5. CURRENT MANAGEMENT

5.1 Department of Conservation

Overview

The Bay of Plenty Conservancy of the Department is responsible for managing the Kaimai-Mamaku Forest Park and a number of other smaller reserves throughout the catchments, with a focus on the following:

- Goat control - northern Kaimai and Mamaku.
- Integrated pest control in northern Mamaku, at Opuiaki.
- Kokako monitoring and management at Mokaihaha.
- Pest plant monitoring and control programmes.
- Threatened species monitoring and management
- Forest condition monitoring throughout the Forest Park.
- Boundary fencing.
- Encroachment resolution - boundary issues with adjacent landowners.
- Management of concessions.
- Recreation management.
- Historic site management.
- Fire management.

The Department of Conservation undertakes monitoring and management within three management zones in the Kaimai-Mamaku Forest Park:

- ‘Northern’ - the northern Kaimai Range;
- ‘Central’ - the southern Kaimai Range;
- ‘Southern’ - Mamaku Plateau.

In the Northern Zone, the emphasis is on: (1) the maintenance of heritage values associated with historical mining and logging operations, and the provision of infrastructure to ensure that these assets are accessible, (2) goat control, (3) hut and track infrastructure.

In the Central Zone, the emphasis is on provision of a more ‘back country’ experience for hunters and trampers, with a network of huts and tracks along the range, accessible from various locations.

In the Southern Zone, the main emphasis is on the maintenance and enhancement of biodiversity values. There is, as yet, minimal provision for recreational use in this area, apart from track networks on the margins and the Ngatuhoa Lodge concession. The Department is considering options for improving access to enable the public to experience the results of the Department of Conservation management activities here.
Goat Control

The New Zealand Forest Service assigned a high priority to goat control in the Kaimai Range (Jane 1978: P.7), and undertook intensive ground-based hunting using dogs and aerial shooting. The Department of Conservation has an extensive goat control programme in the northern Kaimai Range, with a currently high level of ground-based hunting. DOC also has localised goat control areas in the northern Mamaku Plateau (see Figure 16).

The Northern Zone of the Forest Park is subdivided into six units for goat control:

- Wairoa (3,582 ha);
- Waitengaue (2,161 ha);
- Wairakau (1,522 ha);
- Waitawheta West (1,886 ha);
- Te Aroha (1,972 ha);
- Mangakino (2,362 ha).

Goat kills in the Northern Zone for the period 2004-2007 are shown in Figure 17 and 2008-2009 are shown in Figure 18.

Possum Control

Table 19 summarises recent possum control operations on Department of Conservation-administered land within the Kaimai-Mamaku project area. Possum control operations within Mokaihaha, the Opuiaki Core Area, and Otanewainuku (adjacent to the project area) are also described in written summaries of those projects, elsewhere in this report (see also Figure 16).
Figure 17 - Department of Conservation goat kills 2004-2007.
Figure 18: Department of Conservation goat kills 2008-2009.
Table 19: Recent possum control operations on DOC-administered land within the Kaimai-Mamaku project area.

<table>
<thead>
<tr>
<th>Treatment Area</th>
<th>Area (Ha)</th>
<th>Year</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mokaihaha</td>
<td>848</td>
<td>2001</td>
<td>1080 in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002</td>
<td>1080 in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2003</td>
<td>Cholecalciferol in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>1080 (aerial)</td>
</tr>
<tr>
<td></td>
<td>c. 2,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opuiaki Canopy Area</td>
<td>4,470</td>
<td>2006</td>
<td>1080 (aerial)</td>
</tr>
<tr>
<td>Opuiaki Core Area</td>
<td>1,130</td>
<td>2002</td>
<td>Set-up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2003</td>
<td>1080 in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2004</td>
<td>1080 in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2005</td>
<td>1080 in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>1080 (aerial)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2007</td>
<td>Cholecalciferol in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td>1080 in bait stations</td>
</tr>
<tr>
<td>Orokawa</td>
<td>354</td>
<td>1995</td>
<td>Brodifacoum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1996</td>
<td>Brodifacoum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2001</td>
<td>1080 (ground)</td>
</tr>
<tr>
<td>Otanewainuku</td>
<td>925</td>
<td>1994</td>
<td>Traps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1997</td>
<td>1080 (ground), cholecalciferol, traps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1999</td>
<td>1080 (ground), brodifacoum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006</td>
<td>1080 (ground)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2007</td>
<td>Cholecalciferol in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td>Cholecalciferol in bait stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2009</td>
<td>Cholecalciferol in bait stations</td>
</tr>
<tr>
<td>Otawa</td>
<td>830</td>
<td>2001</td>
<td>Cyanide, traps</td>
</tr>
<tr>
<td>Waiorongqomai, Kaimai Mamaku Forest Park</td>
<td>975</td>
<td>1994</td>
<td>Brodifacoum, traps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1996</td>
<td>Brodifacoum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2003</td>
<td>Cyanide, traps</td>
</tr>
</tbody>
</table>

The Department also administers a block system for private commercial possum hunters, and there has been increased interest in possum hunting over the last two years or so, in response to higher fur prices (B. Angus, Department of Conservation, pers. comm.). This activity has been mainly in the northern Kaimai and frontal ridge country, some of which includes northern rata.

Deer

The Department administers a hunting permit system for recreational hunting. Aerial hunting is not permitted, although aerial poaching is reported occasionally (B. Angus, Department of Conservation, pers. comm.).

Sites Managed for Intensive Predator Control

The Department of Conservation undertakes intensive predator control at Opuiaki and Mokaihaha, as described below.

Opuiaki Ecological Area

Opuiaki Ecological Area, in the upper Wairoa catchment, has long been recognised for special values in relation to both vegetation and fauna. The Opuiaki Ecological Area has received intensive biodiversity management from the Department of...
Conservation since 2003, when a five-year possum and rat control programme was undertaken to secure forest health and to protect and increase the remnant populations of threatened species such as North Island kokako, brown kiwi, kākā, kākāriki, and falcon (see Figures 19 and 20). The Opuiaki kokako population is one of 23 identified as needing active management to achieve North Island Kokako Recovery Plan objectives (Innes and Flux 1999).

In 2003, bait stations were set up through 1,130 ha of forest containing most of the known kokako territories, and filled with 1080, targeting possums and rats. Possum and rat control has been carried out annually since then. 120 mustelid traps were set up in 2004 to provide additional protection to North Island kokako and any North Island kākā, North Island brown kiwi, and whio remaining in Opuiaki. These traps were run continuously until June 2009.

In 2003, a kokako census survey located a total of 27 kokako (including seven pairs). A further census survey in 2008 located a total of 49 kokako, including 15 pairs, indicating that possum and rat control since 2003 had allowed the known kokako population to increase substantially.

Since 2006, sustained possum control has been carried out in 4,470 ha surrounding the 1,130 ha ‘core area’, with associated monitoring to assess the response of forest vegetation to the removal of possums (Figure 19).

In 2008, a kiwi detection dog/handler team located and transmitterised a pair of North Island brown kiwi in Opuiaki. In 2009, after 12 months of monitoring indicated no sign of successful breeding, the pair was captured and transferred to Tuhua (Mayor) Island.

Several bird species recorded as present in 1975 (Owen 1999) are currently thought either to have been lost from the area, or are present only in very low numbers (Wildland Consultants 2000). These include whio (blue duck), of which individual birds have occasionally been sighted in the last decade (e.g. in 1998 at Rereioturu Falls (John Heaphy, Department of Conservation, pers. comm., 2000), in 2005 in the Waipapa Stream (Brad Angus, Department of Conservation, pers. comm., 2009), kākāriki (yellow-crowned and, possibly, red-crowned), and North Island rifleman, although kākāriki and rifleman have recently been recorded close to Opuiaki (Robertson et al. 2007, Kelly 2008).
Figure 19: Department of Conservation management zones in Opulaki Ecological Area.
Figure 20: Department of Conservation bait station and trap line layout at Opuiaki.
Mokaihaha Ecological Area

The northern part of Mokaihaha Ecological Area, a remnant of primary indigenous forest protected as part of the Department of Conservation-administered Horohoro Forest Conservation Area, is drained by tributaries of the Waihou River, and is part of a larger site which has undergone two distinct phases of possum and rat control since 2001 (see Figure 21). The objective of the first phase was to increase the breeding success and total size of the North Island kokako population, which had previously been surveyed in 1977, 1983, and 1997. The 1997 survey found a total of 50 kokako, including 18 territorial pairs. The Mokaihaha population is one of 23 identified as needing active management to achieve North Island Kokako Recovery Plan objectives (Innes and Flux 1999). In 2001 and 2002, 2 separate operations using 1080 pellets in bait stations over 848 ha reduced possum Residual Trap Catch (RTC) indices to <2%, and rat tracking tunnel indices to ≤1%. A third operation in 2003, using cholecalciferol in bait stations, resulted in a possum RTC of 3.4% and a rat tracking tunnel index of 6%. A kokako census survey in 2004 found a total of 50 kokako, including 22 pairs (Evans 2009).

