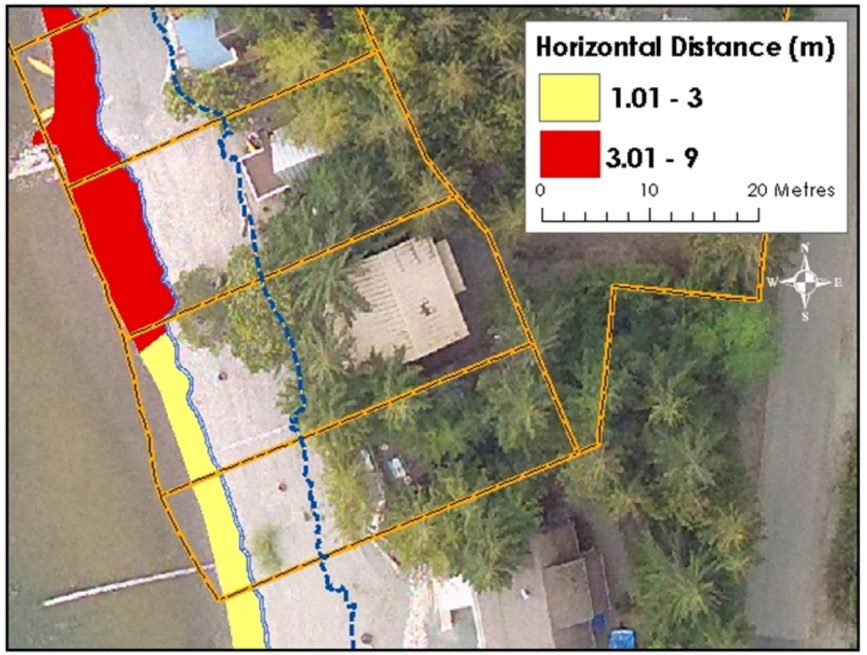
Potential Incremental Flooding Risks on Homes

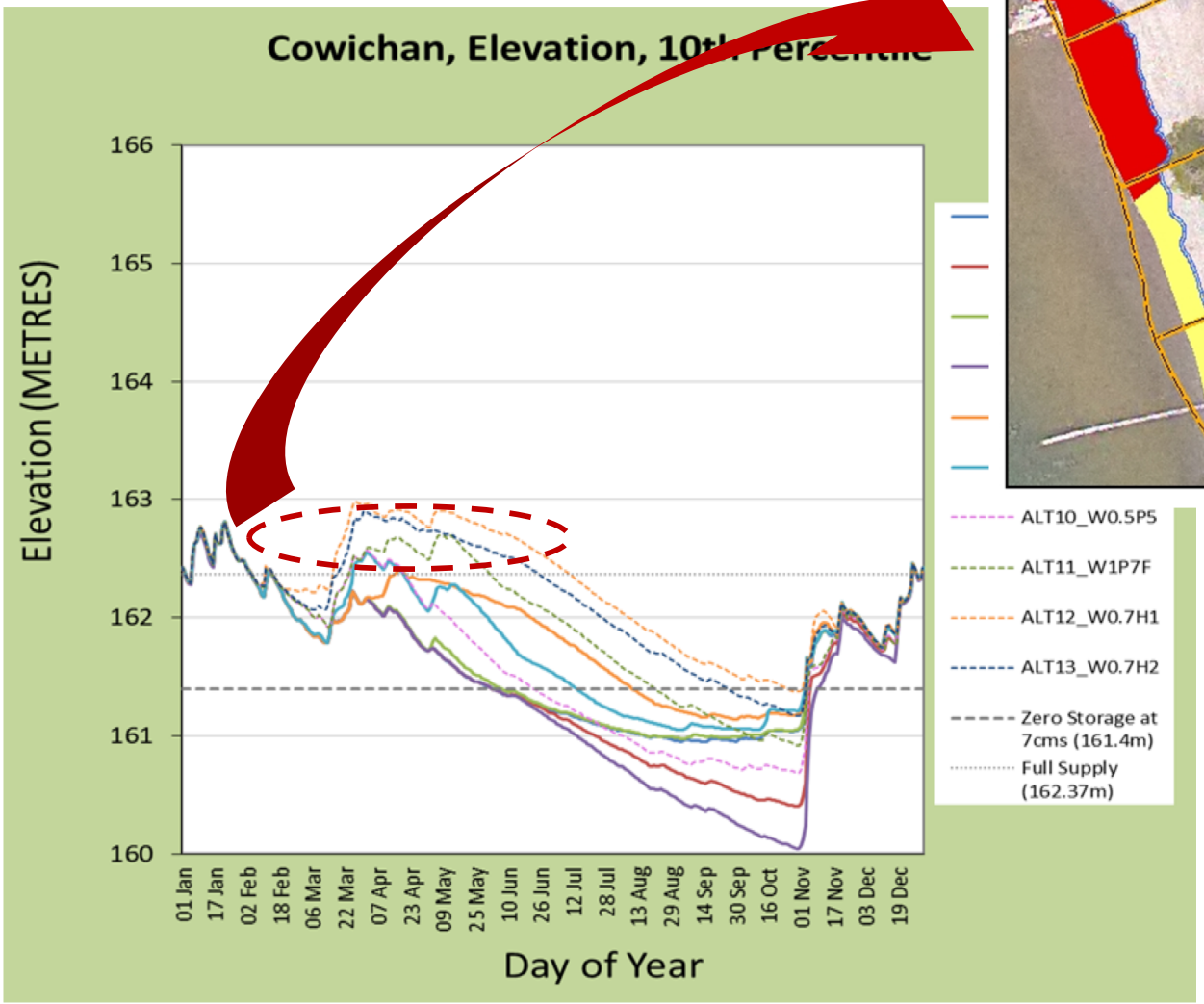
Results Summary

- The peak spring inflow event in the 2050s hydrological dataset is probably equivalent to about 1 in 10 year return period event (based on the historical dataset in March) and this would result in lake levels rising up to ~164.3 based on the current weir and operations (i.e., ALT 1).
- The incremental increases in lake levels (by up to +40cm) during the early control period were in the range of 164.5m to 165m range where there appears to be an increase in flood risk for about an additional 40 or so homes.
- Accordingly, all the new alternatives were designed to limit any incremental lake level increase during this event to no more than 10cm. This became a hard constraint.
- As well, the consulting team recommends a more detailed flooding risk assessment of lakefront homes after the WUP, if changes are proposed to the weir or operations.

Potential Incremental Inundation of Lakefront Areas

Why did we review this?





Potential Incremental Inundation of Lakefront Areas

What is the natural boundary and why does it matter?

- Because it defines where property rights begin and where compensation may be warranted; if, for example, a regulatory decision led to higher lake levels during the control period where lakefront properties were used to regularly store water this would affect owners' legal rights to use and enjoy their properties.

- According to the EAB ruling in 2013,

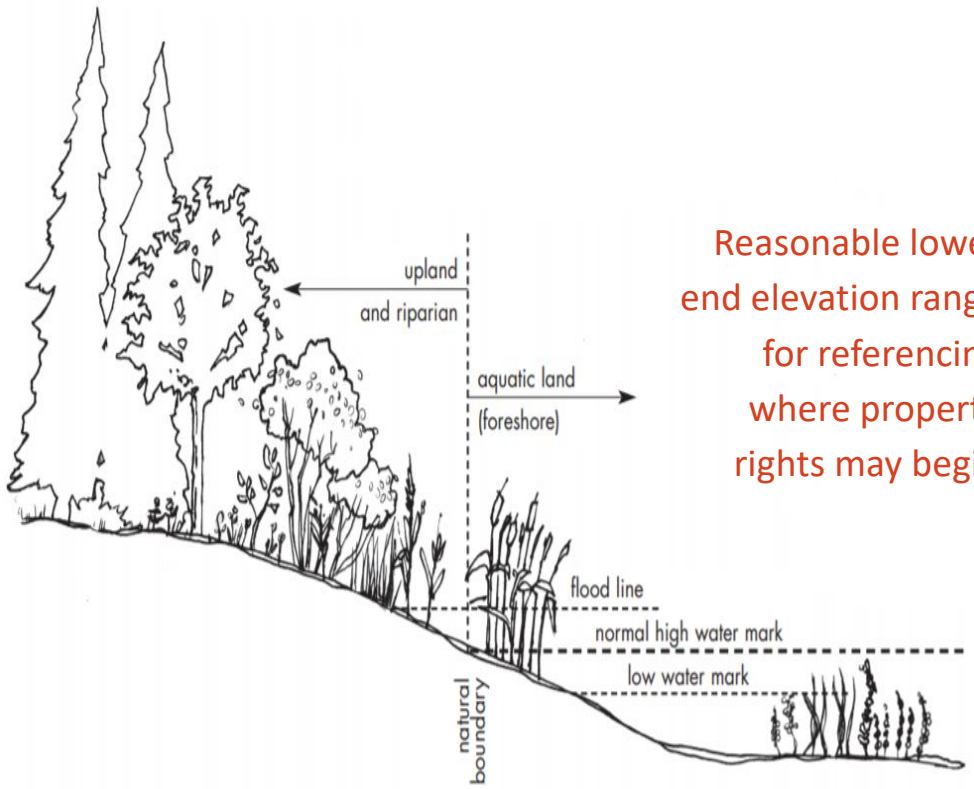
  [110] *"[…] property rights end at the "natural boundary" of the lake, which is close to the high water mark of the lake. Below the natural boundary, the property belongs to others."*

Potential Incremental Inundation of Lakefront Areas

Defining an elevation range for the natural boundary?

According to the *Land Act*, the natural boundary is defined:

> *"the visible high water mark of any lake, river, stream or other body of water where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the body of water a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself."*



Reasonable lower end elevation range for referencing where property rights may begin

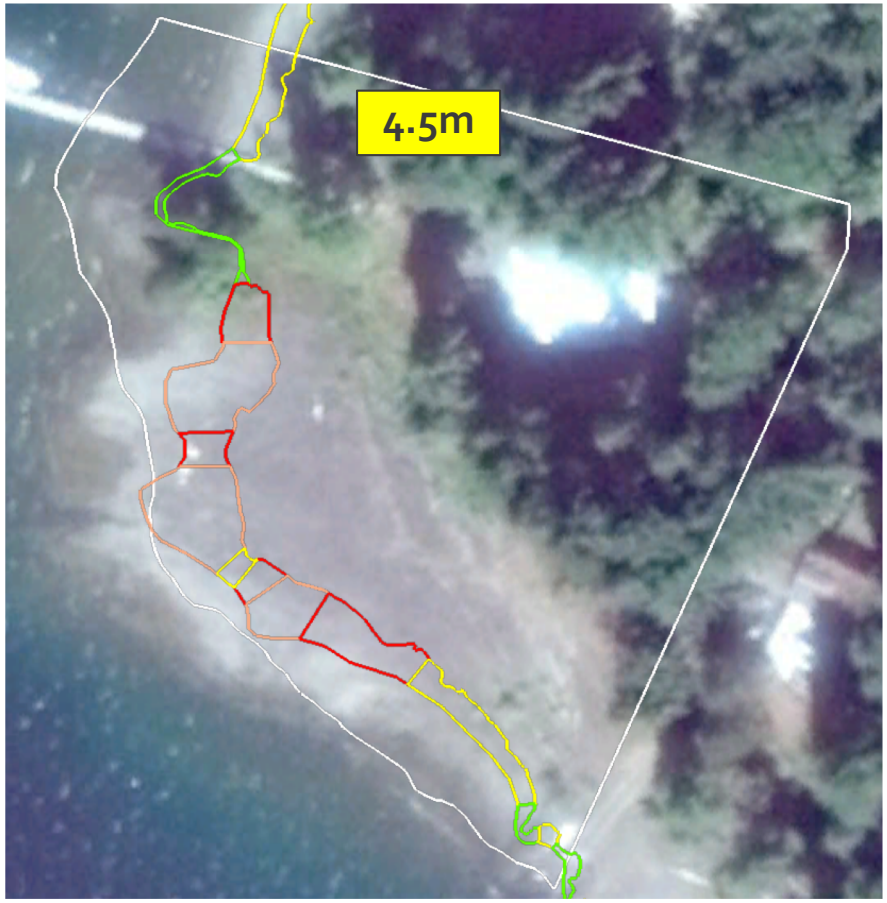
Natl Boundary Ref Points	Discussion and rationale
> 162.37m	**EAB** panel concluded […], above the full storage level of 162.37m
Betw 162.4 - 163m	Elevation range for **exposed tree roots** in KWL erosion study
162.7m +	Cursory review of **native riparian vegetation** in redline photos
162.8m	**Average winter lake elevation** from Nov 1 to Feb 28 (1953 to 2018)
162.87m	**MFLNRO guidance documents** specific to the Okanagan region
164.0m	CVRD **riparian area regulation** by-law.
164.0m	**Normal Annual High Water Level** for Cowichan Lake.
164.1m	CVRD **land title survey** carried out in 1990 (Lot 9 of VIP51348)

Potential Incremental Inundation of Lakefront Areas

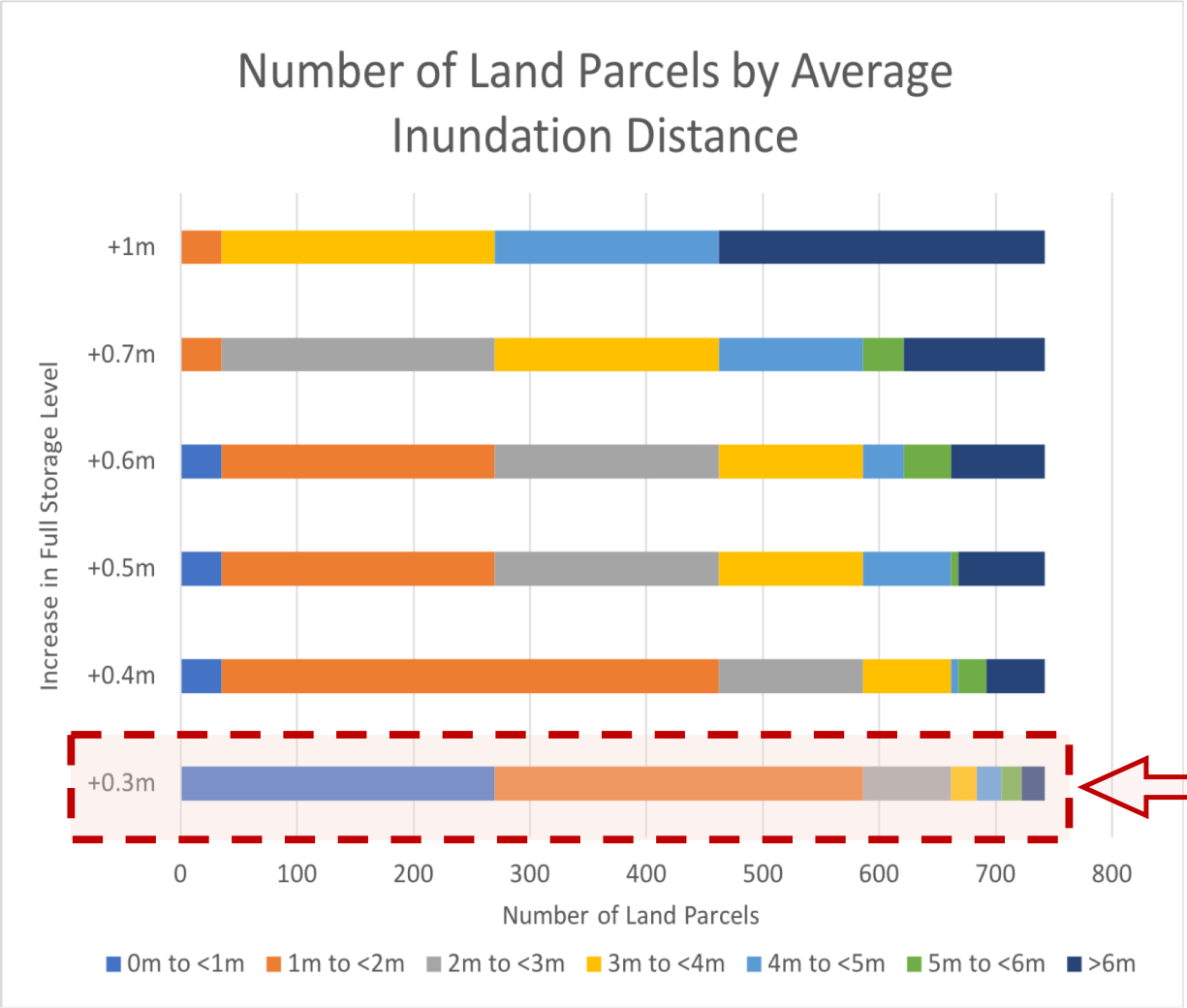
Our cursory review,

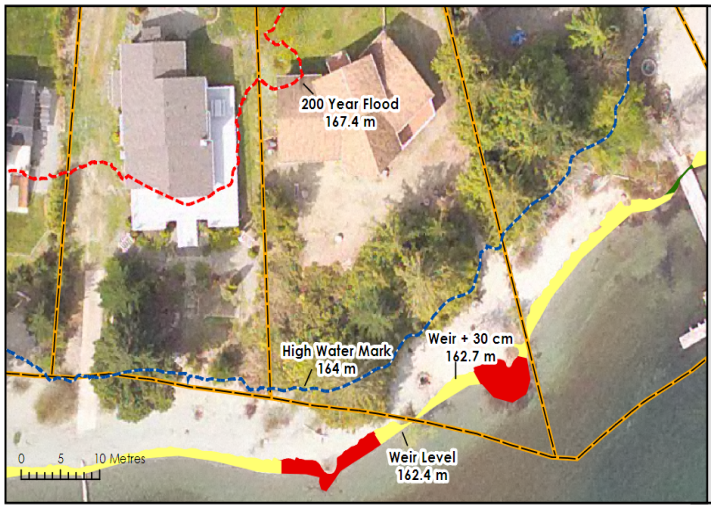
- Used an existing CVRD dataset from analytical work to illustrate the horizontal distance between current full storage (162.37m) and a 0.3m increase in lake elevation, provided in four 2m distance bands.
- Used land parcels (PIDs) as property boundaries and extended property lines to intersect the shoreline data.
- Assessed the average distance based on the relative proportions of each distance band to account for the natural shoreline variation of a given property.
- Assumed a linear relationship to extrapolated results to different increases in lake elevation (e.g. a 1m distance at +0.3m = 1.33m at +0.4m increase and 2m at a +0.6m increase).
- Results are summarized for 742 of 775 land parcels reviewed (33 parcels had no data or were not waterfront) at +0.3m to +0.7m and +1m increased in lake elevation.
- Did not distinguish between property use type (i.e. residential, park, industrial etc.).

