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WATER AUGMENTATION OPTIONS FOR IRRIGATION IN THE MOTUPIKO CATCHMENT

Funded by
MAF Sustainable Farming Fund,
Tasman District Council,
Motupiko Catchment Water Augmentation Committee

Questions

1. How much land could be irrigated in the Motupiko catchment?
2. Where are the most suitable small-medium dam sites?
3. How much water is needed?
4. Which dam sites are most cost-effective?
5. Is water augmentation affordable and wanted?

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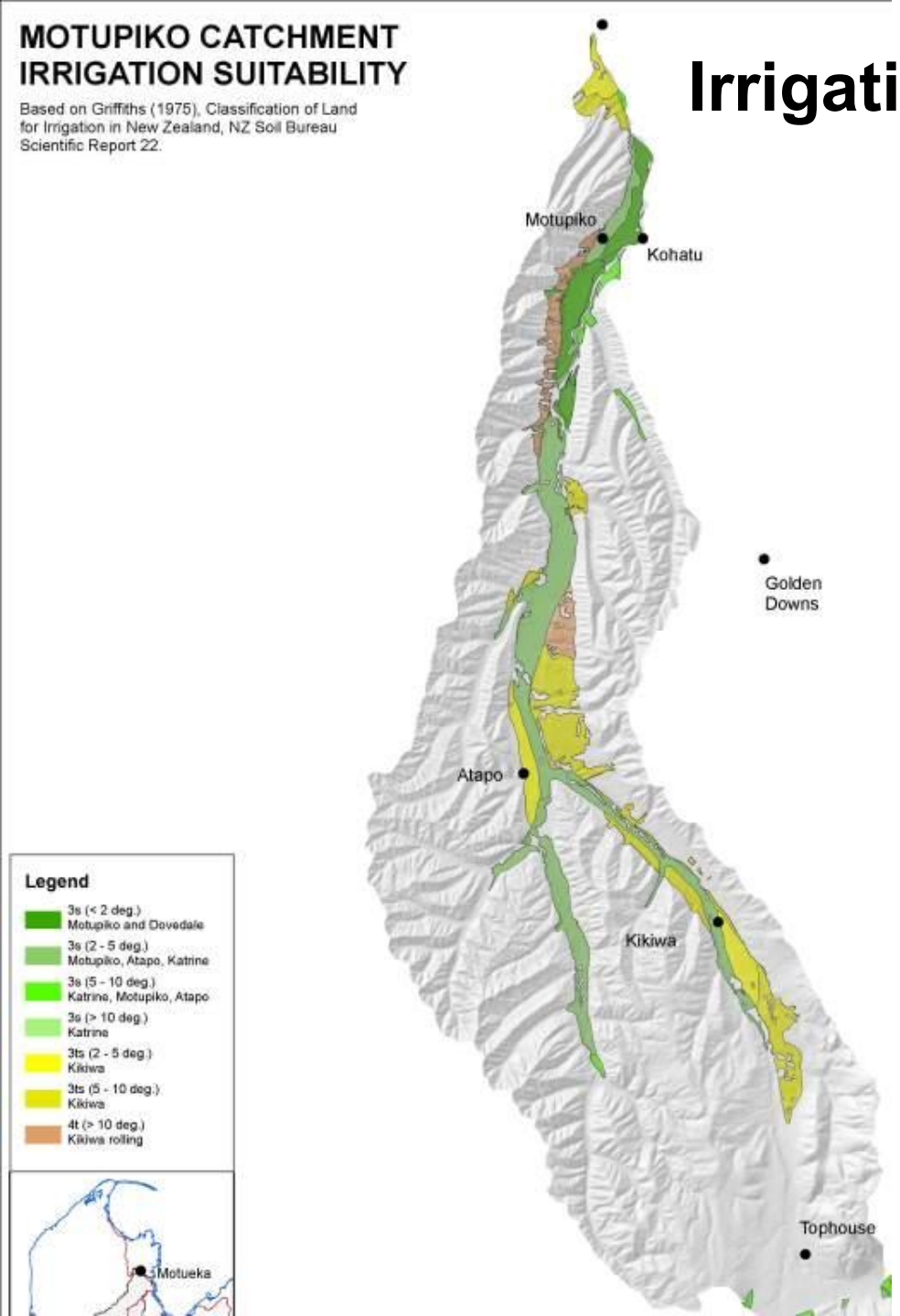

Irrigation suitability based on:

- Slope
- Soil drainage
- Soil permeability
- Soil infiltration
- Soil depth to impermeable layer
- Available water in root zone
- Available rooting depth
- Maximum stone content

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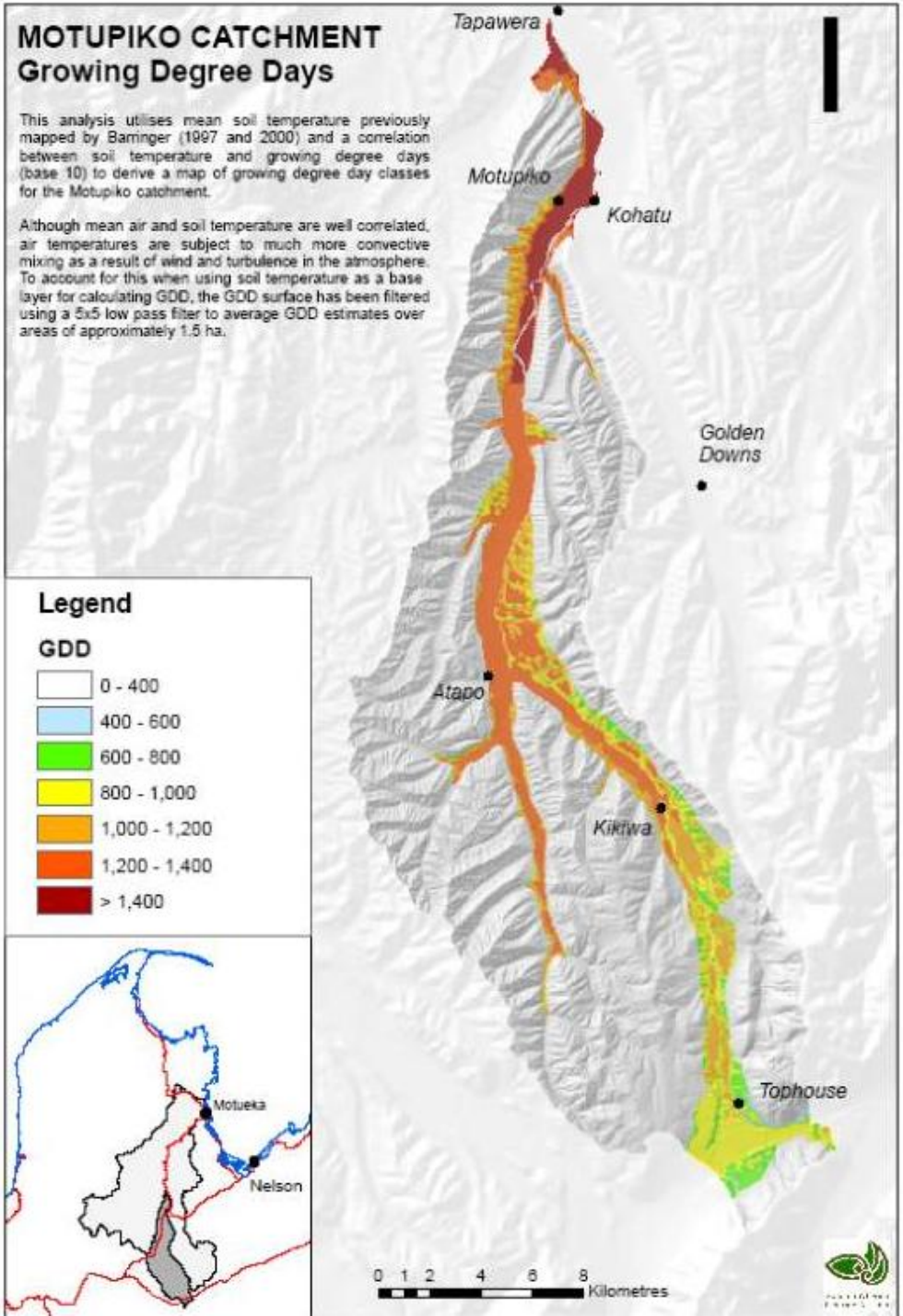

