Bow River Basin
Identification of Possible Flood Storage Opportunities

9 December 2015

Before we start….

- Why is this work important
- The “Design Flood”
- Residual flood risk – why we shouldn’t consider ourselves safe from flooding with just one line of defense eg: dykes
- On Friday and Saturday, over 400 mm of rain fell in a 36 hour period in the North West of England > 1 in 1000 year event.
- Here are a few photos:

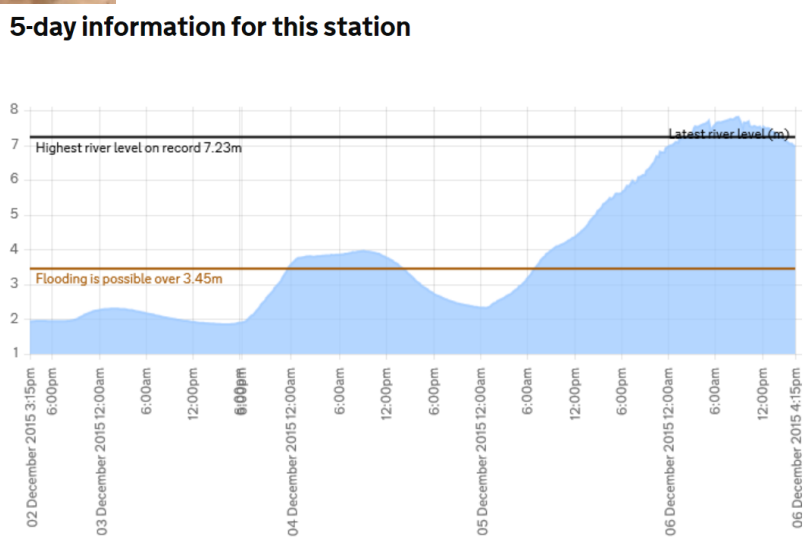
This area was protected with a dyke

Typical scene in rural Cumbria, England on Saturday 5th December 2015 after more than 400 mm rain in 36 hrs

Residual Flood Risk

Residual Flood Risk

Carlisle City Hall



- Without the defences Carlisle was at risk of flooding when the gauge was above 3.45 m
- The river reached 7.81 m
- Just above the the defences (1% AEP plus 600 mm freeboard)

Why does this matter?

- There is always a risk that the design standard for any flood defence can be exceeded.
- Layers of flood defences, resilient construction, and emergency management provides mitigation
- Defences should be constructed to protect existing infrastructure; however,
- Development policies in the flood plain should not take into consideration that an area is defended.
- There will always be a residual risk.

Flood Storage Opportunities in the Bow River Basin General Points

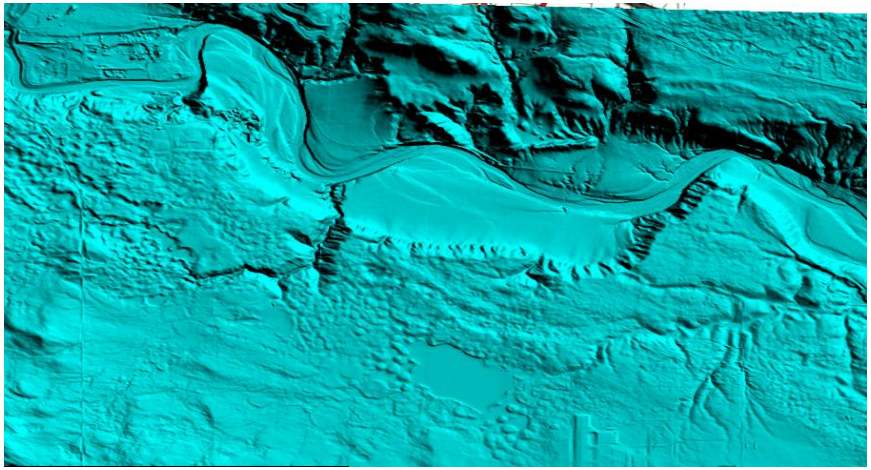
- Amec Foster Wheeler was asked to identify potential flood storage opportunities within the Bow River watershed upstream of Calgary.

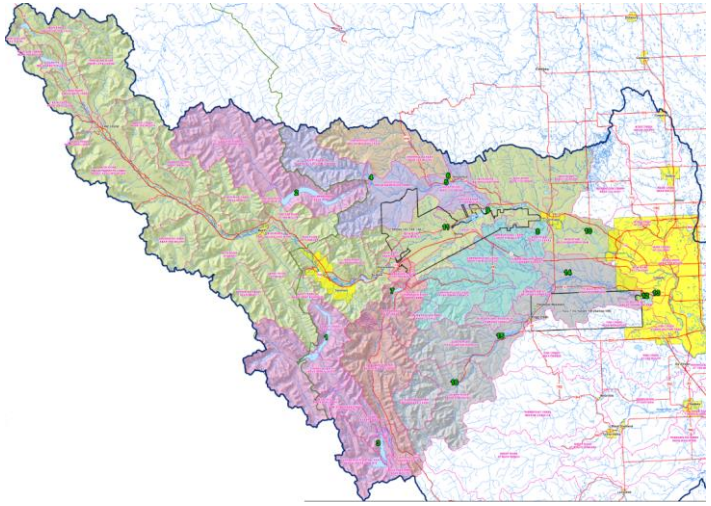
- The work was conducted at a high level to determine if, and where, flood storage opportunities exist within the Bow Basin River watershed

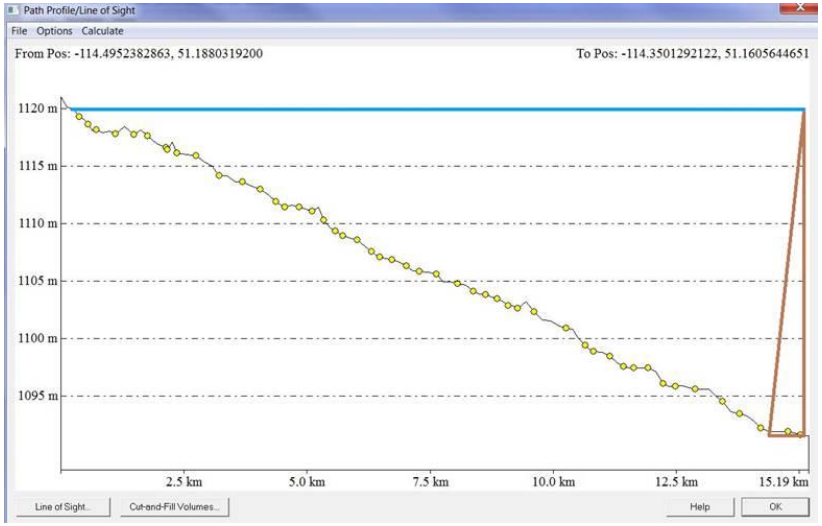
- Amec Foster Wheeler undertook a comprehensive review of storage opportunities; with a focus on flood mitigation.

