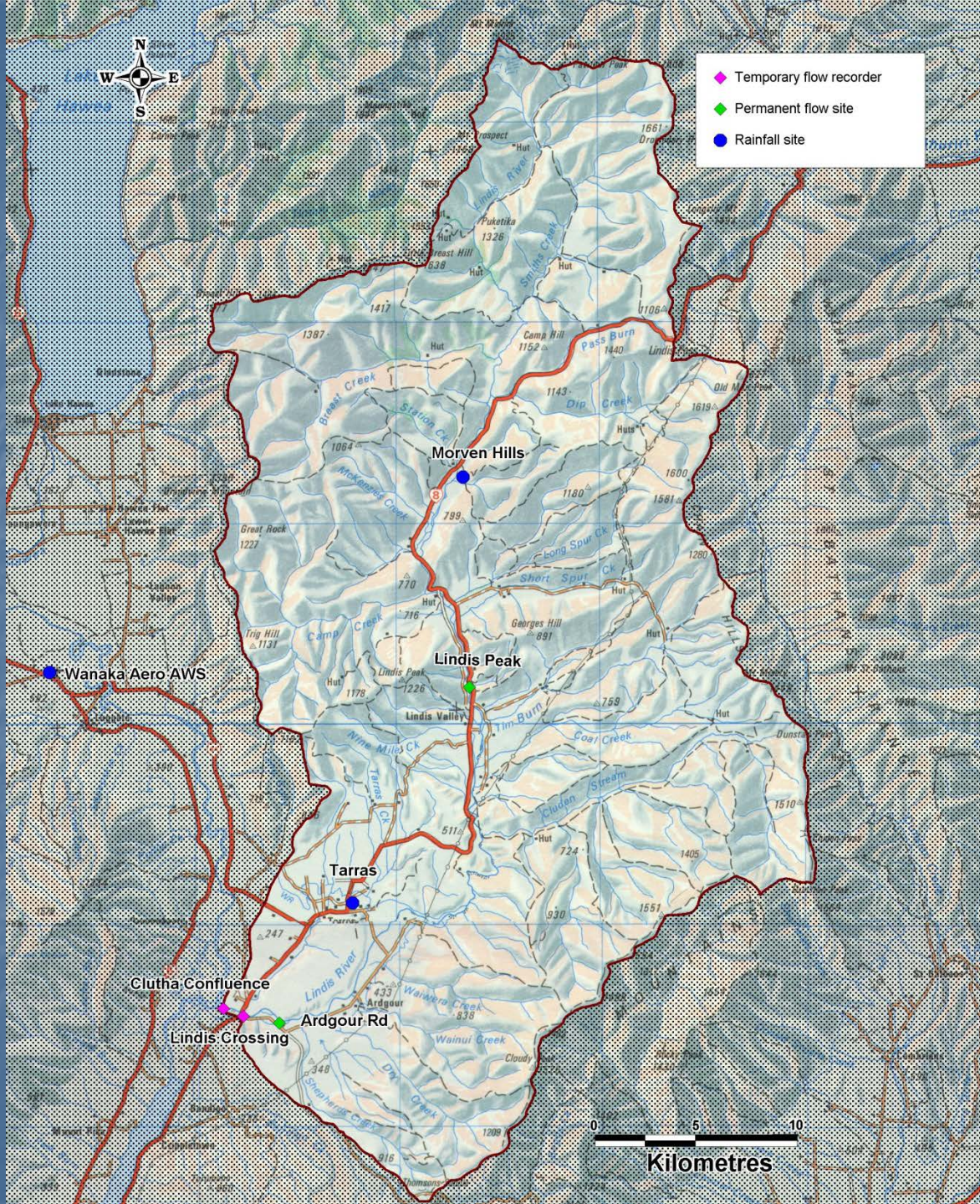


# Effects of minimum flow scenarios on community and natural values of the Lindis River

Matt Dale: Otago Regional Council





# Natural values of the Lindis River



# Native fish

■ Koaro

