10 March 2006

Enhancing Water Use Flexibility and Security using the Motueka Catchment as a case study

Discussion Paper

Andrew Fenemor and Jim Sinner

Research context

Landcare Research and Ecologic Foundation are undertaking a joint research project to develop, in conjunction with stakeholders, policy proposals to improve outcomes from water allocation, using the Motueka catchment as a case study (see Fig. 1). The project aims to integrate ecological, socio-cultural, and economic aspects of resource management to promote sustainable development of water and associated land resources.[1] We are exploring proposals for improving allocation and related outcomes from the amount of water available once instream and aquifer sustainability limits have been determined. Management approaches and policies identified for the Motueka catchment should also have relevance for water management in other New Zealand regions.

There is no pressing or imminent water crisis in the Motueka River catchment, but some pressure points are emerging. Some zones are "fully allocated" and there is additional unmet demand for water. Water quality and habitat have declined over time, particularly in the lower catchment.

Experience elsewhere in New Zealand has shown that as land use intensifies over time, and as water users perceive allocations to be approaching limits, tensions arise over water allocation and water quality. Some perspectives of Motueka stakeholders, as expressed in recent interviews[2], are summarised in the box on page 2.

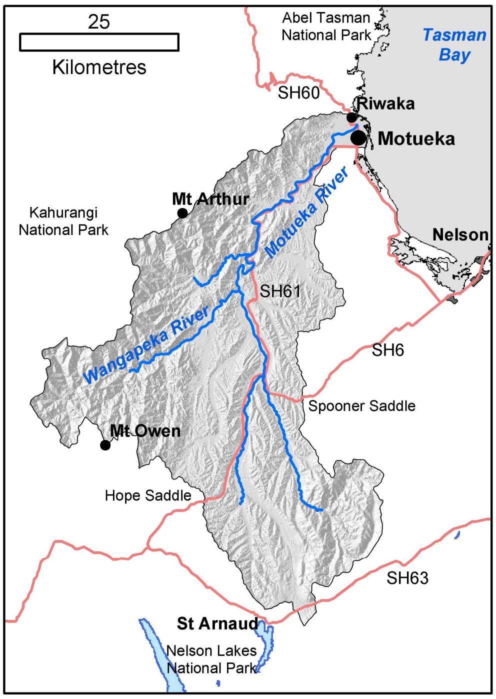

Figure 1. The Motueka catchment

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[1] This work is part of Ecologic's research on Institutions for Sustainable Development and Landcare's Integrated Catchment Management programme. Both are funded by the Foundation for Research Science and Technology, with support from a range of other business and government organisations, including Tasman District Council (TDC). However the views in this paper are the views of the authors, Andrew Fenemor of Landcare Research and Jim Sinner of Ecologic, rather than of the TDC.

[2] Interviews were conducted with: Extractive users and advisors (Liz Martin, Richard Horrell, Guthrie Beatson, Julian Raine, John Bealing, Lew Metcalfe, Mark Freeman); In-stream users (Neil Deans, Debs Martin); Maori (Barney Thomas, Graham Thomas); a TDC councillor and a TDC staff member (Richard Kempthorne, Mary-Anne Baker).

Stakeholder Perspectives

Extractive Users

Irrigators and other extractive users want security of supply and certainty of tenure, though the degree of security required varies with land use. Some see allocation limits as constraining development options. Users also want flexibility to respond to times of stress, not just drought but also frost.

Iwi

Maori remind us of Article 2 of the Treaty of Waitangi – the Crown guaranteed Maori the possession (*tino rangatiratanga*) of their lands, forests, fisheries and other taonga. Some consider they should have a greater say in how water is managed. Water does not belong to anyone – it should be available to water the productive land in the catchment. Local Maori are particularly concerned to ensure that sufficient water is available to irrigate leasehold land, and that water is managed cautiously so as to ensure adequate supplies for the future.

In-stream Users

Trout fishers, canoeists and rafters, other recreational users and other environmental interests want to ensure adequate flows in the river, including flushing flows as provided for in the Water Conservation Order. They are concerned about access to the river, and about deterioration in water quality if land use intensifies.

Council and other community stakeholders

TDC councillors and staff are interested in seeing water managed to achieve the best outcomes for the community. They consider there is room for improvement in how water is allocated and managed, for example to increase flexibility and reliability for users. They indicated that, amongst the wider community, some feel that water should be used first and foremost in the catchment, for residents and to irrigate productive land. Others consider there is sufficient water to allow some to be exported from the catchment to benefit others in the region.

Recent developments and trends

In the upper Motueka catchment, growth in demand for water is primarily for irrigation. In the last ten years there has been a trend to more irrigation of dairy pasture and berryfruit, pipfruit and hops, all of which require 30-35 mm of water per week during their production season, between November and April. While irrigation demand has recently been increasing because of a move of production from the more expensive land nearer the coast (Waimea, Moutere and Motueka), the area in berries was greater several decades ago when Tapawera was the centre of NZ berryfruit production. Tobacco irrigation was also a major user up to the 1980s.

Two zones are "fully allocated" in the upper Motueka (Tadmor and Motupiko) and two in the Motueka/Riwaka Plains (Hau and Riwaka). This means the total water permits authorised meet or exceed the available amount specified in the Tasman Resource Management Plan (TRMP)[3]. These zones have unmet demand for water, as indicated by waiting lists, water permit applications having been declined, or potential water users having gone elsewhere. Other zones are nearing their allocation limits. See Table 1.

Table 1. Allocations limits in Motueka water management zones

[3] See Part V, Water chapters 30 and 31, TRMP.

MOTUEKA WATER MANAGEMENT ZONES	ALLOCATION LIMITS (litres/sec)
Upper Motueka	1000
including:	
Wangapeka	265
Motupiko	110*
Tadmor (total augmented flow)	56*
Tapawera Plains	515
Motueka/Riwaka Plains	
Hau Plains	228*
King Edward	135
Central Plains	855
Umukuri	133 g/w; 62 Brooklyn River
Swamp	73 g/w; 31 L Sydney River
Riwaka	30* g/w; 170 river waters

g/w = groundwater
** = fully allocated zone*

Population and employment have increased in the upper catchment, although the portion due to increased irrigation is unknown. Other factors are forestry harvesting and improved mobility enabling commuting out of the catchment.

