Cost projections for eradication and containment options for the National Pest Management Plan for bovine tuberculosis (NPMP TB)

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Background

This document was initially prepared for the Project Governance Group (PGG) meeting on 25th May 2015, but has been updated to include strategic variations and technical modifications since requested by the PGG, TBFreeNZ, and other experts.

Empirical cost projections for the NPMPM TB are developed for a number of strategic and funding scenarios. The projections are based on the predicted cost per ha of achieving TB freedom for each of the current management areas with Vector Risk Areas (VRAs), based on the current probability of TB freedom (PoF; values range from 0 = infected to 1.0 = free, and were subjectively estimated by TBFreeNZ's Area Diseases Managers) for each area.

Key assumptions are:

1. Each year of active management increases PoF by 0.05 if eradication is assumed to take 19 years (see 4 below), or by slightly more or less (by up to three years) if the desired eradication timeline specified is a few years shorter or longer respectively.
2. Active management (vector control and surveillance) ceases at a 'stopping rule' (SR: currently when PoF = 0.95)
3. Current strategic approaches and management techniques continue unchanged, except the prioritisation of areas is changed to fit each particular funding scenario
4. An all-area average annual vector control cost of $9.16/ha/y is assumed for all areas, for both ground and aerial control, except that a multiplier of 1.5 is applied in ground control areas in which more than 50% of the area is good possum habitat. This includes contractor and internal TBFreeNZ directly related to planning and implementing the vector management programme, but none of the livestock testing and disease management costs nor the cost or research, and corporate/Head Office function). The cost is derived empirically from the actual expenditure over the last four years in a subset of Vector Control Zones (VCZs; the spatial units in which wildlife TB hosts are managed. The subset of VCZs used for this have all been targeted for eradication before 2026 under the current (3rd) NPMP and all require further management before each VCZ can be declared statistically free of TB (i.e.; until a quantified PoF of 0.95 is achieved. Achieving of TB freedom at this cost is assumed to take 19 years. This timeframe is empirically based on these areas already having been under control for an average of 13.5 years and assuming an average of 5 further years of management is required. It is assumed that speeding up the eradication process to achieve statistical freedom in a shorter time would require a proportionately greater cost/ha/yr (i.e. the total cost stays the same).

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5. TB is assumed to randomly re-emerge in a percentage [2.5%; (1-SR)/2] of areas declared statistically free and be detected at a some random interval 1-20 years after the initial declaration of TB freedom. The cost of 're-eradication' is assumed to be proportionate to the time to detection (100% at 20 years) and was assumed to apply to an area of 20,000ha. It was assumed there was no subsequent second re-emergence.
6. At the national level, spending on vector management in any particular year was set at the minimum amount of either (1) the scheduled cost or (ii) the maximum amount possible with a specified total funding envelope for the NPMP programme as a whole after all of the non vector costs (livestock testing, disease management, contact centre, research, and corporate) had been subtracted. Estimates of non-vector costs were provided by TBFreeNZ for each year until 2040, with a different set of estimates for each of the strategic options being costed.
7. By 1 July 2016, it was assumed that only 8.5m ha of VRA will remain (i.e.; that almost 1m ha of current VRA will have reached or exceeded the stopping rule by then). It is conservatively assumed all of that will require management.

Eradication projections

Under the above assumptions, an immediate start in all VCZs from mid-2016 would incur an initial 2016 vector management cost of $77m. That substantially exceeds the $53m budgeted for 2015/16, and (by even more) the amount initially available for vector management under options where the total funding envelope is reduced by up to a quarter from recent levels. Some deferral of vector management will therefore be required. VCZs were therefore prioritized as follows;

(i) All of the unmanaged or still infected (PoF = 0) areas where eradication will take the longest were afforded a high priority – because these are predicted (under the assumptions above) to take 16-22 year of management to be declared free, they determine how quickly national freedom can be achieved. Deferring these areas (total of ~2m ha) automatically results in prediction of a longer time to freedom.

(ii) All long-managed areas where the recent or current occurrence of Tb in livestock or ferrets indicates that there is still a substantial risk of TB transmission from wildlife to livestock are also afforded high priority. This should not only provide the fastest possible reduction (under the above costs assumptions) in vector-caused TB levels in livestock, but also a reduction in disease management and testing costs that will enable increasing proportion of the funding available to be spent on vector management

(iii) Areas already in the process of being declared free (PoF>0.8) were also afforded priority, so that the investment in that expensive process was not wasted by having to be repeated in future.

In all of the above areas, it was assumed eradication management would begin immediately. For all of the remaining (lower priority) the initiation of vector management aimed at eradication was deferred by up to a maximum of 12 years depending on the option being evaluated, and even linger in areas where high numbers of livestock provide an early warning system for detecting persistent TB presence in wildlife well before it could spread to multiple VCZs. Deferral was treated stochastically across multiple iterations of the costing model – in any one iteration, a VCZ targeted for deferral was assigned a start date between zero and the maximum amount of deferral specified.

This had the effect of spreading start dates for the lower priority VCZs evenly over the first decade of the programme. Limited sensitivity testing indicated that changing any of the above priorities above had only modest effects on cost or predicted time to national freedom, except that deferral of vector management in large areas of never managed and/or still infected areas always increased timelines.

This prioritisation approach ('worst' areas first) is a fundamental reversal of the current strategic approach (progressive roll back from the easiest areas). As the almost 2m ha of currently unmanaged VRA afforded an immediate start is largely remote mountainous or forested areas, this will see a large increase in the area of aerial 1080 poisoning required in the next five years. As all the high-risk-to-livestock areas are afforded high priority, it is assumed that numbers of vector-induced breakdowns in livestock will decline to near zero more or less linearly over the next 10 years (i.e. livestock will be almost completely TB free by 2026).