General Points

- The process took into consideration:
  - Natural topographic features
  - River slope and upstream storage potential
  - Suitability of the location from a hydrology perspective
  - Location of nearby infrastructure (settlements, roads, railways)



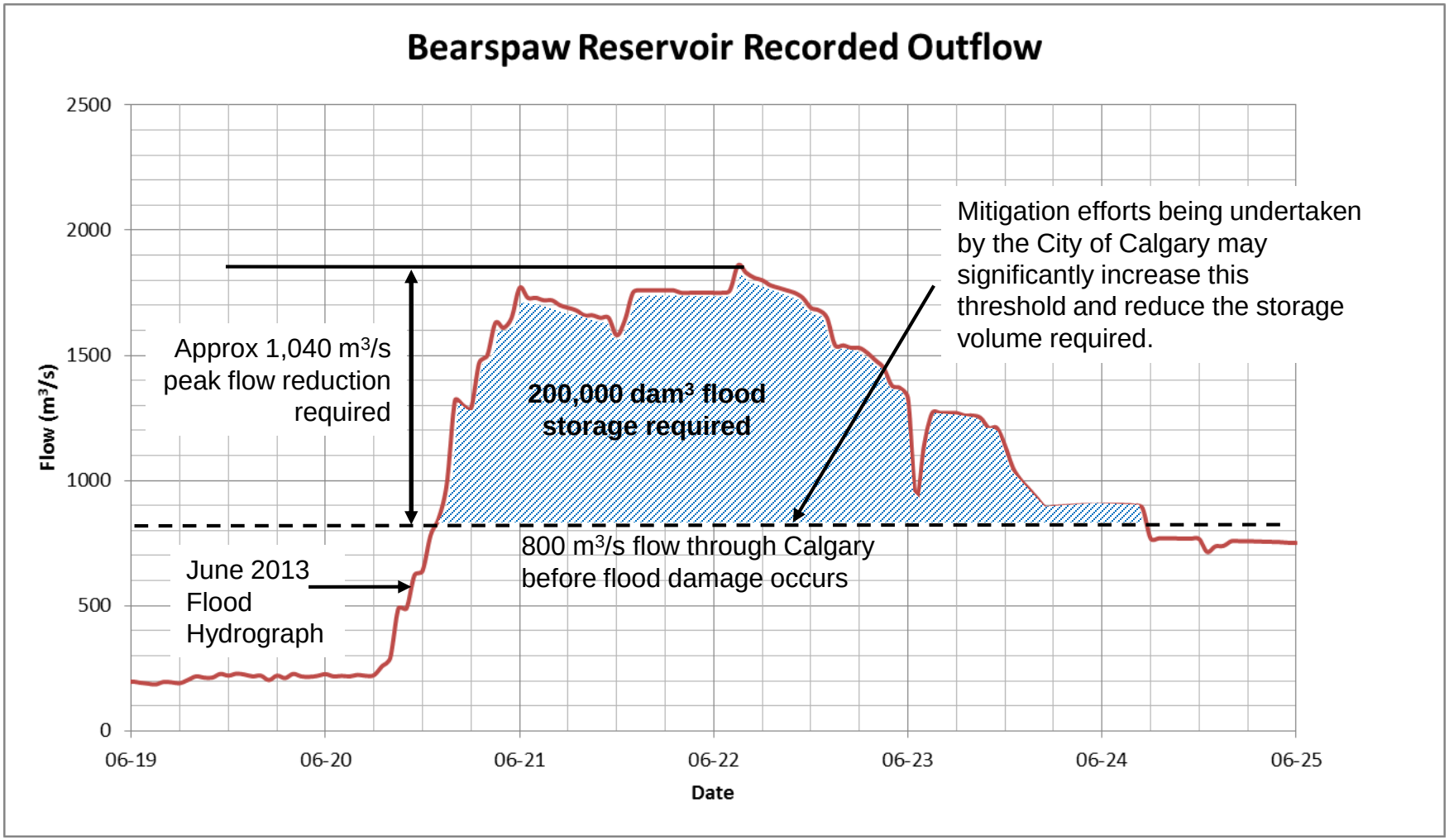




General Points

- The process did not take into consideration:
  - Geotechnical feasibility or potential geo-hazards
  - Land ownership or rights
  - Environmental impact
  - Socio-political aspects
  - Administrative boundaries
  - Economics (benefit/cost ratio)
  - Any work that is currently being undertaken or planned by the City of Calgary.