Further pest control did not occur until 2006, when two areas of Mokaihaha (each around 900 ha, the western site being the bait station grid used between 2001 and 2003) became study sites for Landcare Research’s Multiple Pest Dynamics Project. An aerial 1080 operation in 2006 was followed, from 2006 to 2009, by sustained rat control in the western part of Mokaihaha Ecological Area (Ruscoe et al. 2009).

A kokako census in 2009 located 49 kokako, including 19 pairs. The size of the known kokako population has remained relatively stable since 1997, suggesting that the level of possum and rat control since 2001 has been sufficient to at least prevent a decline in total population size.

Ecological surveys carried out by the Department of Conservation in 2008 confirmed the presence of both long-tailed and short-tailed bat, bush falcon, North Island kākā, and rifleman, as well as other less-threatened indigenous forest bird species. Deer and pig sign was common; feral goats and wallabies were not detected. While the forest canopy was assessed as being in reasonable condition, impacts of browsing animals on the forest understorey were described as ‘severe’, with many areas characterized by bare ground, or unpalatable ferns and shrubs. Palatable plant species were generally less abundant, or absent altogether from the understorey. Pest plants were found to be largely confined to forest edges and are not thought to pose a significant threat. Recent land-use change from exotic plantation forest to pasture was also identified as a potential threat, through increasing edge effects such as wind throw and weed invasion on the forest margins, and reducing the availability of habitat corridors between Mokaihaha and surrounding natural areas (Kelly 2008a).

Threatened Plants

The Department maintains a database of threatened species records and undertakes threatened plant inventories (refer to various Cashmore references in this report). There are numerous threatened plant records within the project area, as summarised in Section 4.9 of this report.
Figure 21: Department of Conservation pest control treatment area, Mokaihaha Ecological Area.
Pest Plant Management

The Department of Conservation has undertaken various pest plant inventories within the project area and maintain a database of weed species and known locations (see Figure 11). Control work has been undertaken in various locations, for many species, as summarised in Table 20:

Table 20: Department of Conservation weed control undertaken for particular species at various locations in the Kaimai-Mamaku project area.

<table>
<thead>
<tr>
<th>Site/Location</th>
<th>Weed Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maungaruhine Pā HR (No. 3 Road)</td>
<td>Kiwifruit, old man’s beard, cathedral bell, ginger, gorse, blackberry, Japanese honeysuckle, montbretia, wandering Jew, garden escapes, Chinese lantern, cypress tree, gum tree.</td>
</tr>
<tr>
<td>Demeter Road End Stewardship Area</td>
<td>Blackberry, gorse, pampas, ginger, woolly nightshade, Chinese lantern, Japanese honeysuckle.</td>
</tr>
<tr>
<td>Otawa Stewardship Area</td>
<td>Ginger, blackberry, gorse, Japanese honeysuckle, pampas, wandering Jew, Mexican daisy.</td>
</tr>
<tr>
<td>Otanewainuku No. 2 Road</td>
<td>Wandering Jew, Japanese honeysuckle, jasmine, woodland poppy.</td>
</tr>
<tr>
<td>Omanawa RD (Hidden Gorge SR)</td>
<td>Banana passionfruit, jasmine, cathedral bell, ginger, blackberry, watsonia, bougainvillea, wattle.</td>
</tr>
<tr>
<td>Whakamarama Road-End (KMFP)</td>
<td>Mint, red cestrum, wandering Jew, selaginella, pines, gorse, blackberry, climbing asparagus, woolly nightshade.</td>
</tr>
<tr>
<td>Aongatete</td>
<td>Wandering Jew.</td>
</tr>
<tr>
<td>Thompsons Track</td>
<td>Montbretia, Japanese honeysuckle, bulbs, wormwood, watsonia.</td>
</tr>
<tr>
<td>Rea Road</td>
<td>Montbretia</td>
</tr>
<tr>
<td>Dickeys Flat</td>
<td>Gorse, Japanese honeysuckle, blackberry, montbretia, barberry, lemon mint.</td>
</tr>
<tr>
<td>Karangahake</td>
<td>Mexican daisy, woolly nightshade, eelagnus, laurel, pampas, Madeira vine, periwinkle, wandering Jew, Japanese honeysuckle, montbretia, ivy, buddleia, cotoneaster, selaginella.</td>
</tr>
<tr>
<td>Crown Rd, Karangahake</td>
<td>Chocolate vine.</td>
</tr>
<tr>
<td>Karangahake Railway</td>
<td>Bamboo etc.</td>
</tr>
<tr>
<td>Mt Te Aroha Road</td>
<td>Mexican daisy, pampas, broom, montbretia, Spanish heath, gorse, blackberry.</td>
</tr>
<tr>
<td>Tui Mines</td>
<td>Pine trees, pampas, agapanthus, buddleia, ginger, montbretia, pink headed knot week, pitted crassula, plectranthus, red cestrum, strawberry dogwood, stone crop, privet, wandering Jew.</td>
</tr>
<tr>
<td>Waiorongomai</td>
<td>German ivy, English ivy, onion grass, arum lilly, wandering Jew, hawthorn, Chinese privet, Japanese honeysuckle, Mexican daisy, selaginella, montbretia, cape gooseberry, grey willow, barberry, periwinkle (buck rock), blackberry, gorse.</td>
</tr>
<tr>
<td>Till Road End (KMFP)</td>
<td>Hydrangea, Japanese honeysuckle, German ivy.</td>
</tr>
<tr>
<td>Kaimai Summit</td>
<td>Wandering Jew, Japanese honeysuckle, gorse, blackberry, broom, jasmine, aluminum vine, buddleia, montbretia, ivy’s breeches, Mexican daisy, Spanish heath, selaginella, sycamore.</td>
</tr>
<tr>
<td>Old Kaimai Road (down by stream)</td>
<td>Blackberry, gorse, ginger, selaginella, montbretia, jasmine, wandering Jew, contorta, barberry, hydrangea, grape.</td>
</tr>
<tr>
<td>Grammers Road</td>
<td>Pine regeneration.</td>
</tr>
<tr>
<td>Woodlands Road</td>
<td>Pine regeneration.</td>
</tr>
<tr>
<td>Site/Location</td>
<td>Weed Species</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Orokawa Bay SR</td>
<td>Japanese spindle tree, ginger, Mexican devil, phoenix palm, cape ivy, acmena, montbretia, cotoneaster, pampas.</td>
</tr>
<tr>
<td>Taumata Scenic Reserve</td>
<td>Black ivy, ivy, gorse, grey willow, privet, buddleia.</td>
</tr>
<tr>
<td>Wainui Scenic Reserve</td>
<td>Climbing asparagus, woolly nightshade.</td>
</tr>
<tr>
<td>Snodgrass Road</td>
<td>Kiwifruit, woolly nightshade, banana passionfruit, climbing asparagus.</td>
</tr>
<tr>
<td>Te Puna Stream</td>
<td>Woolly nightshade.</td>
</tr>
<tr>
<td>Aongatete River</td>
<td>Woolly nightshade, gorse.</td>
</tr>
<tr>
<td>Welcome Bay Rd Wetland</td>
<td>Gorse.</td>
</tr>
<tr>
<td>Ngapeke Road</td>
<td>Wild ginger, woolly nightshade, pampas, mignonette vine.</td>
</tr>
<tr>
<td>Orokawa Bay SR</td>
<td>Ginger, pampas.</td>
</tr>
<tr>
<td>Maungarauahine Pā HR</td>
<td>Kiwifruit, old man’s beard, cathedral bells, ginger, gorse, blackberry.</td>
</tr>
<tr>
<td>Waimapu Stream Marginal Strip</td>
<td>Woolly nightshade.</td>
</tr>
<tr>
<td>Mangorewa</td>
<td>Grey willow, crack willow, climbing spindleberry, ivy.</td>
</tr>
<tr>
<td>Horohoro Forest</td>
<td>Heather</td>
</tr>
<tr>
<td>Endean Road, Horohoro Forest</td>
<td>Wandering Jew, hydrangea.</td>
</tr>
<tr>
<td>Patetere SR</td>
<td>Heather, contorta, pampas, wattle, barberry, cotoneaster, gorse.</td>
</tr>
<tr>
<td>Mamaku Forest</td>
<td>Contorta.</td>
</tr>
<tr>
<td>Ex-FRI</td>
<td>Contorta, heather.</td>
</tr>
<tr>
<td>Upper Waihou</td>
<td>Old man’s beard.</td>
</tr>
<tr>
<td>Mokaihaha Ecological Area</td>
<td>Contorta, heather.</td>
</tr>
<tr>
<td>Arahiwi SR</td>
<td>Ivy.</td>
</tr>
<tr>
<td>Selwyn SR</td>
<td>Heather.</td>
</tr>
</tbody>
</table>

Source: Data supplied by Department of Conservation.