Water quality in the catchment is generally high – but degradation is evident in some areas, e.g. the Motupiko River and the lower Sherry River, where there has been recent intensification of land use. The Motupiko experiences substantial temperature fluctuation in summer, and the Tadmor River frequently exceeds temperature guidelines. Nitrate nitrogen concentrations and conductivity increased significantly at the Motueka Woodstock site since 1989, but not at upstream sites, suggesting that these changes may be related to changes in land use within the upper Motueka Catchment over the last 16 years.[4]

Other upper tributaries are likely to experience similar problems if land use intensifies, including the upper Motueka itself and perhaps the Wangapeka.

Furthermore, the Tasman District Council (TDC) is considering a transfer of water from the Motueka Plains to consumers along the coast to Mapua.

The level of utilisation of existing water permits varies, ranging from 100% utilisation at peak periods in the Hau to an estimated 50% in the middle and upper catchment. In the Hau plain, irrigated land use is exclusively apples and kiwifruit, grown on gravels requiring more regular irrigation, so peak demand occurs at the same time for all irrigated land. In the other zones, a wider range of uses on heavier soils, with peak demand occurring at different times, results in lower peak utilisation.

Land in plantation forest, mostly Crown land licensed to forest owners, is expected to be stable for the foreseeable future, as licenses require replanting. Existing forests in the upper catchment are of variable ages, many entering a harvest cycle, some for the third time. Water yields to forested tributaries will increase by up to 100% after

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[4] Young et al, 2005, pp. ii, 31-32.

harvest, until replanted forests achieve canopy closure[5]. There is a possibility of processing of forestry products in the catchment, with associated water demand.

There is a risk of significant sediment input from harvested forest land on Separation Point granite soils, e.g. the Newports block near the junction of the Wangapeka and Motueka rivers, and also from the Dart River flowing into the Wangapeka.

In the lower catchment, the town of Motueka is expanding and there is also continuing development of lifestyle blocks throughout the catchment. However, compared to water use for irrigation, the growth in water demand for domestic and reticulated supply is unlikely to be a significant percentage of total demand. Nevertheless, water for household consumption is usually accorded the highest priority in times of shortage. Reticulation of Motueka's water supply would, if implemented, replace the individual domestic bores currently supplying most of Motueka.

The Motueka Water Conservation Order, approved in 2004, limits abstractions to 12% of the flow from the mainstream Motueka and 6% from the Wangapeka, and also limits changes to water quality and river form. TDC has given effect to the order by imposing allocation limits in five management zones in the upper catchment, two of which (Motupiko and Tadmor) are already fully allocated.

A Motupiko Water Augmentation Committee has recently been formed to oversee a feasibility study of dam sites and water release into the fully allocated Motupiko catchment.

TDC considers there is sufficient water available in the Middle Motueka Zone (from the Wangapeka confluence to the top of the plains) and on the Motueka plains to irrigate all of the suitable land, and this is recognised within current rules in the TRMP. However, the Council has proposed and is investigating installing a pipeline from near the Motueka River on the Motueka Plains to supply reticulated water to new residential developments in the coastal zone from Motueka along to Mapua.

Further information on the Motueka catchment

For those who are interested in more detailed background information, we have provided a separate appendix document, covering the following:

- Physical overview of the Motueka Catchment
- Socio-economic overview of Motueka catchment
- Existing framework for water management
- Water quality and flows in the Motueka catchment and their implications for ecological and biophysical values.

[5] Rowe, L.K.R., Jackson, R.J., Fahey, B.D (2002) Land use and water resources: hydrological effects of different vegetation covers. Landcare Research Contract Report LC0203/027.
Rowe, L.K.R (2003) Land use and water resources: a comparison of streamflow from New Zealand catchments with different vegetation covers. Landcare Research Contract Report LC02032/188

Objectives for water management

In considering possible changes to the water management regime for the Motueka catchment, it is important to have clear objectives in mind, recognising that the economy and society are embedded within a bio-physical system (Fig 2).

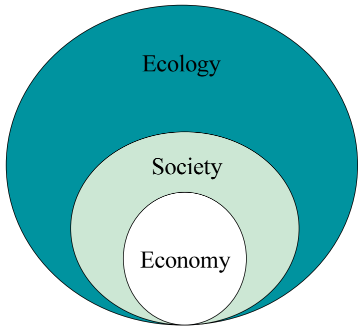

Figure 2. Embedded systems

In the broad context of sustainable development, we suggest the following as a (draft) objective for management of water resources in the Motueka catchment:

Enhance public benefit (i.e. long-term community well-being) from water resources in the Motueka catchment taking into consideration:

- *Ecological requirements (such as those established by the Motueka Water Conservation Order and any other standards established by the Tasman Resource Management Plan);*
- *Social concerns (such as any TDC policy regarding change to existing land use patterns) and the equitable distribution of benefits across different groups of water uses in the catchment;*
- *Cultural values associated with water and any iwi claims to water; and*
- *Economic values (e.g. productive, amenity, etc) associated with both out-of-stream use (i.e. abstraction) and instream flows.*

Desired outcomes
Thus, in practice we suggest that any policy changes should be consistent with the following outcomes:

1. Ecological/biophysical –

Instream flows, groundwater levels and water quality will be maintained at current settings and, in some cases, possibly enhanced (e.g. by specification of instream flow protections where they do not currently exist).

2. Economic –

The value of output from irrigated land will increase over time, and the value of water permits will rise accordingly. This will have flow-on effects for local service and input providers. At the same time, the value of river-related tourism activity will be maintained or enhanced.