Bow River
Requirements to Mitigate the June 2013 Flood

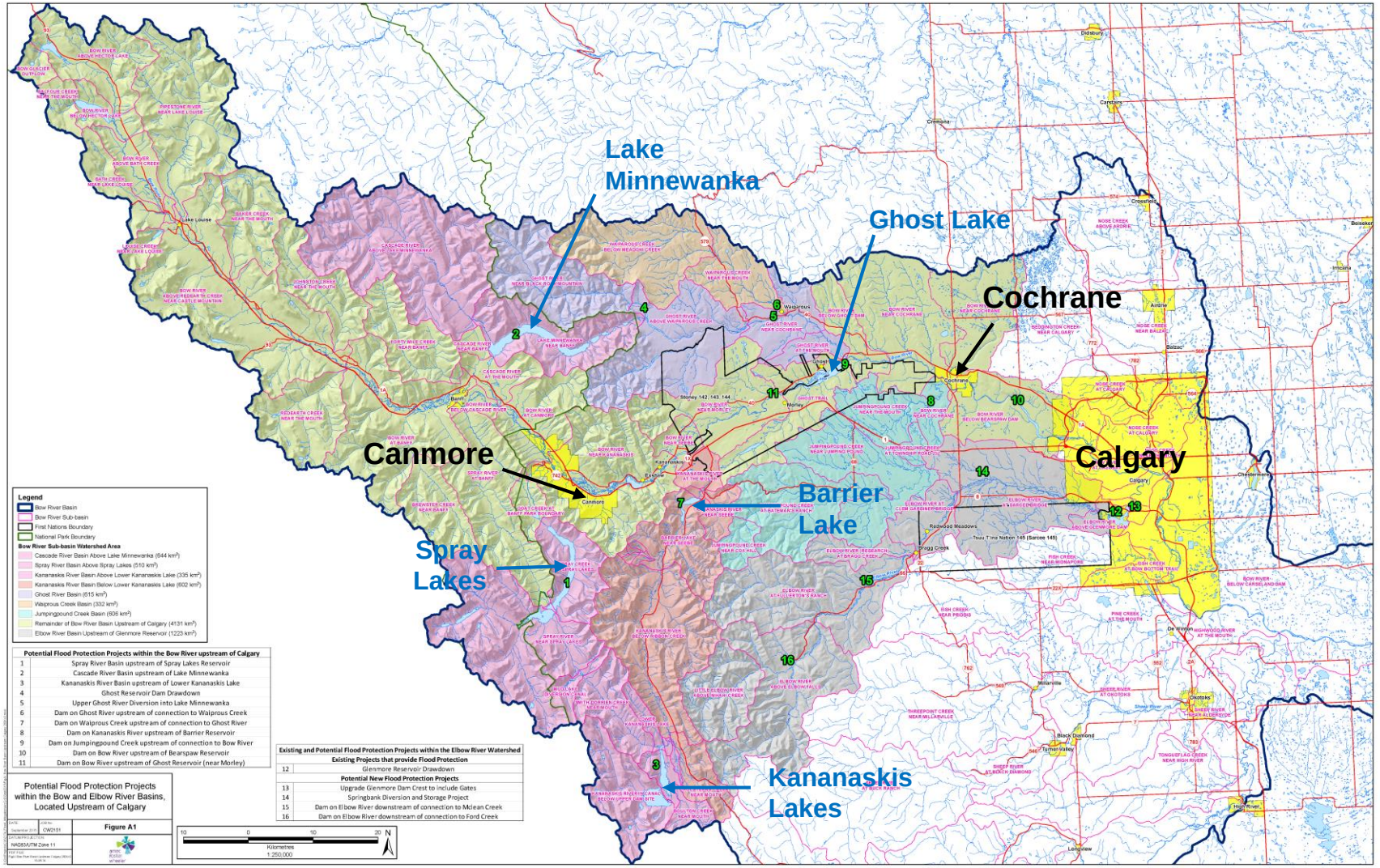


Flood Storage Opportunities Overview

- A total of 11 potential flood storage concepts have been identified.
  - 4 are classified as operational opportunities using existing facilities
  - 7 are classified as new project opportunities.

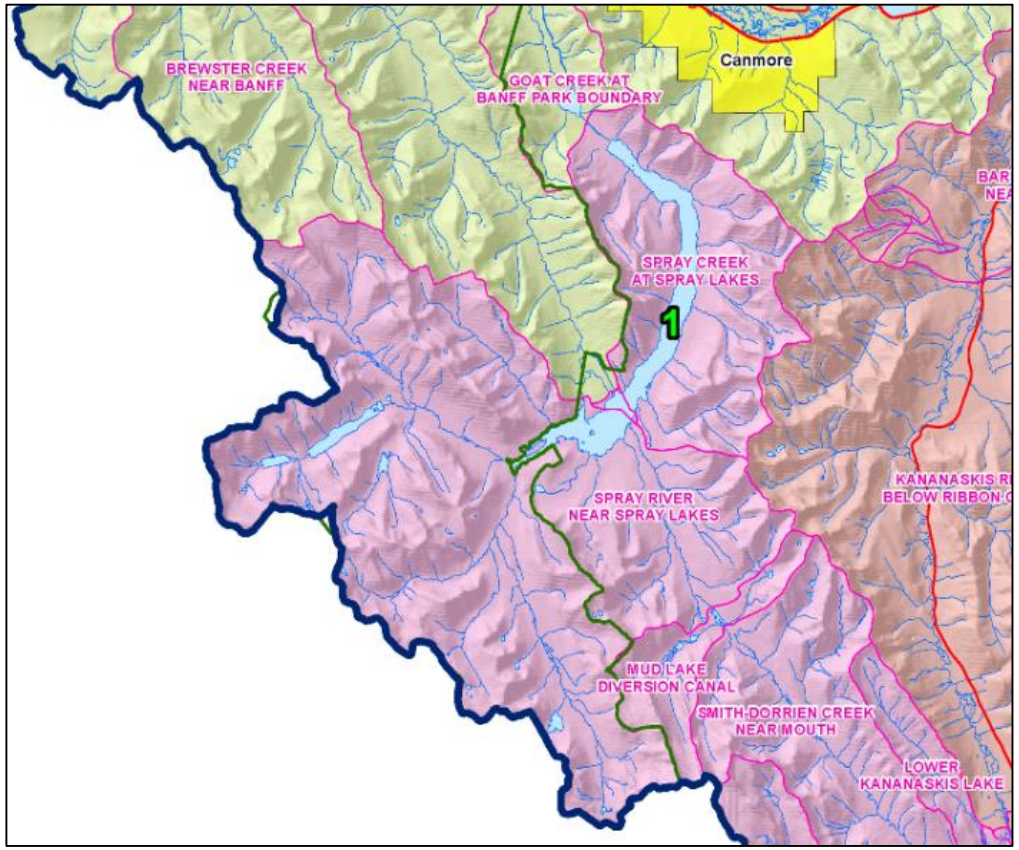
- Further study is required to determine conceptual level viability and feasibility (eg: geotechnical suitability, geohazards)

Flood Storage Opportunities Location Map



Operational Opportunities in Tributary Watersheds with Existing Facilities

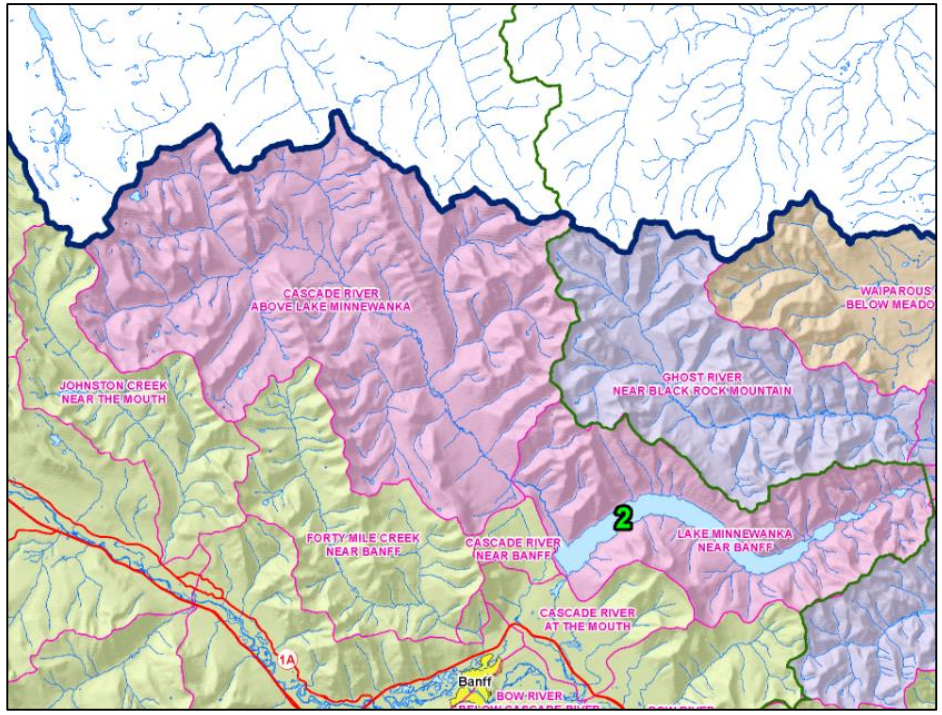
- 1. Spray River Basin Upstream of Spray Lakes Reservoir
  - 510 km^2 regulated area (6.6% of the Bow Basin upstream of Elbow River)