Potential Incremental Inundation of Lakefront Areas



Potential Incremental Inundation of Lakefront Areas





CVRD carried out an assessment of 577 lakefront parcels in 2012 whose land title surveys intersected with different elevations:

162.4m – 47% (269 parcels)
162.7m – 60% (346)
164.0m – 91% (523)

Note: these inundation distances of lakefront areas assume water levels are increased by the heights on the y-axis

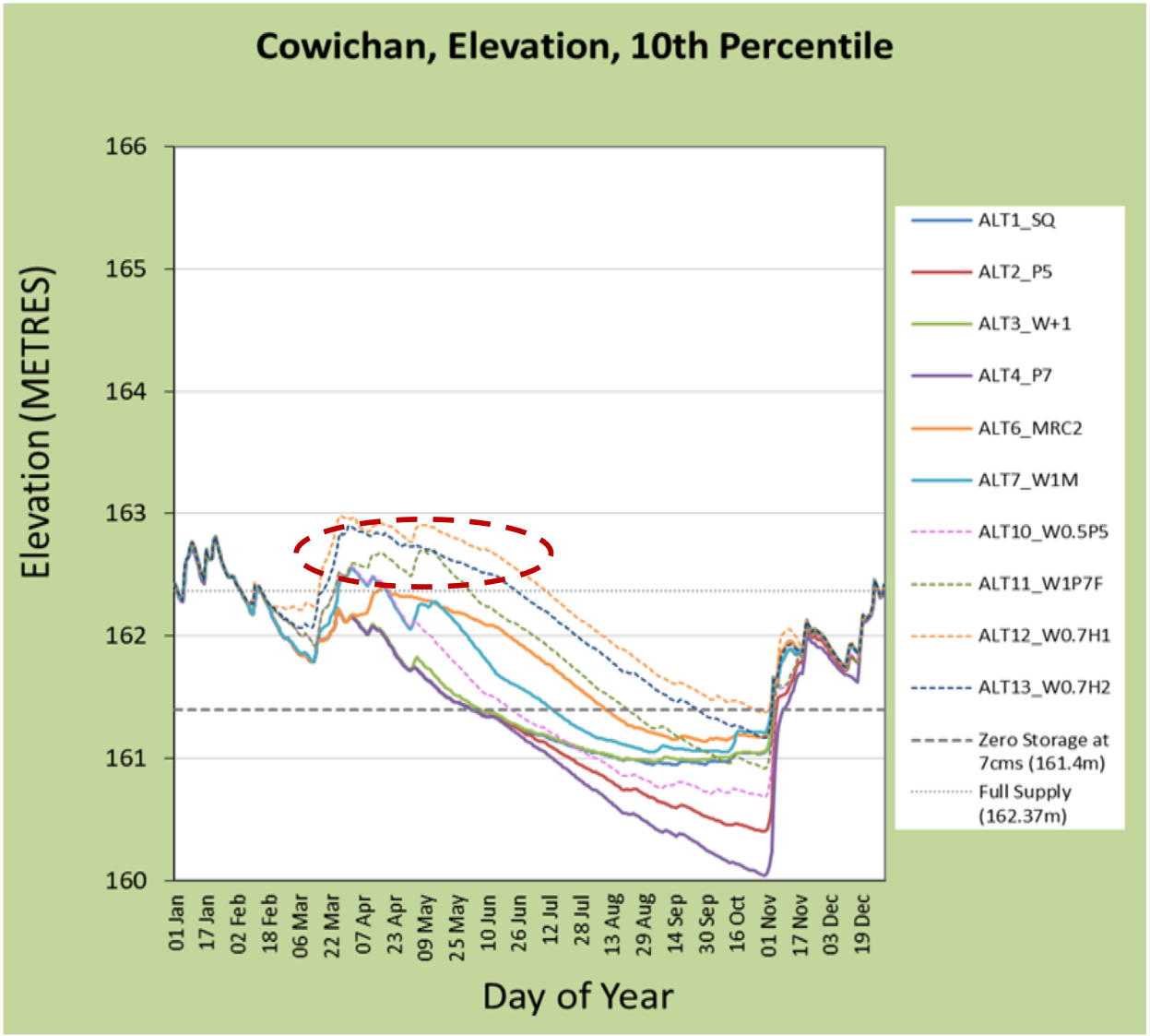
Potential Incremental Inundation of Lakefront Areas

Results Summary

- A higher weir and the corresponding higher lake levels during the control period will inundate lakefront areas to varying degrees around the lake: from 0 to 6m or more of horizontal length depending on the slope and weir ht. These effects would be most pronounced in the early spring and would diminish to below the height of the existing weir between mid May - mid July in most years.
- If the natural boundary turns out to be within the lower estimated elevation range of between 162.7m to 163m, any increase in the weir height above 0.3m to 0.4m may result in a legal requirement to compensate about 60% of the lakefront properties given that their properties intersect with the 162.7 elevation contour. The amount of compensation would be commensurate with the duration and horizontal distance of inundation.
- The PAG may also want to acknowledge inundation effects of lakefront properties whose properties lines are above wherever the new weir crest is in some manner?
- As well, the consulting team recommends a more detailed assessment of the natural boundary and field surveys if any increase is recommended in the weir.

Potential Risk of Increased Erosion

Why did we review this?



Because higher lake levels during the control period in the spring and early summer could increase exposure to wave action, which may reshape shorelines over time.

Potential Risk of Increased Erosion

Results Summary

- We relied on a review of the hydrographs in combination with an erosion study carried out by KWL in 2014.
- There are a lot of uncertainties on whether slightly higher lake levels during the control period would led to increases in exposure to wave action (from motorized boating), but certainly the risk of erosion would increase and this would vary at different sites around the lake.

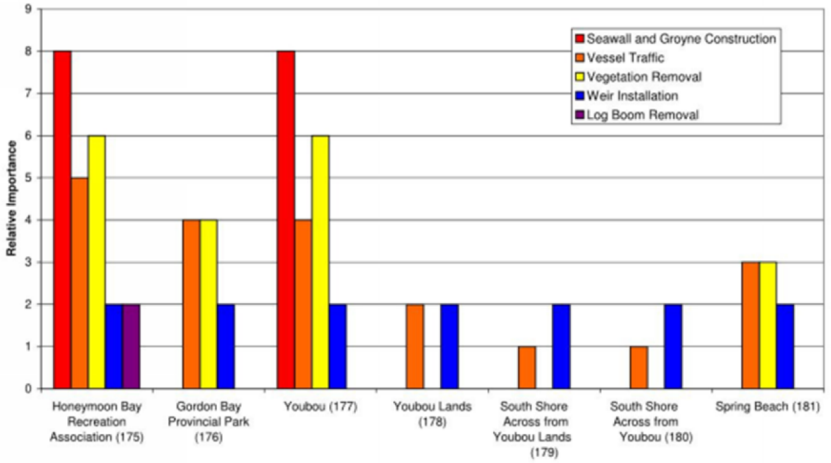


Figure 5-2: Relative Importance of Erosion Mechanisms at Each Site

- The consulting team therefore recommends that the PAG may want to consider a post WUP study to assess erosion risk (based on whatever changes were being proposed), which would include a compensation mechanism for lakefront properties can demonstrate potential adverse erosion as a result of any implemented changes in water levels.

Cowichan WUP

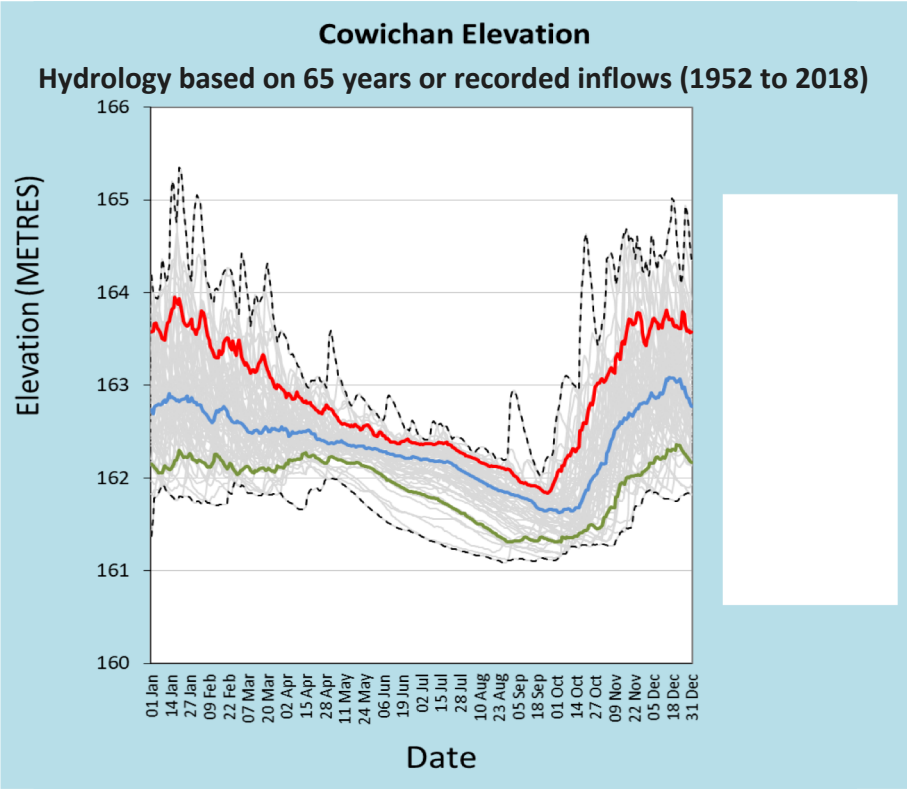
Assessing the Water Use Alternatives

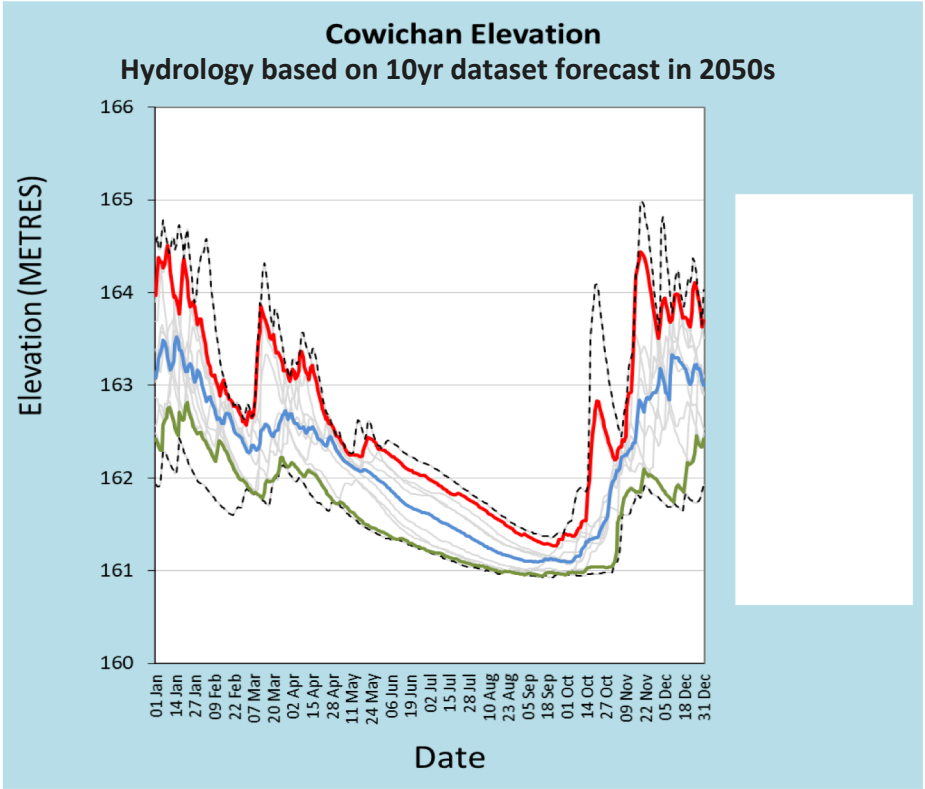
Assessing Alternatives

Hydrological Modeling

A couple of points to highlight

- Statistical summaries are not as meaningful when working with small datasets (n=10)

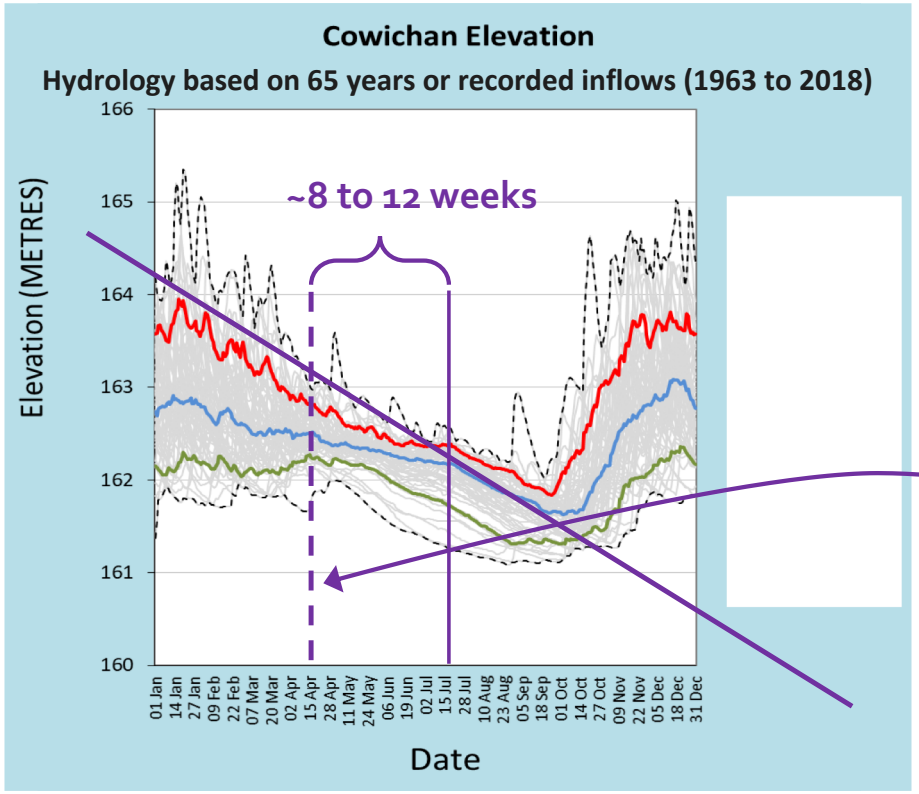


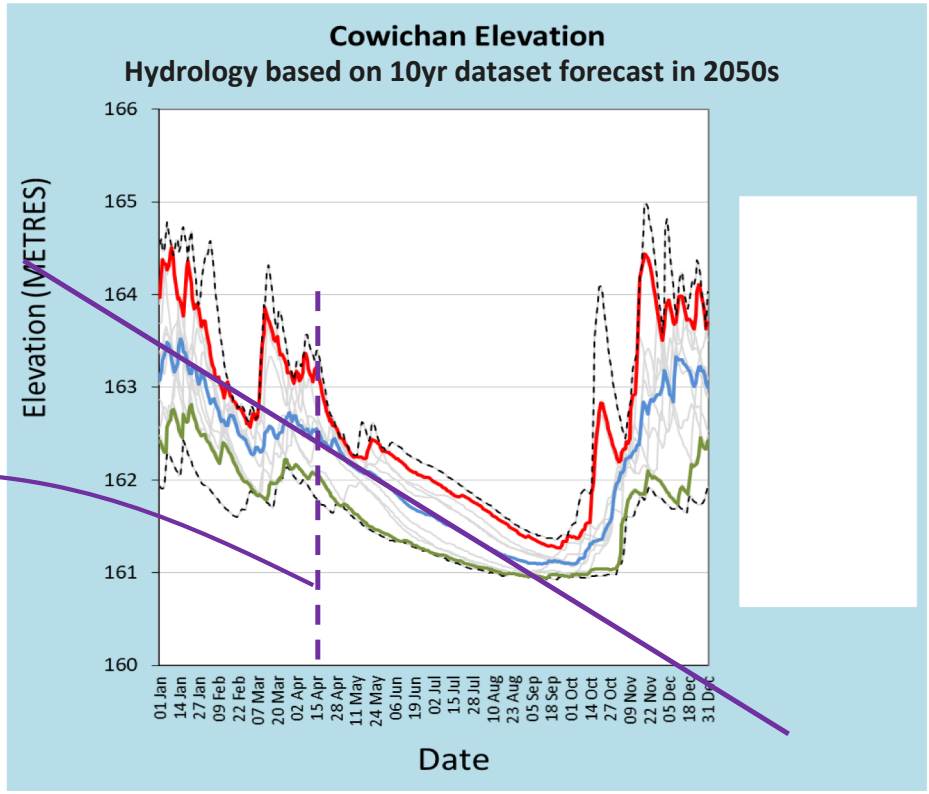


Assessing Alternatives

Hydrological Modeling

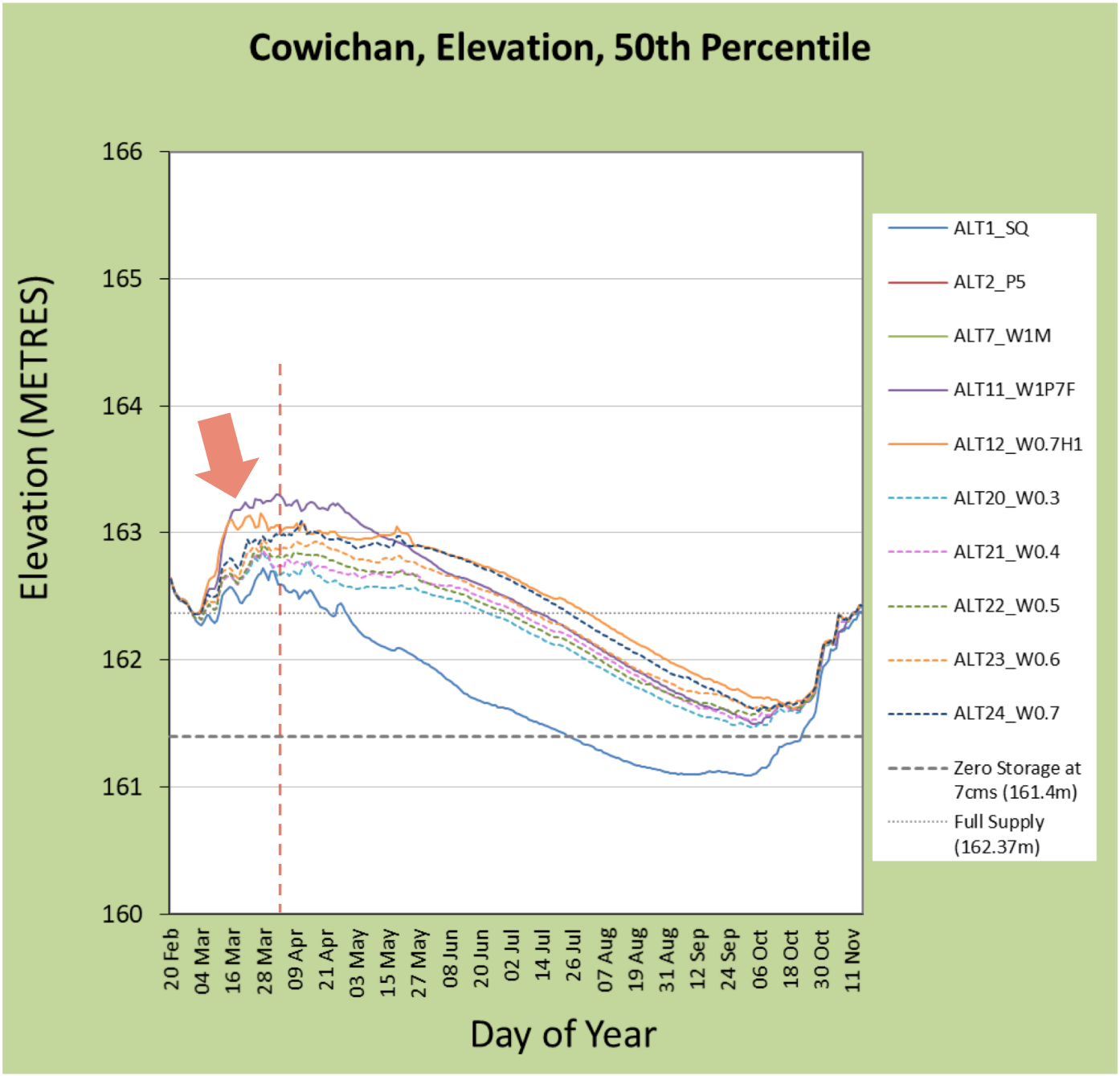
As an aside…… on forecast climate change effects and the resulting changes in hydrology