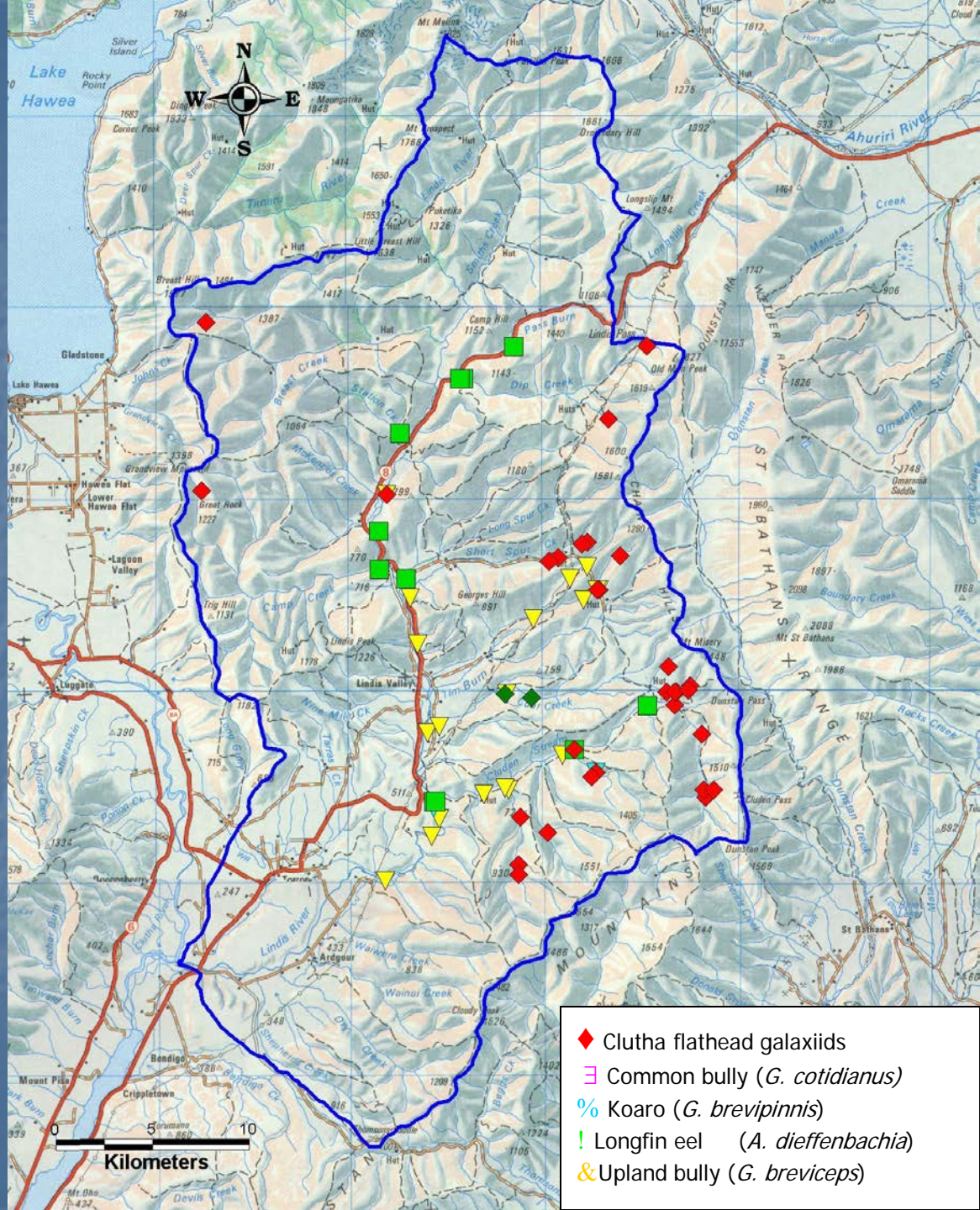
■ Common bully

■ Upland bully

■ Longfin eel

■ Clutha flathead galaxias

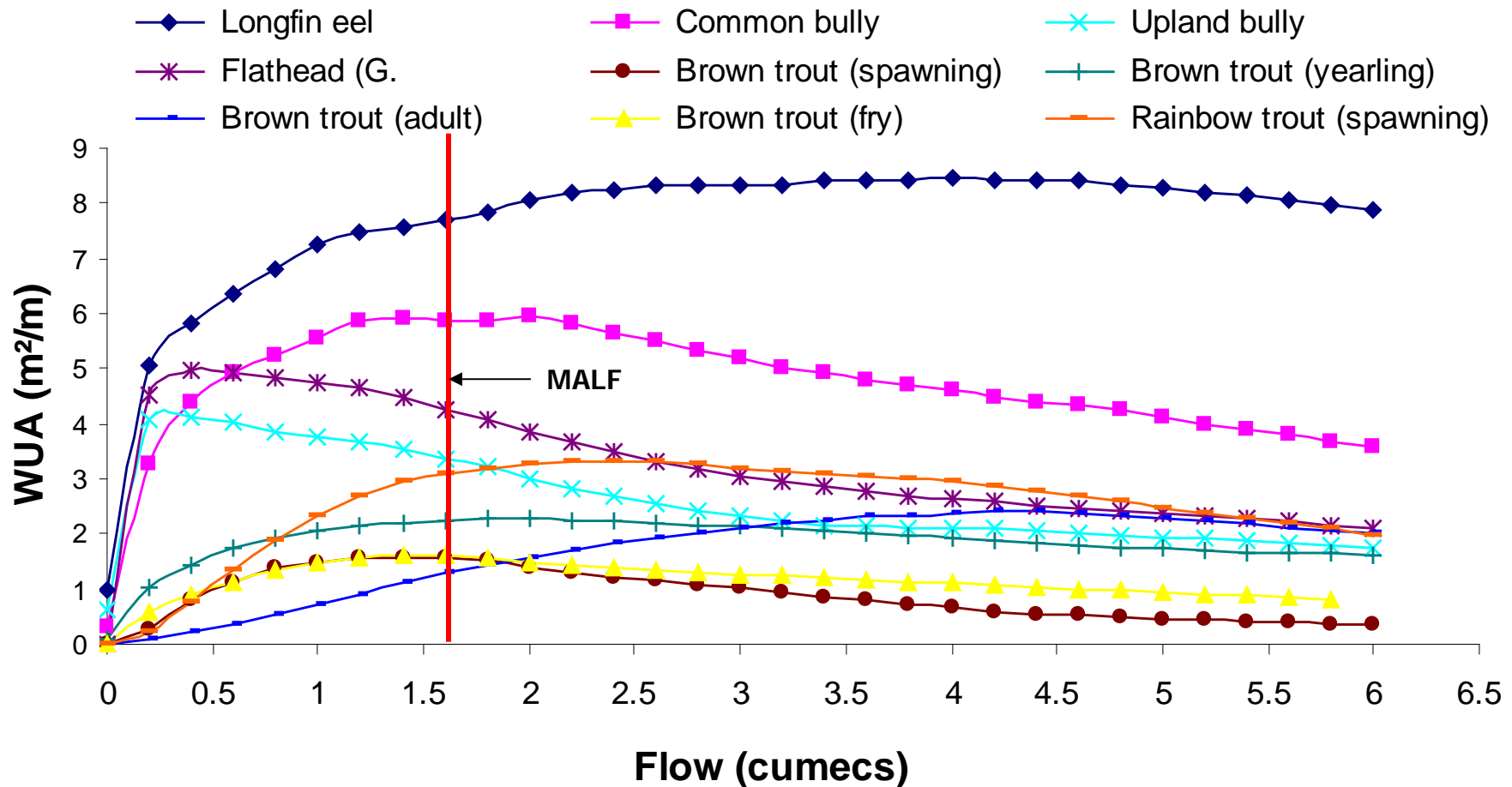
■ Clutha flathead galaxias is listed as being in gradual decline