Climate limitations

Growing Degree Days

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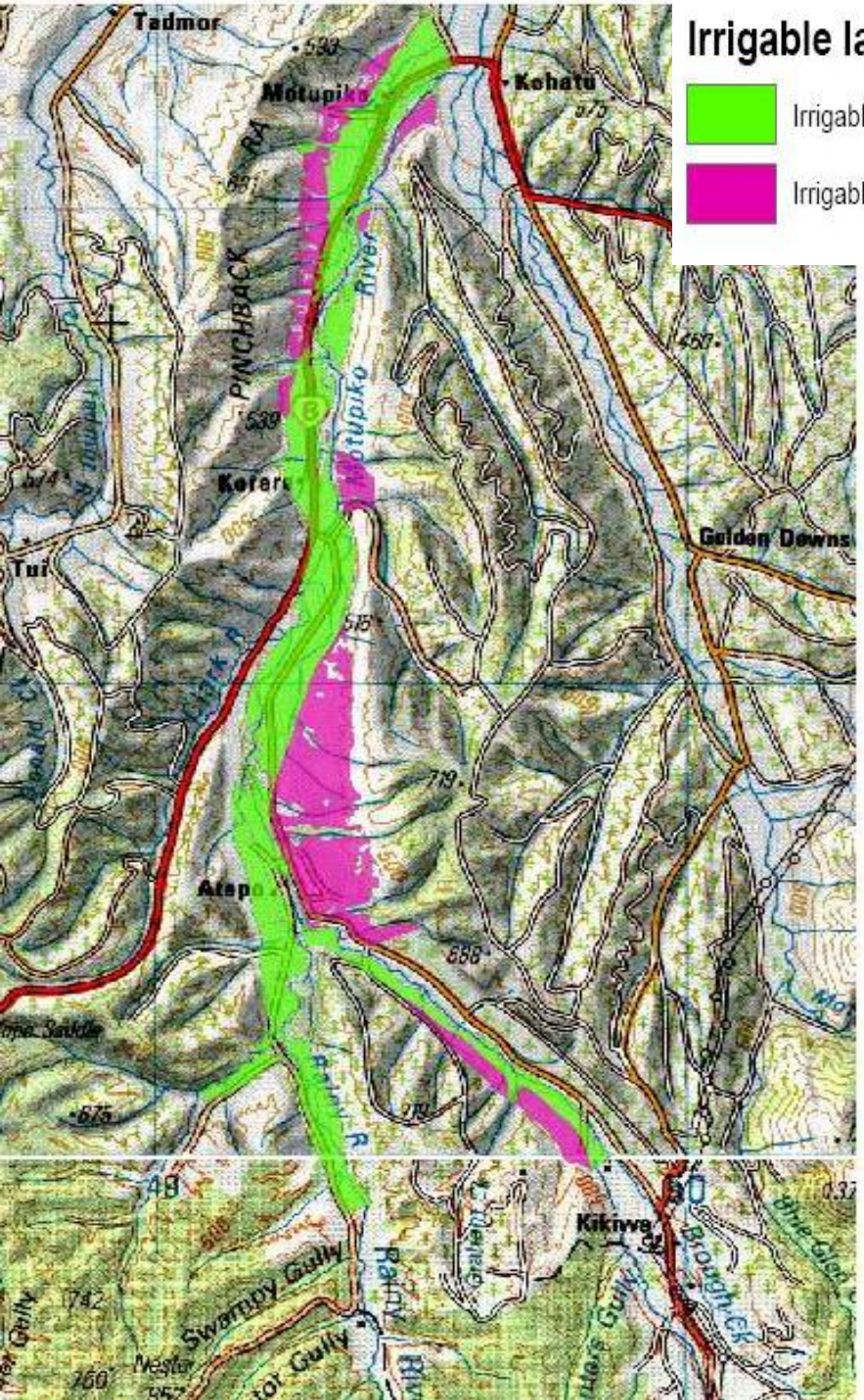
What irrigated crops could be grown?

- Pasture for dairy
- Brassicas
- Seed crops
- Raspberries, hops, cherries
- Vegetable crops – potatoes, peas
- Grapes – too frosty?
- Biofuels, hemp
- Land use change opportunities
- Climate change may bring new opportunities



How much land could be irrigated in the Motupiko catchment?

Total potential = 6600 ha

Minus climatically unsuitable, river beds, steeper land, forested land = 3228 ha

More than 5 degree slope = 1204 ha

Less than 5 degree slope = 2024 ha

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Desk Top Study of Potential Dam Sites

- Map based exercise, 3 categories:
  - small (<1Million cubic metres water storage)
  - medium (1 to 5M m^3)
  - large (>5M m^3)
- Design Concept: release irrigation water into river when required downstream
- Dams: Need long and flat valleys, steep sides to minimise earthworks
- Turkey's Nest reservoirs: cut and fill to Moutere Clay base on valley floor, divert water into it.

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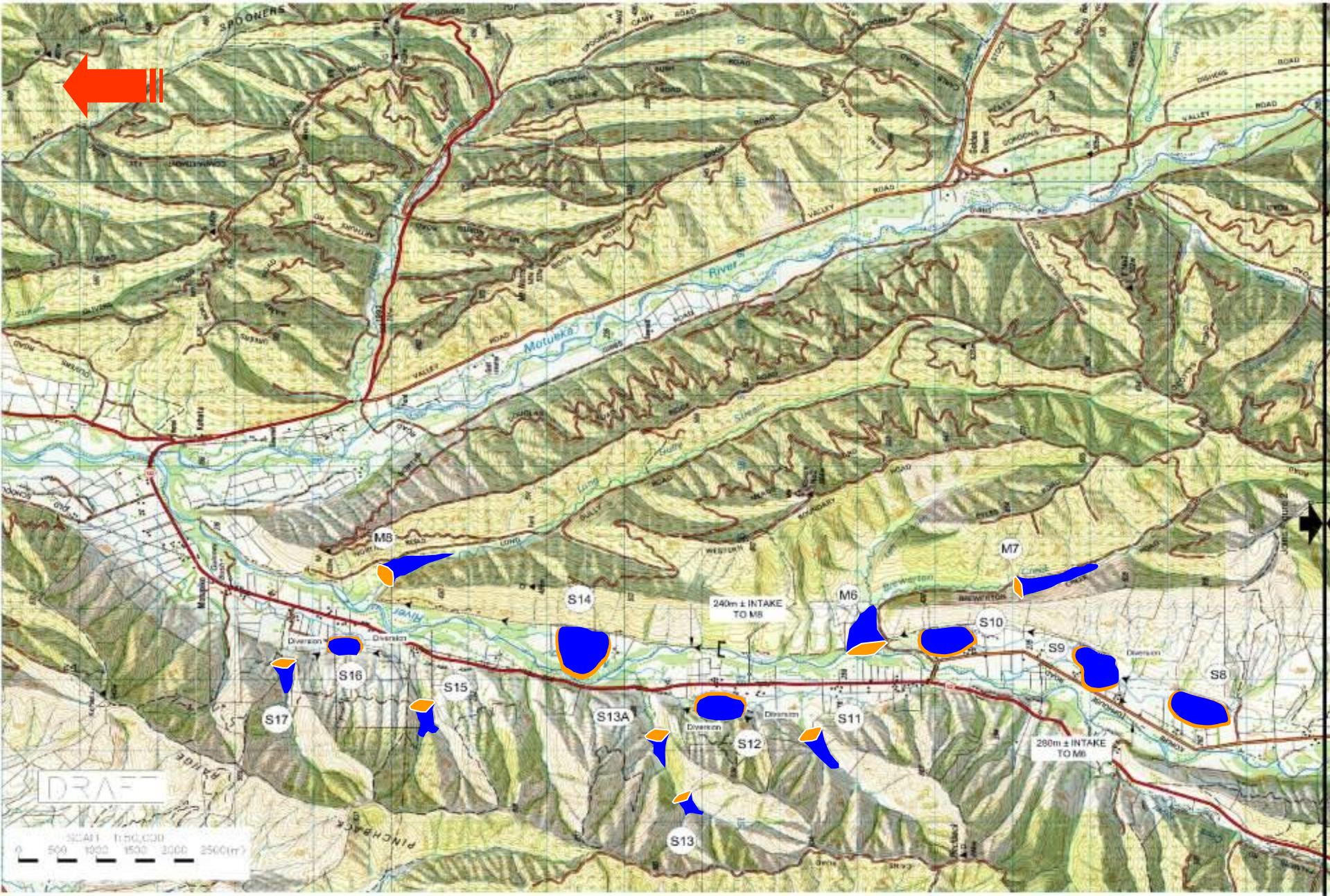
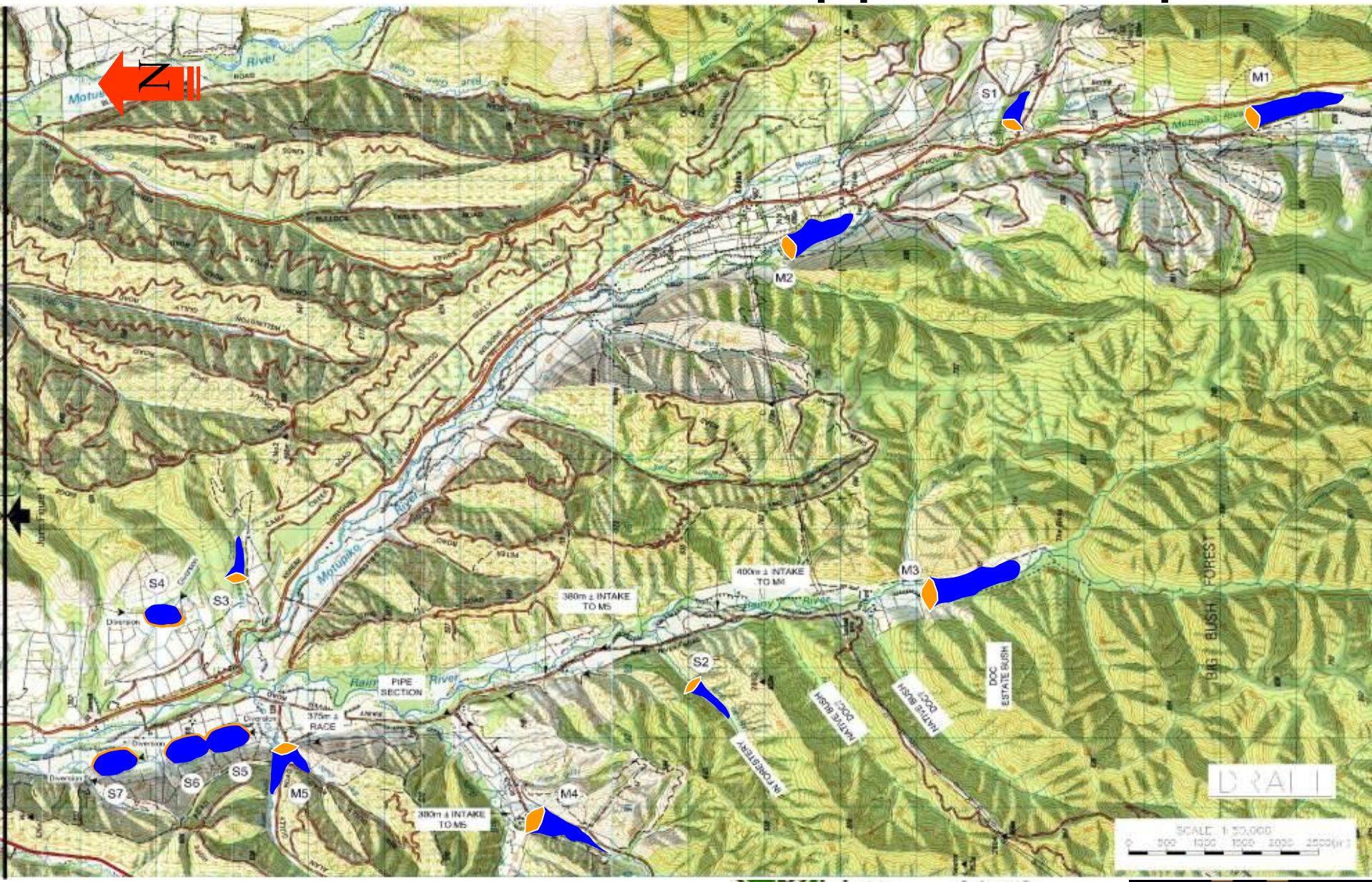
Potential Dam Sites – lower Motupiko