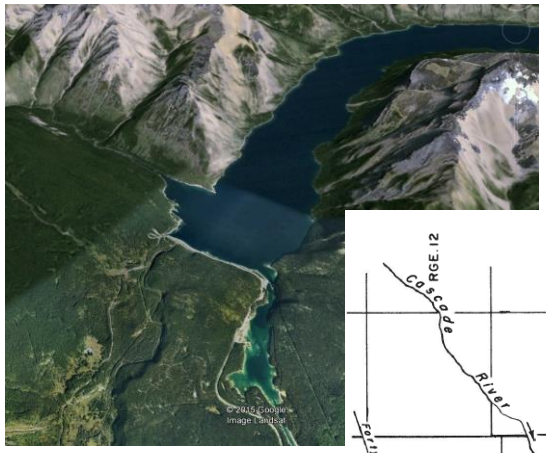


Source: Jack Borno (Panaramio)

Operational Opportunities in Tributary Watersheds with Existing Facilities

- 2. Cascade River Basin Upstream of Lake Minnewanka.
  - 644 km^2 regulated area (8.5% of the Bow Basin upstream of Elbow River)



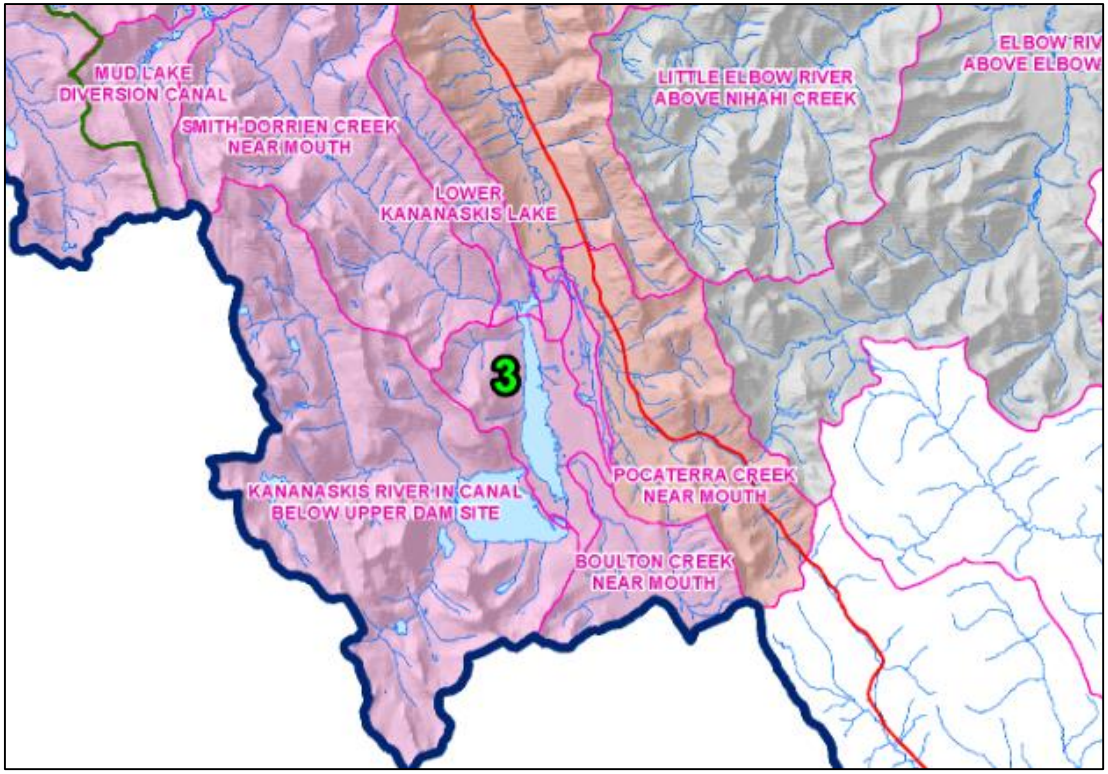


Source: Google Earth Pro

Source: W-E-R, 1986

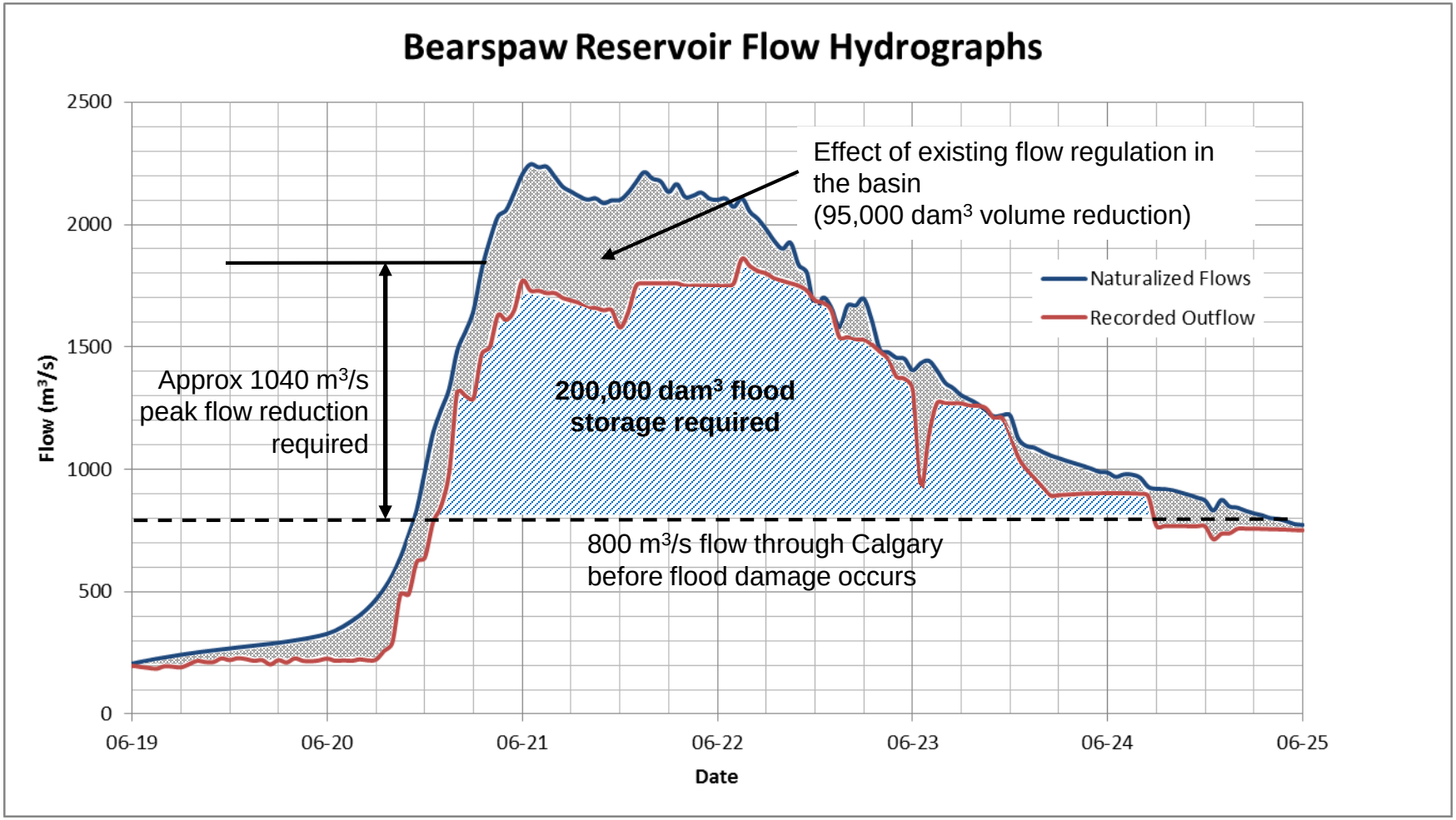
Operational Opportunities in Tributary Watersheds with Existing Facilities