- ◆ Clutha flathead galaxiids
- Common bully (*G. cotidianus*)
- Koaro (*G. brevipinnis*)
- ! Longfin eel (*A. dieffenbachia*)
- & Upland bully (*G. breviceps*)

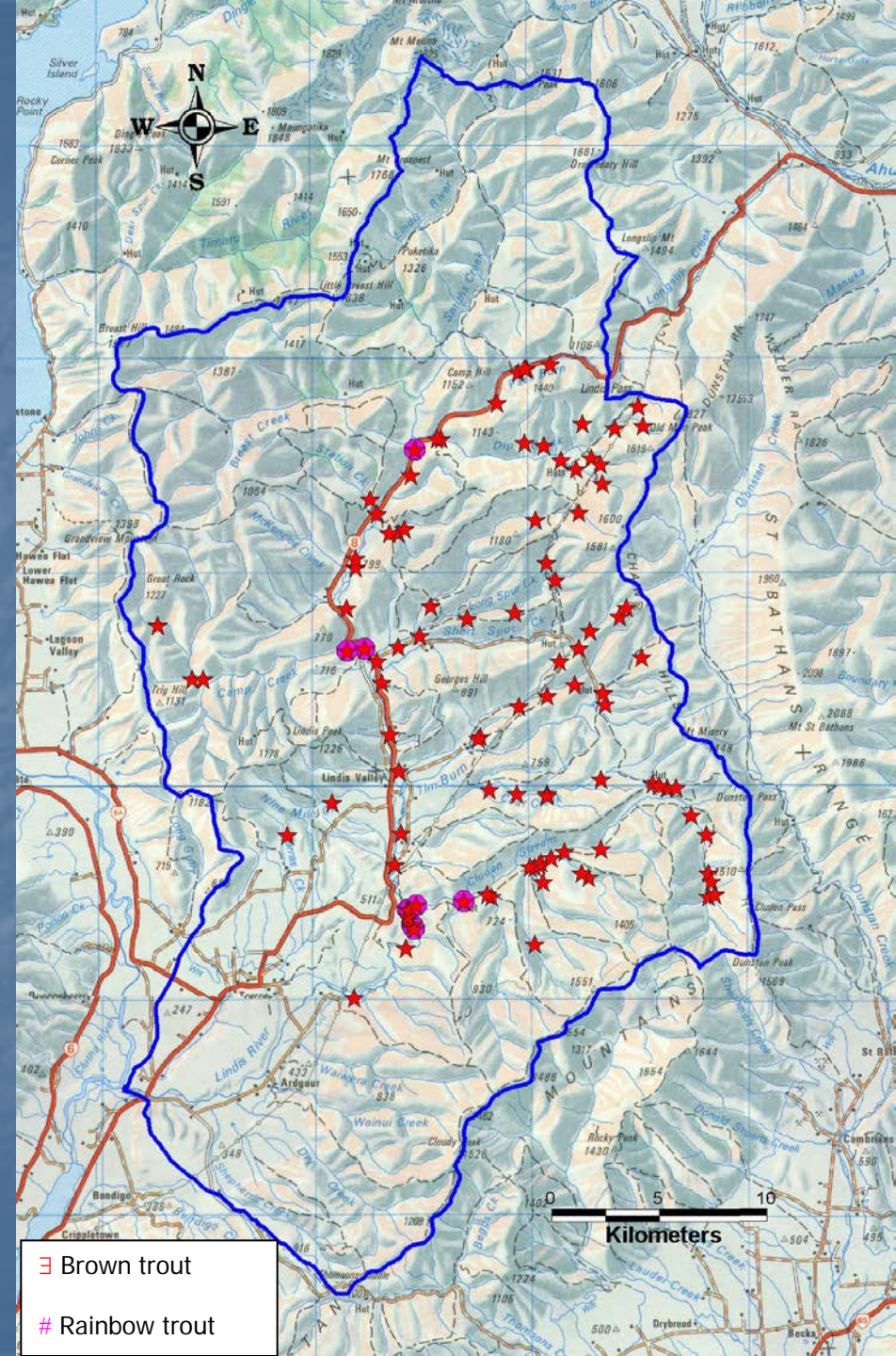
- Native fish in main stem of the Lindis generally inhabit the edges of the river and are relatively unaffected by flow reductions until flows become very low.
- When native fish are forced into refuge pools during low flows, high mortality can occur due to trout and bird predation.
- Some native fish can burrow into the gravel and survive for short periods if the gravel remains wet.
- The Clutha flathead galaxias is of high conservation importance but is only found in small tributaries.
- Will be largely unaffected by minimum flows, but setting correct residual flows are of high importance in maintaining habitat for this species.