Vegetation Monitoring Overview

Vegetation monitoring is used to evaluate vegetation condition in relation to the influences of natural processes and factors such as introduced browsing animals. A range of techniques is available, including permanent sample plots, transects, and foliar browse assessments. An overview of all vegetation monitoring currently undertaken by the Department of Conservation is shown in Figure 22. It is evident that there is a strong concentration of monitoring effort in the northern catchments, with other effort focussed on foliar browse assessments in selected southern and central catchments.

Vegetation monitoring in the northern Kaimai is shown in Figure 23, in the southern Kaimai in Figure 24, at Opuiaki in Figure 25, and at Otanewainuku-Otawa in Figure 26.
Figure 22: Vegetation Monitoring Network within Kaimai - Mamaku
Figure 23: Department of Conservation vegetation monitoring network in the northern Kaimai Range.
Figure 24: Department of Conservation vegetation monitoring network in the southern Kaimai Range.
Figure 25: Department of Conservation vegetation monitoring network in the Opuiaki Ecological Area.
Figure 26: Department of Conservation vegetation monitoring network on the Otanewainuku-Otawa Range.
Vegetation - Permanent Sample Plots

Two exclosure plots were established in the southern Kaimais in 2000/01, and twelve 20 × 20 m plots were established in the Kaimai Range in 2004/05. (B. Angus, Department of Conservation, pers. comm.). A number of plots were established by the New Zealand Forest Service in 1974 and some of these plots were remeasured in, 1984 and 1985. A number of new plots were also established in 1984 and 1985. Information is held in the National Vegetation System (NVS) database, but no remeasurement has occurred since then. A deer exclosure plot is maintained within the Aongatete Forest Restoration Trust pest control area and is used for educational purposes. There is one 20 × 20 exclosure and related control plot in Otanewainuku, established in 1980, and this has been remeasured twice.

New Zealand Forest Service ‘Eco-Survey’ transects established in 1960 were remeasured in 1982 (Williams and Leathwick 1990). This remeasurement found that Mamaku Plateau forests were not experiencing the same degree of ungulate impacts as Pureora and Kaimanawa, the other two central North Island forests included in the study. ‘Eco’ transects at Opuiaki were previously measured in the 1960s.

A network of permanent plots has been established throughout New Zealand, by the Ministry for the Environment, on an 8 km grid, to measure carbon sequestration and indigenous biodiversity. This system is known as the ‘Land Use Carbon Analysis System (LUCAS) and plot locations are shown in Figure 22.

Vegetation - Canopy Condition Assessment

Rata view monitoring of 153 northern rata trees was established in 2000 and remeasured in 2008. Although the initial measurement in 2000 found living northern rata to be in moderate condition, most had suffered canopy thinning as a result of possum browse damage. The 2008 remeasurement of 140 rata (Woods 2008) found that perimeter dieback had increased, along with canopy density. Average tree condition had declined slightly from 2000. Woods (2008) concluded that it was unclear whether aging of rata trees or possum impacts were the cause of the slight deterioration in tree condition.

Twelve Foliar Browse Index (FBI) lines (Payton et al. 1999) were established in the northern Kaimai Range in 2000 to assess possum impacts on possum-preferred species such as kohekohe, mahoe, pate, and tawa. The twelve lines were located in a random manner. The 2000 measurement found that kohekohe were in good to excellent condition compared to possum-free sites, such as Little Barrier Island, and other possum-affected sites, such as Te Kauri Park Scenic Reserve near Kawhia. Remeasurement of seven of the 12 FBI lines was completed in 2009, with the balance of five lines to be remeasured in early 2010 (B. Angus, Department of Conservation, pers. comm.). Results to date of this monitoring indicate that possum-preferred species are in moderate to good condition, in relation to possum impacts.

Eleven Foliar Browse Index (FBI) lines were established in the southern Kaimai Range in 2000, to monitor mahoe, kamahi, and pate. The initial measurement found that 3% of mahoe showed signs of possum browse, but that half exhibited signs of trunk use. Kamahi were in poor condition: 73% had foliar cover of less than 55%,
and nearly one third exhibited obvious signs of browsing damage. Remeasurement of these FBI lines in 2008 (Woods 2008) found an increase in mahoe and pate foliage cover, but increasing browse levels on mahoe, from 2001. The greatest number of trees found dead were kamahi, which also exhibited a deterioration in foliage cover from 2000. Browse scores on kamahi were higher in 2001 than 2008, which led Woods (2008) to suggest that kamahi may be unable to recover from single severe browse events, and rather that they go through a period of long slow decline. Alternatively, the increase in browse damage on mahoe, coupled with the decrease in kamahi browse scores may indicate that diet switching is occurring.

Ten Foliar Browse Index (FBI) lines were established in the northern Mamaku Plateau, five within the Opuiaki Ecological Area in 2004, and five in 2005 within the Canopy Area around the Opuiaki core management area.

Six FBI lines have been established in the Otawa/Oropi forests to evaluate kohekohe, mahoe, mangeao, raukawa, and kamahi. Results obtained from these lines show that seventy percent of kohekohe exhibit evidence of browsing, about 20% of individuals had foliar covers less than 50%. Almost half the raukawa have foliar cover scores less than 50%, and more than half the kamahi had foliar cover less than 50%. These results suggest that possum browse is having a significant negative impact on canopy condition. A high degree of spatial variation in the severity of possum browse was noted during the 2000 FBI measurement (Willems 2000) and also in casual observations by Department of Conservation staff in recent years (B. Angus, Department of Conservation, pers. comm.).

Five FBI lines were established in 1994 in the Otanewainuku Conservation Area (Corbett 1994), and three new transects were added in 2000. The FBI lines in the Otanewainuku survey assessed kohekohe, mahoe, pate, and kamahi, and the 2000 remeasurement observed significant recovery of kohekohe canopy cover since the 1994 measurement (Willems 2000). This recovery was attributed to possum control operations within the area. Another measurement in 2003 showed canopy condition has declined seriously (Corson 2003). A further remeasurement in 2009 (Slimin 2009) showed that, in years where possum control was performed, canopy condition for all indicator species was healthy, with kohekohe being close to optimum foliar cover of 60-70 percent. However in the period where control did not occur (2000-2005) canopy condition declined seriously (Slimin 2009).

Possum and Rat Monitoring

Residual Trap Catch (RTC) monitoring of possums throughout the northern Kaimai Range in April/May 2000 returned an average RTC of 17%, although individual trap lines varied from 10% to 33% (Willems 2000).

A possum and rat survey conducted in 1994 (Wills 1994) in Opuiaki and the Woods Mill Block found a possum trap catch index of 9.3%, rat trap index of 9.2%, with one stoat also trapped in Opuiaki. In the Woods Mill Block, possum trapping returned a catch rate index of 13.3%, and a rat trap index of 5.1%.

A possum and rat survey was also carried out and reported for Opuiaki Ecological Area in 2005, in association with predator control operations there (Thyne 2006). The
initial possum trap catch rate of 10% pre-treatment declined to 0.26% post-treatment, and the rat trap catch of 10% declined to 0% as a result of the pest control operations.

Pre- and post-control monitoring of possums and rodents have accompanied annual control operations from 2003-2008 within the Opuiaki Core Area. Post-control operation indices range from 0.1% to 2.7% for possum residual trap catch indices and 0% to 32% for rodent tracking tunnel indices.

### Deer, Goats, Possums, and Vegetation Condition

The New Zealand Forest Service (Dale and James 1977) established a network of transects throughout the project area to sample the density of deer, possums, and goats, based on faecal pellet transects and associated vegetation assessments. Transect locations are shown in Figure 27. These transects were last measured in 1985 (B. Angus, Department of Conservation, pers. comm.).