- 3. Kananaskis River Basin Upstream of Lower Kananaskis Lake
  - 360 km^2 regulated area (4.6% of the Bow Basin upstream of Elbow River)



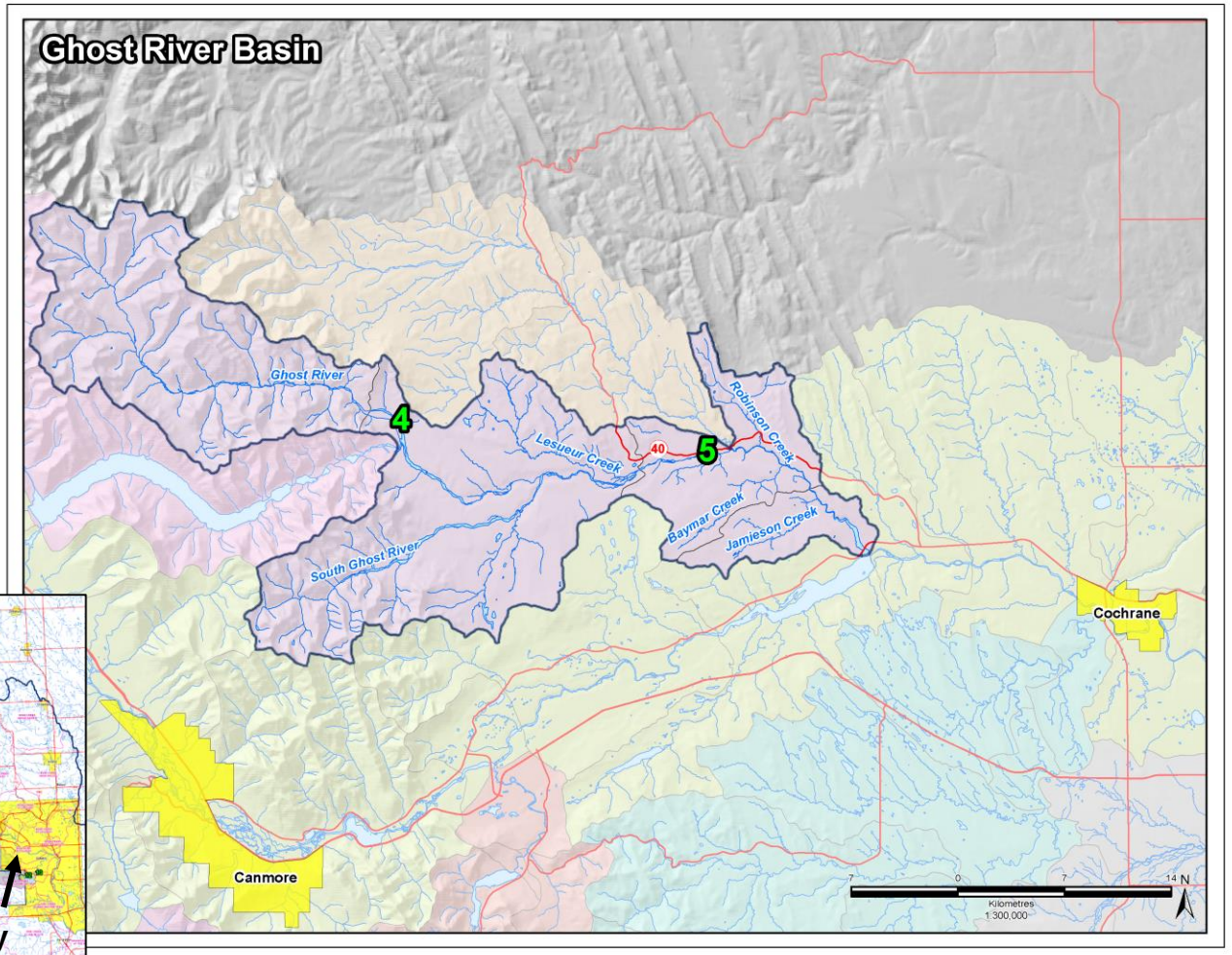
Source: CH Williams, 2009

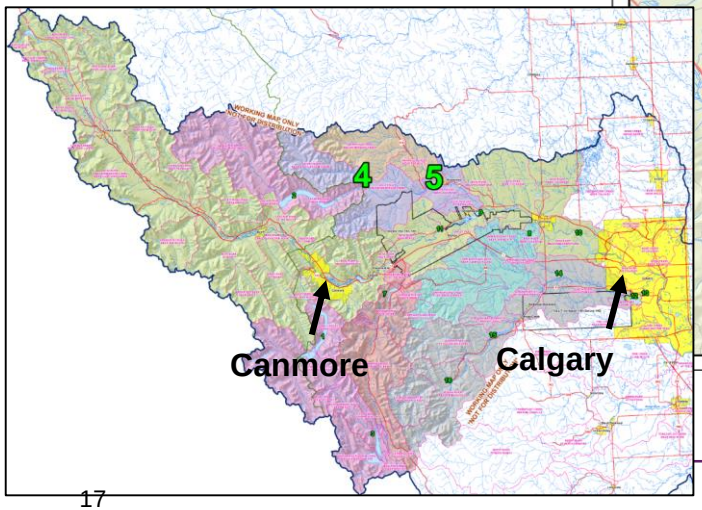
Effect of Existing Regulation During the June 2013 Flood