3. Socio-cultural –

Employment in land-based industries will increase gradually over time, providing stability and possibly some population growth for Tapawera and the surrounding area, as well as for the township of Motueka.

Population growth in existing urban settlements will not be constrained and rural sub-division for lifestyle properties will continue.

Recreational, amenity and spiritual values associated with the Motueka River and its tributaries will be maintained and, in some cases, possibly enhanced.

Land use will change gradually over time, well within the ability of communities to adapt to any resulting social changes.

Tangata whenua will have access to water for development of tribal lands, or for other uses if this better enables them to provide for their well-being.

Emerging issues

Here we pose some questions for debate. These are developed from our perceptions of water allocation issues both in Tasman District and elsewhere around NZ, and also from stakeholder comments from an initial round of interviews carried out in February 2006.

Issue #1: Allocation limits and Security of Supply
Setting allocation limits for abstractive use involves making a trade off between having a few users with high security of supply vs many users with relatively low security of supply (i.e. high risk of rationing during low flows). Over-allocation, and even the current water allocation limits, can leave users with insufficient security of supply for their operations on occasion. Factors such as climate change and land cover change – for example, as occurs during the forestry cycle - can also affect security of supply in the medium to longer term.

Security of supply for an individual user is also influenced by how water permit allocations are determined, e.g. by crop type, soil type or assessed water demand (including for non-irrigation uses). For example, if water is allocated on the basis of soil type, grape growers might get an allocation of 35 mm/ha/wk but only need 18mm/wk, creating a significant buffer against rationing (and thus increasing their security of supply) or enabling transfer of excess water to another user.

Some existing and potential water users will decide not to invest in irrigation or industrial development because of uncertainties about their security of supply into the future.

- Can TDC's current "security of supply" framework be more clearly and appropriately defined in a way that enhances the community benefits from the mix of potential water uses, and if so, how?
- Should allocation per hectare be based on site-specific water demand as assessed by the Council (if so, how?) or should it be the same basis for everyone?
- If climate change results in greater variability of water flows from year to year, how should this be acknowledged in the "security of supply" framework?

Issue #2: Utilising the available resource
In the medium term, all zones in the Motueka catchment are likely to be fully

allocated, which would be a constraint on future development. In average or wetter years, there is actually sufficient water in the rivers to enable more abstraction, but under the current regime additional permits cannot be authorised without undermining the security of supply of existing users. Augmenting supplies through storage of winter flows is one way to address this problem, but this can be expensive and even with storage it is important to make best use of the available resource.

- How can more permits be authorised to take advantage of higher flows, when they occur, without undermining instream flow requirements or security of supply for existing users?

Issue #3: Protecting instream values
Recreational activity in the Motueka is thought to be increasing, although data is limited (Basher, 2003, pp.81-83). The Motueka is a nationally important brown trout fishery, and the rivers are also widely used for swimming, boating, whitebaiting, canoeing, picnicking, and other activities. Although the flow regime (including variability of flow) is protected under the Water Conservation Order, habitat degradation (e.g. loss of riparian vegetation) is likely to be one cause of declines in trout populations, and reductions in water quality (e.g. from intensification of land use) would also impinge on other recreational uses.

- How can the effects of intensive land use on water quality and instream values be better managed?

Issue #4: Flexibility and flow sharing amongst abstractive users
Procedures for water-sharing during restrictions make it difficult for users to work together to make best use of limited supplies. This can cause unnecessary hardship during periods of water shortage. Provisions for transferring permits from one use/user to another, through administrative procedures, have resulted in few transfers occurring.

- How easy or difficult is to share water during restrictions?
- How can the TRMP better facilitate water sharing during low flows?
- Under what constraints should transfers of water allocations among users be made a permitted or controlled activity[6] in the TRMP?

Issue #5: Alternatives to First-in, First-served
Many catchments around New Zealand have experienced conflict over who should get permits as water resources near full allocation. The current "first-in, first-served" regime creates some perverse incentives in these situations (e.g. "gold rush" behaviour), but there is as yet no agreement on what should replace it.

- Where there is competition for limited amounts of unallocated water, how can this be allocated efficiently and equitably to achieve the community's objectives?

Issue #6: Setting priorities and reserving water

[6] A permitted activity can be carried out as-of-right, subject to the specified conditions being complied with; a controlled activity requires an application to be lodged with the Council but consent must be granted if specified criteria are met (although this may be granted with conditions).

Population growth in the lower catchment will cause competition between irrigators, industry and community water supplies. The Council could specify priority water uses in its plan, or future needs could be met through trading among existing users.

Scientific investigations indicate that there is sufficient unallocated water under the Motueka Plains to supply water to users outside the catchment, e.g. reticulated supply to the Mapua area and irrigation schemes up the Moutere Valley, even after reserving water for future community water demand and for Maori perpetual leasehold land.

- Under what circumstances should water be reserved for "high priority" uses based on potential future water demand (for example for irrigation/urban supply or other end uses)?
- How can such reservations be provided for?

Issue #7: Improving Efficiency of Water Use

Increasing demand for water creates pressure to ensure that allocated water is used efficiently. Water that is allocated but unused benefits the environment, but water applied inefficiently may have other consequences such as leaching of contaminants, loss from the system, and little productive benefit.

- Should users be subject to tighter specification and regular review of water permits, or given more information on efficient water use and left to decide efficiency measures for themselves?
- Would a volumetric charge for water allocations – with proceeds applied to Council's water planning and management costs – encourage more efficient use, and better tailoring of usage vs allocations?
- If the TDC does not enforce "use it or lose it", should permits be more easily transferable to encourage more efficient use of allocated water?

Policy approaches for discussion

To address the issues outlined above, and to establish a robust long-term management framework for sustainable development of Motueka water resources, we suggest the following policy approaches, grouped into three areas for action:

A. Flexibility and Security for users

1. **Security of Supply** – Allocation limits should explicitly state the security of supply objective, e.g. aim to provide irrigators with 100% of their authorised water allocation in 9 years out of 10. Where not already established, instream flow regimes need to be defined for tributaries, and management triggers for groundwater abstractions, along with allocation limits, before threats to sustainability arise.