Potential Dam Sites – upper Motupiko



Dam Site Shortlisting

Initial selection based on:

1. Available water in the catchment
2. Approximate storage capacity of each site
3. Geology and Location
4. Current land use
5. Potential environmental effects

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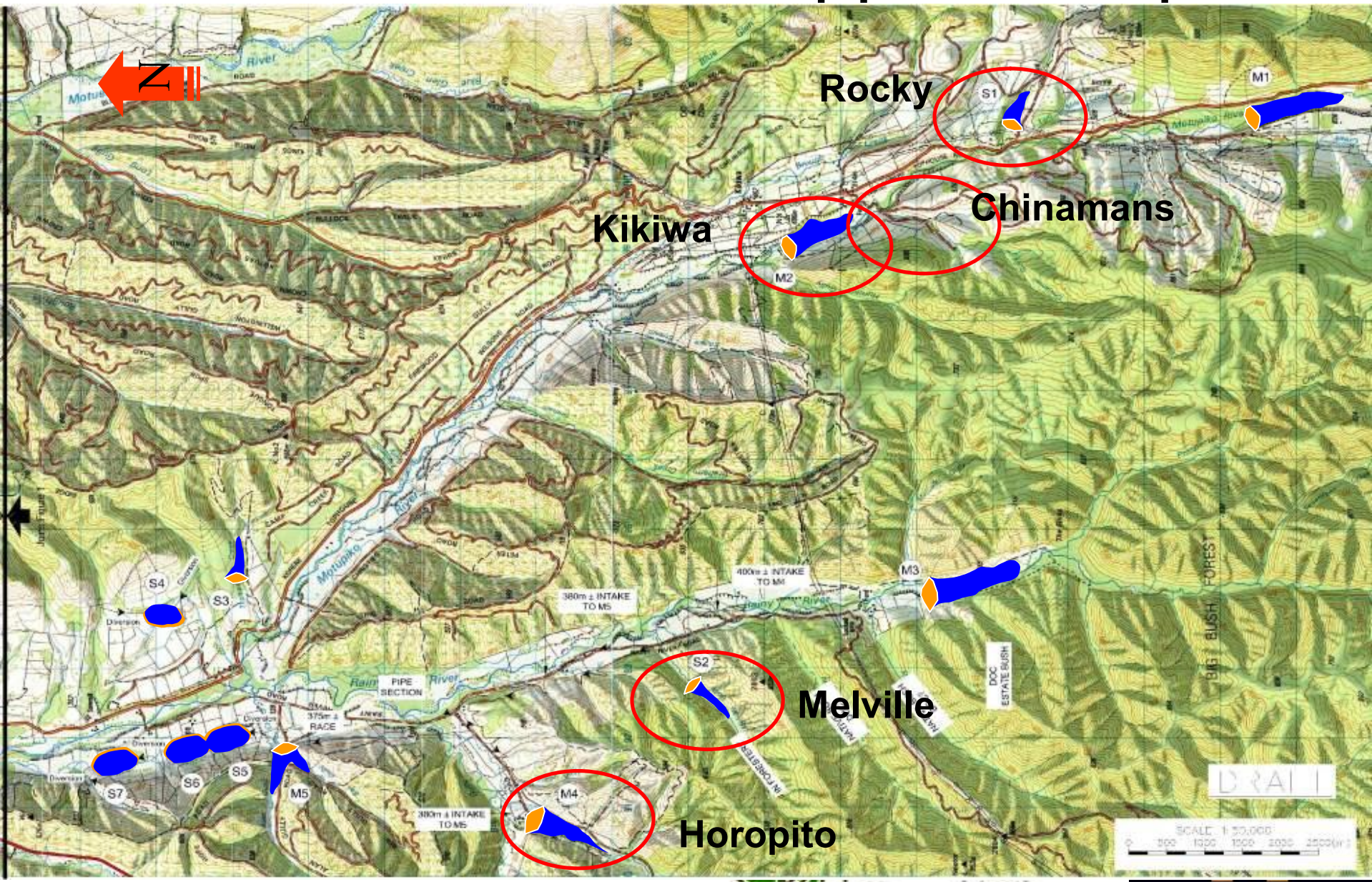
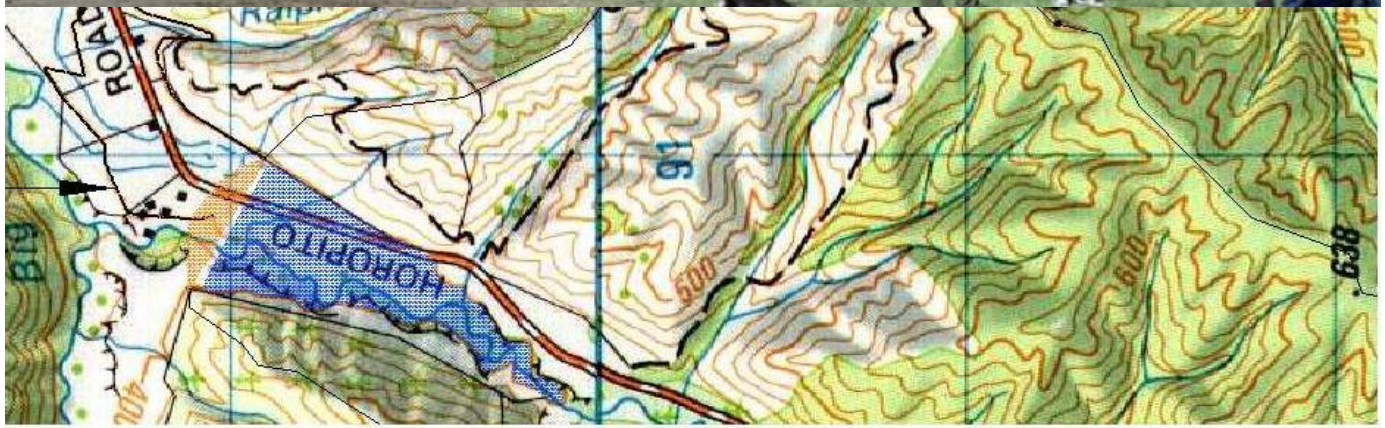
Shortlisted Dams for cost estimation & water storage potential

- Kikiwa (M2), 31m high, for 2100 Ha irrigable area
- Horopito (M4), 20m and 27m high for 500 and 1000 Ha irrigable areas
- Melville (S2), 30m high for 500 Ha
- Rocky (S1), 31m high for 500 Ha
- Chinamans, 25m high for 200 Ha

Potential Dam Sites – upper Motupiko



Horopito site, South Branch Big Gully, upper Rainy



DAM SITE M4
SCALE 1:20,000

Kikiwa site, Main Motupiko Valley

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Rocky Gully site

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Chinamans Gully site

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Melville site, upper Rainy

DAM SITE S2

SCALE 1:20,000

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How much water needs to be stored?