# Habitat availability for native fish



# Introduced fish

- Brown trout
- Rainbow trout
- Is considered a locally important brown trout fishery
- A study in 2002 (Unwin & Image) showed that approximately 150 angler days were spent on the Lindis during the 2001/02 season

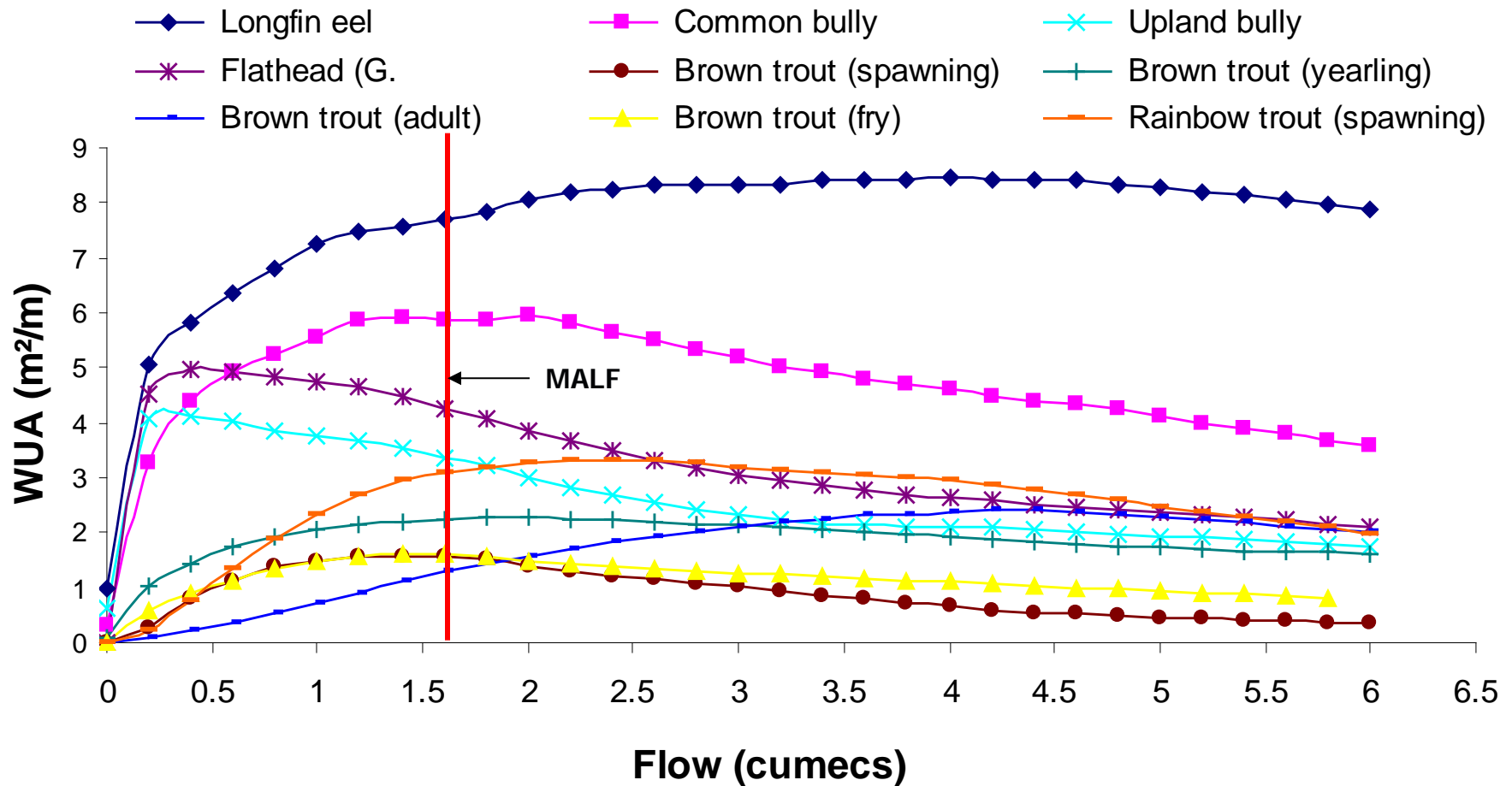


- ★ Brown trout
- ★ Rainbow trout

- Due to natural habitat constraints (optimum flow for adult trout is about twice the natural Mean Annual Low Flow or "MALF"), the Lindis River does not support a significant adult trout fishery.
- However, the Lindis is one of the major trout spawning and juvenile rearing areas for both browns and rainbows from Lake Dunstan and the Clutha River.
- Spawning and juvenile rearing are considered to be the major instream values for introduced sports fish.



# Habitat study -



# Flow requirements for juvenile trout rearing

- Brown trout
  - Optimum flow: 1.4 m<sup>3</sup>/s
  - Point of inflection: 0.75