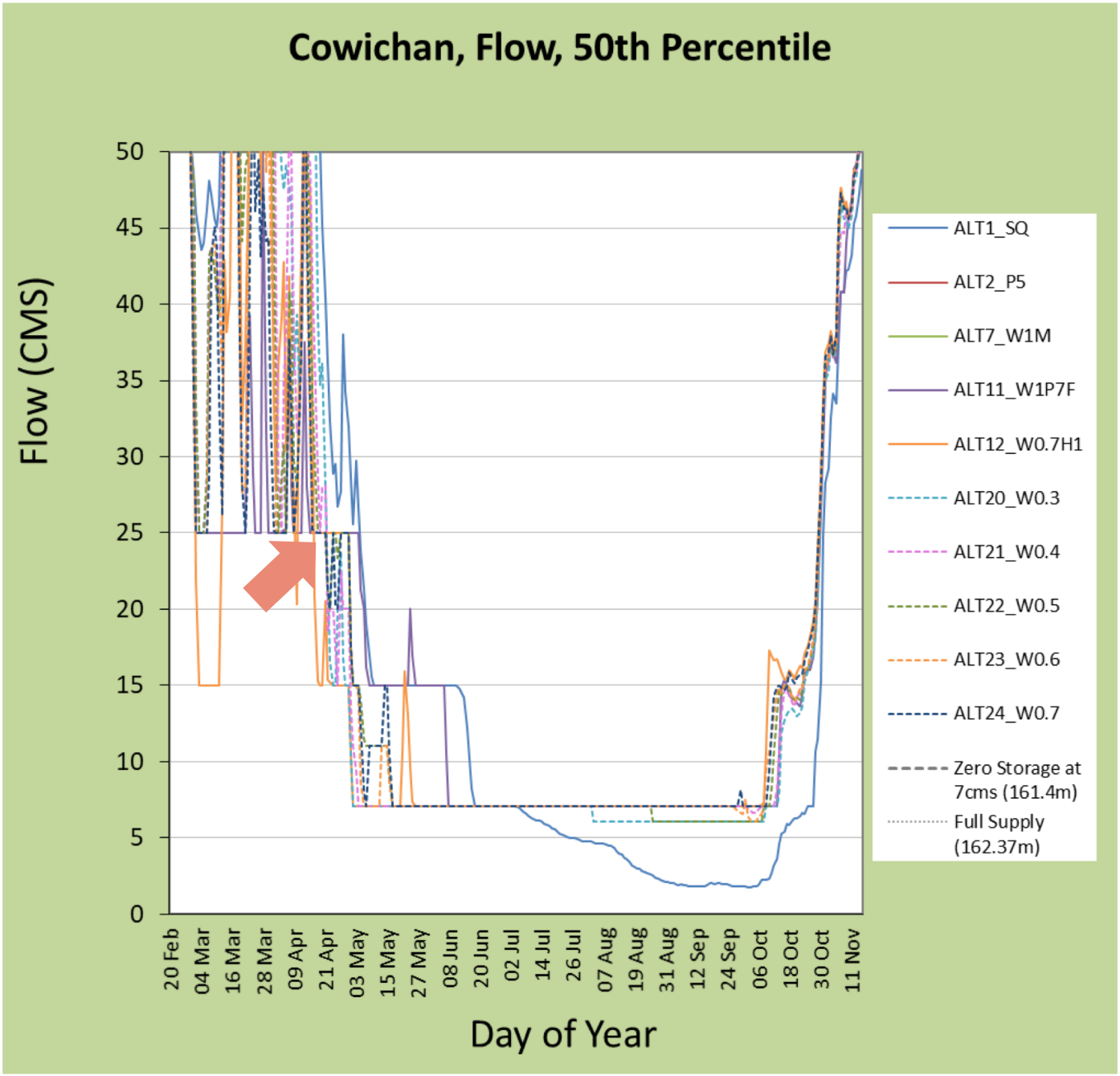


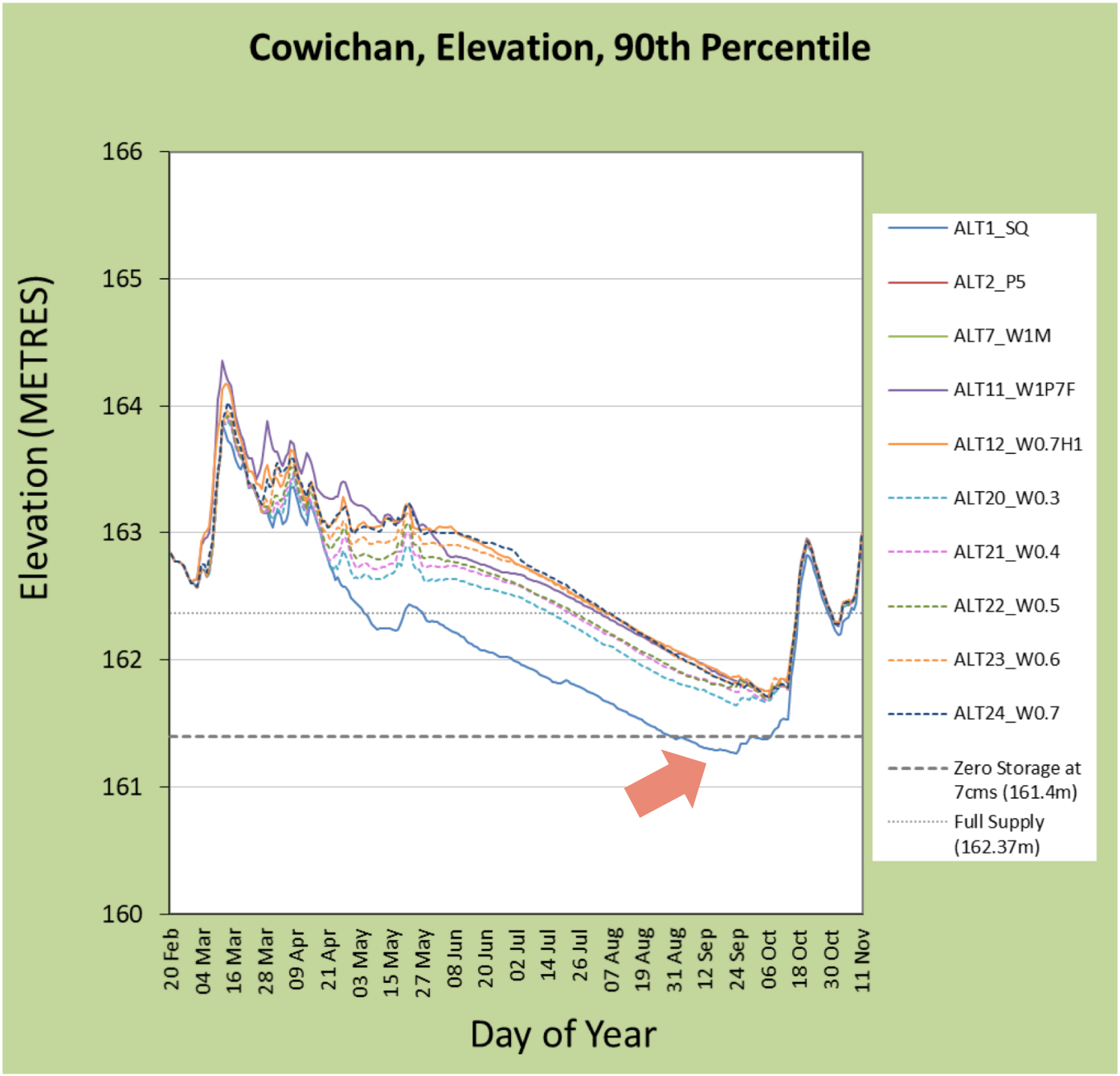


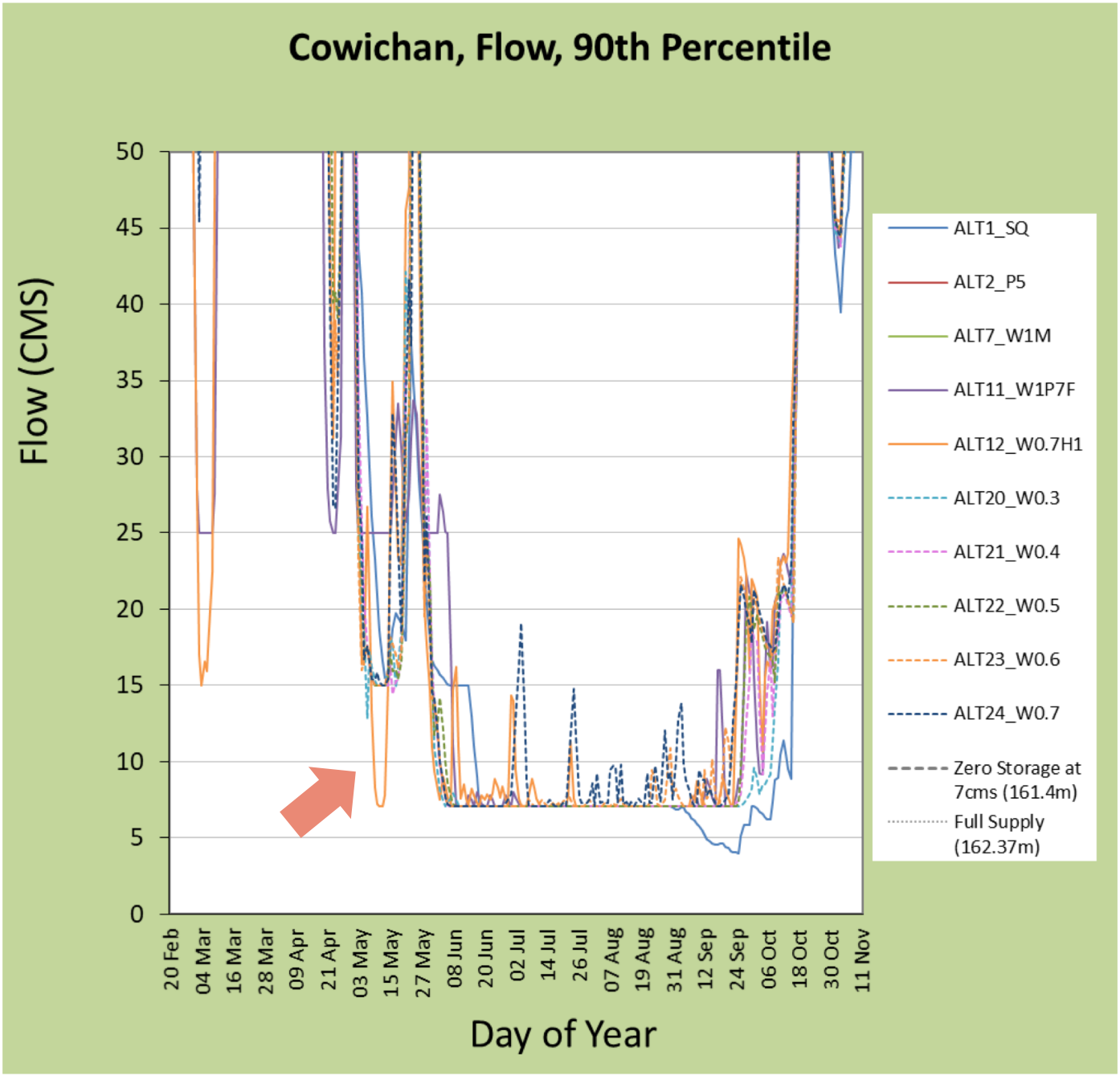
Assessing Water Use Alternatives

Hydrology - Future Simulated 2050s Dataset


Cowichan, Elevation, 50th Percentile
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

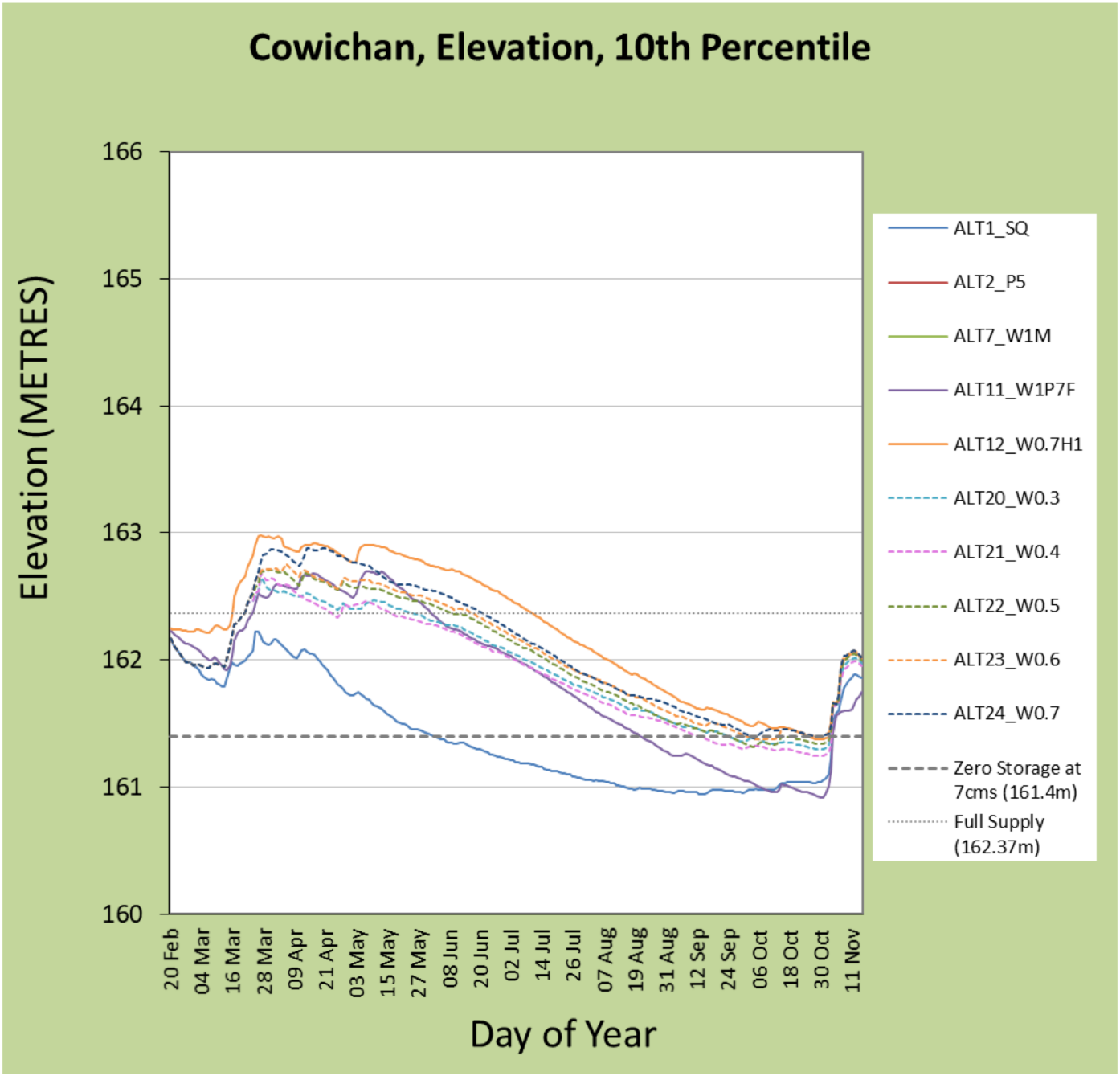

Cowichan, Flow, 50th Percentile
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