- Irrigation demand
  - How much water required?
- Reservoir input
  - How much water available for storage?
    - Natural flows
    - Diverted flows
- Reservoir storage
  - Height v storage & area
- Reservoir release for irrigation abstraction
  - Flow losses to groundwater
  - Natural river flow use for irrigation

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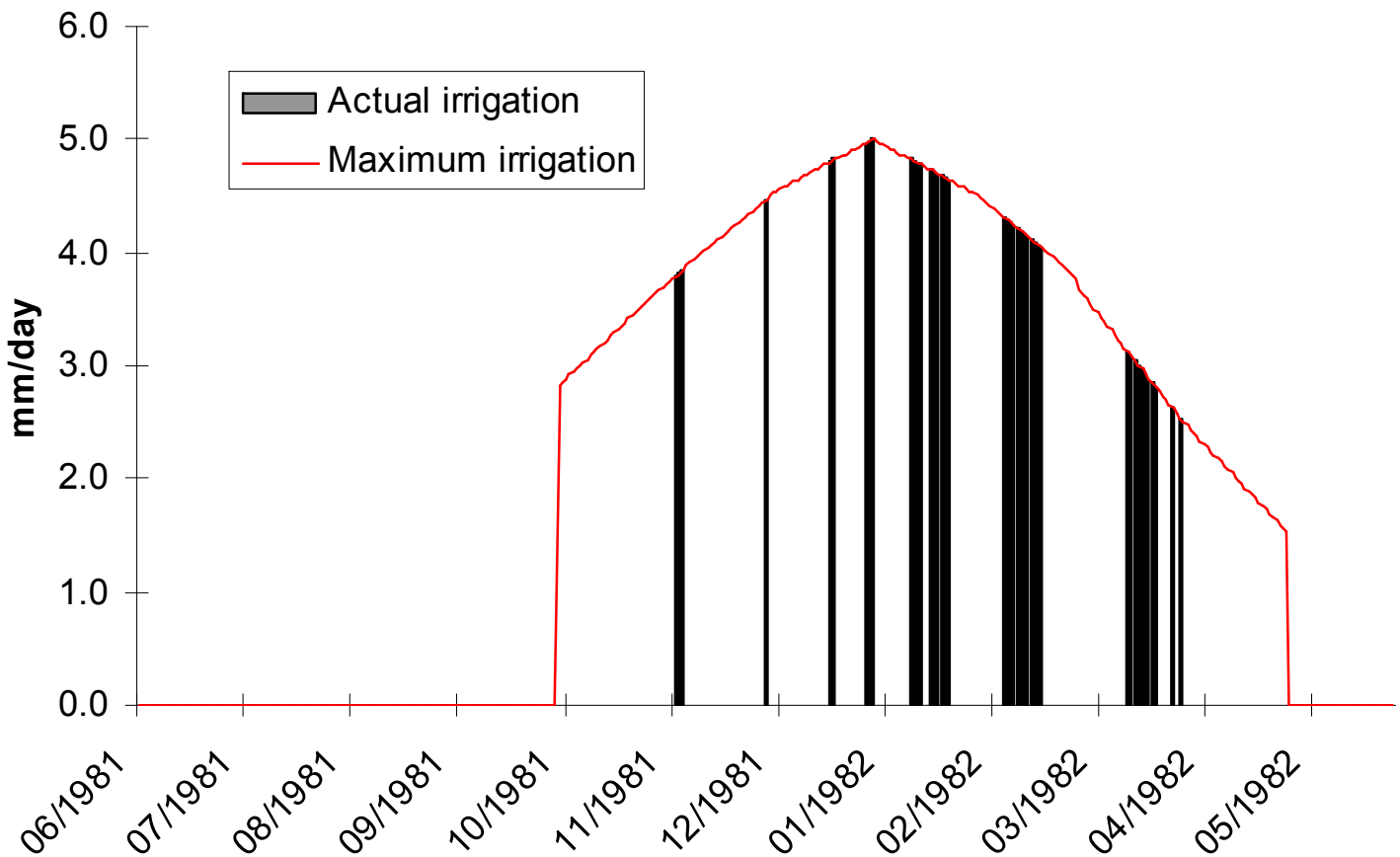
Irrigation System Model (i)

- Calculating irrigation water demand
  - Rainfall (50 year record)
  - Evaporation demand
  - Soil moisture time series
  - Verified on pasture water usage for Wangapeka

Irrigation System Model (i)

- Irrigation demand



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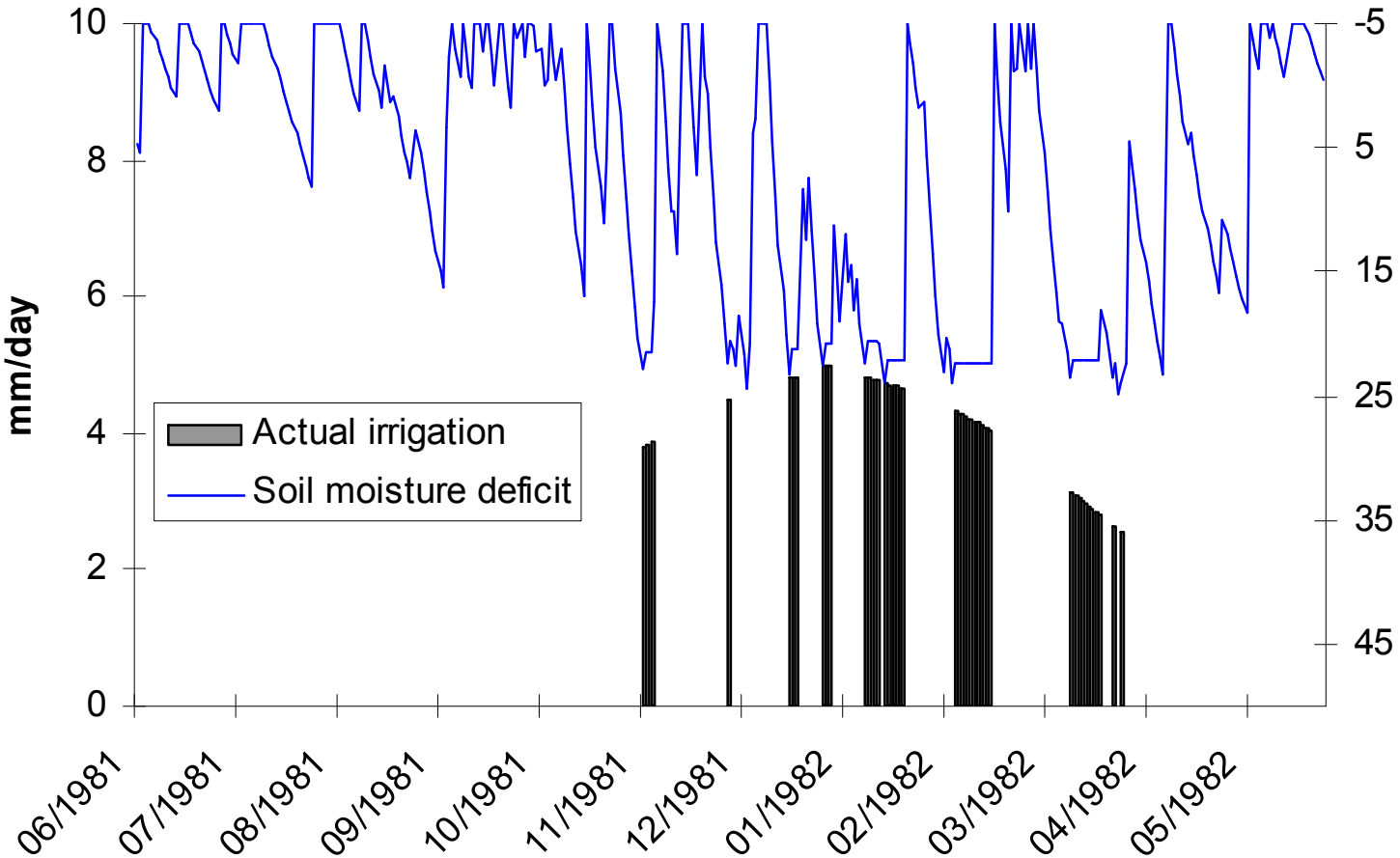
Irrigation System Model (i)