# The importance of refuge pools









# Flushing flows

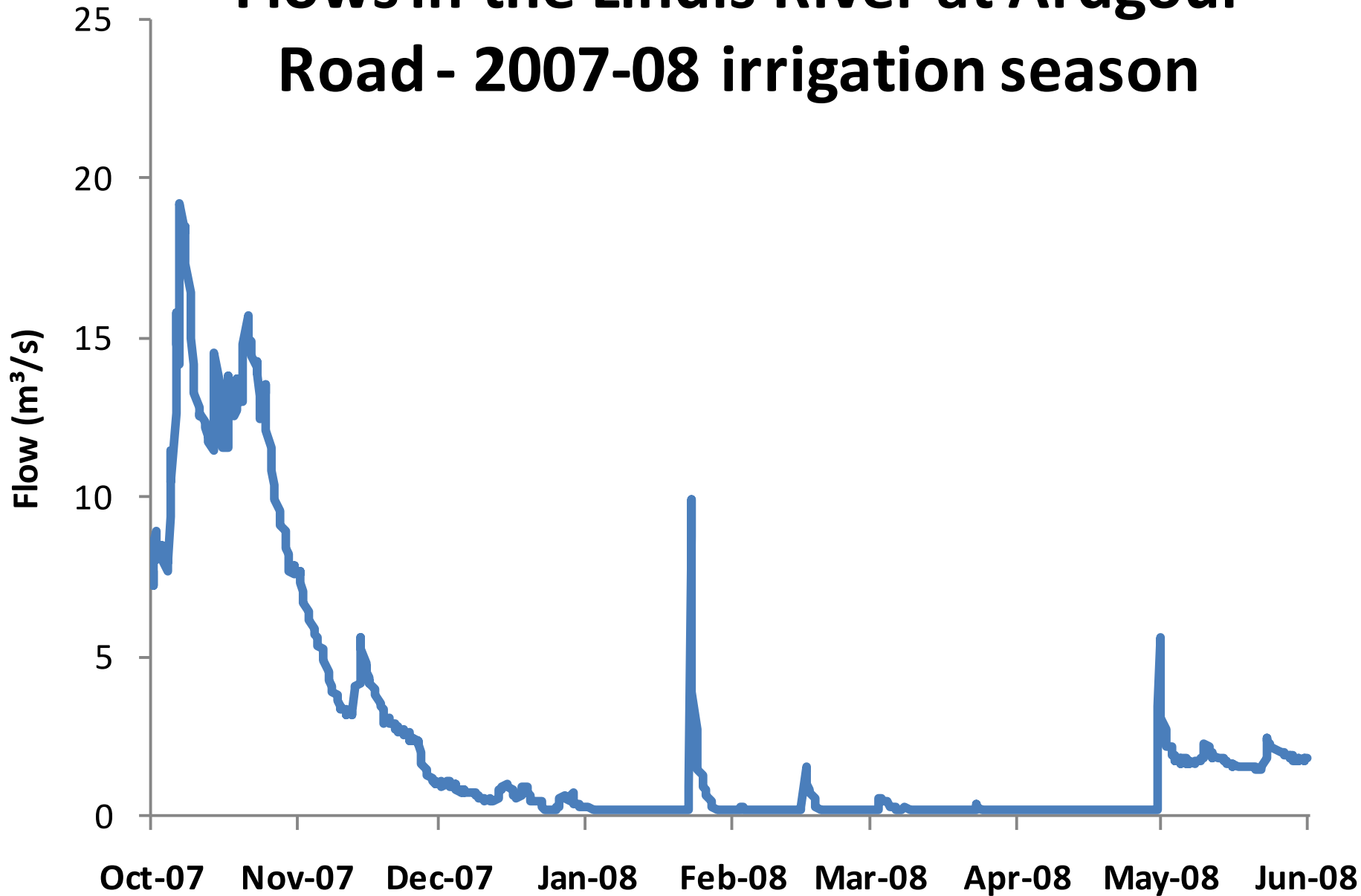
- Flushing flows remove fine sediment and algae.
  - Are very important for the overall "health" of the river.
  - Improve the habitat quality of the stream.
  - Usually occur at between 3 and 6 times the median flow (7.8 – 15.6 m<sup>3</sup>/s).
  - Are important to the Lindis River due to the presence of didymo.



# Flood flows

- Flood flows are able to scour the bed and move larger substrate as well as finer sediments, algae and many invertebrates and introduced fish.
- Flood flows generally occur at about 10 times the mean flow ( $42 \text{ m}^3/\text{s}$ )

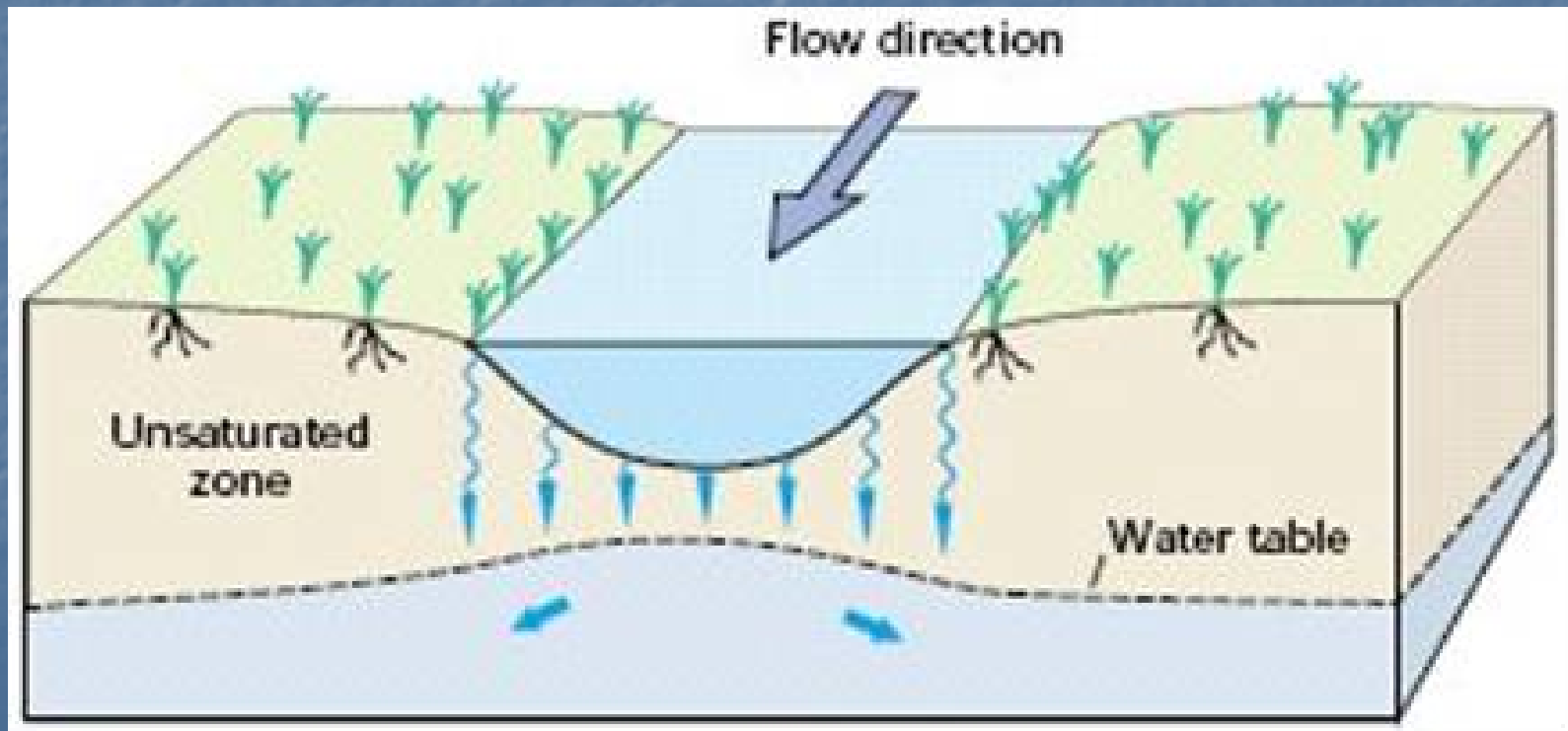
# Flows in the Lindis River at Ardgour Road - 2007-08 irrigation season