New Opportunities in Tributary Watersheds
4. & 5. North Ghost River and Ghost River

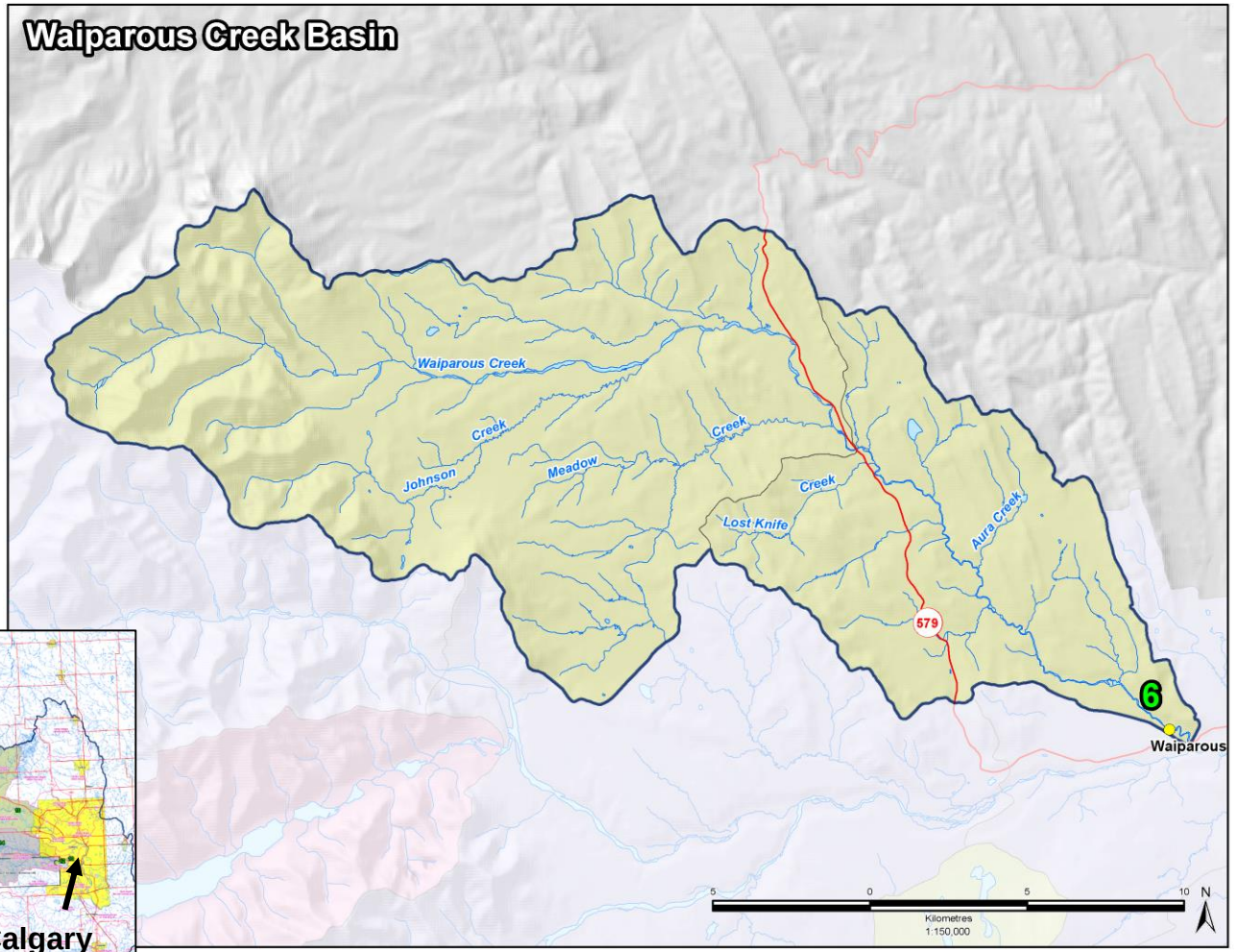
- **Enlarge North Ghost River Diversion to Lake Minnewanka (4)**
  - 230 km^2 (2.9% controlled)
  - Approx 20,000 dam^3
- **Dam on Ghost River upstream of Waiparous Creek (5)**
  - General area had previously been identified by the Flood Advisory Panel
  - 615 km^2 (7.8% controlled)
  - 50,000 dam^3 to 70,000 dam^3 storage potential