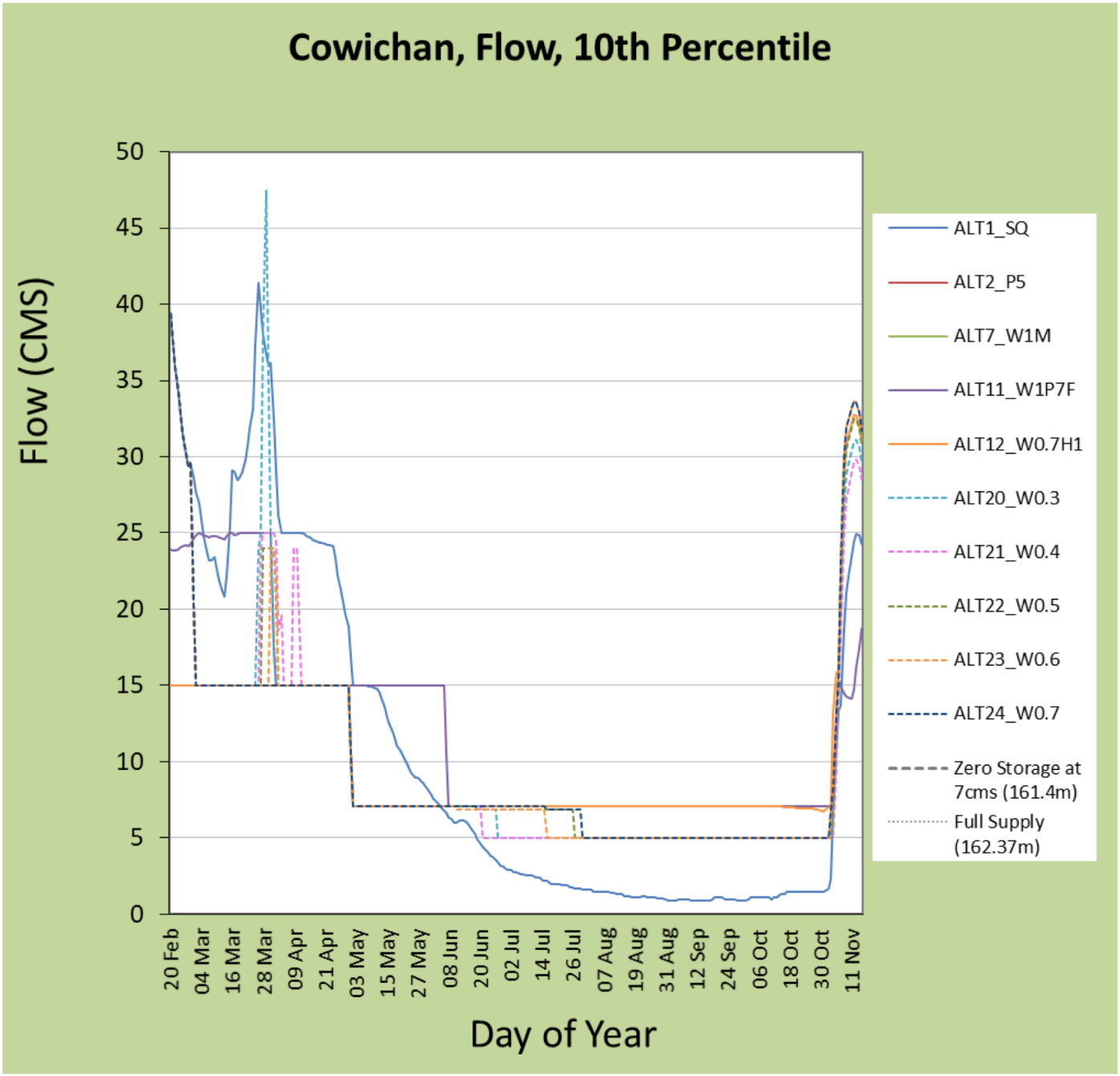

Cowichan, Elevation, 90th Percentile
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

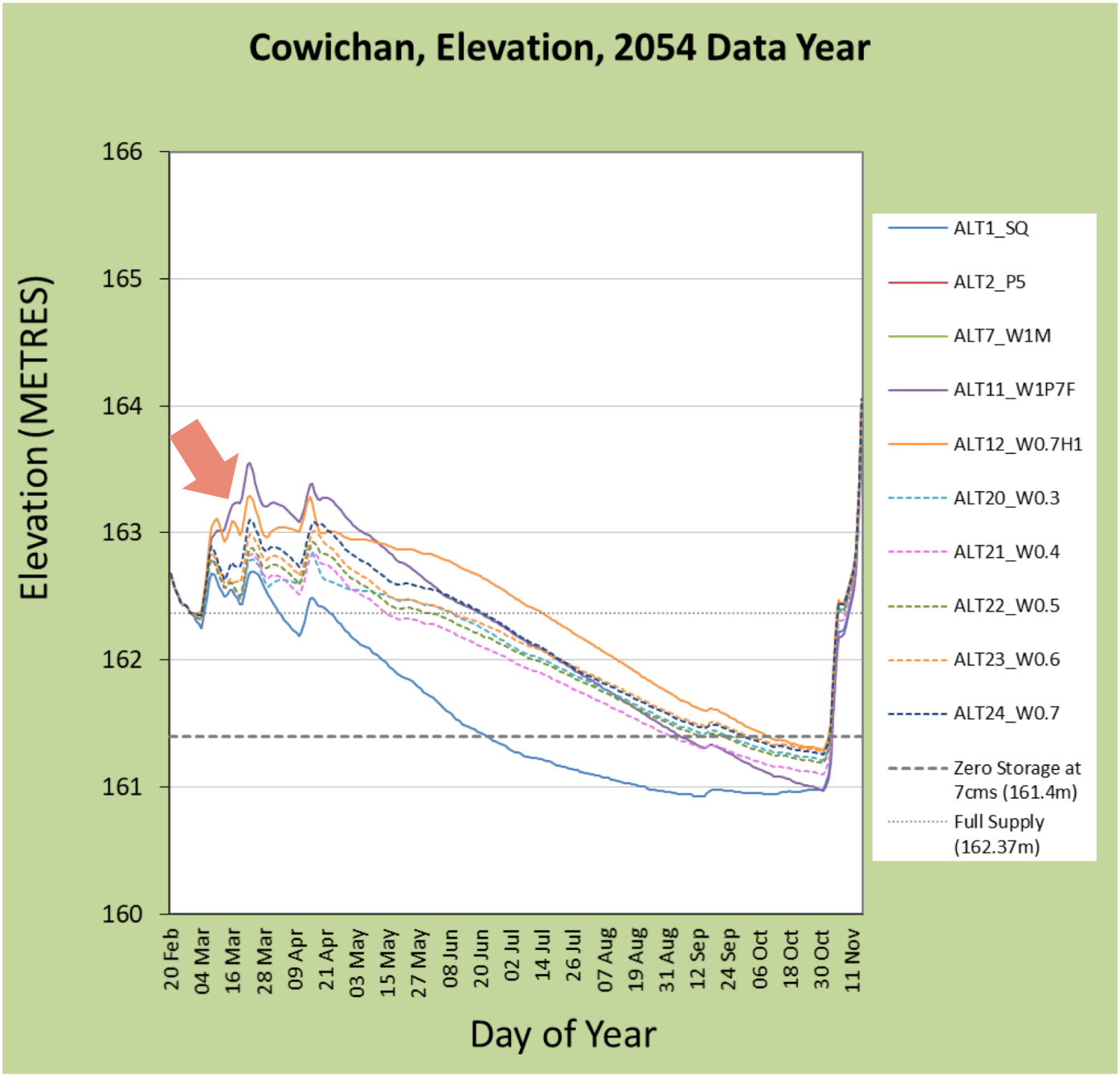

Cowichan, Flow, 90th Percentile
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

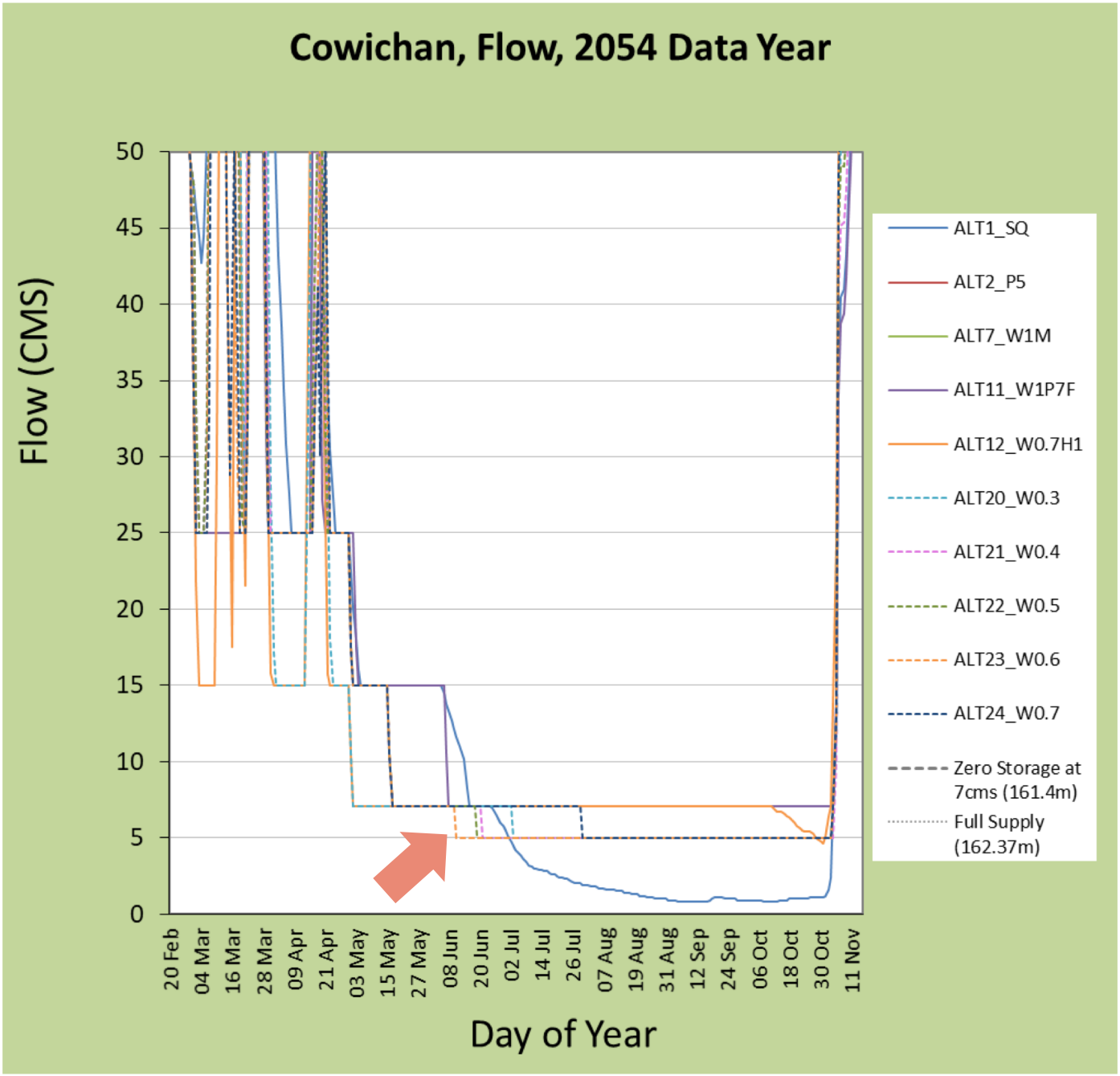
Assessing Water Use Alternatives

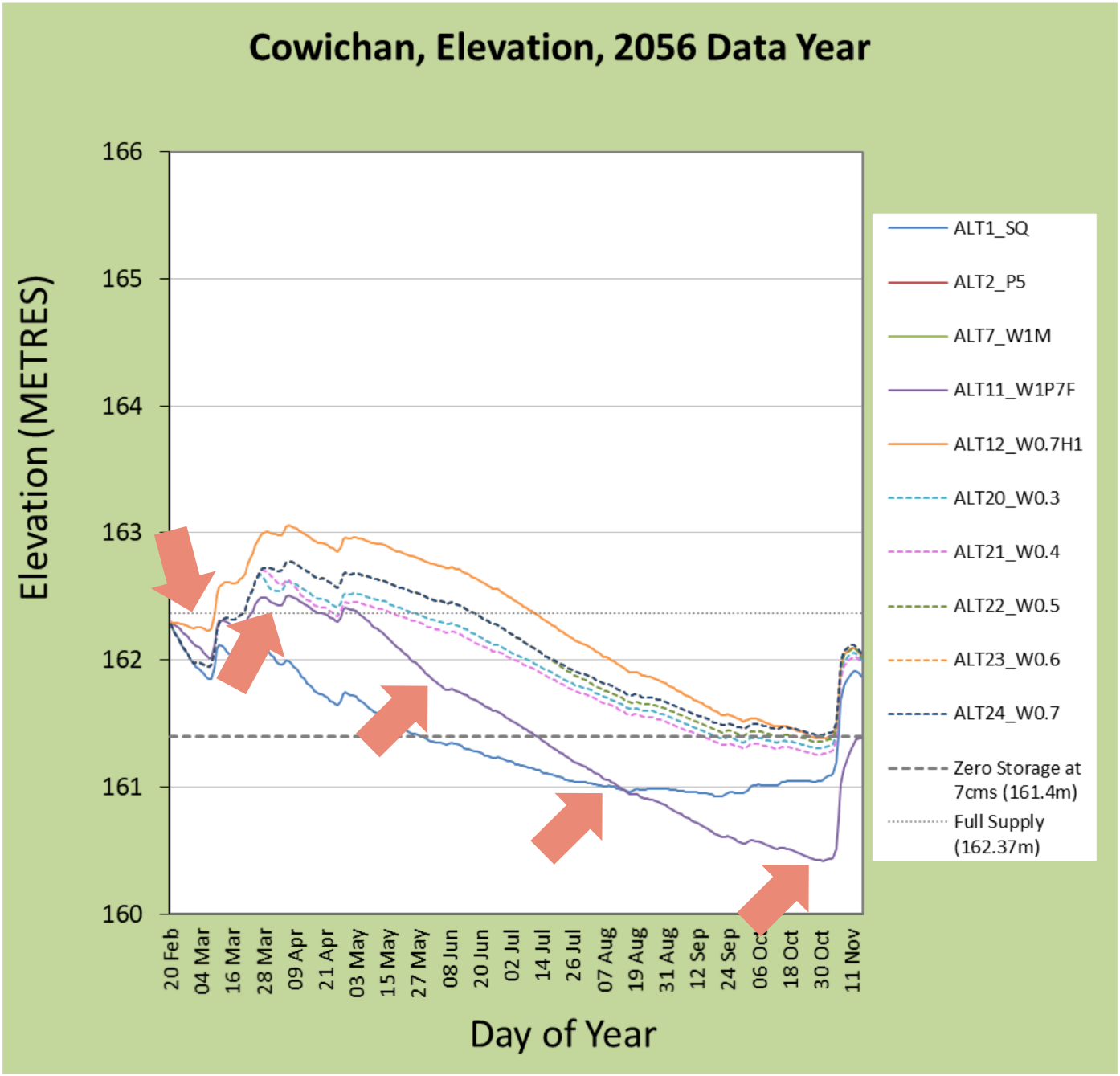
Hydrology – Low Spring/ Summer Inflows

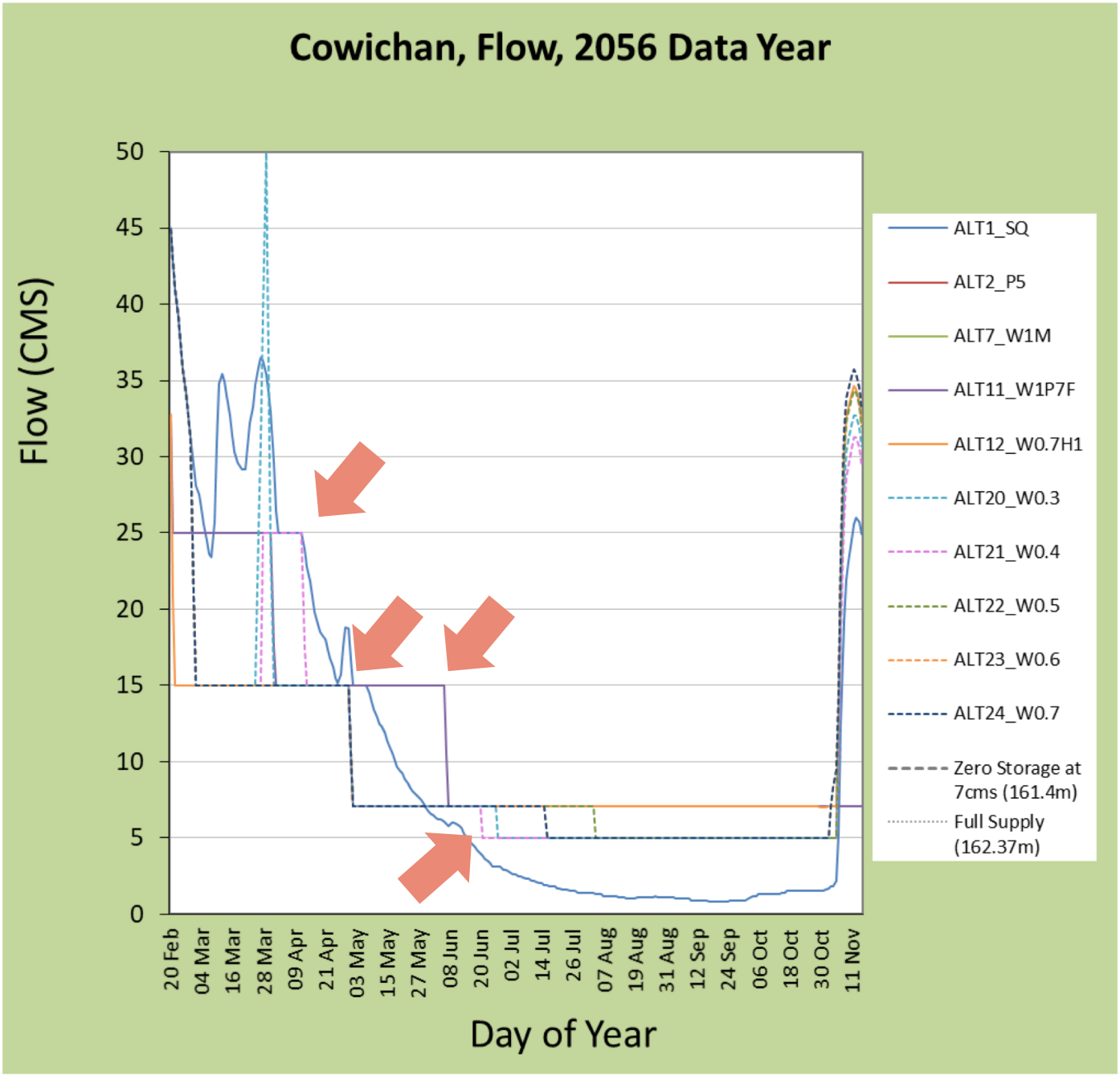

Cowichan, Elevation, 10th Percentile
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Flow, 10th Percentile
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, 2054 Data Year
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