2. **Flow Sharing –** Water user/catchment groups should be enabled to manage the available water supplies during restrictions, provided they record actual usage and do not exceed the total permitted takes. This could be facilitated by greater transferability of permits (see below). The TRMP currently provides for flow sharing in the Riwaka catchment, but this could be extended to management zones throughout the Motueka catchment.

3. **Transferability** – Downstream transfers of water take permits could be permitted subject to compliance with conditions regarding local effects (specified in the regional plan or the site consent). Subject to these same conditions, upstream transfers could be permitted within defined zones once these are reviewed to ensure the boundaries are sufficient for this purpose. Transfers could be reported to TDC via the internet and be effective immediately, facilitating flow sharing and leasing of allocations (non-permanent transfers) during times of water restrictions.

4. **Water Management Committees** – WMCs could have a stronger role for liaison with TDC, implementing flow sharing (as per 2 above) and developing and implementing plans for meeting sub-catchment or tributary targets for water quality (see "Third party effects" below). Committees should include representatives of in-stream interests as well as abstractive users.

B. Allocation

5. **Priority classes of permits -** Once the first allocation limit has been reached, the council could make available additional permits (e.g. Class B, C …) with lower priority (and lower security of supply) – these would have to cease take or suffer larger cutbacks in take before Class A permits were subject to restrictions.[7]

   TDC could reserve water for future use by saving a specific amount of the Class A allocation. Class B permits could still be issued, and these would have relatively high security of supply in the meantime. This security would gradually decline to that of a normal 'B' permit as the reserved Class A water was taken up.

6. **First-in First-served vs. alternatives** – As a water resource nears full allocation, there is sometimes a "gold rush" to get a permit. Where demand exceeds supply for allocation of the available water, how should water be allocated? Options include:

   - First-in, first-served (as at present)
   - Ballot
   - Council determination (e.g. based on efficiency, equity and/or uses most consistent with Council policy and sustainable development generally)
   - Sale by Council (e.g. auction, tender or fixed price)
   - Other?

[7] e.g. The Motueka Water Conservation Order allows abstraction of 12% of the river flow. The TDC allocation limit of 1000 l/sec is the amount available without restrictions being in force. If this allocation limit is fully subscribed, restrictions would start when river flows fall to about a 5 year low flow, about a 96% security of supply (a 20% cut 1 year out of 5). If the allocation limit were split into A and B components, with A permits unrestricted until low flows fall to a 10 year low flow, then the A allocation limit would be about 815 l/sec but more than the remaining 195 l/sec could be allocated to B permits, if they were first restricted earlier (say at a 2 year low flow), and more could be allocated as C permits e.g. for filling storage when there are no restrictions on take.

7. **Specification and administration of permits** – a number of improvements could be made in the way that permits are specified and administered.

   a. **Abstraction volumes** – Permits would specify a maximum instantaneous abstraction in l/sec, a weekly maximum and a seasonal or annual maximum. For new permits and renewals, the allocation would be based, as at present, solely on soil type.
   b. **Duration and scheduling of permits** – Duration should reflect the payback period for water use infrastructure. This could be 30 years but with a 10-year review period to adjust, if necessary, to changing flow information. Another possibility is renewal for an additional 10 years after each review, so permits would never expire. [This would require a change to the RMA.]. Continue the process of common expiry and/or review dates within each management zone, to enable costs of the review process to be shared across all users and to ensure that any changes to permit conditions will take effect for all permit holders at the same time.
   c. **Metering, monitoring and user pays** – Compliance with prescribed allocation limits is important for users to have trust in the allocation system. Under the TRMP, water metering is currently required of larger new takes, and will be required of all water permit holders in the Motupiko, Tadmor, Tapawera Plains and Wangapeka catchments by May 2006. It is already mandatory for permits in these zones of the Motueka/Riwaka Plains: Riwaka, King Edward, Hau Plains, Swamp and Umukuri Zones. Water meters should be required in all zones by the time their allocation limit has been reached. Reporting and recording could be simplified (e.g. via electronic transmission rather than manual data entry). All monitoring and compliance costs should be funded by water users rather than general rates.

C. Managing Third-party Effects of local use

8. **Permit to take vs site-specific effects** – The water permit would specify the amount of allocation and rationing rules, with a standard format for all permits. Site-specific effects of take and use, including proximity effects on neighbours and streams, would be managed through rules in the regional plan or, where these are incomplete, via a non-transferable site consent.

9. **Water quality** – Where there is existing or potential water quality degradation, water management committees and/or catchment groups (e.g. of about 10-20 properties) should be empowered to develop catchment plans specifying land use practices that will be implemented to achieve water quality objectives. Individual land users would then develop property plans incorporating these practices. Where necessary to ensure compliance, the catchment plans could be given statutory effect through the TRMP, e.g. as the basis for a "site consent" referred to above.

Expected Outcomes

If the policy measures outlined above were implemented, we would expect certain things to be different compared to what would emerge under the existing policy settings. These outcomes depend on good design of the proposals as a package, essentially a refinement to make current systems more effective, flexible and resilient into the future.

Economic outcomes

Fuller utilisation of existing permits, greater water use efficiency, and allocation of "B class" permits would enable expansion of irrigated area. Improved clarity of security of supply, flow-sharing arrangements, and the ability to transfer water permits would enable irrigators to achieve greater security for high value crops. These factors would lead to an increase in the total value of production from the catchment and increase demand for capital, inputs and labour, providing an economic stimulus to the surrounding communities. Additional economic activity at the margins of water utilisation can also be expected to involve greater financial risks for holders of 'B class' permits.

Environmental outcomes

There would be somewhat greater use of allocatable water, with corresponding effects on river flows and water tables, so allocation limits would need to be set in anticipation of full usage developing over time. Flows and aquifer levels would still be within the range protected by the MWCO and TRMP. Other policy options (user-pays and/or tendering, if these were implemented) could offset such increases in absolute levels of water abstraction, or even lead to reductions in the use of allocatable water.