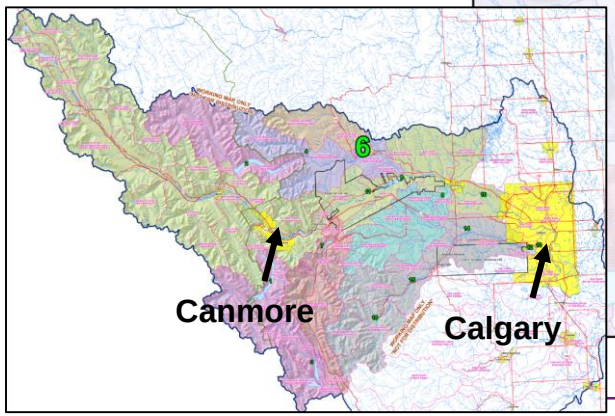




New Opportunities in Tributary Watersheds
6. Waiparous Creek

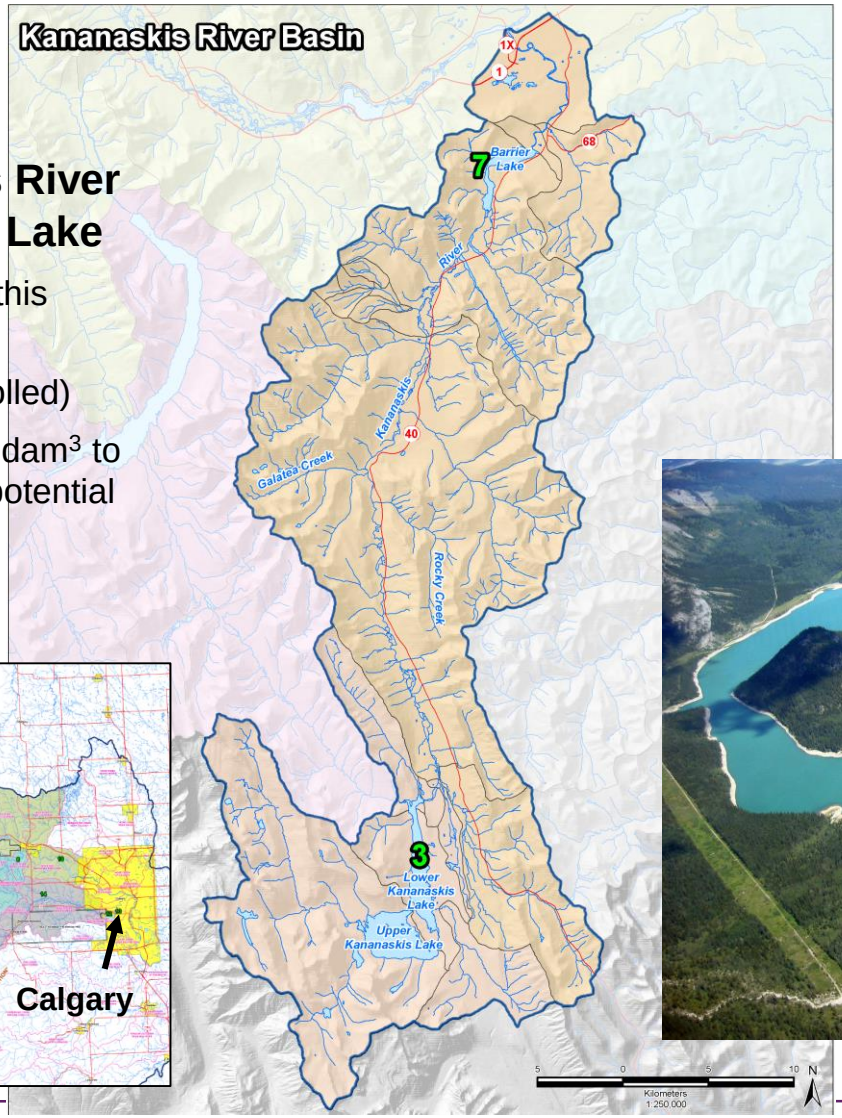
- **Dam on Waiparous Creek upstream of the Ghost River**
  - General location had previously been identified by the Flood Advisory Panel
  - 332 km^2 (4.2% controlled)
  - Approximately 30,000 dam^3 to 40,000 dam^3 storage potential

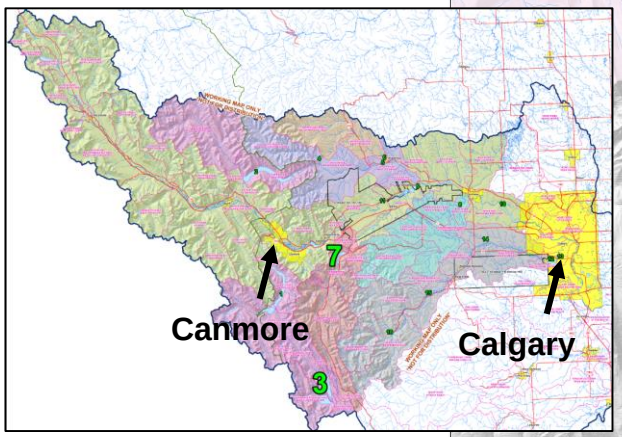




New Opportunities in Tributary Watersheds
7. Kananaskis River

- **Dam on Kananaskis River upstream of Barrier Lake**
  - More than 1 option at this location
  - 899 km^2 (11.4% controlled)
  - Approximately 80,000 dam^3 to 90,000 dam^3 storage potential