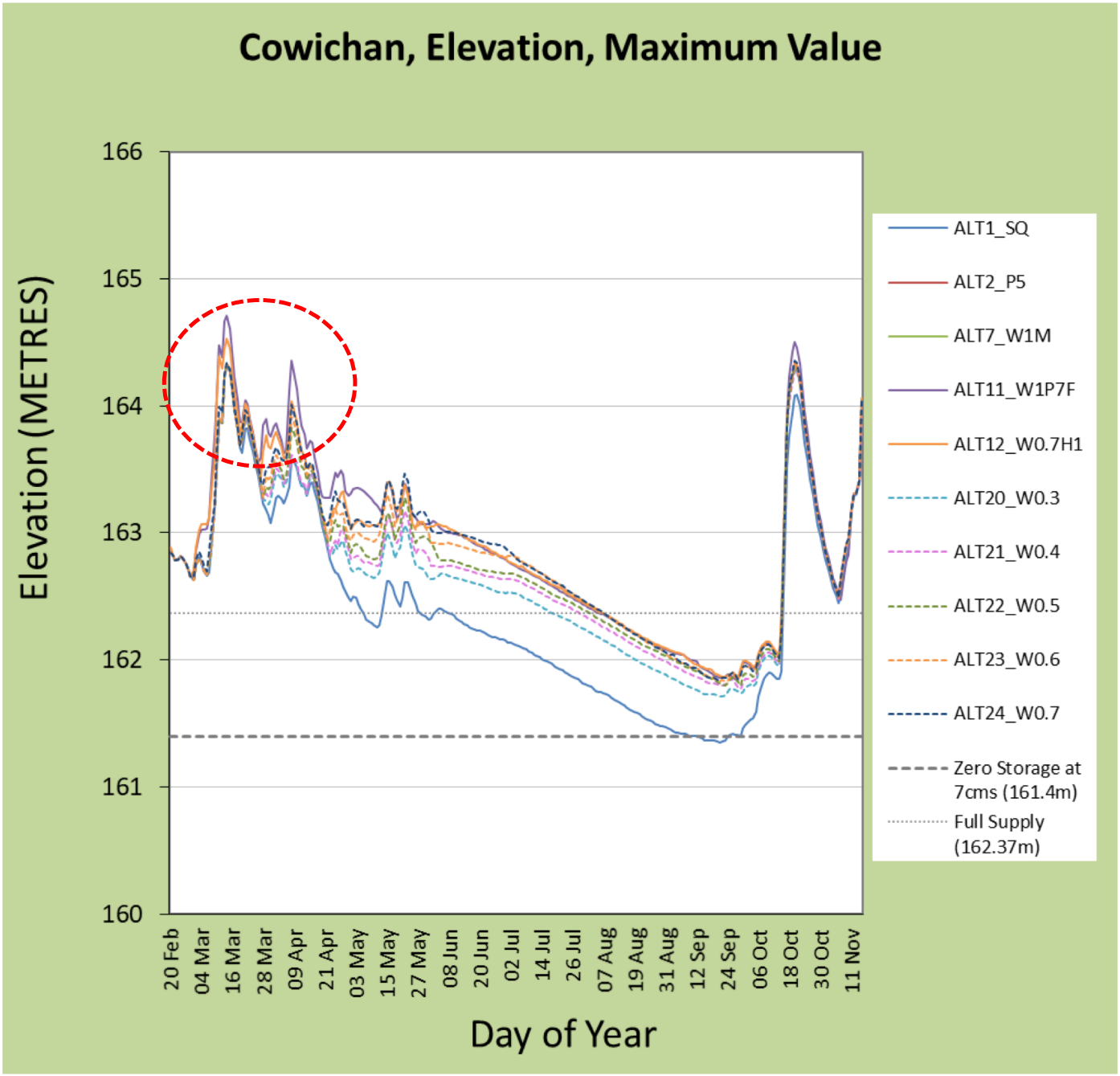

Cowichan, Flow, 2054 Data Year
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, 2056 Data Year
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

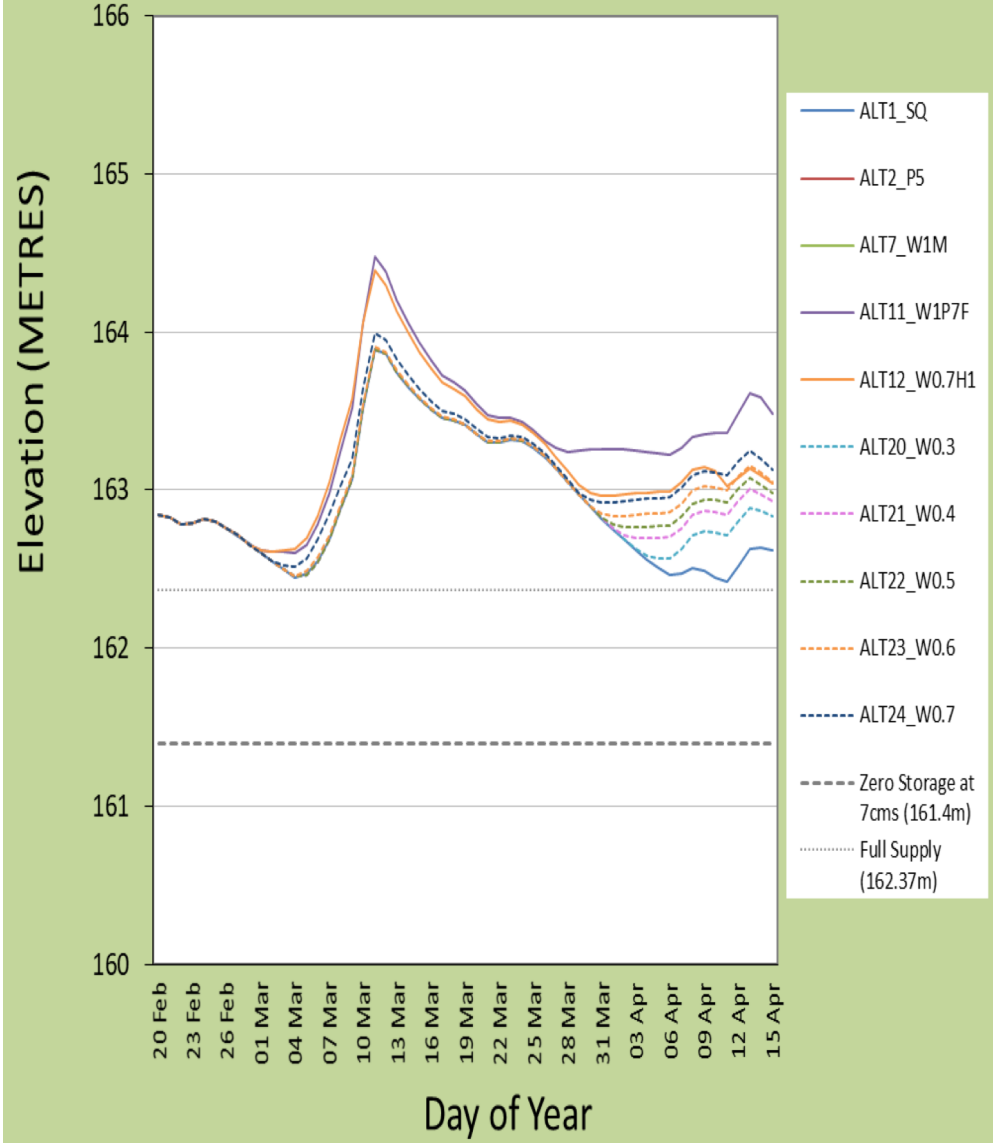

Cowichan, Flow, 2056 Data Year
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

Assessing Water Use Alternatives

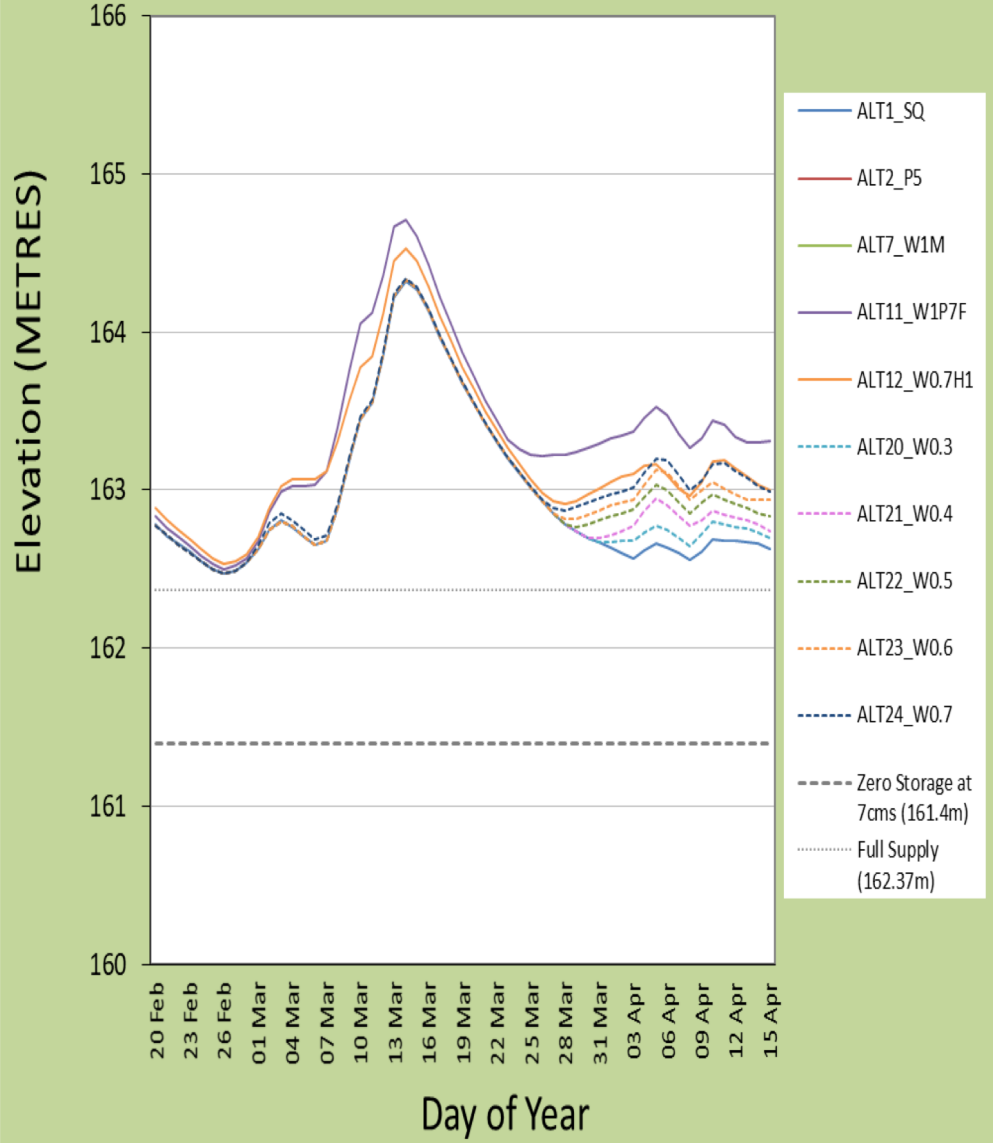
Hydrology – High Inflow Springs / Falls

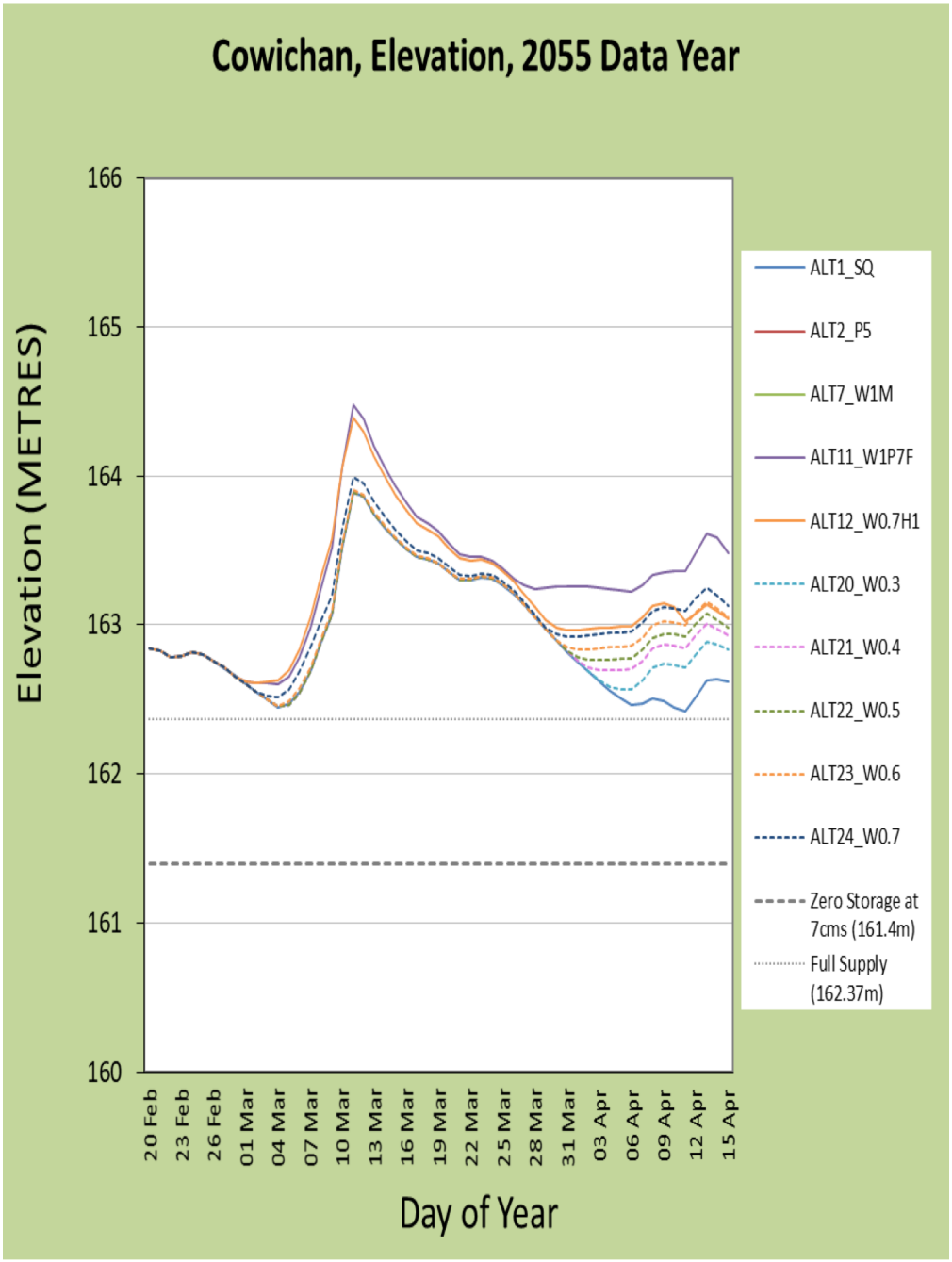

Cowichan, Elevation, Maximum Value
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