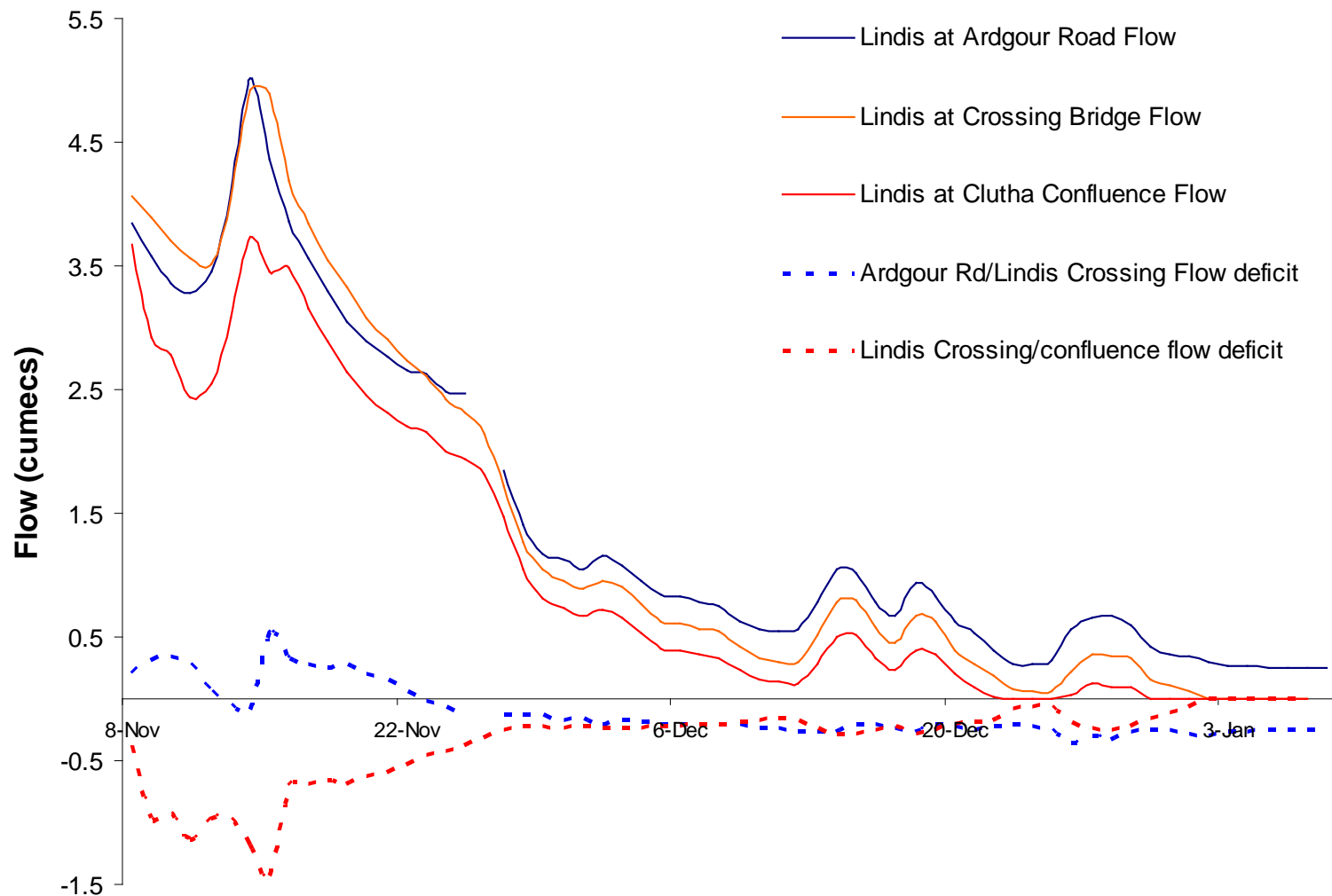
# Hydrology of the lower Lindis River



- During the later half of the irrigation season, the gravel aquifer of the Lindis River becomes disconnected from the surface water.



- Surface water is continually lost to the groundwater at an average rate of 97 l/s/km between Ardgour Rd and Lindis Crossing, and at 190 l/s/km between Lindis Crossing and the Clutha confluence.
- At least 440 l/s is required at the Ardgour Rd flow recorder to maintain flow continuity in the lower Lindis



- Monitoring of flows in the lower Lindis showed that there is a constant loss of 0.44 ( $\text{m}^3/\text{s}$ ) between the Ard gour Rd flow recorder and the Clutha confluence.