- Irrigation demand



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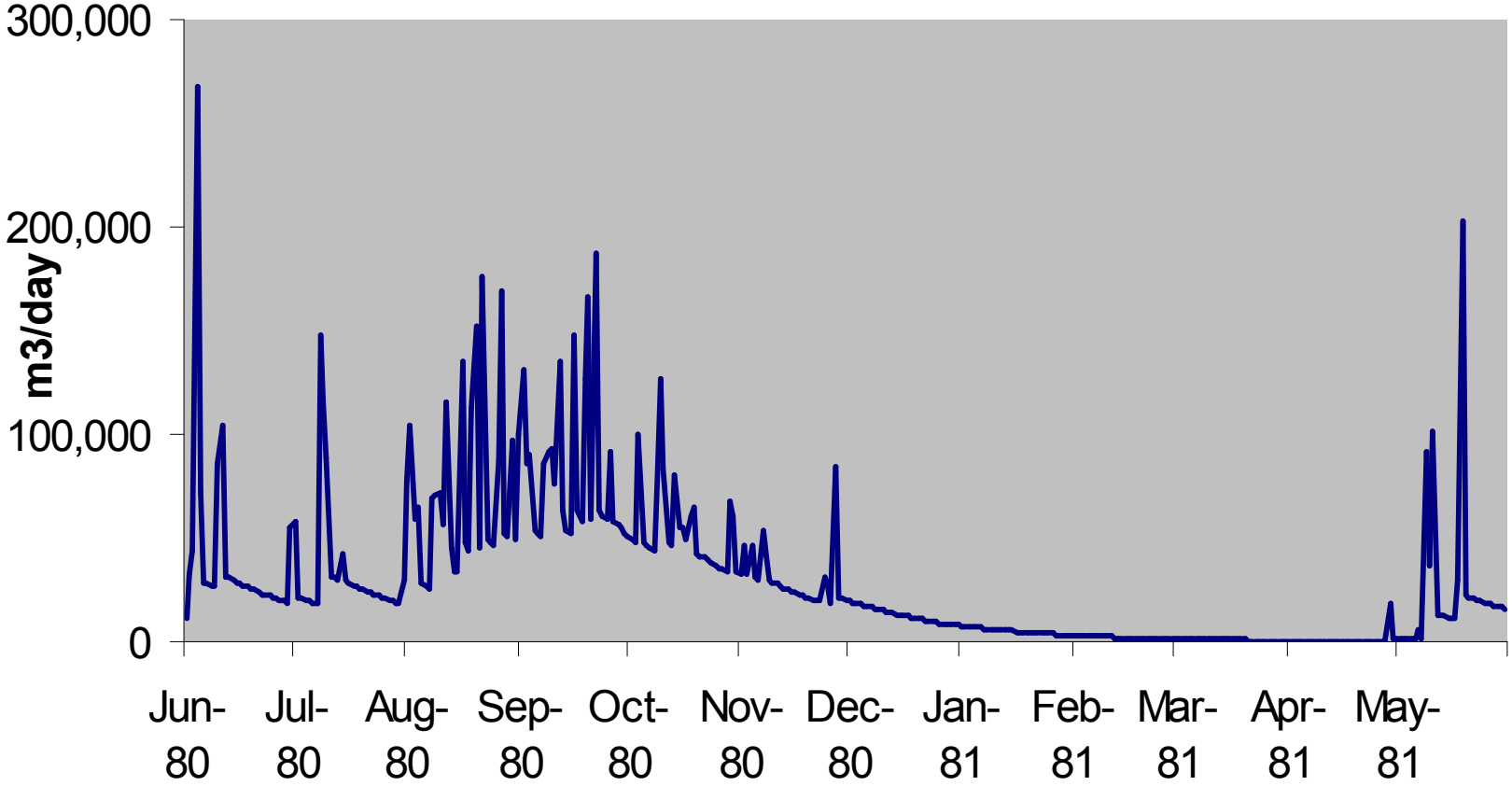
Irrigation System Model (ii)

- Reservoir inflows - Horopito



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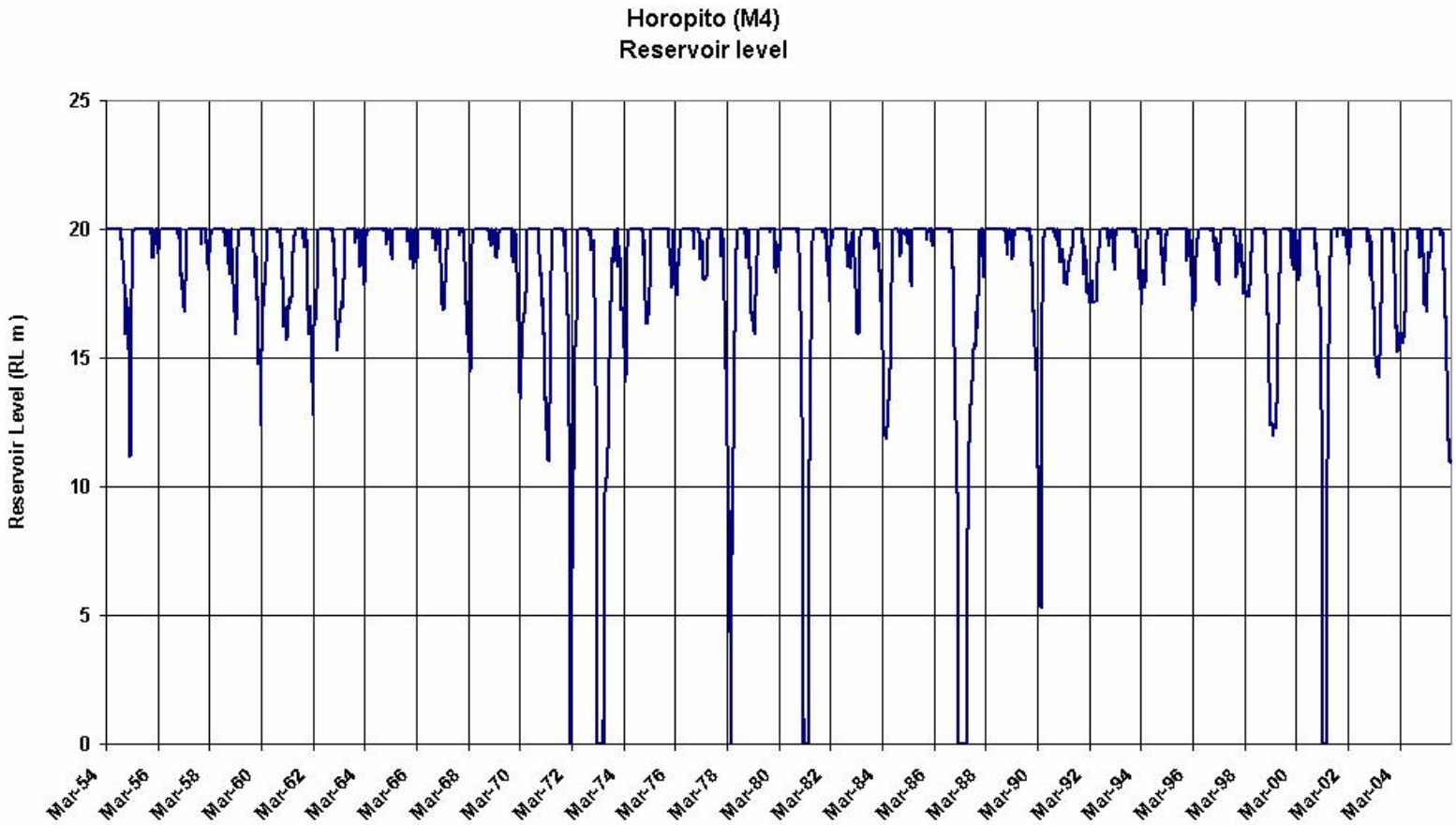
Irrigation System Model (iii)