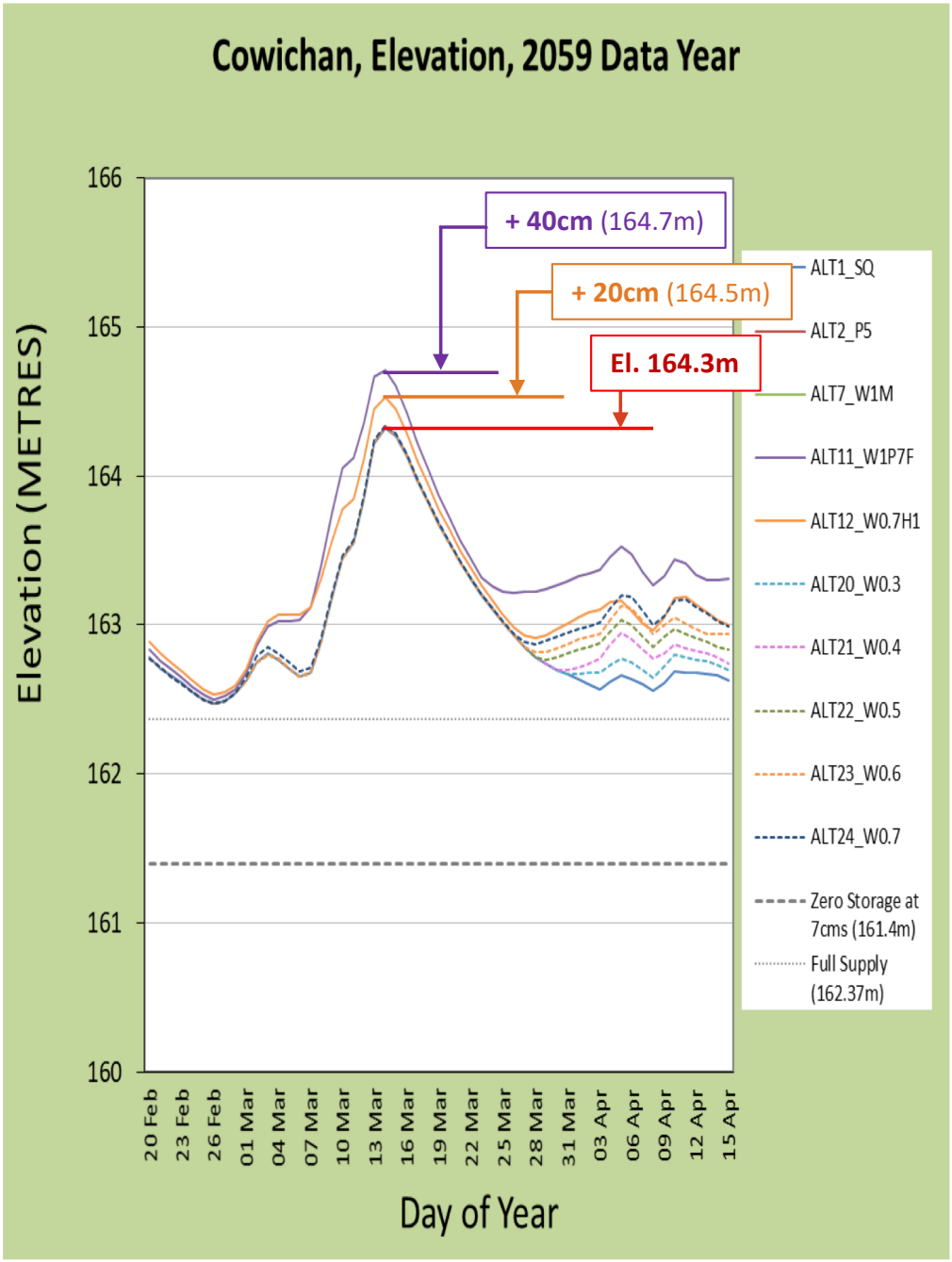
Cowichan, Elevation, 2055 Data Year

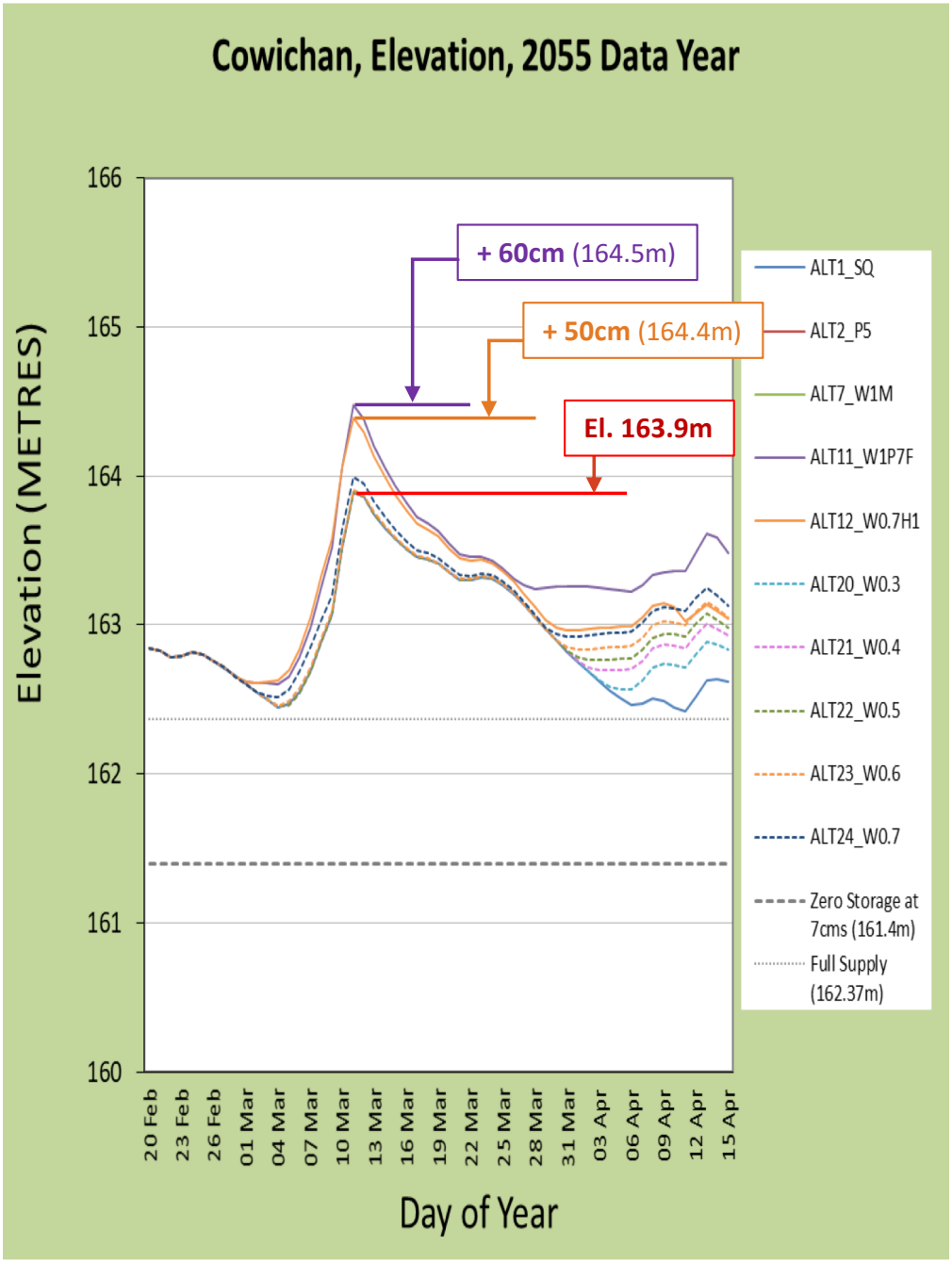


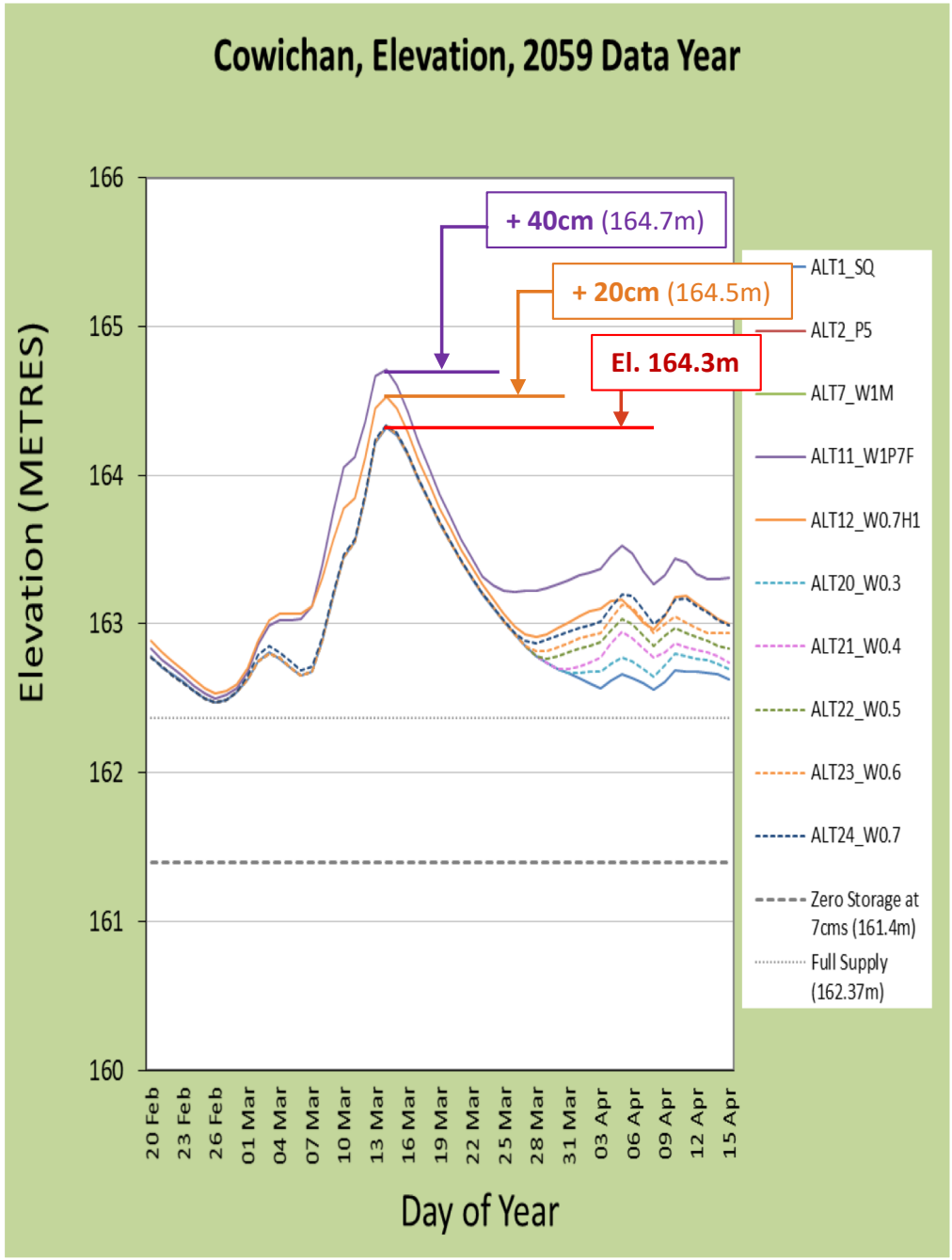
Cowichan, Elevation, 2059 Data Year

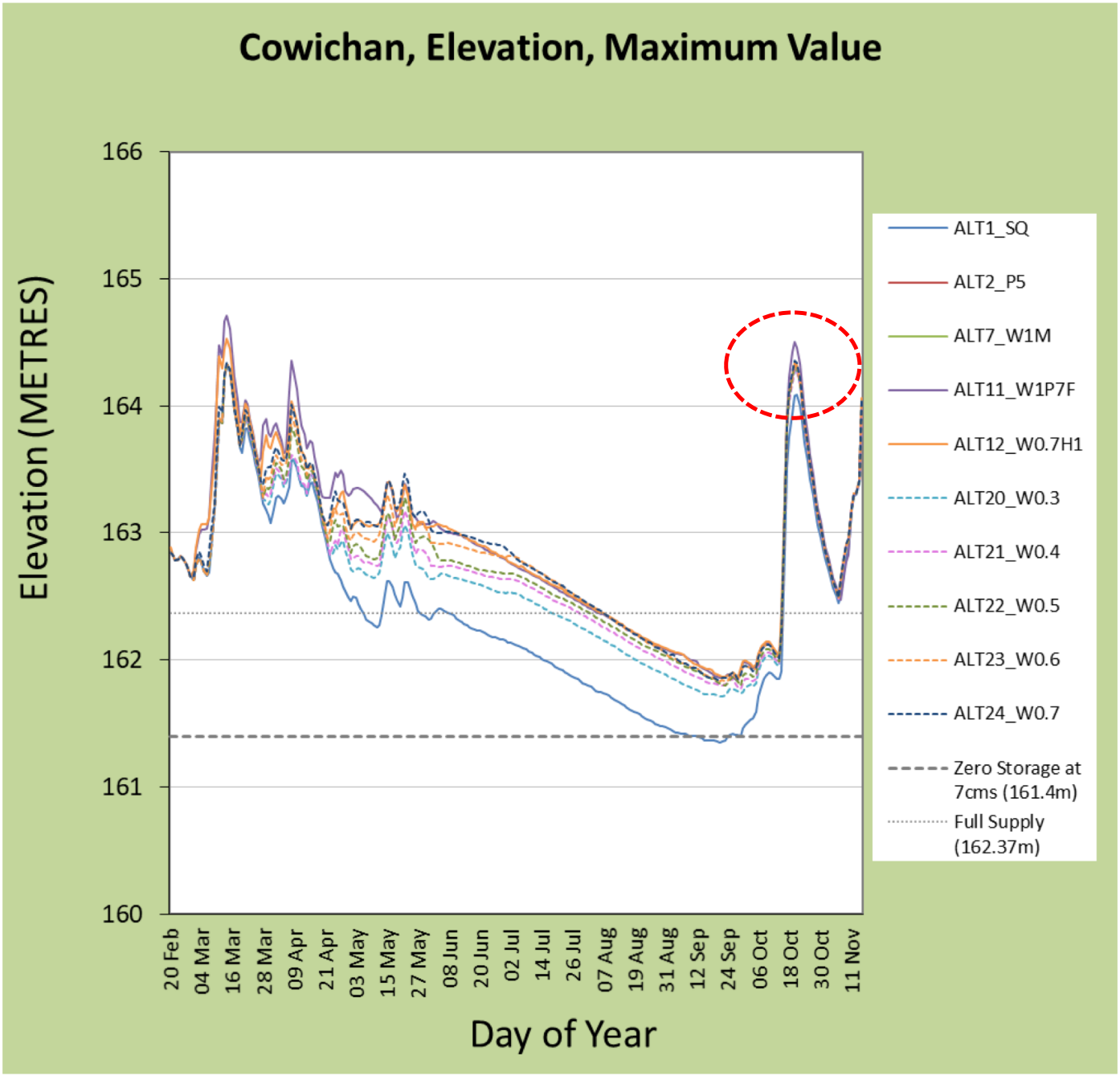


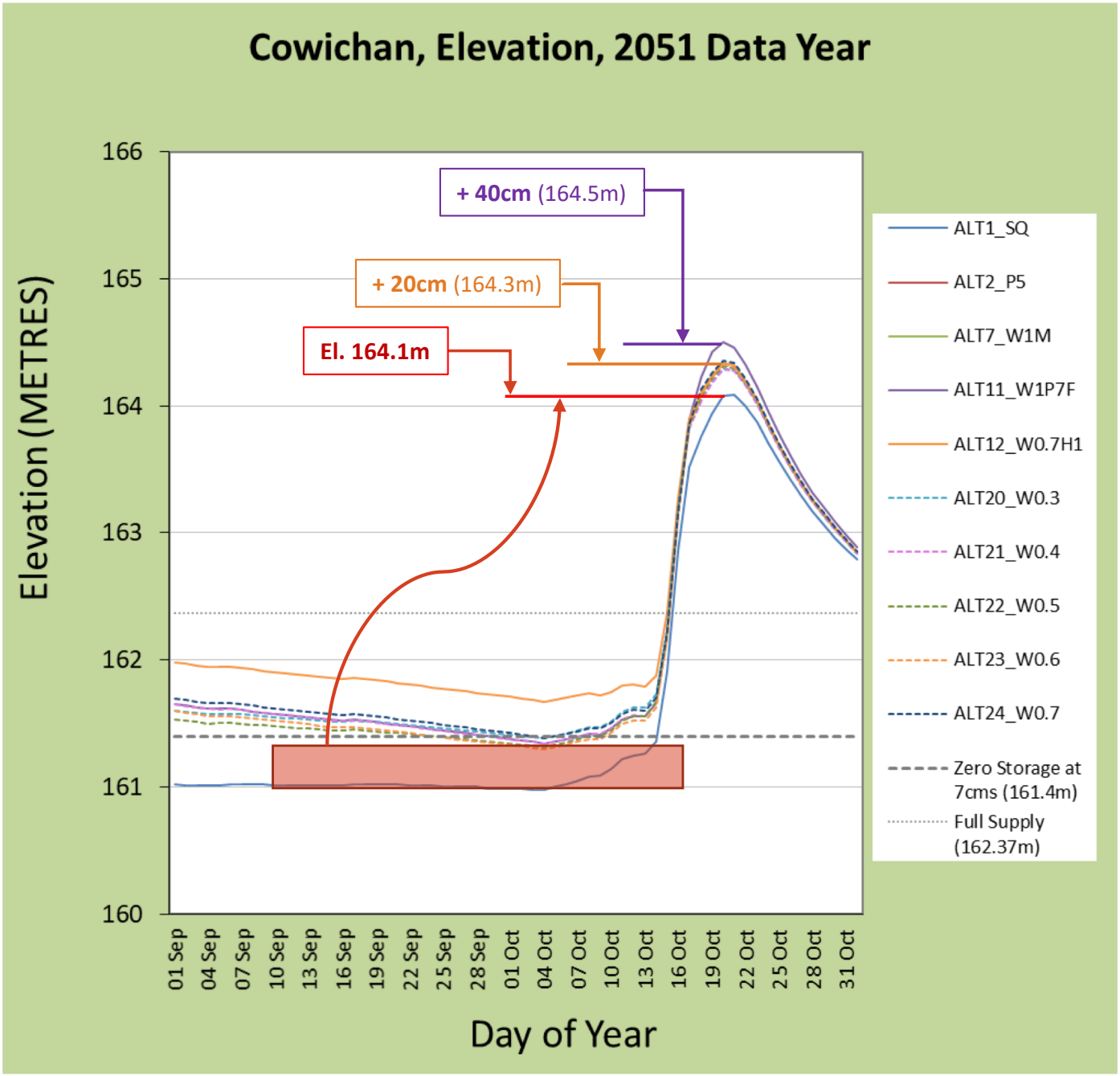

Cowichan, Elevation, 2055 Data Year
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
23 Feb
26 Feb
01 Mar
04 Mar
07 Mar
10 Mar
13 Mar
16 Mar
19 Mar
22 Mar
25 Mar
28 Mar
31 Mar
03 Apr
06 Apr
09 Apr
12 Apr
15 Apr
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, 2059 Data Year
+ 40cm (164.7m)
+ 20cm (164.5m)
El. 164.3m
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
23 Feb
26 Feb
01 Mar
04 Mar
07 Mar
10 Mar
13 Mar
16 Mar
19 Mar
22 Mar
25 Mar
28 Mar
31 Mar
03 Apr
06 Apr
09 Apr
12 Apr
15 Apr
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, 2055 Data Year
+ 60cm (164.5m)
+ 50cm (164.4m)
El. 163.9m
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
23 Feb
26 Feb
01 Mar
04 Mar
07 Mar
10 Mar
13 Mar
16 Mar
19 Mar
22 Mar
25 Mar
28 Mar
31 Mar
03 Apr
06 Apr
09 Apr
12 Apr
15 Apr
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