Know your ABC's

# Flow "A" = 1,600 l/s

- Is equal to the 7-day Mean Annual Low Flow (MALF) at Lindis Peak.
- Will maintain a flow of 1,380 at Lindis Crossing and 1,160 l/s at the Clutha confluence
- Is within the "point of inflection" flow range for adult brown trout





Flow "B" = 1,200 l/s

- Will maintain a flow of 980 l/s at Lindis Crossing and 760 l/s at the Clutha confluence.
- Is within the optimum flow range for trout fry and yearlings

# Flow "C" = 960 l/s

- Will maintain a flow of 740 l/s at Lindis Crossing and 520 l/s at the Clutha confluence.
- Is equal to the 10 year 7-day low flow at Lindis Peak, and is representative of a particularly low flow at this site.
- Is just below the optimum flow range for juvenile trout.
- All refuge pools will be maintained.

# Flow "D" = 750 l/s

- Will maintain a flow of 530 l/s at Lindis Crossing and 310 l/s at the Clutha confluence.
- Is the point below which juvenile trout habitat begins to decline sharply (point of inflection).
- Habitat may become limiting for juvenile trout below Lindis Crossing.
- Riffles will become shallow and some fish may begin to move into refuge pools.



# Flow "E" = 400 l/s

- Will maintain a flow of 180 l/s at Lindis Crossing.
- Surface flows will cease approximately 200m upstream of the Clutha confluence.
- Refuge pools will be maintained in all but the last 200 m of river.
- Almost all trout will move into refuge pools.
- High fish mortality will occur from stranding in the lower section and predation in the refuge pools from trout and birds.



# Flow "F" = *The status quo*

- In the past few years the summer low flows in at the Ardgour Rd flow recorder are about 150-200 l/s.
- No surface flow is visible at the Lindis Crossing bridge over the summer period unless there is significant rain.
- Large numbers of trout and native fish die from stranding and predation every year.
- Very few trout older than 1 year are found below Ardgour Rd during the summer.





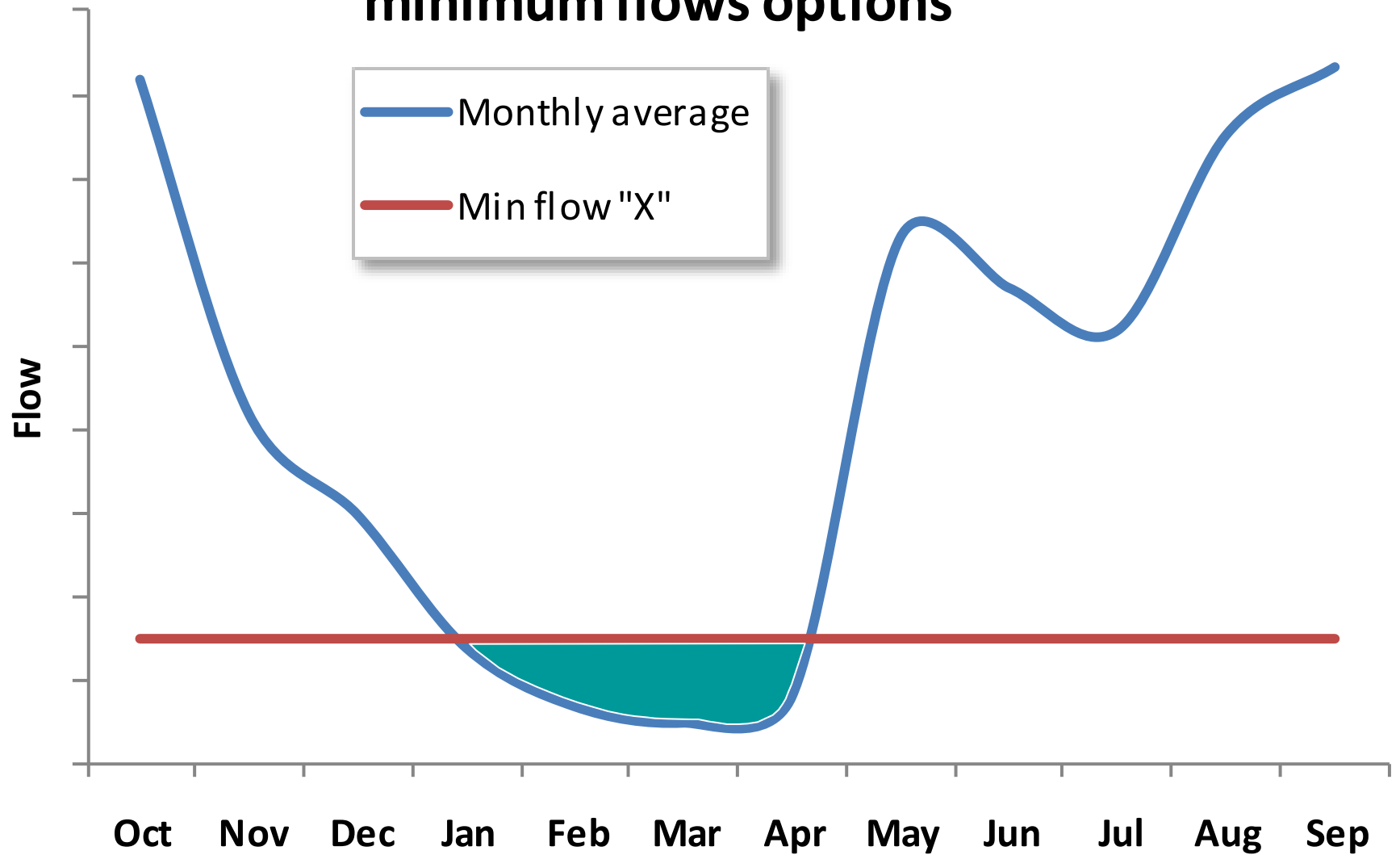
# An example of the dual minimum flow option

- When flows at Lindis Peak drop below 960 l/s, the minimum flow at Ardgour Rd drops from 750 l/s to 400 l/s.
- When flows at Lindis Peak return to 1,600 l/s (MALF), the minimum flow at Ardgour Rd returns to 750 l/s.