Intensification of land use may lead to water quality decline, but perhaps less decline than would occur in the absence of the proposed measures. There would be more frequent monitoring throughout the catchment, in support of Water Management Committees' water quality roles, enabling any adverse trends to be identified and addressed by those committees and TDC. The proposed measures would help to ensure that water quality continues to comply with the provisions of the MWCO and meet the needs of instream users.

Social and cultural outcomes

New local collaborative arrangements (Water Management Committees) would enhance mutual understanding and social cohesion between people with diverse interests in water management.

Reservations of water for future uses would be clearer, without precluding use of the water by others until such time as the reserved water is needed.

Intensification of land use would provide more local job opportunities, especially in the upper catchment, allowing Tapawera and the district to continue to grow.

More efficient enterprises, including those with good market linkages, would tend to grow over time.

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Enhancing Water Use Flexibility and Security using the Motueka Catchment as a case study: Appendix[8]

Physical overview of the Motueka Catchment

(from Fenemor 2005, Motueka Field Guide, ICM Research Programme)

1.1 Motueka River Basin Physical Features

Total basin area 2,170 km^2

- ♦ Located between 41^{o}00' S and 41^{o}45' S latitude, and 172^{o}30' W and 173^{o}00' W longitude.
- ♦ Entirely within the boundaries of the Tasman District, South Island, New Zealand.

1.2 Motueka River Physical Features

- ♦ Elevation: sea level at Tasman Bay to 1800 m in alpine headwaters
- ♦ Length: 110 km
- ♦ Breadth: 18 km near the mouth to 50 km at the headwaters
- ♦ Average depth: <1 m
- ♦ Delivers 62% of the freshwater inflow to Tasman Bay

1.3 Major Lakes and Bays in Basin:

- ♦ No major lakes
- ♦ Motueka River discharges into Tasman Bay, a productive and shallow coastal body of high cultural, economic, and ecological significance.

1.4 Major Rivers and Waterways in Basin (* = long term flow data exists):

- ♦ Motueka River *
- ♦ Important west flank tributaries (Riwaka*, L. Sydney, Brooklyn, Shaggery, Rocky, Pokororo, Graham, Pearse)
- ♦ Important east flank tributaries (Waiwhero, Orinoco, Dove)
- ♦ Major headwater tributaries:
  - i) Baton *
  - ii) Wangapeka *, including the Dart and Sherry
  - iii) Tadmor *
  - iv) Motupiko
  - v) Upper Motueka
  - vi) Stanley Brook *

1.5 Hydrologic Budget:

- ♦ Average annual precipitation: 1040 - 4030 mm measured over catchment
  - i. >4030 mm estimated in mountainous regions

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8 This appendix accompanies a discussion paper that is part of Ecologic's research on Institutions for Sustainable Development and Landcare Research's Integrated Catchment Management programme. The information was sourced from various places and there is some resulting overlap in the four sections.

- Number of rain days >1mm: 102-137
- 50-year, 24-h rainfall event: 141-229 mm
- Annual sunshine hours: ~2400 h
- Annual pan evaporation: 1105 mm
- Annual days of air frost: 31-92 days
- Annual discharge from the Motueka River at Woodstock: 844 mm
- Mean annual flow: 58.1 $m^3 s^{-1}$
- Mean annual 7-day low flow: 10.1 $m^3 s^{-1}$
- 50-year flood event: 2050 $m^3 s^{-1}$

1.6 Geology

- Complex limestone, marble, and calcareous mudstone (Mt Arthur Group) volcanic rock (Riwaka complex) formations (western headwaters)
- clay-bound Pliocene-Pleistocene (Moutere Depression) gravels (dominant, mid-basin)
- erodible (Separation Point) granites (mid-basin)
- ultra-mafic (Dun Mountain) mineral formation (eastern headwaters)
- sandstone-siltstone (Maitai Group) formation (eastern headwaters)

1.7 Hydrogeology

- alluvial plains aquifers (horticulture):
- upper aquifer (1-10 m depth, transmissivity 2000 m^3/day/m)
- middle aquifer (10-16 m depth, transmissivity >4000 m^3/day/m
- lower aquifer, (>16 m depth, transmissivity >2500 m^3/day/m)
- Moutere gravels (pasture, horticulture, forestry): 3-120 m^3/day/m
- Alluvial valley aquifers (dry land pasture, dairy, horticulture): like the upper plains aquifer (i.e., 2000 m^3/day/m, decreasing away from the river).
- Mountain calcareous complexes: high and unknown (sinkholes, caverns).

1.8 Topography

- Flat alluvial plains at mouth, sea-level, young relatively fertile soils
- Rolling and steep hill country in lower basin, low-fertility soils
- Flat alluvial terraces in upper basin valleys, young relatively fertile soils
- Rugged mountainous terrain in headwaters, with a wide range of fertility and permeability

1.9 Seasons & Climatology

- Cool, humid with distinct wet and a dry (austral summer) seasons
- Dry season can lead to water shortages on dominant Moutere Gravels
- Climate is affected by:
- Air masses from Tasman Sea (westerly, warm), South Pacific (northerly and easterly, moderate), and Southern Ocean (southerly, cold).
- Orographic effects are pronounced.
- Location of the basin within a small island mass, situated within a temperate zone.
- Shelter of the western mountains

1.10 Land-use & Land cover

- Native "bush", scrub and grassland in headwaters: southern beech (*Nothofagus*), podocarps (40%)
- Commercial forestry on steeplands: radiata pine, Douglas fir (25%)
- Dry land pasture and scrub: pasture grasses, sheep
- Valley bottom riparian areas: berry crops, hops (35%)
- Coastal plains: fruit trees, hops