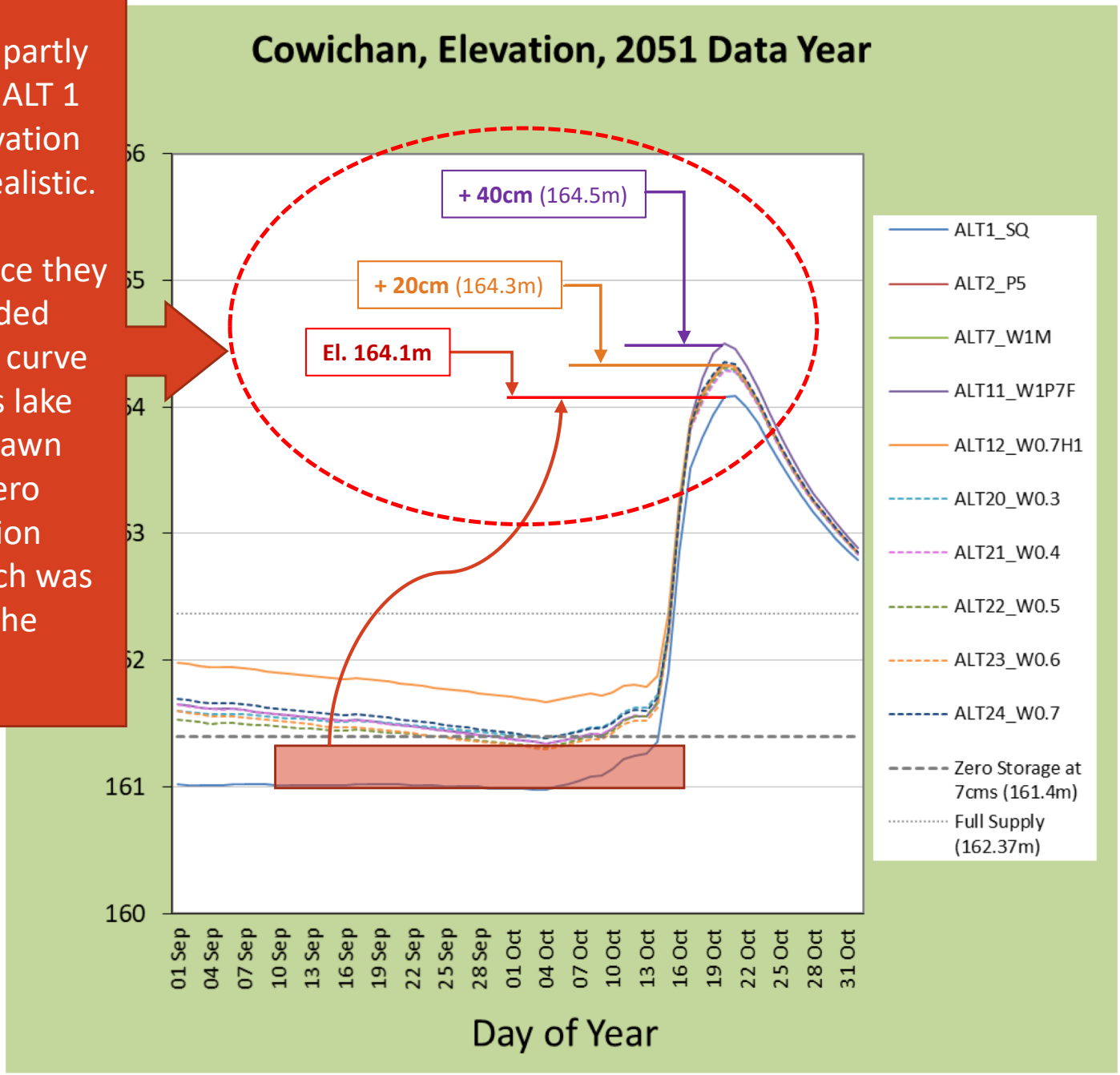

Cowichan, Elevation, 2059 Data Year
+ 40cm (164.7m)
+ 20cm (164.5m)
El. 164.3m
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
23 Feb
26 Feb
01 Mar
04 Mar
07 Mar
10 Mar
13 Mar
16 Mar
19 Mar
22 Mar
25 Mar
28 Mar
31 Mar
03 Apr
06 Apr
09 Apr
12 Apr
15 Apr
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, Maximum Value
Elevation (METRES)
166
165
164
163
162
161
160
20 Feb
04 Mar
16 Mar
28 Mar
09 Apr
21 Apr
03 May
15 May
27 May
08 Jun
20 Jun
02 Jul
14 Jul
26 Jul
07 Aug
19 Aug
31 Aug
12 Sep
24 Sep
06 Oct
18 Oct
30 Oct
11 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, 2051 Data Year
+ 40cm (164.5m)
+ 20cm (164.3m)
El. 164.1m
Elevation (METRES)
166
165
164
163
162
161
160
01 Sep
04 Sep
07 Sep
10 Sep
13 Sep
16 Sep
19 Sep
22 Sep
25 Sep
28 Sep
01 Oct
04 Oct
07 Oct
10 Oct
13 Oct
16 Oct
19 Oct
22 Oct
25 Oct
28 Oct
31 Oct
Day of Year
ALT1_SQ
ALT2_P5
ALT7_W1M
ALT11_W1P7F
ALT12_W0.7H1
ALT20_W0.3
ALT21_W0.4
ALT22_W0.5
ALT23_W0.6
ALT24_W0.7
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

These higher elevations are partly a result of the ALT 1 Reference Elevation which is not realistic.

Note. In practice they would be avoided through a rule curve which requires lake levels being drawn down to the zero storage elevation (161.4m), which was not built into the alternatives



Assessing Water Use Alternatives

Performance Measures

HANDOUT CONSEQUENCE TABLE

Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Culture and Heritage												
FSC Harvesting	See fish PMs		H	0	0	0	0	0	0	0	0	0
Traditional Knowledge	See fish PMs		H	0	0	0	0	0	0	0	0	0
Ceremonial Bathing	TBD		H	0	0	0	0	0	0	0	0	0
Environment - River												
Fish Passage	Adult summer CHK migration (10%tile)	HSI	H	0.00	0.00	0.09	0.09	0.00	0.00	0.08	0.00	0.08
Fish Passage	Adult fall CHK migration (10%tile)	HSI	H	0.00	0.00	0.26	0.20	0.00	0.00	0.00	0.00	0.00
Lateral Connectivity	Side channel connectivity (10th %tile)	%	H	0.78	0.78	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	Steelhead parr (10th %tile)	HSI	H	0.00	0.75	0.80	0.80	0.75	0.75	0.75	0.75	0.75
Rearing	Chinook fry (10th %tile)	HSI	H	0.39	0.39	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	Early Steelhead incubation (10%tile)	HSI	H	0.31	0.31	0.45	0.00	0.00	0.00	0.00	0.00	0.00
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	8	10	9	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Industry and Commercial												
Catalyst Paper	Impacted operations days	days/yr	L	74	0	0	0	0	0	0	0	0
Agriculture	Placeholder			0	0	0	0	0	0	0	0	0
Commercial Fisheries	See fish PMs			0	0	0	0	0	0	0	0	0
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Flooding and innundation	Max High Water Event - Feb 1 to Feb 28	meters	L	164.6	164.6	164.6	164.6	164.6	164.6	164.6	164.6	164.6
Flooding and innundation	Max High Water Event - Oct 1 to Nov 20		L	164.1	163.9	164.5	164.3	164.3	164.3	164.3	164.3	164.4
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, steep slope	meters	H	6.2	6.5	3.3	2.9	4.0	3.8	3.8	3.4	3.2
Private Property Lkfrnt Areas	Frontage length - vegetated, mod slope	meters	H	17.7	18.2	14.3	14.3	15.8	15.4	15.2	14.8	14.6
Docks and Wharves	*Placeholder*			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Private Water Pump Intakes	See Community Water Supply PMs			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lake Cowichar	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lake Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste Water Dilution	Effl dilution ratio (200:1) – Upper River	days/yr	L	72.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste Water Dilution	Effluent dilution ratio (40:1) – Lower River	days/yr	L	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, Mod slope	wt days	H	0.0	0.0	10.8	17.7	2.5	5.0	4.5	8.7	17.6
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Beach Use Areas - Lake	Beach user days -vegetated, Mod slope	wt days	H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Boating & Tubing - River	Decrease in summer tubing days	days	L	36	0	0	0	0	0	0	0	0
Boating & Tubing - River	Decrease in river boating days	days	L	44.5	45.5	0	0	35.5	3	25	6.5	0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0

Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (10%ile PMs)												
Fish Passage	10%ile - Adult summer CHK migration	HSI	H	0.00	0.00	0.09	0.09	0.00	0.00	0.08	0.00	0.08
Fish Passage	10%ile - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.20	0.00	0.00	0.00	0.00	0.00
Lateral Connectivity	10%ile - Side channel connectivity	%	H	0.78	0.78	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	10%ile - Steelhead parr	HSI	H	0.00	0.75	0.80	0.80	0.75	0.75	0.75	0.75	0.75
Rearing	10%ile - Chinook fry	HSI	H	0.39	0.39	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	10%ile - Early Steelhead incubation	HSI	H	0.31	0.31	0.45	0.00	0.00	0.00	0.00	0.00	0.00
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0

Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (10%ile PMs)												
Fish Passage	10%ile - Adult summer CHK migration	HSI	H	0.00	0.00	0.09	0.09	0.00	0.00	0.08	0.00	0.08
Fish Passage	10%ile - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.20	0.00	0.00	0.00	0.00	0.00
Lateral Connectivity	10%ile - Side channel connectivity	%	H	0.78	0.78	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	10%ile - Steelhead parr	HSI	H	0.00	0.75	0.80	0.80	0.75	0.75	0.75	0.75	0.75
Rearing	10%ile - Chinook fry	HSI	H	0.39	0.39	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	10%ile - Early Steelhead incubation	HSI	H	0.31	0.31	0.45	0.00	0.00	0.00	0.00	0.00	0.00
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0

Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (MEDIAN PMs)												
Fish Passage	MEDIAN - Adult summer CHK migration	HSI	H	0.05	0.05	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Fish Passage	MEDIAN - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.26	0.13	0.18	0.13	0.13	0.26
Lateral Connectivity	MEDIAN - Side channel connectivity	%	H	0.90	0.90	0.87	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	MEDIAN - Steelhead parr	HSI	H	0.05	0.75	0.80	0.80	0.78	0.80	0.78	0.80	0.80
Rearing	MEDIAN - Chinook fry	HSI	H	0.51	0.51	0.50	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	MEDIAN - Early Steelhead incubation	HSI	H	1.00	1.00	0.50	0.00	0.50	0.50	0.50	0.50	0.50
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0

Cowichan Water Use Plan

Public Advisory Group Meeting # 4

May 8, 2018

compass

ECOFISH RESEARCH

Assessing Water Use Alternatives

Consequence Table Review

Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (MEDIAN PMs)												
Fish Passage	MEDIAN - Adult summer CHK migration	HSI	H	0.05	0.05	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Fish Passage	MEDIAN - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.26	0.13	0.18	0.13	0.13	0.26
Lateral Connectivity	MEDIAN - Side channel connectivity	%	H	0.90	0.90	0.87	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	MEDIAN - Steelhead parr	HSI	H	0.05	0.75	0.80	0.80	0.78	0.80	0.78	0.80	0.80
Rearing	MEDIAN - Chinook fry	HSI	H	0.51	0.51	0.50	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	MEDIAN - Early Steelhead incubation	HSI	H	1.00	1.00	0.50	0.00	0.50	0.50	0.50	0.50	0.50
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0

Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (MEDIAN PMs)												
Fish Passage	MEDIAN - Adult summer CHK migration	HSI	H	0.05	0.05	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Fish Passage	MEDIAN - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.26	0.13	0.18	0.13	0.13	0.26
Lateral Connectivity	MEDIAN - Side channel connectivity	%	H	0.90	0.90	0.87	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	MEDIAN - Steelhead parr	HSI	H	0.05	0.75	0.80	0.80	0.78	0.80	0.78	0.80	0.80
Rearing	MEDIAN - Chinook fry	HSI	H	0.51	0.51	0.50	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	MEDIAN - Early Steelhead incubation	HSI	H	1.00	1.00	0.50	0.00	0.50	0.50	0.50	0.50	0.50
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0

Supplemental Information

Increased Incremental Risk of Flooding

- Alternatives 11 & 12 increase lake levels during peak spring inflow event by +35-40cm (164.7m) and +20cm (164.5m) respectively
- About ~ 40 additional homes (from 18 to 58) are at greater risk of flooding as lake levels increase from 164.5m to 165m based on a cursory assessment of where contour lines intersect with building outlines on Google Earth

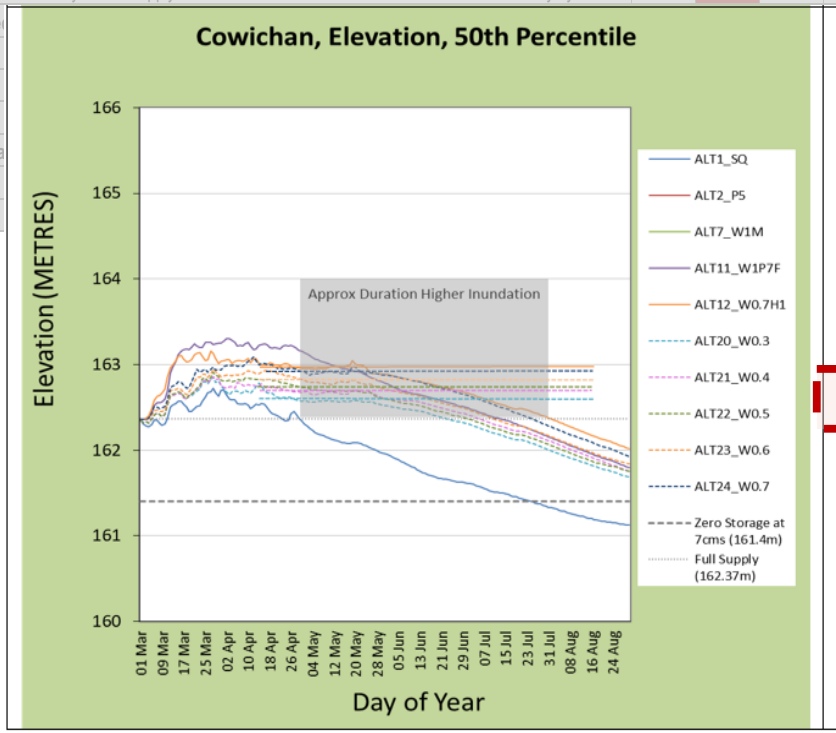
Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (MEDIAN PMs)												
Fish Passage	MEDIAN - Adult summer CHK migration	HSI	H	0.05	0.05	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Fish Passage	MEDIAN - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.26	0.13	0.18	0.13	0.13	0.26
Lateral Connectivity	MEDIAN - Side channel connectivity	%	H	0.90	0.90	0.87	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	MEDIAN - Steelhead parr	HSI	H	0.05	0.75	0.80	0.80	0.78	0.80	0.78	0.80	0.80
Rearing	MEDIAN - Chinook fry	HSI	H	0.51	0.51	0.50	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	MEDIAN - Early Steelhead incubation	HSI	H	1.00	1.00	0.50	0.00	0.50	0.50	0.50	0.50	0.50
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Supplemental Information

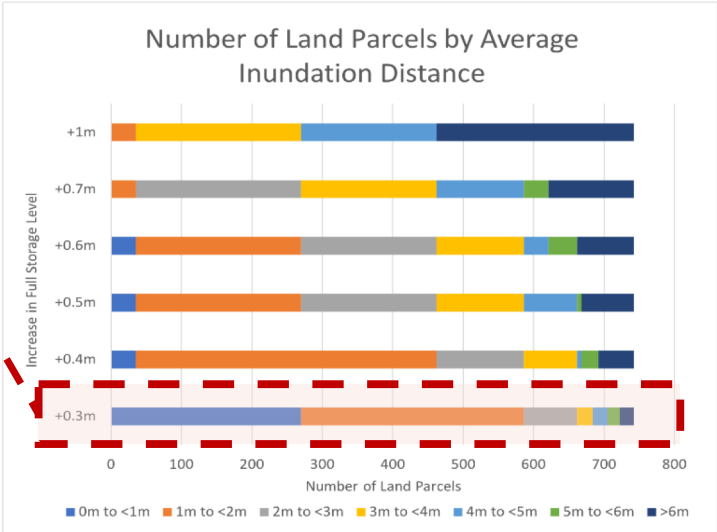
There are two sides to this PM:

- Potential aesthetic effects of higher water levels during the control period associated with less frontage areas and where the lake begins
- Potential inundation of lakefront areas where water will be stored for portions of the control period potentially affecting some owner's property rights (i.e., use and enjoyment).



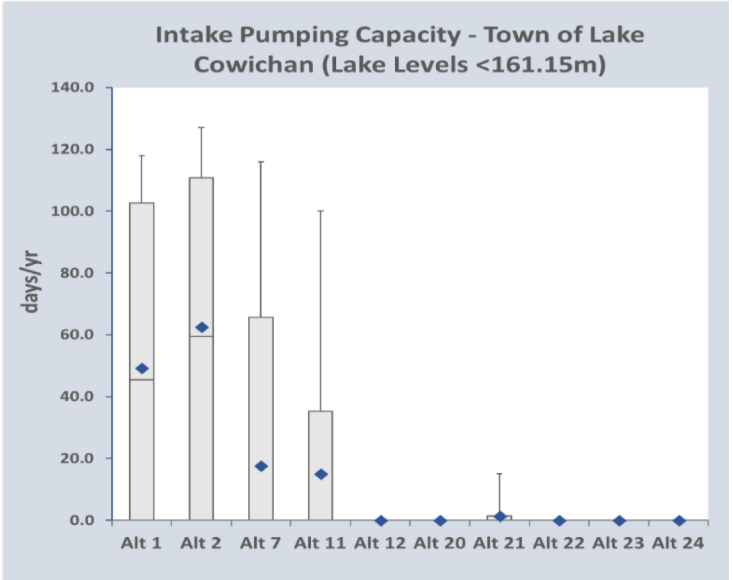
Using the median value to represent average lake levels through the spring and summer, the inundation effects are a max of:

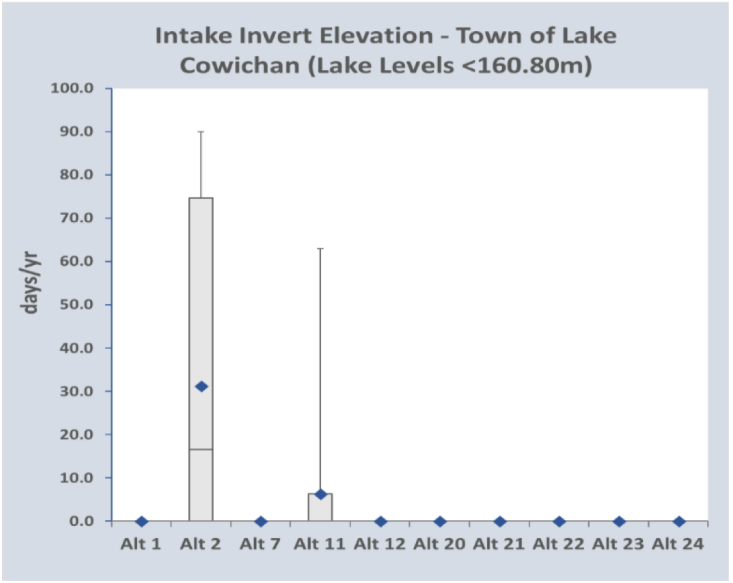
- Alt 11: up to 70cm for ~10wks
- Alt 12: up to 55cm for ~12wks
- Alt 20: up to 15cm for ~ 7wks
- Alt 21: up to 25cm for ~8wks
- Alt 22: up to 30cm for ~ 8wks
- Alt 23: up to 40cm for ~9wks
- Alt 24: up to 45cm for ~11wks