### Lizards

Whitaker (2000) undertook a survey for lizards and frogs within the Opuiaki Ecological Area, and within nearby Department of Conservation-administered land within the catchments of the Waiwhakarewarewa, Waiwhakangau, and Waiomou Streams. Day and night-time searches of indigenous forest, shrubland, and stream habitats located a number of forest geckos and introduced green and golden bell frogs. Other species not found, but thought to be probably present, included Pacific gecko, green gecko, copper skink, and striped skink. Ornate skink, Hochstetter’s frog, and southern bell frog were considered to possibly be present. A capture and release project for striped skink (*Oligosoma striatum*) was undertaken in the northern Kaimai, on Mt Te Aroha.

### Frogs

A survey for Hochstetter’s frogs undertaken in 2003 covered the northern and southern Kaimai Range and the very northern part of the Whakamarama plateau (Smuts-Kennedy 2003). This survey included Oropi Forest, in three blocks of land administered by the Department of Conservation. Seven Hochstetter’s frogs (*Leiopelma hochstetteri*) were found in two of 38 streams/tributaries in Otawa Forest, including the site where a frog was originally found in 1992. These surveyed forests lie to the northeast of the Mamaku Plateau and no indigenous frogs were found on the Mamaku Plateau, which is composed of much younger rhyolite and ignimbrite flows than the geological structure of frog habitats in the northern Kaimai Range and Otawa. The survey extended northward from the southern boundary of SH29. Five specimens of Hochstetter’s frog were found, all in northern parts of the Kaimai Range. Preferred habitat is on steep slopes of ‘minimally-degraded stream headwaters’, in sites shaded with overhead vegetation.
Figure 27 - New Zealand Forest Service transects for faecal pellet assessments in the Kaimai Range (source: Dale and James 1977).
Boundary Management

The Department of Conservation has, since the early 1990s, put considerable effort into boundary management, to reduce encroachments by domestic stock, especially escapes from farms and establishment of new feral goat infestations in the Forest Park. (There has been good evidence of escaped farm goats forming new feral populations). This has involved the establishment of a landowner database and a long programme of landowner liaison and boundary fence management. The Department of Conservation has also advocated for District Plan controls on goat farming, along with Forest and Bird, and the Western Bay of Plenty District Plan now contains a fencing standard for goat farms.

Historic Site Management

Considerable effort has gone into restoration of historic sites, site interpretation, and improvement of access to such sites. The main focus of this work has been in the Waiorongomai Valley, in the Middle Waihou catchment.

Fire Management

The Department is a rural fire authority and has responsibilities for fire permits, fire management, and physical responses to any wild fires within or adjacent to Conservation land.

Recreation

There is an extensive network of walking tracks (400 km) and huts (7) within the Forest Park, as shown in Figure 28. The network of recreational facilities is heavily used, with about 200,000 users per annum (K. Knill, Department of Conservation, pers. comm.). Further information is provided in Section 4.13 above.

5.2 Environment Waikato

Environment Waikato manages erosion and flooding issues in the Waihou catchment under the auspices of Waihou Valley Scheme, which is increasingly integrating other environmental considerations into their management practices. The Clean Streams project provides funding support for landowners to protect water ways to help improve water quality.

- Waihou Catchment Management
  - Flood protection on plains
  - River management
  - Upper catchment protection

- Clean Streams programme
  - Stock exclusion - fencing water ways
  - Enhancement planting
Figure 28: Department of Conservation track and hut network in the Kaimai-Mamaku project area.
Waihou Catchment Scheme

Conversion of land to pastoral use and mining may have contributed to the increased frequency of the flooding events which have been an issue since the late 1800s, particularly within the Ohinemuri and Lower Waihou (Kessells 2008). A combination of intensification of land use within the river flood plain, and modification of upper catchments have both contributed to increasing impacts of flood events (Kessells 2008).

A range of flood protection measures were implemented, in a somewhat haphazard fashion, up to the 1940s when the Hauraki Catchment Board was formed by statute under the Soil Conservation and Rivers Control Act, 1941 (Kessells 2008). Hauraki Catchment Board assumed full control of Waihou Scheme from the Ministry of Works in 1960, and identified the need for extensive and long term solution to flooding and soil conservation within the Waihou (Kessells 2008). In 1971 the now $14 million scheme was initiated at Netherton and stopbanking the Waihou River commenced. This was the largest and most complex flood control scheme ever attempted in New Zealand (Watton 2006), and was also the first whole catchment scheme in the country. In addition to stop-banking in lower reaches, the project included upper catchment protection, involving fencing of streamsides and planting with willows and poplars. Recently water quality and biodiversity aspects have been incorporated. After 42 years of involvement with the Waihou Catchment Scheme the Hauraki Catchment Board was disbanded as a result of local government restructuring, and the newly formed Waikato Regional Council assumed management of flood protection works (Watton 1995 in Kessells 2008). Three managers currently oversee on-the-ground works, based in Paeroa.

Environment Waikato purchased a number of pastoral marginal strips as a component of the Waihou catchment scheme. Environment Waikato (EW) owns over 2,500 hectares of land within the Waihou and Piako River catchments (Wildland Consultants 2008b). Land purchased by EW was initially planted with fast-growing exotic tree species to establish riparian vegetation in an effort to rapidly stabilise river and stream banks. More recently, water quality and biodiversity aspects have been incorporated into the catchment management scheme and EW now have a strategy to replace early plantings with indigenous species on land they manage. This land comprises a variety of ecosystem and landform types, including forested hill country, riparian areas, wetlands, and flood plains. Forty-four sites where biodiversity values could be enhanced were identified by Environment Waikato, and Wildland Consultants (2008b) reported on enhancement opportunities at each site, and prioritised sites for implementation. This strategy will be implemented over a number of years. The Department of Conservation also has land in marginal strips along the Waihou River.

The Waihou River riparian habitat restoration report recommends enhancing riparian areas along the lower reaches of the Waihou and lowland tributaries as well as restoring significant wetlands to improve fish and bird habitat.
In steeper parts of the Waihou catchment, the EW Farm Plans initiative provided a subsidy for retiring steeply erodible land. Included within the initiative was a 70% subsidy on fencing costs, with conditions, and a 35% subsidy on maintenance of fencing through time. Also subsidies for control of plant and animal pests on retired land. The Farm Plans Initiative resulted in c.120 land approval agreements within the Waihi Basin and along the Kaimai Range. These agreements are valid for 99 years. Where land approval agreements were reached for areas covered by indigenous vegetation EW advocated covenanting the agreements with QEII Trust. This resulted in a three-way sharing of costs.

In upper catchments, much of the former Crown land is now pine forest, including lands managed by Rayonier and Matariki Forests. Many of these former Crown-owned pine forests were established under the Waihou Catchment Management Scheme. Other pine forests established under the Waihou catchment scheme were handed over to the New Zealand Forest Service, then sold. Some were purchased by Environment Waikato, and are still in Environment Waikato ownership, i.e. the area in the vicinity of Thompsons Track.

The ‘Clean Streams’ initiative was set up by Environment Waikato in 2002, with a fund of $10 million dollars to subsidise fencing of riparian strips on private land. The fund provides 35% of the cost of fencing, and subsidises the planting of indigenous species within fenced marginal strips. The fund is competitive, with applications assessed on a range of criteria including position within catchment, whether the project is part of a joint effort by neighbouring landowners, site profile, and exposure.

The four zones within the Waihou catchment have distinctly different soil conservation requirements. The majority of soil conservation works completed under the Waihou Valley Scheme (WVS) has occurred along the Kaimai Range and the edge of the Mamaku Plateau, including the establishment of approximately 3,000 ha of protection/exotic plantation forest in upper catchments. The protective forests in upper catchments, which are mostly indigenous forests (68.5% of ‘mountain zone’, 91,693 ha), are major soil conservation assets of the Waihou Catchment Scheme (van der Weteringh 1997).

Environment Waikato monitors rainfall and river flows throughout the catchment. Automated rainfall recorders are located on the Kaimai Summit (Rapurapu catchment), and at Te Aroha and Waihi, while river flow recorders are located at Okauia, Shaftesbury, Te Aroha, Karangahake, and Queens Head (Waihi). Environment Waikato and NIWA also carry out water quality monitoring at a number of sites along the Waihou River (Whites Road, Okauia, Te Aroha) and some of its tributaries (Ohinemuri, Oraka, Waiomou and Waiohoto)

- Whites Road - upper catchment
- Okauia - middle catchment
- Te Aroha - middle to lower catchment
- Ohinemuri at Paeroa - Ohinemuri river draining Waihi Basin

Appendix 2 gives an overview of the water quality data at the above four sites, showing water quality in relation to standards for ecology and swimming.
5.3 Environment Bay of Plenty

Environment Bay of Plenty has a number of management initiatives dealing with issues in the Tauranga Harbour catchments:

- Catchment management planning;
- Sustainable land management;
- Sustainable coastal management;
- Biodiversity protection and enhancement;
- Consent requirements and monitoring;
- Estuary, Land and Coast Care Groups;
- Environmental Enhancement Fund;

The Tauranga Harbour Integrated Management Strategy (Environment Bay of Plenty, 2006) identified sedimentation from the Tauranga catchments to the harbour as the largest environmental management issue for the western region. In response to this strategy, Council made a commitment to undertake a three-year sediment source study by the National Institute of Water and Atmospheric Research (NIWA) of the southern Tauranga Harbour and its catchments. The results of this study will complement the existing work in the catchments and further guide land management and policy decision-making for the western Bay of Plenty.