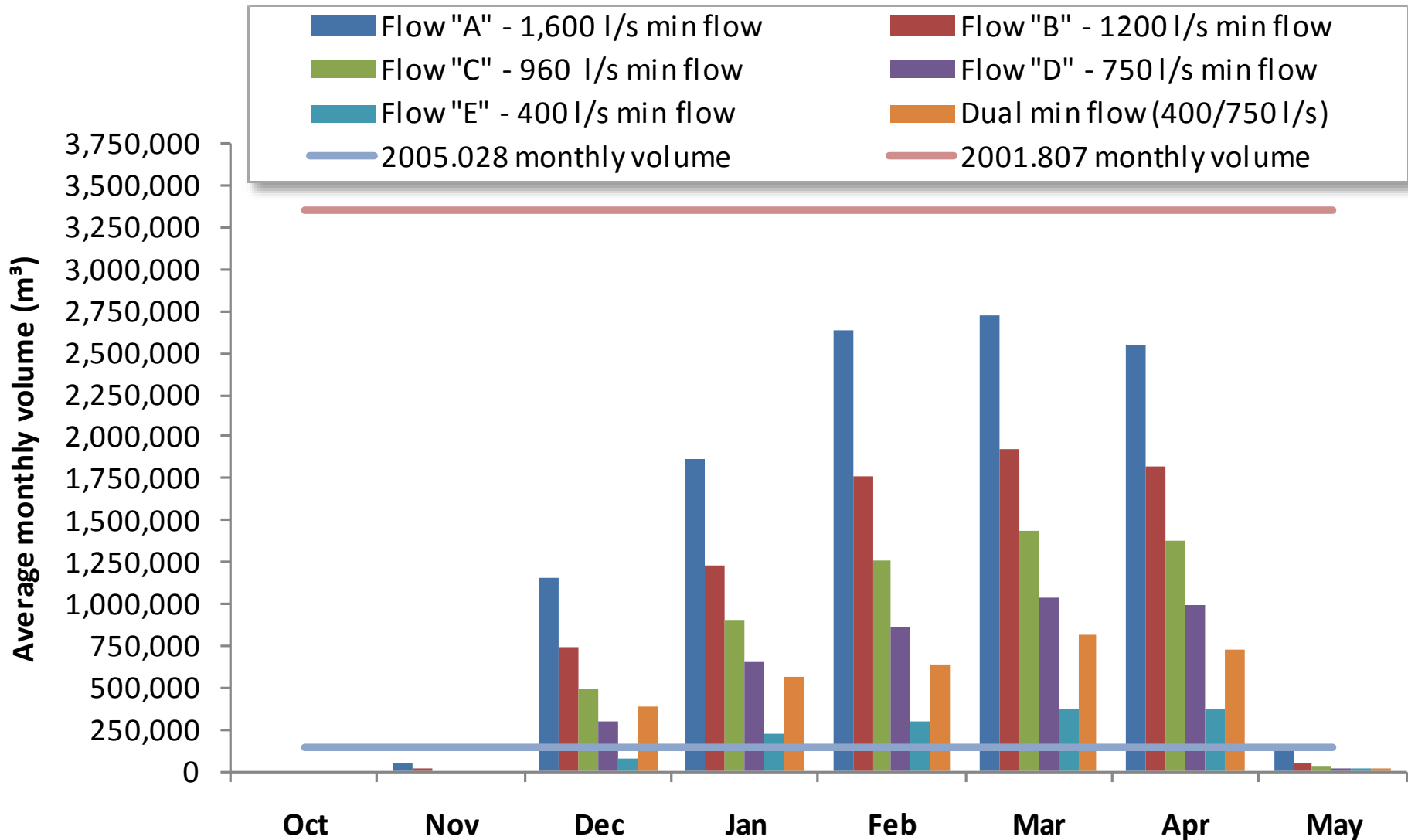
- Variable flow regime designed to reflect inflows from the upper catchment.
- When flows drop from 750 l/s to 400 l/s, flow continuity will not be maintained.
- Most refuge pools will remain and allow fish to survive until flows return to 750 l/s.
- Flows drop below 960 l/s at Lindis Peak for an average of 2% of the irrigation season, and below 1,600 l/s approximately 14.5 % of the irrigation season.
- Shares risk between water users and instream values

The effects of various  
minimum flow scenarios on  
water availability

# Calculation of monthly water volumes made unavailable for abstraction under various minimum flows options



# Comparisons of average monthly volumes not available for abstraction from the Lindis River in relation to current flows



Winter minimum flow?!?!?!?



# Winter instream values

- The key instream value in the Lindis River during winter is brown and rainbow trout spawning.
- Habitat requirements for native fish in the main stem of the Lindis remain largely unchanged.
- Flow requirements for trout spawning
  - Rainbow trout
    - Optimum flow: 2.2 m<sup>3</sup>/s
    - Point of inflection: 1.6 m<sup>3</sup>/s
  - Brown trout
    - Optimum flow: 1.4 m<sup>3</sup>/s
    - Point of inflection: 0.75



# Comparison of proposed winter minimum flow and monthly average flows in the Lindis River at Ardgour Rd.