- Reservoir storage & release - Horopito



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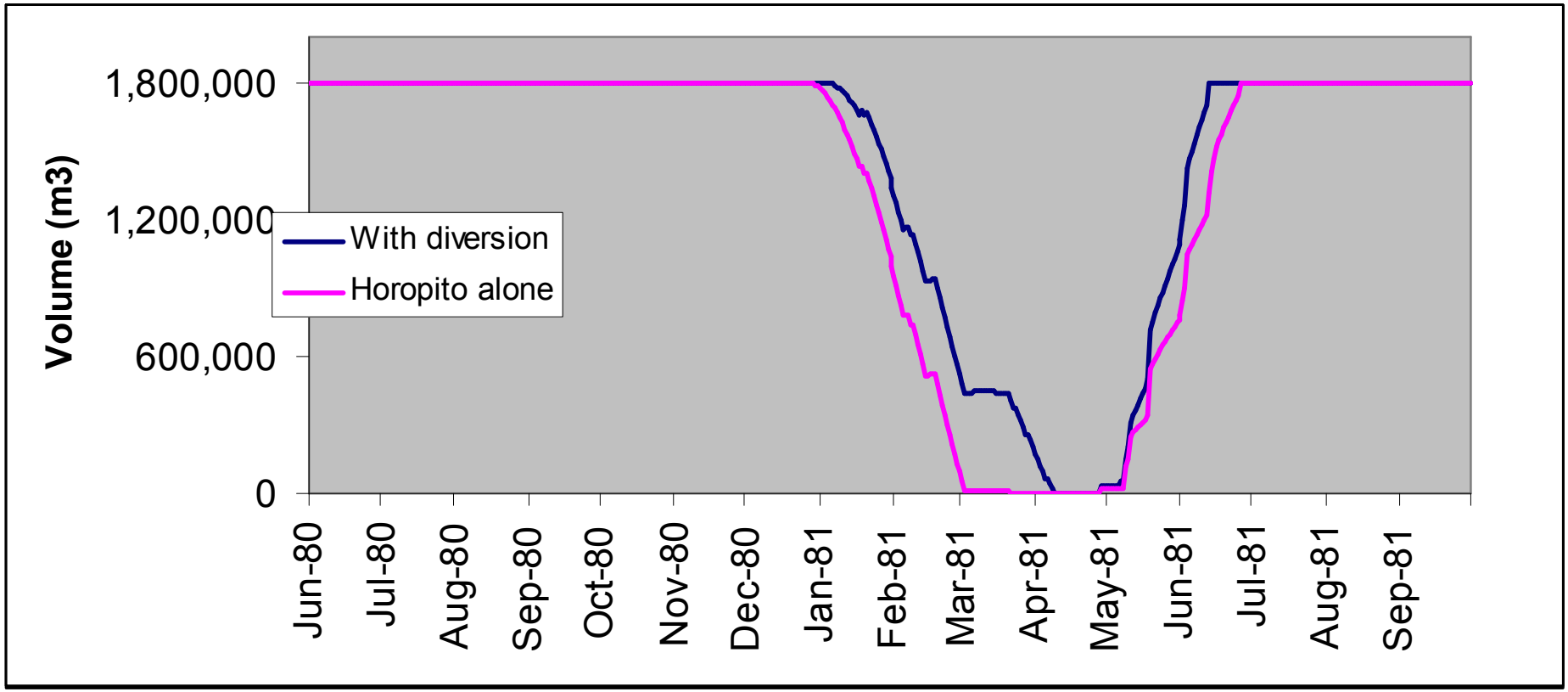
Irrigation System Model (iii)

- Reservoir storage & release - Horopito



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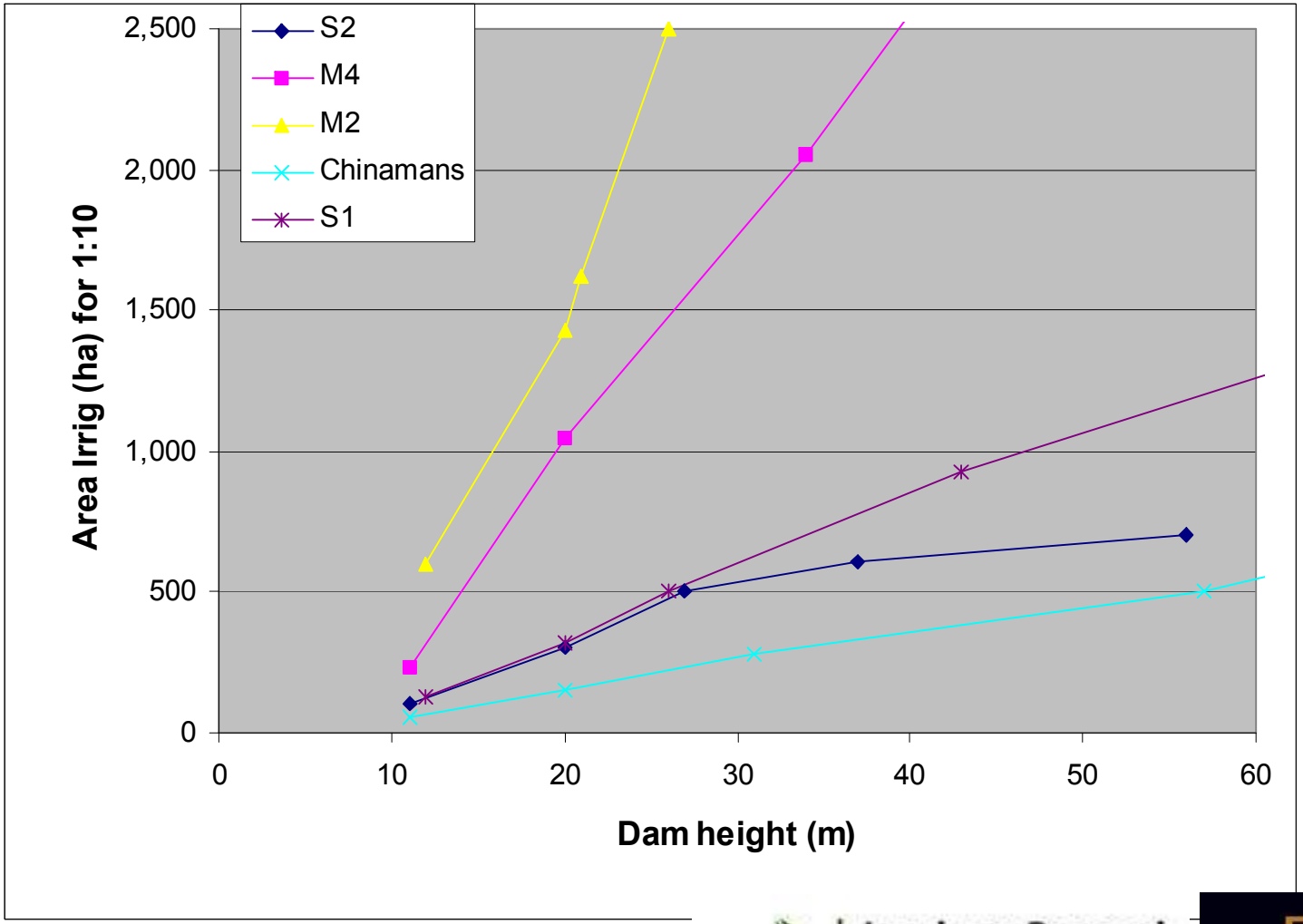
Dam height vs area irrigated

Based on 1:10 frequency of emptying reservoir



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Initial Desk Top Costing- Comparative Costs

- Bulk Fill, from gully cross-section only
- Stripping, assume 0.5m strip over base of dam
- Cut-off, assume 2m cut-off under crest
- Filters, chimney drain and base blanket
- Rip-rap, wave protection on reservoir
- Monitoring, standpipes and level
- Pipe work for diversion, spillway and intake

Percentages of total cost

Description of works	% total of total cost
Bulk earthworks – fill	26
Bulk earthworks – stripping of dam footprint and borrow area	4
Dam filters and rip rap protection	14
Dam internal drainage, monitoring and instrumentation	2
Local access roads	2
Dam structures, spillway and release systems	11
Contingency/uncertainty, designers fees, contractors establishment	28
Land and financing	13