**SmartGrowth Strategy**

SmartGrowth is a joint project between Environment Bay of Plenty, Tauranga City Council, Western Bay of Plenty District Council, and tangata whenua. The SmartGrowth area covers all east-flowing catchments from Waihi to Otamarakau, covering the catchments flowing into Tauranga Harbour included in this study. The purpose of SmartGrowth is “to develop and implement a strategy for the sustainable development of the western Bay of Plenty sub-region for the period 2000-2050”. One component of the SmartGrowth Strategy is the identification and prioritisation of existing and potential ecological linkages within the Tauranga Harbour catchment for future restoration effort (Wildland Consultants 2007c, 2007d, Environment Bay of Plenty 2006, and 2007). Many of the corridors identified are centred on streams and rivers that connect areas of high ecological value in the upper catchment (the Kaimai Range and Mamaku Plateau) and lower catchments (Tauranga Harbour). For example, both the Wainui River and Uretara Stream connect Category 1 natural areas at their upper and lower ends.

**Ecological Management Corridors**

Environment Bay of Plenty (2006) identified six priority ecological corridors in the catchment of the Tauranga Harbour as part of the SmartGrowth Strategy. These ecological corridors are further explained by Wildland Consultants (2007a) and listed below:
The ecological corridors comprise actual or potential ecological linkages between areas of indigenous habitat in the SmartGrowth project area. Four of the corridors - Tuapiro, Work Road, Te Puna, and Hidden Gorge - extend from the Harbour inland to the Kaimai Range, one extends from the harbour inland to the Papamoa Hills, and the remaining one is located on the margins of Tauranga Harbour, between Aongatete and Waipapa.

Regional Monitoring

Environment Bay of Plenty monitors a range of environmental indicators as part of the Natural Environment Regional Monitoring Network (NERMN)\(^1\).

As part of the NERMN programme, Environment Bay of Plenty monitors rainfall and river flow at a number of sites in the catchment. The following sites are where rainfall data is collected:

- Tuapiro at Woodlands - Tuapiro catchment;
- Waipapa at Goodall’s - Te Puna/Waipapa catchment;
- Tauranga Harbour at Omokoroa - Te Puna/Waipapa catchment;
- Rapurapu at Kaimai Summit - Wairoa catchment;
- Waimapu at McCarroll’s Farm - Waimapu catchment.

River level data is collected at these sites:

- Tuapiro at Woodlands - Tuapiro catchment;
- Waipapa at Goodalls - Te Puna/Waipapa catchment;
- Wairoa above Ruahihi Power Station - Wairoa catchment;
- Wairoa below Ruahihi Power Station - Wairoa catchment;
- Waimapu at McCarroll’s farm - Waimapu catchment;
- Kopurererua at State Highway 29 - Omanawa catchment.

NERMN also includes sediment monitoring within Tauranga Harbour, sediment modelling within Tauranga Harbour catchments (results anticipated in late 2009), and river water quality monitoring (including 10 waterways within the Tauranga Harbour catchment).

---

\(^1\) The aim of the NERMN is “to provide scientifically defensible information on the important physical, chemical and biological characteristics of the Bay of Plenty Region as a basis for the preparation of Council policy statements and regional and coastal plans, and the monitoring of the suitability and effectiveness thereof” (Taylor and Park 2001).
Environment Bay of Plenty also monitors fresh water quality for bathing standards and air quality monitoring at 3 sites in the Tauranga catchment, as required under the national standards for bathing and air quality.

Storm and tidal information, water level, and barometric pressure is also measured at three sites on the Tauranga Harbour, as part of the coastal monitoring programme.

A variety of monitoring is also undertaken through the land management section at Environment Bay of Plenty. This includes: protection area monitoring, pest plant monitoring, and ad-hoc monitoring of indigenous and introduced species by some of the care groups.

Vegetation and Habitat Monitoring

Environment Bay of Plenty has a network of dune monitoring sites along the Bay of Plenty coastline, including the stretch between Bowentown and Waihi Beach.

Environment Bay of Plenty also periodically undertakes forest canopy condition assessments along the regional coastline, including the section north of Waihi Beach to Orokawa Bay.

5.4 Other management and monitoring

Otanewainuku

The Otanewainuku Kiwi Trust oversees a project, initiated in 2001 by Forest and Bird’s Te Puke branch, to ensure the long-term survival of kiwi in Otanewainuku Forest, and to protect the indigenous flora and fauna for future generations. This site is on the eastern margin of the project area. Since 2006, the project has also incorporated possum and rat control (see Figure 29), and the project’s goals have widened to include restoration of the North Island kokako population.

Resident kiwi numbers, estimated to be around 50 birds in 1984, had dropped to six known birds in 2006. Four captive-reared kiwi (one male, three females) were released into Otanewainuku in 2007. One pair has formed and produced four nests, however no eggs have successfully hatched. The Trust’s plans to build and operate a pest-fenced kiwi crèche near Otanewainuku were put on hold in 2009, pending the Kiwi Recovery Group’s review of national kiwi crèche facilities, and the Trust is now planning to source Operation Nest Egg (ONE) - reared kiwi from Whirinaki Forest.

North Island kokako were transferred from Otanewainuku to Little Barrier Island in 1983, and one or two kokako are now thought to remain within the project area. A kokako was also heard calling nearby, at Otawa trig, in 2002. The Trust is planning to reintroduce North Island kokako to the project area in 2010.

The Trust commenced mustelid trapping in 2002, initially using a contractor, but subsequently using volunteers, covering 935 ha. In 2006 a bait station network covering 925 ha was established and annual possum and rat control has been carried
Figure 29: Operational area for intensive pest control undertaken by Otanewainuku Kiwi Trust.
out since. Possum control has generally been successful, achieving Residual Trap Catch (RTC) indices of 1-8%, however the rat control has been less successful, as indicated by tracking tunnel indices ranging from 11 to 72%.

Stoat and rodent trapping data has been collected since 2002 by the Otanewainuku Kiwi Trust, and this shows annual summer peaks in trapping rates typical of stoats, presumably due to the occurrence of stoat pups that have left natal dens.


**Aongatete**

The Aongatete Forest Restoration Trust, established in 2006 by Forest and Bird’s Tauranga branch and the Katikati Rotary Club, undertakes possum and rat control in c.250 ha of indigenous forest in the Aongatete River catchment (see Figure 30). Bird surveys in September 2008 indicated that key forest bird species were more frequently encountered in areas where possums and rats were controlled, than in areas where no pest control occurred.

Forest and Bird Protection Society have undertaken surveys of the invertebrate faunas within the Aongatete Restoration site, and within the Otanewainuku Kiwi Trust site. Initial results suggest the invertebrate fauna at Aongatete is typical of collapsing forest, while the fauna at Otanewainuku is more typical of healthy mature phase forest (P. Maddison pers. comm.).

**Kaimai (Wairere Falls) Multiple Pest Dynamics study sites**

Two areas - both around 900 ha - of indigenous forest in the vicinity of Wairere Falls became study sites for Landcare Research’s Multiple Pest Dynamics Project in 2006. The southern site is an experimental control where no pest management occurs, while the northern site received continuous stoat control, using trap lines of Department of Conservation 150 traps (Ruscoe *et al.* 2009), from 2006 until February 2009.

**Forest and Bird Society Bird Survey and Monitoring**

As part of its Kaimai-Mamaku Campaign, Forest and Bird recently carried out two bird surveys of the area. The first was a systematic survey carried out in October 2009, using the five minute bird count method. The second, less formal survey, the ‘Everybirdy Day’, involved observers recording birds seen and heard over the course of one hour in the Forest Park and its environs, during November 2009.

**5.5 Care groups**

All catchments except the Paeroa, Middle Waihou, Upper Waihou, and Te Rereatukahia have active care groups (refer to Figure 31). The areas of care group activity are mainly close to the volunteer base. Numerically, most care groups are active in and around Tauranga City, with other care group clusters at Te Puna and Waihi. Urban care group activities focus on vegetation management, both pest plant
Figure 30: Operational area for intensive pest control undertaken by Aongatete Forest Restoration Trust.
Figure 31: Environmental Care Groups within Kaimai - Mamaku
control and planting of indigenous species. There are three care groups active at sites within or adjacent to indigenous forest of the Kaimai-Mamaku Forest Park, all of which have pest animal control as a primary activity. A summary of care group activities is provided in Appendix 7.