Round 3 - Consequence Table

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 11	Alt 12	Alt 20	Alt 21	Alt 22	Alt 23	Alt 24
Environ - River (MEDIAN PMs)												
Fish Passage	MEDIAN - Adult summer CHK migration	HSI	H	0.05	0.05	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Fish Passage	MEDIAN - Adult fall CHK migration	HSI	H	0.00	0.00	0.26	0.26	0.13	0.18	0.13	0.13	0.26
Lateral Connectivity	MEDIAN - Side channel connectivity	%	H	0.90	0.90	0.87	0.84	0.84	0.84	0.84	0.84	0.84
Rearing	MEDIAN - Steelhead parr	HSI	H	0.05	0.75	0.80	0.80	0.78	0.80	0.78	0.80	0.80
Rearing	MEDIAN - Chinook fry	HSI	H	0.51	0.51	0.50	0.25	0.25	0.25	0.25	0.25	0.25
Spawning	MEDIAN - Early Steelhead incubation	HSI	H	1.00	1.00	0.50	0.00	0.50	0.50	0.50	0.50	0.50
Environment - Lake												
Vancouver Lamprey	Lamprey rearing habitat (Scale 1-6)	#	L	7	9	8	1	6	5	4	3	2
Littoral Productivity	Littoral rearing habitat	#	H	0.45	0.10	0.44	0.78	0.72	0.68	0.73	0.72	0.78
Lakefront Properties												
Flooding and innundation	Max High Water Event - Mar 1 to Apr 30	meters	L	164.3	164.3	164.7	164.5	164.3	164.3	164.3	164.3	164.3
Private Property Lkfrnt Areas	Frontage length - un-vegetated, mod slope	meters	H	10.7	11.1	8.2	8.1	9.1	9.0	8.7	8.4	8.3
Municipal												
Community Water Supply	Intake pumping cap. - Town of Lk Cowichan	days/yr	L	45.5	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community Water Supply	Intake invert El. - Town of Lk Cowichan	days/yr	L	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recreation and Tourism												
Beach Use Areas - Lake	Beach user days - un-vegetated, steep slope	wt days	H	0.0	0.0	17.6	30.0	4.8	10.0	9.0	16.9	27.3
Boat Access/Navigtn-Lake	Decrease in dock use days	days	L	113.0	113.0	37.5	15.5	51.5	42.5	46.0	36.0	26.0
Lake Aesthetics	Visual Quality	#	L	3	5	3	1	2	2	2	1	1
Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0





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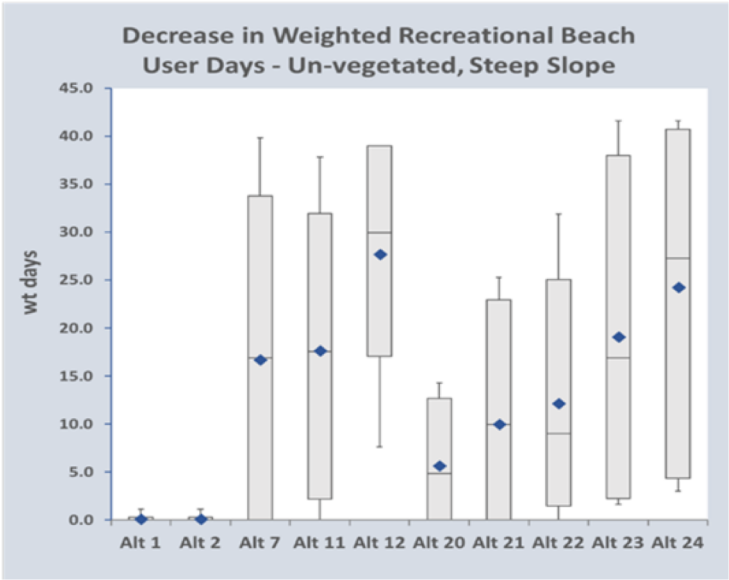

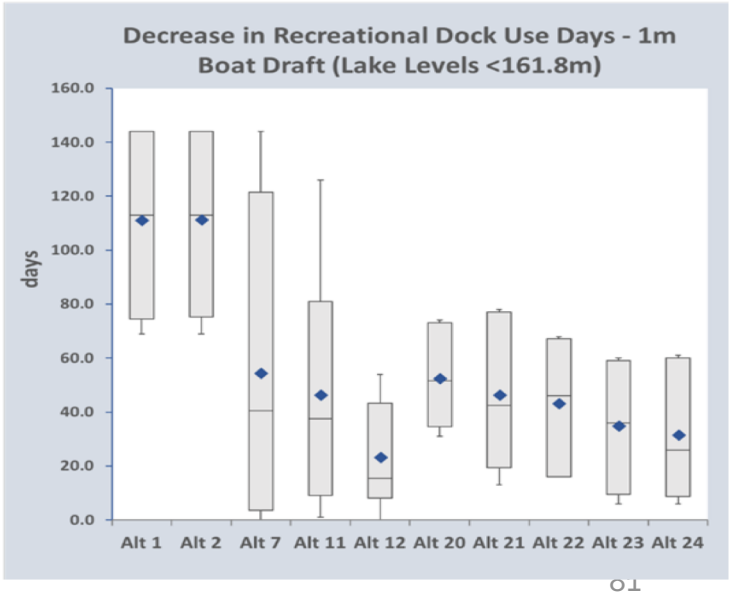

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Water Management												
Capital Costs	Capital costs	M$	L	0	0	26	18	12	13.5	15	16.5	18
Operational Costs	AVG Operational costs (over 10yrs)	M$	L	0.0	5.0	1.0	0.0	2.5	2.0	2.5	2.5	1.0
				0	$5m	~$27	~$18	~$15	~$15	~$18	~$19	~$19

Round 3 - Consequence Table

Interactive Consequence Table…

Cowichan WUP

Other Related Recommendations

CWUP – Other Related Recommendations

Summary

- Within the scope of WUPs there is an opportunity to include other operational related recommendations above and beyond the selection of a recommended water use alternative
- These recommendations are general in relation to:
  - **Conditions** associated with the recommended water use alternative
  - **Monitoring and research studies**, given some of the key datagaps that were highlighted during the process
  - A **review period** for when any changes in water control structures and/or operations should be reviewed based on new information (review periods are typically tied to environmental studies/monitoring once key impact hypotheses have been confirmed) – generally this is in the range of 10-20 years
  - Potential **triggers** for re-opening and updating the WUP based on critical new information that comes to lights (major developments in the watershed, new hydrological conditions, or new impact hypotheses that emerge, etc.)
  - **New enhancement projects** in lieu of potential operational changes in a preferred alternative, if it was considered more (cost) effective

CWUP – Other Related Recommendations

Prelim List of General Recommendations

1. The selected alternative be refined using updated projected **future climate change inflow record** including a longer time series (more than 10 years) and using most recent downscaled climate change projection data,

2. More detailed **flood risk analysis** be carried out for the selected alternative using a longer projected time series (*and depending on the alternative selected, may need to carry out field surveys of homes, if the alternative was associated with increased incremental flood risk during the control period*),

3. A more detailed assessment of the **natural boundary** be carried out to determine the elevation range in relation to any changes in the weir height*; and, depending on the results, development of a preliminary compensation framework to be implemented with the alternative should it be determined that water would be stored and infringe upon property rights.*

4. An **adaptation plan** be developed to assess how the selected alternative is to be implemented over the following 30 year period (until 2050s) including adjustments to operating guidelines, the timing of physical upgrades to the weir and adaptive measures within the proposed weir design (such as a flexible crest weir),

5. The selected alternative be operationalized to allow for **in-season management** within the parameters of better meeting the defined target levels and with consideration to snow pack monitoring, seasonal forecasting, weather forecasting, environmental field work, etc., which may include mandatory pre-spilling criteria being developed.

6. A more detailed **erosion assessment and mitigation** mechanism be developed should it demonstrated that adverse erosion impacts are occurring as a result of the operations of any new alternative.

7. The selected alternative should have a **review period** of no more than 10 -15 years once implemented and based on the necessarily environmental field work and monitoring being carried out;

CWUP – Other Related Recommendations

Prelim List of General Recommendations

Other?

CWUP – Other Related Recommendations

Recommended Environmental Studies

- As summarized in Appendix B of the Pre-Reading Package

Cowichan WUP

Reaching Agreement on a Preferred Alternative

Reaching Agreement on a Preferred Alternative

Two Step Process

1. Straw Poll to gauge the PAG's level of support according to the Round 3 alternatives
2. Facilitated discussion towards identifying a preferred alternative *(which may or may not include consideration of new hybrid options)*

Straw Poll – Level of Support

PAG members are asked to indicate their level of support for each of the water use alternatives, according to:

Endorse	**I fully endorse this alternative**
Accept	**I accept this alternative**; there may be some minor aspects that I am not happy about, but I would be willing to support it
Accept w/conditions	**I can accept this alternative**; but I have reservations and my support is based on the following condition(s)
Oppose	**I do not support this alternative**; because… *(please specify)* *Also, if applicable, indicate what changes would need to occur in order to support an alternative like this?*

Straw Poll – Level of Support

Alternative	Level of Support	Conditions / Comments
ALT 1 – Status Quo		
ALT 2 – Status Quo (w/ pumps)		
ALT 11_W1.0m		
ALT 12_W0.7m		
ALT 20_W0.3		
ALT 21_W0.4		
ALT 22_W0.5		
ALT 23_W0.6		
ALT 24_W0.7		

Choose either:

- Endorse
- Accept
- Accept w/conditions
- Oppose

Describe any conditions

If you oppose an alternative, indicate what changes would need to occur, if any, in order to support an alternative like this?

Straw Poll – Level of Support

Results….

Cowichan WUP

Reaching Agreement – Cont'd

Operationalizing a Preferred Alternative

Alternative X	
Infrastructure	**Conditions / Comments**
• Weir Height +0.Xm	• Prelim weir height of +0.Xm is recommended as an interim height until a more detailed assessment is carried out to confirm that the height of the weir is below the minimum elevation range of the natural boundary • A longer-term compensation mechanism would need to be implemented for any increases in the weir height above the natural boundary range
• Pumping Cap. = 5cms	• The new alternative should have temporary pumping capacity of 5cms to be used as an emergency measure during future severe summer droughts
Operations	**Conditions / Comments**
Control Period • Start Date – Mar 1 • End Date – Nov 5	• The timing of the control period **may be modified** based on a review of in-season hydrological conditions (i.e., snow pack levels, short term weather forecast, long range seasonal forecast, environ monitoring (e.g., snorkel surveys), etc.) **BUT no earlier** than March 1 unless a detailed flood risk analysis concludes that there would be no increased flood risk associated with an earlier start date
Flow Releases Target "Soft" Flows • 25cms: Mar 1 – Apr 30 • 15cms: May 1 – May 15 • 7cms: May 16 – Nov 5 • *Flow Pulses: Sep-Nov** Minimum "Hard" Releases • 15cms: Mar 1 – Apr 30 • 7cms: May 1 – May 15 • 5cms: May 16 – Nov 5	• The magnitude and duration of spring flows of 25cms and 15cms to the Cowichan River **may be modified** based on in-season hydrological conditions (i.e., snow pack levels, short term weather forecast, long range seasonal forecast, environ monitoring (e.g., snorkel surveys), etc.) **as long as**: ○ Lake levels are targeted to reach full pool (i.e., top of the weir) by April 1 each year ○ Lake levels are targeted to drop by NO more than 20cm below the zero storage elevation of 161.4m ○ A detailed assessment of flood risk demonstrates there would not be any incremental increase in flood risk in March. ** Flow pulses as lake levels and inflows permit and as potentially required by the rule curve*
Rule Curve Updates	• Rule curve is modified to ensure that lake levels are targeted to reach close to the zero storage by the end of the control period (to avoid increased flood risk associated with fall storms)
Other Features	**Conditions / Comments**
•	•

PAG Member Support

Go around…

Endorse	**I fully endorse this alternative**
Accept	**I accept this alternative**; there may be some minor aspects that I am not happy about, but I would be willing to support it
Accept w/conditions	**I can accept this alternative**; but I have reservations and my support is based on the following condition(s)
Oppose	**I do not support this alternative**; because… *(please specify)* *Also, if applicable, indicate what changes would need to occur in order to support an alternative like this?*

Cowichan WUP

Support for Other Recommendations

CWUP – Other Related Recommendations

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Cowichan WUP

Public Engagement

Public Information Meeting #2

Proposed Meeting Objectives

- To report out on the planning process and outcomes
- To build capacity in community to understand complexity of trade-offs involved in water use planning in the Cowichan Watershed
- To provide an opportunity for the public to provide input on the draft recommendations

Public Information Meeting #2

Meeting Details

- **June 11, 5:30pm to 8:30pm**
- Town of Lake Cowichan, Centennial Community Hall
- PAG members present in person to speak to their experience and recommendations on a preferred alternative
- Food to be provided - *CVRD to confirm*

Public Information Meeting

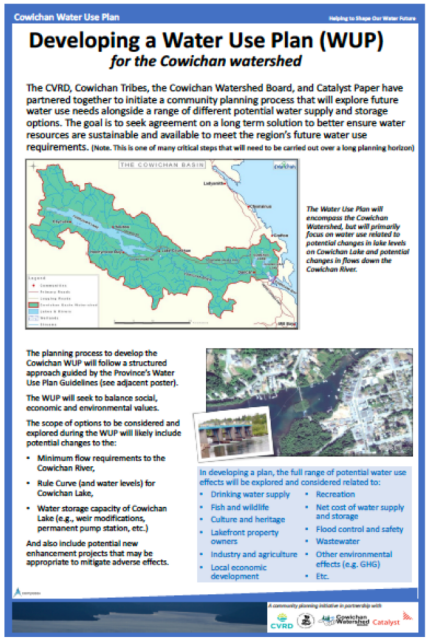
General Format

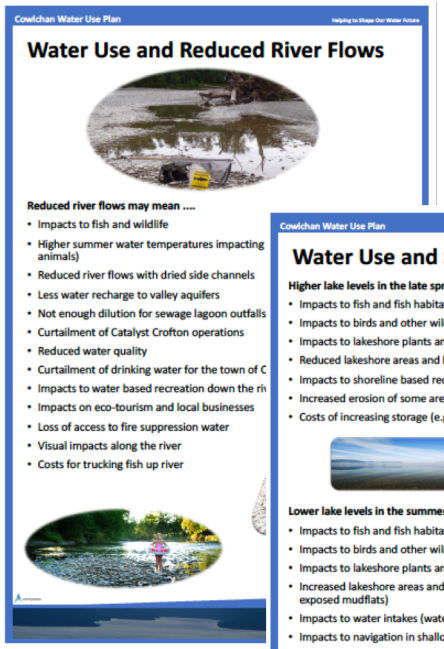
- 1.5 hr Open House – Consulting Team, PAG Members and WUP Partners
- 30 min Presentation – Compass and WUP Partners
- 1 hr Question & Answer – Compass, PAG Members and WUP Partners

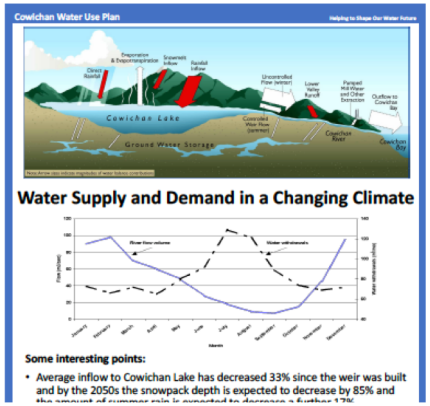
Public Information Meeting

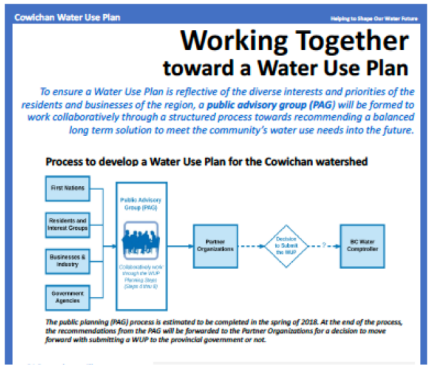
Story Boards (for Open House 5:30pm to 7pm)

- Approximately 10-12 Boards with key messages and important context summarizing the planning process, results and recommendations, and next steps









etc...

Public Information Meeting

Presentation (7pm to 7:30pm)

- Short presentation focused on the approach taken, alternatives that were developed, key trade-offs considered, final recommendations and next steps
- Support slides on hand with more detailed information to address anticipated questions

Q&A Period (7:30pm to 8:30pm)

- Facilitated session
- Microphone for questions from the audience

Public Information Meeting

Record of Public Engagement and Input

- Sign-in sheets to record the number of attendees
- Poster boards and presentation slide deck
- Summary of the question and responses from the Q&A period
- Opportunity to provide written feedback:
  - On the process and the opportunity to provide input
  - On their support for the recommendations
  - On any issues or concerns in relation to the PAG's recommendations
  - On any other points they would like to offer

Public Information Meeting

Next Steps

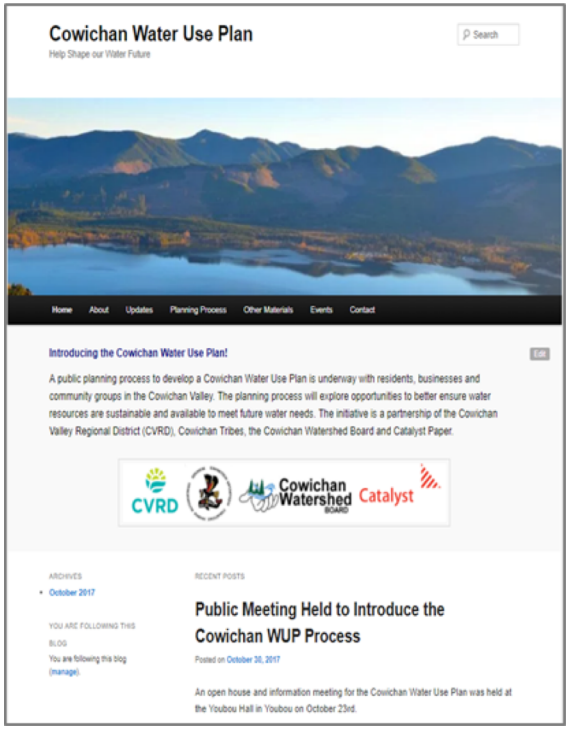
- Notice of public meeting:
  - Advertising in local papers and newsletters
  - Town of Lake Cowichan “Lake Days” June 4 to 10
  - Partner organizations
  - PAG members
- Draft meeting materials
  - Print poster boards wk of June 4 - PAG and Partner review wk of May 28
  - Presentation and written feedback form - PAG and Partner review wk of June 4

Cowichan WUP

Concluding Steps

Concluding Steps

- Draft Meeting notes
- Summary of CWUP outcome posted on public website
- Announcement / advertisements for Public Info Mtg
- June 11 Public Information Meeting w/ PAG Members
- Draft PAG Summary Report on the public planning process
- PAG member sign-off on the final PAG Summary Report
- Partner Organization Presentation and Discussion – Fall 2018



https://cowichanwup.ca/

Thanks!

Go around of parting comments!