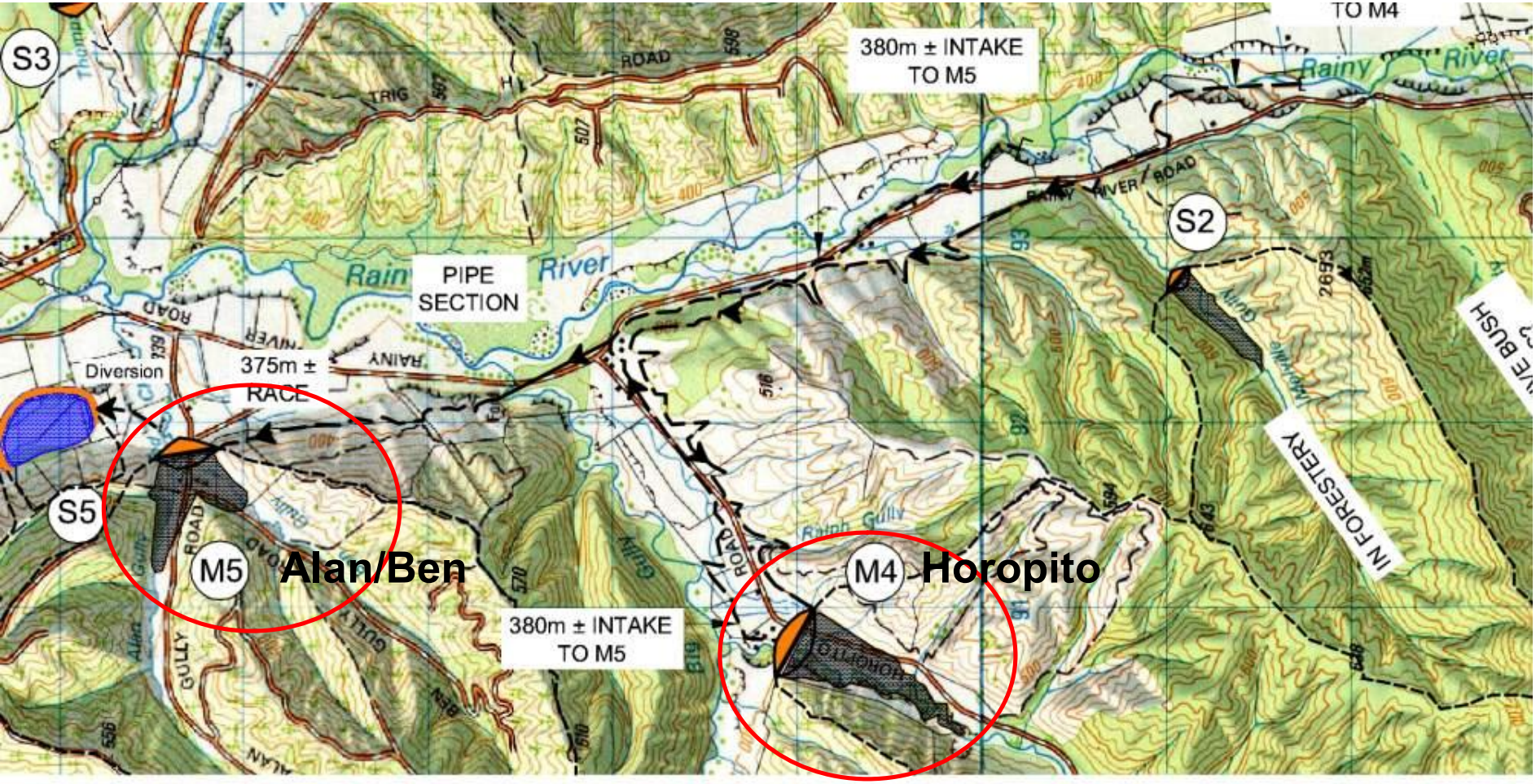
Desk Top Comparative Costings

- Kikiwa (M2) 2100 Ha; Cost $4,900/Ha
- Horopito (M4) 1000 Ha; Cost $5,900/Ha
- Horopito (M4) 500 Ha; Cost $6,300/Ha
- Melville (S2) 500 Ha; Cost $9,200/Ha

Full costings including land costs, financing, 20% contingency, freeboard added

After further review by the committee, looked closer at Horopito (M4) and Alan/Ben gullies (M5)

Horopito and Alan/Ben Dam Sites



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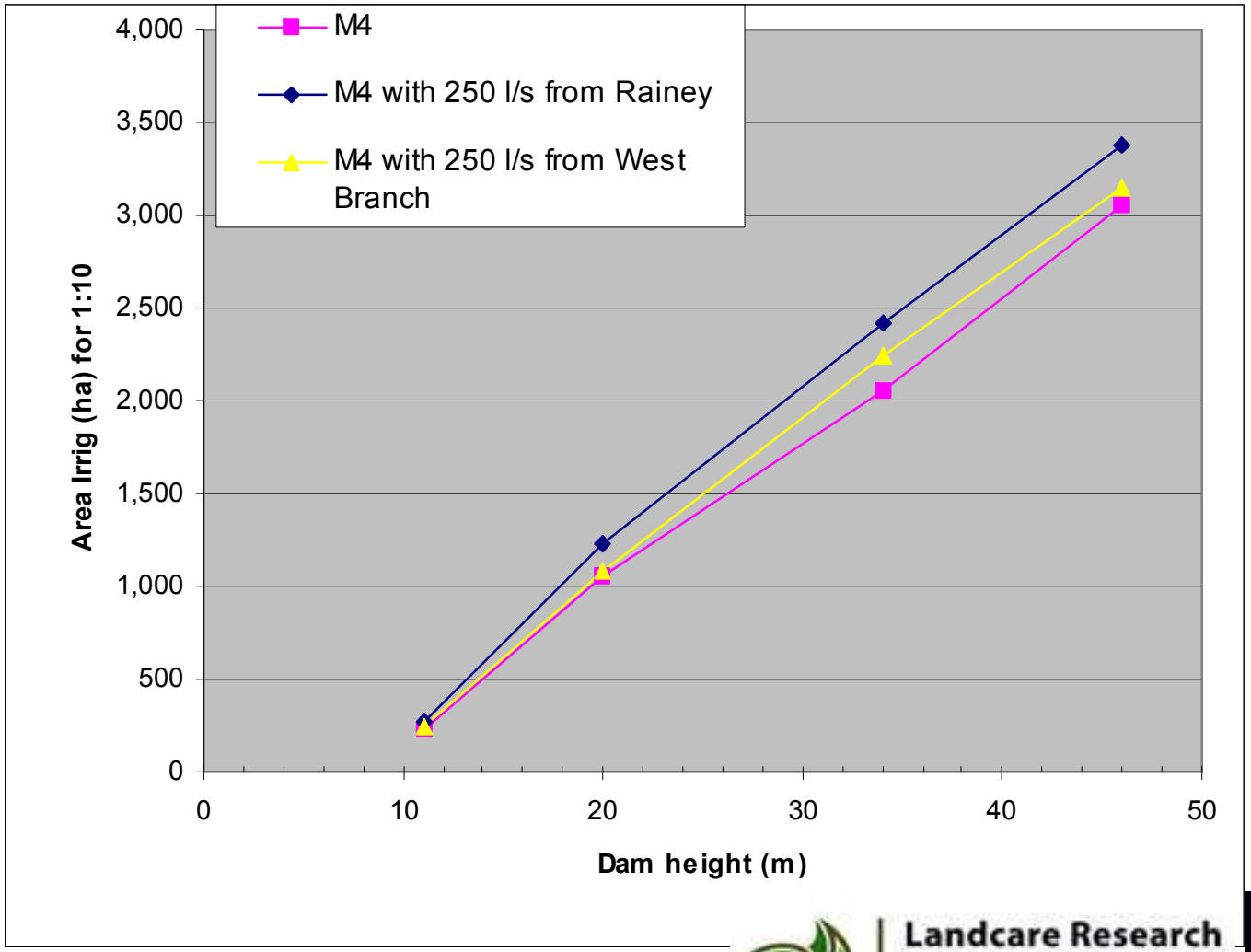
Horopito dam height vs area irrigated, with inflow channel



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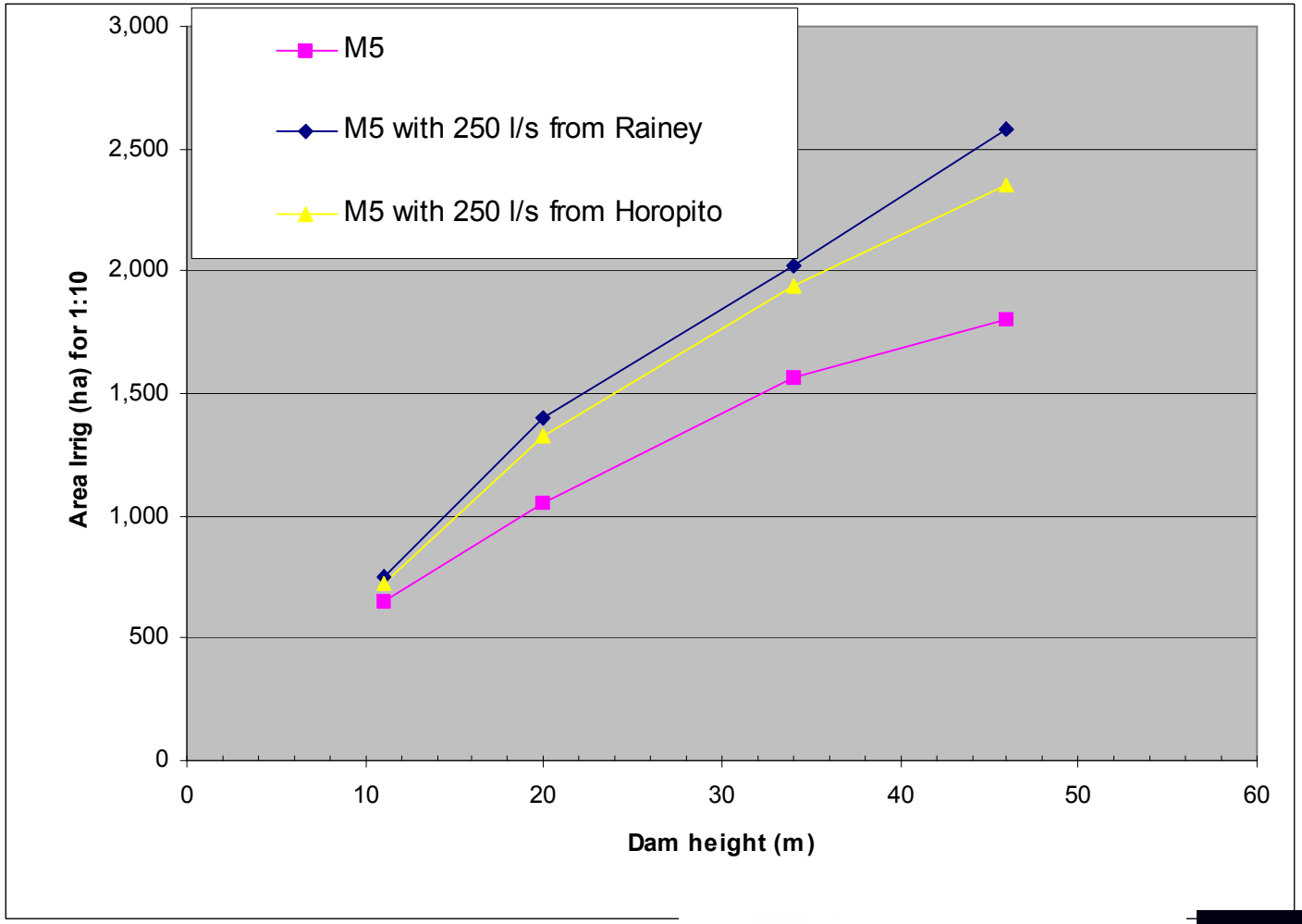
Alan/Ben dam height vs area irrigated, with inflow channel