1.11 Freshwater resources

- Nationally important blue duck habitat, karst and wild & scenic features in Kahurangi National Park
- Nationally important recreational trout fishery in the Wangapeka and Mid-Motueka rivers
- Regionally important whitebait fishery
- Water supply for irrigators and townships
- The Water Conservation Order (Motueka River) was formally gazetted by the Minister for the Environment in April 2004

1.12 Marine resources

- Nationally significant (enhanced) scallop fishery
- Intertidal cockle fishery
- Rapidly expanding mussel farming: aquaculture
- Recreational and commercial fin fisheries
- Extensive delta system linking land, freshwater and marine ecosystems
- Nationally important coastal recreation areas (e.g. Abel Tasman National Park), marine mammals (e.g. Tonga Island Marine Reserve)
- Internationally recognised birdlife (e.g. bar-tailed godwits, pied and variable oystercatchers on Motueka sandspit)

1.13 Population

- ~12,000 in catchment, mostly in the town of Motueka
- Rural population density is about 2/km^2
- ~41,400 in Tasman District (2001 NZ Census)
- Moderate growth: ~2% per annum and probably faster now!

1.14 Pressures on Water Resources

- Water withdrawals (largely irrigation)
  i) Surface water: 132 permits (761 l/s)
  ii) Groundwater: 335 permits (1,715 l/s)
- Permits for discharges into Motueka River:
  i) Few: 10 of 136 in the greater region
  ii) Type: largely stormwater and dairy

1.15 Activities relevant to Tasman Bay

- Marine farming: structures, aesthetics, ecological impacts
- Coastal subdivision and development
- Coastal hazards: erosion, flooding
- Coastal structures: marinas, jetties, wharves, outfalls
- Nuisance plants and animals, impacts on biodiversity.

Socio-economic overview of Motueka catchment

2.1 History of settlement in the Motueka River basin

(from Fenemor 2005)

Archaeological evidence suggests that Māori groups first settled the Motueka River area before 1350 A.D. and more permanent camps and fortifications (pa) were gradually established. Settlement was largely restricted to the coastal areas, although Māori travelled through the catchment in search of valued "pounamu" or greenstone (argillite). Inter-tribal conflicts decimated the local tribes (iwi) in 1828-1830, about 10 years before the first European settlers arrived. Early European settlers were largely interested in sheep grazing land and in gold. Gold operations existed in the area until the early 1900's.

A major flood in February 1877 transformed the shape of the catchment, as a consequence of widespread mass wasting. This event has left a legacy that is important even today. Subsequent flooding prompted the local river board to construct stopbanks in the lower river in the 1950's.

Introduction of tobacco in the 1920's brought a period of growth and prosperity. Decline in the tobacco industry in the 1950's was followed by a rise in fruit tree, berry fruit, and hops and by a rise in commercial forestry. Plantation forests – stocked primarily with exotic species such as Monterey pine (*Pinus radiata*) and Douglas fir (*Pseudotsuga menziesii*) were established on less-fertile, steeplands abandoned and purchased from farmers. More recently, vineyards, marine farming, and tourism have added substantially to the diversity and productivity of the local economy, and lifestyle blocks are increasingly being developed.

2.2 Social & cultural setting

(from Harmsworth 2004; Fenemor 2005)

The Treaty of Waitangi (1840) established a legal basis for the relationship between Māori and pakeha, based on principles[9] of right to govern (kawanatanga), iwi self-management (rangatiratanga), equality, cooperation and redress. After languishing for over 100 years, the treaty has been the basis for recent claims by Māori groups over various land and water resources. Many Māori feel a responsibility to their ancestors (tupuna, tipuna) to uphold, express and articulate Māori culture and values in modern society.

The Waitangi Tribunal has completed hearing claims by Māori tribes (iwi) of Te Tau Ihu (Top of the South) for redress against the Crown, mainly over land in the region. In the Motueka catchment, the tangata whenua comprise the Māori tribes (iwi) Ngāti Rarua, Te Atiawa, and Ngāti Tama, who displaced the Ngāti Apa peoples in an incursion during 1827-28. These three iwi operate from the Te Awhina marae in Pah St Motueka, and are shareholders in commercial entities including the Wakatu Incorporation and Ngāti Rarua Atiawa Iwi Trust.

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[9] Enunciated (and still debated) in Department of Justice (DOJ) 1989: Principles for Crown action on the Treaty of Waitangi. Wellington.

2.3 Land and water use

Land use in the Motueka catchment is dominated by native and exotic forest. Horticulture accounts for only 0.6% of land use but makes a major contribution to the local economy. See Table 1.

Table 1. Land use in Motueka catchment

Native forest		35%
Exotic forest		25%
Pasture/grassland		19%
Scrub		12%
Tussock		7%
Horticulture		0.6%
Pipfruit*	46%	
Berryfruit	18%	
Hops	16%	
Vegetables	16%	
Other	4%	

*Primarily apples and kiwifruit.
Source: Basher, 2003, p.36.

Water permits are held for irrigation, public and private water supply, and timber processing. Above the Motueka Plains, most water permits are for irrigation, apart from the Dovedale and Tapawera public supplies, the Quinney's Bush campground supply, and the Knowles timber mill supply at Pangatotara. There is a diversion of up to 500 l/sec from the Hope catchment to augment flows in the Tadmor River, for irrigation and habitat enhancement.

The primary commercial uses of irrigation water in the Motueka catchment are pasture (for dairy, deer, and beef), hops, pipfruit, and berries[10]. As of March 2002, TDC had approved water abstraction permits totalling 617 litres/sec for the upper Motueka, i.e. above Woodstock. Of this, 445 litres/sec was from groundwater and 172 litres/sec from surface water (Basher, 2003, pp. 51, 59).

The Tasman District Council has a permit to take 6300 m^3/week (10.4 litres/sec) from the Motueka River for the Tapawera community water supply.

Below Woodstock, including on the Motueka Plains, TDC in 2002 had authorised abstractions of 293 litres/sec from surface water and approximately 1300 litres/sec from groundwater. Of the groundwater allocated, about 95% is for irrigation, with about 2% each for industrial and domestic use (Basher, 2003, p.58).