Friends of Puketoki are also monitoring changes in invertebrate composition and abundance through time in response to sustained predator control within Puketoki Scenic Reserve. Monitoring is in early stages, and no clear trends are yet evident. However, some species have shown marked increases in abundance following rodent and possum control (R. Cooper pers. comm.).

6. CATCHMENT SUMMARIES

6.1 Waihou catchments

6.1.1 Waihi

A reasonably large catchment at the northern end of the Kaimai Range, adjoining Waihi township and the Karangahake Gorge. About half of the catchment is upper-catchment indigenous forest, much of which has been logged, while most of the balance is pasture used for dairy farming and dry-stock grazing. Indigenous forest is partly tawa-dominant, with remnant unlogged podocarp/tawa forest, and with an extensive tract of the kauri-softwoods-hardwoods-beeches complex, much of which was logged for kauri. Beech forest occurs on the highest ridges. Remnants of northern rata are present in various parts of the catchment. The upper catchment includes 731 ha of the Ngatukituki Forest Sanctuary and very minor overlaps with the East and West Ngatukituki Ecological Areas, extending on to high ridges along the main range at Mt Te Aroha and Pahiko.

The catchment has a long history of goat control. There is an extensive vegetation monitoring infrastructure, including rata view sites, foliar browse lines, and 20 x 20 m permanent plots.

A typical suite of common forest birds is present, including kererū and tomtit. Kākā and falcon are itinerant visitors. There are pre-2004 records of kiwi, with a cluster of records on the Waitengaue divide. Hochstetter’s frog are present in several sub-catchments. There are quite a number of threatened plant site records for the catchment, and numerous weed records (particularly near Karangahake).

Vegetation condition is moderate, reflecting a long history of browse damage by goats and possums. The lower catchment is heavily modified, with little remaining indigenous vegetation. There is considerable potential for improvement of stream conditions with improved land use practices and riparian retirement and fencing.

The catchment is heavily used for walking-based recreation, with a network of tracks at Karangahake and in the Waitawheta and Mangakino Streams (including two huts). Sections of the Ohinemuri and Waitawheta Rivers are whitewater kayaking/rafting destinations, and both rivers offer good quality trout fishing.
6.1.2 Paeroa

A highly modified catchment on the northern flanks of the project area. Catchment land-use is predominantly farmland (82%), with only 9% in indigenous vegetation, of which less than half is formally protected. Farmland includes steep land on upper slopes with erosion issues, while lower-lying land has significant flooding issues. The main indigenous vegetation types are tawa forest and rimu-tawa forest.

Goat control is undertaken by the Department of Conservation. Pest plants are a significant threat to remnants of indigenous vegetation.

Bird, reptile, bat, and invertebrate populations are probably comparable with those of other mainland forests not subject to intensive predator control.

Limited ecological monitoring is carried out, consisting of Foliar Browse Indices to assess possum impacts on indigenous vegetation.

Vegetation condition in the sub-catchment is considered to be moderate-good, although possum-palatable species such as kohekohe and northern rata are suffering from browse damage in localised areas.

Recreational use is low, except in the vicinity of the Karangahake Gorge (walking, kayaking, trout fishing), but there are historic logging and mining features throughout the catchment. The overall state of indigenous biodiversity in the catchment is poor.

Major requirements and opportunities exist to protect and enhance waterways, exclude stock from forest remnants in the upper catchments, and reduce the impacts of pest plants and pest animals on indigenous vegetation.

6.1.3 Te Aroha

A relatively small and steep sub-catchment adjacent to Te Aroha township, with streams originating on Mt Te Aroha. Lower slopes on easier terrain have a long history of clearance and fire modification, and dominant land uses are urban areas and pastoral farming. This sub-catchment can experience extreme flooding and related damage. Steeper slopes largely retain indigenous forest, characterised by tawa and rimu-tawa forest at lower altitudes, and silver beech-dominant forest on higher ridges around the summit of Mt Te Aroha.

The sub-catchment is part of a long-running feral goat control programme, and possum control has been carried out in the southern part of the catchment. Pest plants are a significant threat, especially adjacent to Te Aroha township.

Overall, the sub-catchment contains high ecological values in the Forest Park, with good quality altitudinal sequences of vegetation, rare plants, and rare fauna (including stag beetle).

Vegetation and species monitoring in place includes rata view sites and a recently-established permanent vegetation plot.
Vegetation condition in the sub-catchment is considered to be moderate-good, however possum-palatable species such as kohekohe and northern rata are suffering from browse damage in localised areas. Pest animal and pest plant impacts are adversely affecting indigenous vegetation and biodiversity. Various land uses are contributing to the poor water quality of the Waihou River.

The sub-catchment receives high recreational use, including walking and mountain biking tracks, and mining heritage sites.

Remediation of the Tui mire tailings, which recently received funding, presents a major environmental challenge.

6.1.4 Middle Waihou

This sub-catchment covers a long section on the western side of the northern and central Kaimai Range, between the peaks of Pahiko in the north and Waianuanu in the south. The area includes special and representative ecological features and sequences within two ecological areas. The upper slopes (c.50% of sub-catchment area) retain extensive areas in indigenous forest, mainly rimu-tawa and tawa forest, logged in places, while softwood-hardwood associations and silver beech-dominant forest and swamp forest occur on the summits and ridges of the main Kaimai Range. Mid-slopes and lower flanks are farmed and have a long history of modification. Much of these areas are now subject to controls in Matamata-Piako District Plan. At lower altitudes, only limited remnants of indigenous vegetation remain.

Parts of the upper sections of the sub-catchment are subject to goat control and possum control (Waiorongomai treatment area). Vegetation monitoring is in place, in northern and southern parts of catchment, including rata view monitoring in the Waiorongomai, and Foliar Browse Index lines.

Bird, reptile, bat, and invertebrate populations are probably comparable with those of other mainland forests not subject to predator control.

Vegetation condition is regarded as being moderate to good. However, understorey browsing, especially by red deer, is becoming more apparent, and there is evidence of sustained browse impacts on possum-palatable species such as kohekohe, northern rata, kamahi, and kaikawaka.

Environment Waikato has key roles in the lower catchments, in relation to riparian protection and waterway enhancement. Pest plant impacts are also significant in these lower areas. Possum impacts in upland forest need further assessment. Other key issues for the sub-catchment are the increasing impacts of red deer on indigenous forests, and the water quality of the Waihou River.

The Kaimai Heritage Trail runs through the Middle Waihou catchment, and the Kaimai Range and Mamaku plateau are accessed by a number of tracks in the Middle Waihou sub-catchment, including the Tuahu Track, Thompsons Track, the Wairere Falls Track and Te Tuhi Track. Recreational hunters use these tracks to access red deer hunting in the southern Kaimai Range and on the Mamaku Plateau.
6.1.5 Upper Waihou

A large catchment encompassing the northern and central Mamaku Plateau, with a considerable network of tributaries, running from near the peak of Waianuuanu in the north to the headwaters of the Oraka Stream in the south. This sub-catchment includes parts of the Mokaihaha and Opuiaki Ecological Areas.

A large proportion of the upland plateau has been cleared of indigenous forest (remaining indigenous vegetation covers 28% of the sub-catchment) and converted to exotic plantation forest (26% of sub-catchment). Remaining indigenous forest is predominantly tawa forest, from which much of the emergent rimu has been removed by selective logging. Most of the lower catchment has been cleared of indigenous vegetation.

Feral cattle and goats are still present in low numbers throughout parts the sub-catchment, and feral goats are subject to ongoing control. Feral pigs and red deer are present, particularly in the Mokaihaha Ecological Area. Significant assemblages of threatened fauna remain in Mokaihaha, including long-tailed and short-tailed bats, and a significant population of North Island kokako, which receives intensive pest animal management. Significant weed issues exist along main access/arterial roads, largely due to the dumping of garden waste.

A geographically isolated population of dwarf galaxias (*Galaxias divergens*) in the Waihou headwaters is a distinctive feature of the sub-catchment’s fauna.

Most of the northern rata in the sub-catchment’s indigenous forests have disappeared due to the impacts of possums. Vegetation condition varies markedly, with obvious deterioration in the south but high quality vegetation, including understorey composition, in the north.