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Summary table

Reservoir	Dam Height (1000ha)	Storage (1000ha)	Dam Height (2000ha)	Storage (2000ha)
Horopito (M4)	20m	1.8M m^3	34m	4.9M m^3
M4 + diversion	18.5m	1.5M m^3	29m	3.8M m^3
Ben + Alan (M5)	19m	2.3M m^3	unfeasible	>6.6M m^3
M5 + diversion	14m	1.6M m^3	33m	4.0M m^3

N.B. Dam height is with no free-board

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Costing for Horopito and Alan/Ben Dam Sites

- Water demand met from dam releases PLUS Motupiko streamflows
- Horopito (M4) could include diversion from West Branch Big Gully – maybe install later
- *Alan/Ben gullies dry up in summer - need a diversion channel from Horopito or Rainy
- Full costings including land costs, financing, 20% contingency, freeboard:

Horopito M4 (500 Ha) 19m high $6300/Ha
Horopito M4 (1000 Ha) 23m high $4800/Ha
Horopito M4 (1350 Ha) 27m high $4570/Ha
***Alan/Ben M5 (1000 Ha) 16m high $5200/Ha**

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Comparison of Horopito and Alan/Ben Dam Sites

- Sites similar with Horopito slightly cheaper option
- Site info for Alan/Ben sketchy - from map only
- Potential for two separate dams and staged construction to meet demand
- Adding diversion channels into both sites increases irrigable area slightly for a given dam size
- Recommend feasibility studies of these two sites

Environmental Effects

- Sedimentation potential
- Downstream hazard potential (dam break)
- Land tenure (incl road reserve; Queens Chain)
- Potential electricity generation
- Aquatic ecology impacts
- Water quality impacts
- Regulatory constraints (Motueka Water Conservation Order)
- Indigenous vegetation loss
- Reservoir effects on current production values
- Cultural impact
- Ease of public access
- Recreation potential

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Environmental Effects & Iwi ‘Fatal Flaws’ Check

Ranginui
The sky father, immeasurable universe

Tawhirimatea
Atua of the wind & air

Tumatauenga
Atua of war & tangata (people)

Nga Atua Kaitiaki

The spiritual guardians

Haumietiketike
Atua of wild foods including fern roots

Rongomatane
Atua of peace & cultivated foods

Tane Mahuta
The fertility force, Atua of ngahere (forests) & nga manu (birds)

Tangaroa
Atua of nga moana (seas), awa (rivers) & roto (lakes)

Papatuanuku
Earth mother, planet earth

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Summary

- Irrigable area = 2024ha in medium term (6600 ha max), mainly below Atapo
- 8 medium storages & 17 small sites identified
- Cost estimates for 2 shortlisted sites and 1000ha irrigated:

  Horopito M4 (1350 Ha) 27m high $4570/Ha

  Horopito M4 (1000 Ha) 23m high $4800/Ha

  Alan/Ben M5 (1000 Ha) 16m high $5200/Ha
- If funded through 20 year loan at 8% interest, $5000/ha capital cost = $501/ha per year

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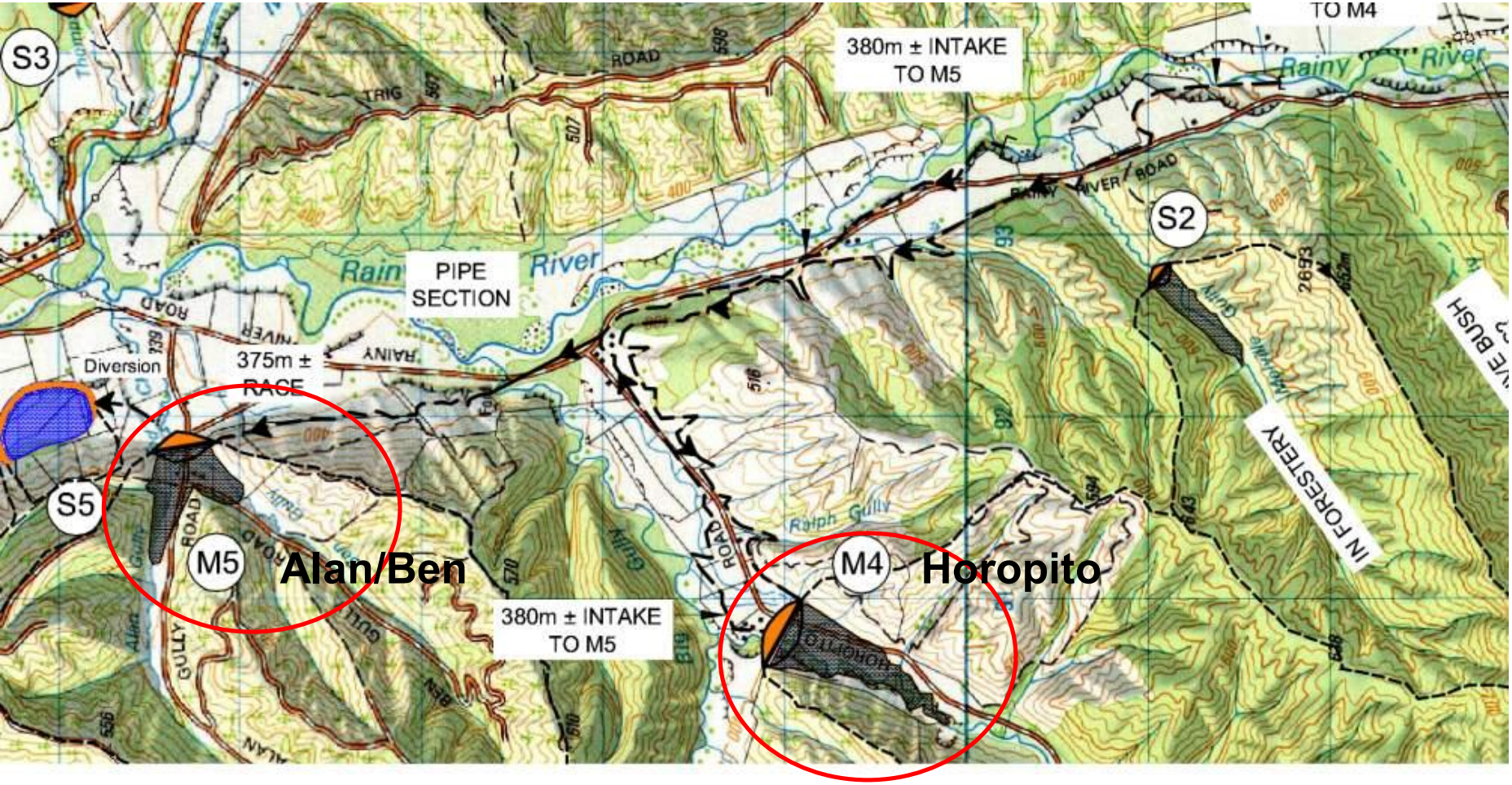
Recent steps…

- Survey of preferred options
- Final report

Recommendations

- Improved topographical data for reservoir storage volume/height accuracy
- More detailed hydrological modelling for the chosen site
- On-site geotechnical investigations to map valley floor deposits and depths to Moutere clay foundation
- Outline design of dams and associated components enabling more accurate sizing and costing.
- Detailed assessment of environmental effects, in particular to determine any residual flow requirements and factors affecting the design
- Assessment of changes to water allocation rules for the Motupiko which would need to be notified for submissions in the TRMP
- If rating is chosen as the charging mechanism, decisions on setting the rates level through Council's Annual Planning process.

Thank you for listening



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