The town of Motueka is the main population centre in the catchment, and services to rural industries are an important part of the local economy. These include banking, management advice, irrigation equipment, fuel and electricity supply, and general farm supplies, as well as labour for harvesting. There is little processing of agricultural and horticultural product within the catchment, but there is a timber mill and treatment facility in the upper Motueka and fish processing and ice cream manufacturing at Port Motueka.

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10 The Tasman District Council does not record the crops irrigated by holders of water abstraction permits. The information cited here was provided by Council staff.

Tourism is an important source of employment in the town of Motueka, and a portion of this activity (primarily trout fishing) is based around the Motueka River and its tributaries.

2.4 Water-related values

(from Fenemor 2002 TDC Evidence for the Motueka Water Conservation Order; Basher (ed) 2003)

Resource management issues for all stakeholders can be grouped into six broad categories: water quantity, sediment, water quality, aquatic ecology, riparian management, and Motueka Catchment – Tasman Bay interactions. All are being researched in the Motueka Integrated Catchment management (ICM) research programme.

Water available from rivers and groundwater is finite, and there is tension (as reflected in the Water Conservation Order process) between water demand for out-of-stream uses versus instream and environmental needs. The effects of land use, particularly forestry, on water yield are also regularly raised by stakeholders.

Water quality concerns include nutrient enrichment, faecal contamination from stock and septic tanks, and sediment generated by land use activities such as agriculture and forestry, and climate extremes. These have consequential impacts on aquatic ecology including fish numbers and algal growth. Riparian vegetation and streamside management offer a means to mitigate some of these effects.

Key tangata whenua issues in the Motueka catchment relate to: (1) relationships and partnerships for planning and policy; (2) loss of mauri (life force) of rivers, streams, and the coastal environment; (3) sustainable resource use; (4) pollution, sediment and contaminated sites; (5) effects of land use and discharges on kai moana (seafood); and (6) biodiversity/biosecurity matters.

The Motueka River has a world-famous trout fishery. After 1995 trout numbers declined markedly but have since begun recovering. There is no consensus on the reasons for this, but large floods, heavy sediment loads, low flows and land use have all been postulated as contributors.

The river and its tributaries are also highly valued and used for other recreational activities including canoeing and rafting, swimming, picnicking, gold fossicking, caving, tramping and scenic drives. For example, the Arthur Range contains the deepest known cave in the southern hemisphere.

2.5 Population, Employment & Incomes

Between 1986 and 2001 (most recent census data), the usually-resident population of the Motueka catchment increased by 16% (from 10,858 to 12,626), compared to 28% growth in Tasman District as a whole.

When disaggregated between upper and lower parts of the Motueka catchment (Woodstock and below), the population growth rates were identical over this period (i.e. both 16%). However the urban/rural split was very different. In the upper catchment, all the population growth took place in rural areas (up by 32%) and

Tapawera township actually declined in population (down by 9%). In the lower catchment, population growth in the more rural areas grew at the catchment-wide rate, while in the more urban areas, population growth was particularly strong in the eastern part of Motueka township (up 24%) but only minimal in Riwaka (up 4%).

Full-time employment in the latest inter-censal period (1996-2001) in the catchment increased by 3% (vs. 9% in Tasman District) while part-time employment increased by 16% (13%). Employment trends were very different between upper and lower Motueka catchment (note ~10% of total employment is in the upper catchment and ~90% in the lower catchment). In the upper catchment, full-time employment increased by 12%, well above the District-wide average, and this was particularly marked in the rural areas (up16%). However , part-time work in the upper catchment declined slightly (down 2%), but particularly in Tapawera (down 36%). In contrast, in the lower catchment, changes in full-time employment were much lower (up 2%) and part-time employment grew much more significantly (up 18%).

The distribution of income sources in the overall Motueka catchment was similar to the District-wide pattern. However, the rural areas in both upper and lower catchment had much higher levels of self-employment, typical of farming communities. For example, in the rural areas of the upper catchment, 43% of people aged 15 years and over were self-employed in 2001, and in the lower catchment, the figure for rural areas was 31%, compared with a district-wide figure of 23% self-employed. Individuals drawing unemployment benefit were more likely to live in the lower catchment (9%) than in the upper catchment (6%), with the highest rates in the rural areas of the lower catchment (12%).

Overall, median household incomes were lower in 2001 in the Motueka catchment ($27,600-$31,600) than in Tasman District ($32,800). However, the highest median household income level was in the rural areas of the upper catchment ($31,600) while the lowest median household income level was found in the most urban part of Motueka township itself ($27,600). Median personal income levels in the Motueka catchment were lower than the District median, with the lowest personal median incomes in the upper catchment. These comparisons suggest more multiple income households in the rural areas of the upper catchment, associated with higher levels of self employment and higher levels of unpaid work on family farms/businesses (13% compared with 5% for the whole catchment and 4% for the whole District).

Existing framework for water management

3.1 Resource Management Act (RMA)

Tasman District Council is responsible for sustainable management of land and water and other natural and physical resources of the Motueka Catchment, and its coastal resources up to 19km offshore, under the Resource Management Act 1991 (RMA).

Included within this mandate, Tasman District Council is responsible for water management including water allocation, water quality management, and the full range of integrated resource management issues. The Council undertakes these functions through:

- preparing and implementing a Regional Policy Statement and regional and district plans, the latter two now being amalgamated under the umbrella of its Tasman Resource Management Plan (TRMP)
- granting or declining resource consents, comprising land use consents, water permits, discharge permits and coastal permits. (Water permits are required for damming, diverting or taking water and a discharge permit is required for discharges to water or onto land)
- investigating and monitoring resources, and reporting on the state of the environment
- monitoring and enforcing compliance of resource uses with their resource consents or relevant permitted activity rules in planning documents
- advocating good environmental practice, and in some cases providing funding or services for supporting this; for example, funding for riparian fencing, soil conservation or wetland protection.