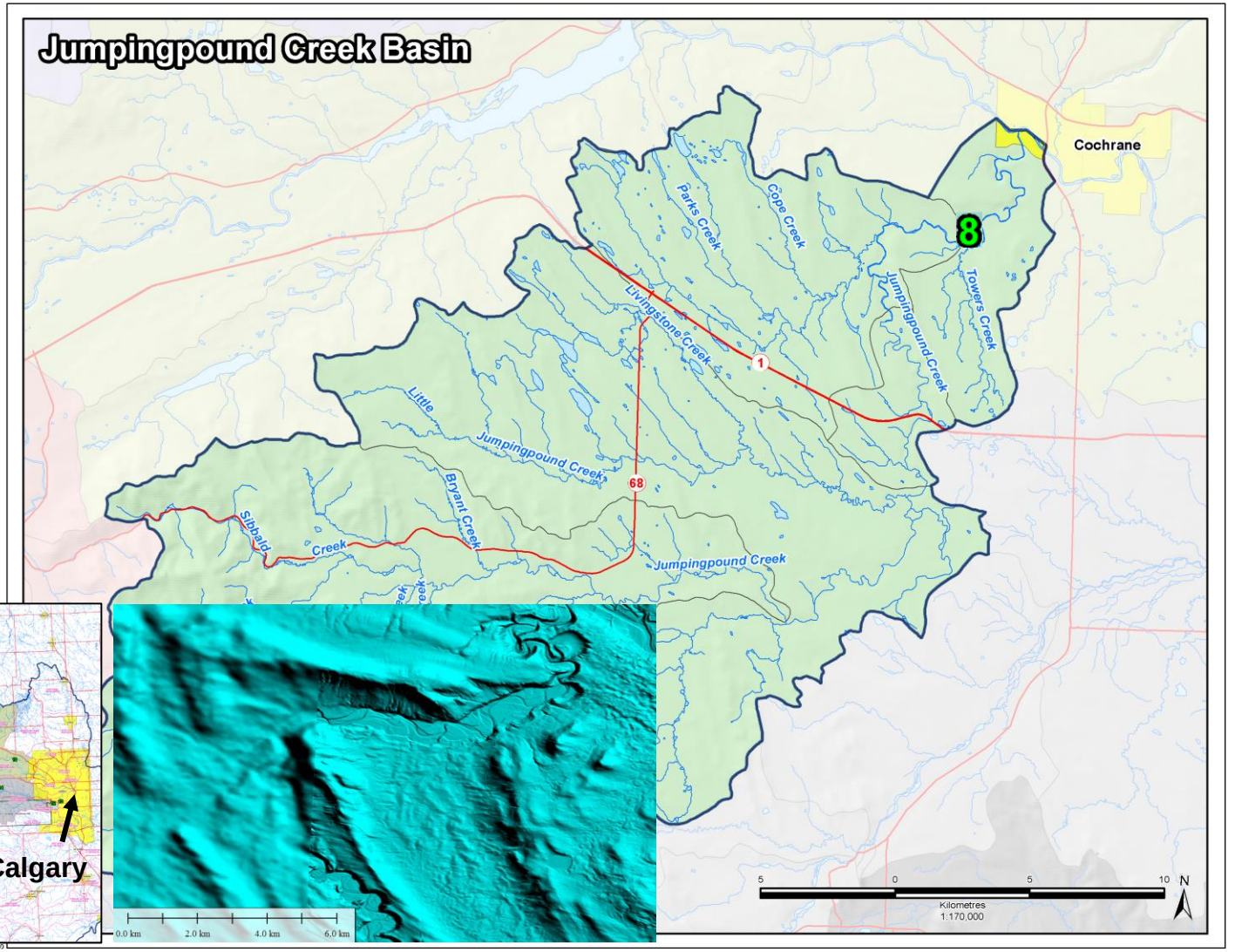




Source: Kevin Lenz, 2006

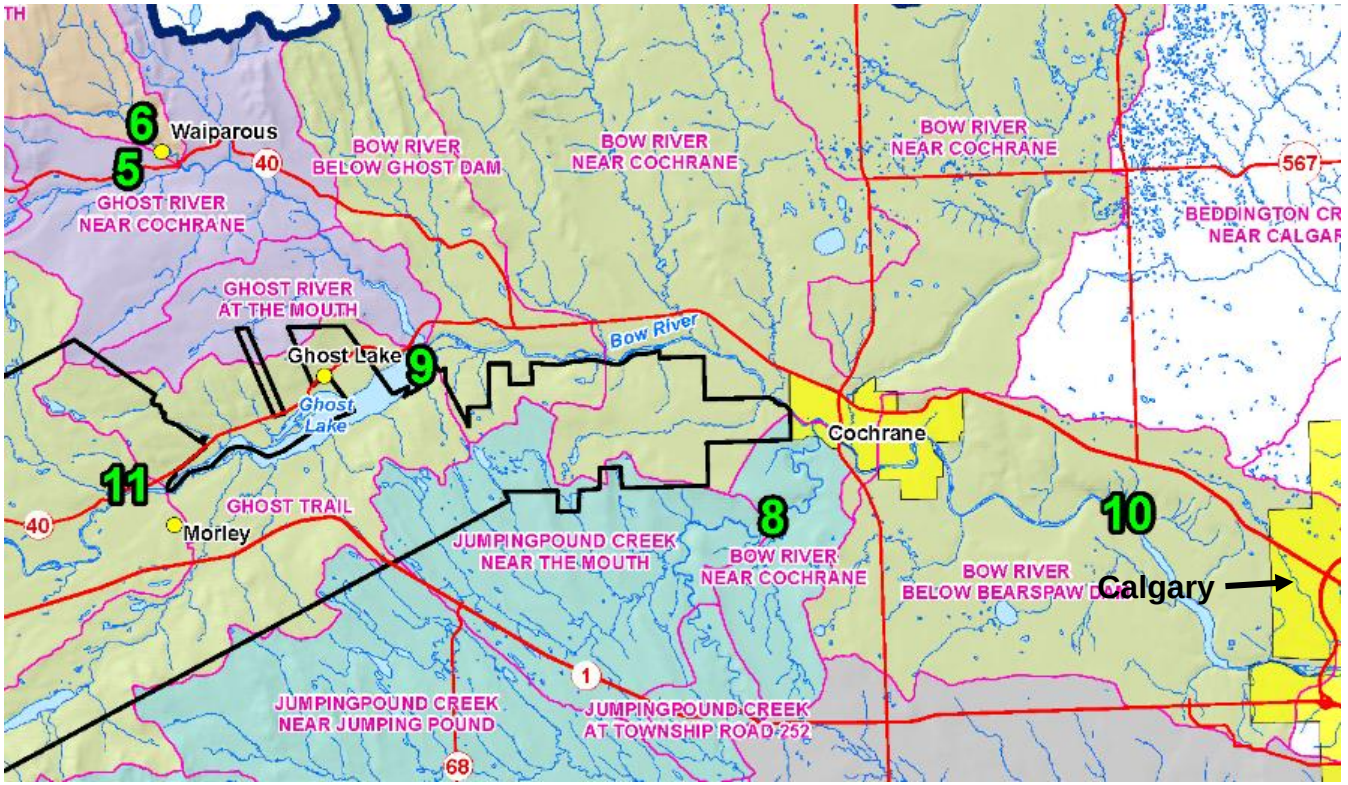
New Opportunities in Tributary Watersheds
8. Jumpingpound Creek

- **Dam upstream of Cochrane**
  - 606 km^2 (7.7% controlled)
  - Approximately 50,000 dam^3 to 70,000 dam^3 storage potential



New Opportunities on Bow River Mainstem
9., 10. & 11. Ghost, Bearspaw, Morley

- **9. Ghost Lake Drawdown (Operational)**
  - Approx. 50,000 dam^3 to 70,000 dam^3 storage potential
- **10. Dam upstream of Bearspaw Reservoir**
  - Approx. 60,000 dam^3 to 80,000 dam^3 storage potential
- **11. Dam upstream of Ghost Lake near Morley**
  - > 150,000 dam^3 storage potential



Conclusions

- There is no silver bullet
- It is likely that we will need more than one scheme and we need redundancy in the overall mitigation strategy
- Local flood mitigation measures, for example in the City of Calgary, will make a significant difference in flow reduction requirements

Summary Table

	Reference	Scheme Description	River	Storage Available (dam^3)	Type of Mitigation or Opportunity
Operational Opportunities in Tributary Watersheds	1	Spray River basin upstream of Spray Lakes Reservoir	Spray River	N/A	Operational
	2	Cascade River Basin upstream of Lake Minnewanka	Cascade River	N/A	Operational
	3	Kananaskis River Basin upstream of Lower Kananaskis Lake	Kananaskis River	N/A	Operational
New Projects on Tributaries to the Bow River	4	Upper Ghost River Diversion into Lake Minnewanka	North Ghost River	Est 20,000	New Project
	5	Dam on Ghost River Upstream of Waiparous Creek	Ghost River	50,000 to 70,000	New Project
	6	Dam on Waiparous Creek Upstream of Ghost River	Waiparous Creek	30,000 to 40,000	New Project
	7	Dam on Kananaskis River near Upstream end of Barrier Lake	Kananaskis River	80,000 to 90,000	New Project
	8	Dam on Jumpingpound Creek Upstream of Bow River Confluence	Jumpingpound Creek	50,000 to 70,000	New Project
Operational Opportunity on Bow River Mainstem	9	Ghost Reservoir Dam Drawdown	Bow River	50,000 to 70,000	Operational
New Projects on Bow River Mainstem	10	Dam on Bow River Upstream of Bearspaw Reservoir	Bow River	60,000 to 80,000	New Project
	11	Dam on Bow River upstream of Ghost Lake (Morley)	Bow River	>150,000	New Project