There are significant land management issues associated with farmland (45% of sub-catchment) in the lower catchment, although there are riparian restoration projects underway. Water quality management is a significant issue. Other significant issues include the impacts of pest animals in natural areas where they are not subjected to active management, and pest plant impacts, particularly along forestry roads.

Walking tracks off SH 29 are used by day-walkers and recreational deer hunters.

6.2 Tauranga-Bay of Plenty catchments

6.2.1 Waiau

The Waiau sub-catchment encompasses the Bowentown-Athenree-Waihi Beach area and is characterised by high levels of land use modification. Vegetation is predominantly pasture and exotic forest, with limited remnants of indigenous vegetation, including regenerating kauri forest, and coastal forest remnants along the coast to Orokawa Bay. There are significant estuarine wetlands on the margins of Tauranga Harbour.
Possum control (1994-2001) has been undertaken to protect pohutukawa stands, as well as pig control (2001-2006), but pigs and goats are currently of concern. Pest plants pose significant threats to coastal forest remnants.

Periodic walk-through monitoring is undertaken, and some sites are also included in EBOP aerial coastal forest monitoring. Dunelands are covered in EBOP’s dune monitoring network, but quantitative data on trends in vegetation condition is otherwise lacking.

Bird, reptile, and invertebrate populations are probably comparable with those of other mainland forests not subject to intensive predator control. Shorebirds utilise the beach between Bowentown and Waihi, including northern New Zealand dotterel.

Major issues requiring focus are pest plant and animal impacts on forest remnants and wetlands.

In terms of recreational use, the coastal track to Orokawa Bay is heavily used, and the area’s beaches are very popular.

6.2.2 Tuapiro

The Tuapiro sub-catchment is fed by two large tributaries, the Waitengaue and the Wairoa Streams. The middle and upper reaches are mostly covered in indigenous forest, including part of East Ngatukiti Ecological Area. Kauri-dominant forest, much of it logged, and tawa-dominant forest are the characteristic vegetation types, with upland forest on the highest ridges. The lower catchment is highly modified, and remaining indigenous vegetation remnants are subject to weed invasion.

Forested areas of the sub-catchment receive ongoing goat control.

Monitoring includes northern rata, foliar browse lines, and permanent vegetation/exclosure plots. Monitoring data indicates that vegetation condition is currently moderate to good, with possum impacts concentrated on individual kohekohe and northern rata.

Hochstetter’s frog occurs in the Wairoa Stream catchment. The condition of bird and invertebrate populations are probably comparable with those of other mainland forests not subject to pest control. The catchment was formerly a ‘hotspot’ for kiwi records.

Riparian protection and control of pest plants in indigenous forest remnants are significant issues in lower parts of the catchment, while impacts of pest animals are pervasive in areas where control is not carried out.

Kaimai Forest Park and its wider network of tracks and huts are accessible through tracks at the end of Woodland Road.

6.2.3 Uretara

Includes Katikati township and margins of Tauranga Harbour, with just over one-third of the catchment (mainly upper catchment areas) in indigenous forest; mostly tawa-
dominant but with a significant semi-coastal element (kohekohe and puriri) and lower levels. A kauri element is present locally, with upland forest on the highest steep country, including part of the East Ngatukituki Ecological Area. Middle and lower reaches of the catchment are highly modified, and are mostly pasture lands (about a third of the total area).

The catchment is within the Department of Conservation’s wider northern Kaimai goat control area.

Monitoring includes northern rata, foliar browse lines, and permanent vegetation/exclosure plots. Monitoring data indicates that vegetation condition is currently moderate to good, with possum impacts concentrated on individual kohekohe and northern rata.

A typical suite of common forest birds is present, including kereru, and there is also a record of rifleman in the catchment. Hochstetter’s frog may be present.

Kaimai Forest Park and its wider network of tracks, huts and local relicts of historic logging activity, are accessible through tracks at the ends of Wharawhara and Lindemann Roads.

Considerable interest exists in ecological restoration. Uretara Estuary Managers are active in the catchment, and EBOP is working with private land owners to protect and enhance indigenous biodiversity.

Major issues in the Uretara sub-catchment include erosion and sedimentation associated with waterways, pest plant impacts in lower-catchment indigenous vegetation remnants, pest animal impacts in unmanaged areas, and improved management of riparian margins to benefit streams and harbour environments.

6.2.4 Rereatukahia

Similar to the Uretara catchment, with c.40% of the upper catchment in indigenous forest and having a heavily modified middle and lower catchment. The upper catchment is mostly tawa-dominant forest but also includes upland forest on the highest ridges. Kauri forest stands remaining here are close to their southern limit on the east coast. The Rereatukahia sub-catchment includes the northern section of Te Hunga Ecological Area. The lower reaches are mostly farmland and horticulture land, extending to the margins of Tauranga Harbour.

The catchment has a long history of goat control. Eradication of a koi carp infestation in the lower catchment has been attempted.

There is no vegetation monitoring within the catchment but monitoring to the north (Uretara) and south (Aongatete) includes similar vegetation types so is likely to be relevant. Monitoring data from those neighbouring catchments indicates that vegetation condition is currently moderate to good, with possum impacts concentrated on individual kohekohe and northern rata.
A typical suite of common forest birds is present, including kereru, and there is a small concentration of old kiwi records in the catchment.

Kaimai Forest Park and its wider network of tracks, huts and local relicts of historic logging activity, are accessible through tracks at the end of Hot Springs Road, and from Thompson’s Track. Hot springs (Sapphire springs) are present adjacent to the lower Rereatukahia Stream.

EBOP is working with private landowners in this area, and there is one landcare group. Management issues that need to be addressed include erosion and sedimentation associated with waterways, impacts of pest plants in lower-catchment vegetation remnants and their spread along Thompsons track, and impacts of pest animals in unmanaged areas.

6.2.5 Aongatete

Aongatete sub-catchment includes a network of streams flowing into Tauranga Harbour, with c.53% in indigenous forest, most of which is situated in the upper catchment. Indigenous vegetation is mostly tawa-dominant and podocarp/tawa forest, with a significant element of upland forest on the highest ridges. Aongatete sub-catchment includes a significant proportion of the Te Hunga Ecological Area.

Intensive predator control is being implemented by the Aongatete Forest Trust over c.250 ha in the vicinity of the Aongatete Lodge, with positive responses in bird populations. The Aongatete catchment has a long history of goat control, but goats are currently absent or at very low levels in the Aongatete catchment, and the area is not a focus of current goat control operations.

Vegetation monitoring includes a network of foliar browse lines, located generally at lower elevations, although there are also foliar browse lines just outside of the catchment on the upper ridges in the middle Waihou catchment. In tawa-dominant forest, palatable understorey species have been removed from all but inaccessible sites. Tawa is shade-tolerant (and browse-tolerant) and will continue to regenerate, but the understorey composition of tawa-dominant forest is now much less diverse. Possum-palatable canopy species have also been affected and Foliar Browse Index data suggests that the overall condition of vegetation is moderate, with evidence of sustained impacts on possum-preferred species.

A typical suite of common forest birds is present, including kereru, and there is an old kiwi record. Where sustained pest animal management is occurring, as within the Aongatete Forest Trust area, indigenous bird populations are likely to be more healthy than at unmanaged sites.

Kaimai Forest Park and the network of tracks and huts are accessible from Aongatete Lodge. Ngatamahinerua plateau and the upper Aongatete catchments are hunted recreationally for red deer.

The lower catchment is highly modified, being mostly pastoral and horticulture, and EBOP is working with private landowners in this area.
Issues that need to be addressed within the Aongatete sub-catchment include erosion and sedimentation associated with waterways, pest animal impacts in unmanaged areas, and pest plant impacts in lower-catchment vegetation remnants.

6.2.6 Te Puna

A relatively small catchment with only c.25% remaining in indigenous vegetation, with the balance in pasture and orchards. Indigenous vegetation is mostly cutover tawa-dominant forest located in the headwaters, although there are also remnants in the middle reaches of the catchment.

Intensive pest control is underway in the Puketoki Reserve, with positive responses in birds and invertebrates. Pest control is also being undertaken on Māori land, in conjunction with Landcare Research. Care groups are very active. In the upper catchment, Whakamarama Inc. is undertaking riparian retirement, while a number of groups are operating in the vicinity of the Omokoroa Peninsula. EBOP and Western BOP District Council are working closely with these groups and a catchment management assessment has recently been undertaken.

There is one foliar browse line in the catchment, and monitoring in the Te Puna and adjacent catchments indicates that the overall condition of vegetation is moderate, albeit with evidence of sustained impacts on possum-preferred species. Overall, vegetation condition is probably in slow decline. Where intensive management of pest animals is carried out, vegetation condition is probably stable or improving.