3.2 Tasman Resource Management Plan (TRMP)

The TDC's Tasman Resource Management Plan includes both regulatory and non-regulatory methods for managing land, water and coastal resources. It contains policies and specifies how the policies will be implemented. This includes the setting of rules, which may require people to carry out their activities in accordance with these rules or to apply for a resource consent. Other methods of implementing plan policies are monitoring and investigations; financial incentives; and education and advocacy.

Rules in the plan control water-related activities such as discharges to water, land and air; water takes from rivers and groundwater; damming and diversion of rivers; and diversion and discharge of water from wetlands and land. The level of prescriptive rules for water allocation depends on the present and potential pressure for water use in individual water bodies or catchments, as well as the level of knowledge of the availability and variability of water in each water body. The TRMP (s18.4) also has NZ's first rules limiting afforestation of land in locations where that afforestation would reduce the supply of water already allocated to downstream water users.

3.3 Motueka Water Conservation Order (WCO)

The Motueka WCO, gazetted by Government in 2004, sets high level rules to recognise and protect the following values deemed to have national significance: the wild and scenic character of the Wangapeka above the Dart confluence, several streams providing blue duck habitat, the karst systems of Mt Arthur and Mt Owen, the brown trout fishery of the main stem between the Wangapeka and Shaggery confluences, and the Wangapeka River and parts of the river that may contribute flows or spawning waters to support the brown trout fishery.

The WCO sets a low flow management regime to protect the fishery while accommodating limited growth in water demand in the Motueka catchment. In the Wangapeka, no more than 6% of the flow may be taken, while in the mainstem Motueka the limit is 12% as measured at Woodstock. The WCO also contains limits on changes to water quality and river form. Since the WCO came into force, TDC has made changes to the Water chapter of the TRMP to set water allocation limits in upper Motueka sub-catchments to 'operationalise' the flow sharing provisions (Fenemor, 2004).

Limits for these zones are shown in the following table. Allocations in the upper catchment cannot exceed 1000 l/sec, including permits in the tributaries listed, each of which has its own allocation limit. If each of these tributaries were fully allocated, there would be only 54 l/sec remaining for the rest of the upper catchment.

UPPER MOTUEKA WATER MANAGEMENT ZONES	ALLOCATION LIMITS (litres/sec)
Upper Motueka	1000
including:	
Wangapeka	265
Motupiko	110 fully allocated
Tadmor (total augmented flow)	56 fully allocated
Tapawera Plains	515

3.4 Irrigation user groups

TDC sets water allocation policy in a consultative manner with water user committees who also advise and liaise over Council action when restrictions on water use need to be imposed during drought. Water user committees have been formed in the upper Motueka, Tadmor, Motueka/Riwaka Plains, Hau Plains and Riwaka zones. In addition, a Motupiko Water Augmentation Committee was formed in 2004 to oversee a feasibility study of dam sites and water release into the fully allocated Motupiko catchment.

3.5 Iwi liaison committee

The three Motueka iwi (Ngāti Rarua, Te Atiawa, and Ngāti Tama) have formed the Motueka Iwi Resource Management Advisory Komiti (MIRMAK), which meets monthly at Motueka's Te Awhina marae. MIRMAK is a forum for discussion of iwi views on resource consent applications, development proposals and planning issues. In addition, MIRMAK is working with the Motueka ICM research programme developing iwi environmental management systems on GIS to help inform their input into these processes.

3.6 Fish & Game/ DOC

The Nelson-Marlborough Fish & Game Council represents sport fishers and gamebird hunters and has a statutory responsibility to advocate for freshwater habitat protection for fishery management purposes. DOC has a similar responsibility to advocate for the protection of native habitats. Both agencies strongly influence and participate in Council policy processes for freshwater management, and Fish & Game initiated the application that led to the Motueka Water Conservation Order.

4. Water flows, water quality and their implications for ecological and biophysical values

4.1 Instream flows & associated biodiversity

Instream flows for trout habitat within the Motueka River and its larger tributaries have been investigated thoroughly in the process leading to the decisions on flow and water quality limits in the Motueka Water Conservation Order. For smaller streams, the Motueka ICM programme has developed a "Quick Smart" methodology to determine flow needs, but this has not been widely applied yet.

Instream flow needs for other values including other ecological values, recreation, landscape values and iwi cultural values are less well numerated, for either larger or smaller streams. The TRMP lists values for the Motueka, including the eel fishery, trout spawning, native fish, wildlife habitat including blue duck, and internationally significant karst values (Schedule 30.1).

4.2 Water quality

Water quality has been investigated within the ICM research programme and by TDC, and like most NZ rivers declines in the lower reaches mainly due to the effects of farming. For example, (Young and others 2005, State of Surface Water Quality in Tasman District) found that concentrations of suspended solids, nitrate nitrogen, total nitrogen, *Escherichia coli*, and *Campylobacter* were higher at sites draining pastoral and horticultural land than in similar-sized streams draining native or plantation forest. Nitrate levels in groundwater under irrigated crops are higher than under dry land and concentrations reflect the rate of flow and hence dilution in the underlying aquifer. Research in the ICM programme also showed the significant bacterial loading created by cows crossing streams, and the benefits of bridging to reduce these impacts. Temperature fluctuations in tributaries like the Motupiko and Tadmor exceed guidelines for fish during summer, and there are signs of the effects of land use intensification in water quality in smaller catchments like these.

4.3 Groundwater levels and their impacts on the coastal zone

A groundwater flow model has been developed for the Motueka/Riwaka Plains and has been used by TDC to set water allocation limits in the TRMP for those water management zones. A similar model is being developed within the Motueka ICM programme for the upper Motueka aquifer around Tapawera; one aim of the research is to better understand the linkages between river flows and groundwater usage. There is only a small amount of groundwater available in the more confined middle Motueka reach between these upper and lower Motueka water management areas. The Motueka/Riwaka model estimates steady state (mean) groundwater to the coast of about 2500 litres/sec when there is no irrigation pumping.