Bird, bat, lizard, and invertebrate populations are probably comparable with those of other mainland forests not subject to intensive control.

Te Tuhi track and the Leyland O’Brien Walkway are accessible from the end of Whakamarama Road.

Retirement of high gradient pasture streams is now recognised as a high priority. The Omokoroa Peninsula is a designated urban growth node, and considerable urban expansion is planned for this catchment. Other significant management issues for Te Puna sub-catchment include erosion and sedimentation associated with waterways, pest plant impacts in lower-catchment vegetation remnants, pest animal impacts in unmanaged areas. Improving connectivity between upper and bottom parts of catchments is also desirable, particularly in relation to care group desires for increased abundance of indigenous wildlife in lower catchments, and improved access to recreational infrastructure via the Whakamarama Road end.

6.2.7 Wairoa

Wairoa is the largest single catchment in the project area, at nearly 37,000 ha, with a significant proportion (58%) in indigenous vegetation and the balance in pasture and exotic plantation forest (some of which has recently been converted to pasture). The upper catchment includes a significant proportion of the Opuiaki Ecological Area, containing a large tract of podocarp/tawa forest and stands of podocarp forest on alluvial terraces which are of considerable ecological significance. Much of this area has never experienced high numbers of browsing ungulates and, as a result, has a
good quality understorey. The middle reaches of the river includes a hydro dam and lake. The lower catchment is heavily developed for farming and includes the settlement of Bethlehem and ecologically significant wetlands on the margins of Tauranga Harbour.

Sustained control of possums, rats, and stoats has been undertaken since 2003 within the Opuiaki Ecological Area, with related monitoring.

Vegetation monitoring includes a network of foliar browse lines across the catchment. Foliar Browse Index monitoring suggests vegetation condition is moderate where pest animals are not controlled, with evidence of sustained impacts on possum-preferred species, and vegetation condition is probably in slow decline. Understorey condition on the northern Mamaku Plateau, including Opuiaki, is among the best in the North Island. The cobalt-deficient soils appear to be incapable of supporting large populations of ungulates.

A significant suite of threatened species is present, including kokako, kākā, falcon, rifleman, long-tailed cuckoo, kiwi, long-tailed bat, and short-tailed bat. Periodic census surveys of the Opuiaki kokako population are carried out.

The Wairoa River is heavily utilised for flat-water rowing and kayaking in the lower reaches and, further upstream, white-water kayaking and rafting are very popular when adequate flows are released from the hydro structures. Lake McLaren is used for walking, kayaking, and picnicking. Trout, rudd, and tench are present in the lake. Ngatuhoa Youth Lodge is heavily used by school, youth and other interest groups, and has a linked network of walking tracks.

Particular issues for the Wairoa catchment include erosion and sedimentation associated with waterways, pest plant impacts in the lower-catchment vegetation remnants, pest animal impacts in unmanaged areas, recent, and large-scale conversion of exotic plantation forest to dairying in the upper catchment around Omanawa, with attendant impacts on water quality and loss of wildlife corridors, and the need for ongoing intensive pest management at Opuiaki.

6.2.8 Omanawa

A heavily modified catchment with less than 40% remaining in indigenous vegetation, of which c.50% is private land, within the Omanawa and Kopurererua catchments. A significant number of covenants have been established over privately-owned forest. The remaining indigenous forest is mostly tawa-dominant or podocarp/tawa. Exotic plantation forest is a significant land use and parts have recently been converted to pasture. Lifestyle blocks are common, even within and adjacent to indigenous forest in the middle section of the catchment. The lower catchment is now heavily developed, with significant subdivision above SH 29. Wetlands in the lower reaches of the Kopurererua Stream are being restored (TCC is heavily involved) and the very lowest reaches include industrial land uses and wetlands on the margins of Tauranga Harbour.

No vegetation monitoring is carried out in indigenous forest in the upper catchment, but foliar browse lines at Otawa-Otanewainuku are in similar vegetation types and are
likely to be directly relevant. TCC has vegetation and habitat monitoring in place in natural areas in the lower catchment. The overall condition of vegetation is likely to be moderate, but with sustained impacts on possum-preferred species, and overall vegetation condition is probably in slow decline.

A typical suite of common forest birds is present, including kereru, tomtit, and whitehead, and there are records of kākā and long-tailed cuckoo, with old kiwi records in the catchment.

Recreational use within the Omanawa sub-catchment is largely restricted to recreational hunting of red deer and fallow deer.

Key management issues include erosion and sedimentation associated with waterways, pest plant impacts in lower-catchment vegetation remnants, pest animal impacts in unmanaged areas, water quality in the Kopurererua and Omanawa Rivers, and recent forestry-to-dairy conversions in upper catchment around Ngawaro, with related impacts on water quality and fragmentation of wildlife corridors.

6.2.9 Waimapu

Similar to Omanawa in that only c.29% remains in indigenous vegetation, and a large proportion (46%) is pasture. The lower catchment includes Tauranga City and the margins of Tauranga Harbour. The Waimapu catchment has long been recognised as part of a significant ecological corridor (c.f. Beadel 1995). The upper catchment is mainly cutover tawa-dominant forest. The middle and lower catchment is highly modified and there is considerable scope for riparian protection works.

Part of the upper catchment is within the Otawa possum control block (830 ha), which was treated in 2001. The upper catchment is also immediately adjacent to the Otanewainuku Kiwi Trust pest control project, and there will be ‘spillover’ benefits from that project. The Waimapu care group operates in the lower reaches of the Waimapu Stream and on the margins of Tauranga Harbour. A number of other care groups are carrying out ecological restoration projects within the catchment.

Vegetation monitoring includes one foliar browse line in the catchment, with others located in similar vegetation types in adjacent catchments. Monitoring results in and adjacent to the Waimapu catchment suggest that, beyond management areas, the overall condition of vegetation is moderate but there is evidence of severe impacts on possum-preferred species, and vegetation condition is probably in decline. Where sustained possum control is being carried out, palatable species such as kohekohe and northern rata are recovering.

A typical suite of common forest birds is present, including kereru and robin, with records of long-tailed cuckoo and kākā, and old records of kiwi.

Recreational uses include the track to the Otanewainuku mountain summit, off Mountain road. Also, Otawa forest contains a fallow deer population popular with recreational hunters.
Particular issues for the Waimapu catchment include erosion and sedimentation associated with waterways, pest plant impacts in vegetation remnants throughout all tributary catchments, pest animal impacts in unmanaged areas, and ongoing dumping of organic and inorganic rubbish from road access points, contributing to ongoing spread of pest plants.

6.2.10 Otawa

The Otawa sub-catchment has the lowest proportion of indigenous forest (18%), compared to other sub-catchments within the study area, with the balance in pasture, horticulture, and urban. About half of the indigenous vegetation is in formal reserves but a significant proportion of the balance is protected with Nga Whenua Rahui kawenata and there are also some small Western BOP District Council covenants. Remaining indigenous forest is tawa-dominant, with some podocarp/tawa forest in the vicinity of the Otawa high point. Indigenous vegetation in the middle reaches of the catchment is heavily fragmented and there is considerable potential for ecological restoration. The lower parts of the Otawa catchment have been heavily modified by conversion to pasture grassland, orcharding, and urban land uses.

Part of the upper catchment is within the Otawa possum control block, which was treated in 2001. Occasional goat control is carried out. Two care groups are operating in this catchment. The wider ‘catchment’ also includes Mauao, and TCC is undertaking restoration works there, and Coast Care is active on beaches at Mt Maunganui.

Two foliar browse lines are present on the upper watershed ridge and there are another 12 in adjacent catchments that are also relevant to the vegetation types present at Otawa. Monitoring results in and adjacent to the Otawa catchment suggest that, outside managed areas, the overall condition of vegetation is moderate but there is evidence of severe impacts on possum-preferred species, and vegetation condition is probably in decline.

A suite of typical forest birds is present, including kereru. Kiwi are present (in low numbers) to the south at Otanewainuku, and there are old records from Otawa. Individual kokako may still be present. Hochstetters’ frog have been searched for and not found, although they are present in the adjoining Raparapahoe Stream catchment. Little blue penguin and grey-faced petrel breed at Mauao.

Recreational use within the catchment is centred on Otawa Forest, which contains a walking track and a fallow deer herd popular with recreational hunters.

Particular issues for the Otawa catchment include erosion and sedimentation associated with waterways, water quality in the Waitao stream, pest plant impacts in lower-catchment vegetation remnants, fragmentation of lower-catchment habitats and the consequent need for ecological restoration and creation of linkages along streams, and pest animal impacts in unmanaged areas.