Funding scenario 1: Eradication with total spend capped at $70m p.a.

Total vector control costs are ~$830m from 2016. Total funding is $1,100m. After an initial drop in levels of vector management, a decline testing and disease management costs enable an increased percentage of the $70m to be spent on vector management vector control until about 2029, with a rapid decline after that (Fig. 1). National statistical TB Freedom is achieved by 2032-2034, with sporadic breakdowns potentially occurring for up to 20 years after that but mostly within five years of national TB freedom.

Decreasing the Stop Rule to 0.90 reduces costs (both vector and total) by ~$50m and shortens the time to freedom by 1-2 years. The cost of post-freedom mop up triples from ~$7m total to ~$21m.

All of the ~2m ha of remote country not currently managed areas will be close to being free by 2030, and the last of the three aerial 1080 operations at ~5-yearly intervals in them that are usually required will have been completed (i.e.; aerial 1080 use will have reduced to near zero by 2030).

Funding scenario 2: Eradication with total spend capped at $60m p.a.

Vector and total costs are largely unchanged, but are spread over a longer period. With the initially small reduction in testing, disease management and other non-vector costs, the funding cap requires a 38% initial reduction in vector control activity, and therefore deferral of management in more areas and for longer. If high-risk-to-livestock areas remain a priority, deferral affects some of the currently unmanaged areas that require 20 years of management. This lag results in a 4-5 year increase in the time to freedom to about 2038-2040 (Fig 2).

The effect of reducing the Stop Rule to 0.9 is the same as for the $70m cap (i.e.; reduced costs (vector and total) by ~$50m, a 1-2 year shorter time to freedom and a tripling of mop up costs. The need for aerial 1080 is likely to extend well into the 2030s, by up to 5 years.

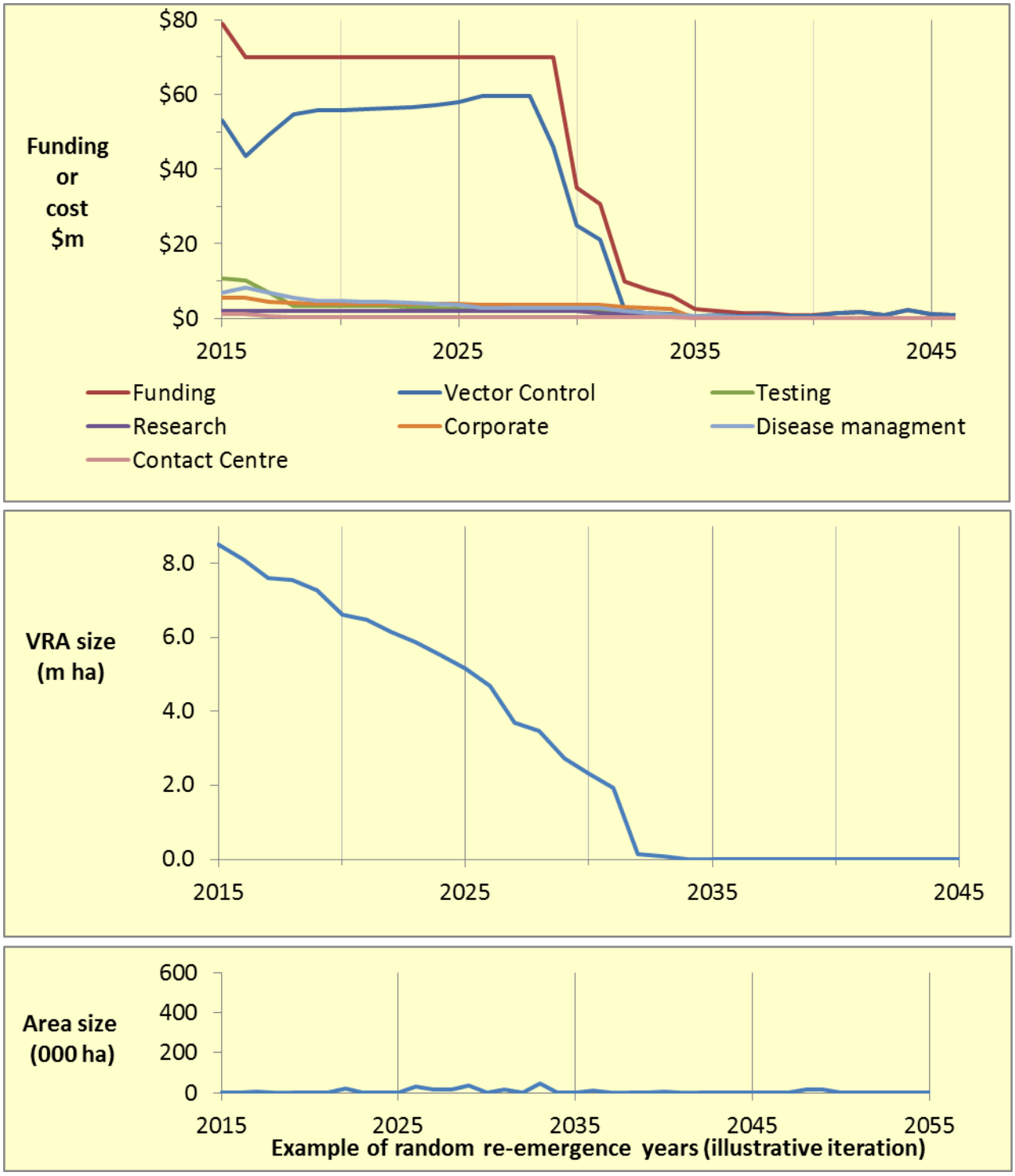

Figure 1 Cost and funding projections and timelines for TB freedom and biological eradication of TB under an initial funding cap of $70m p.a

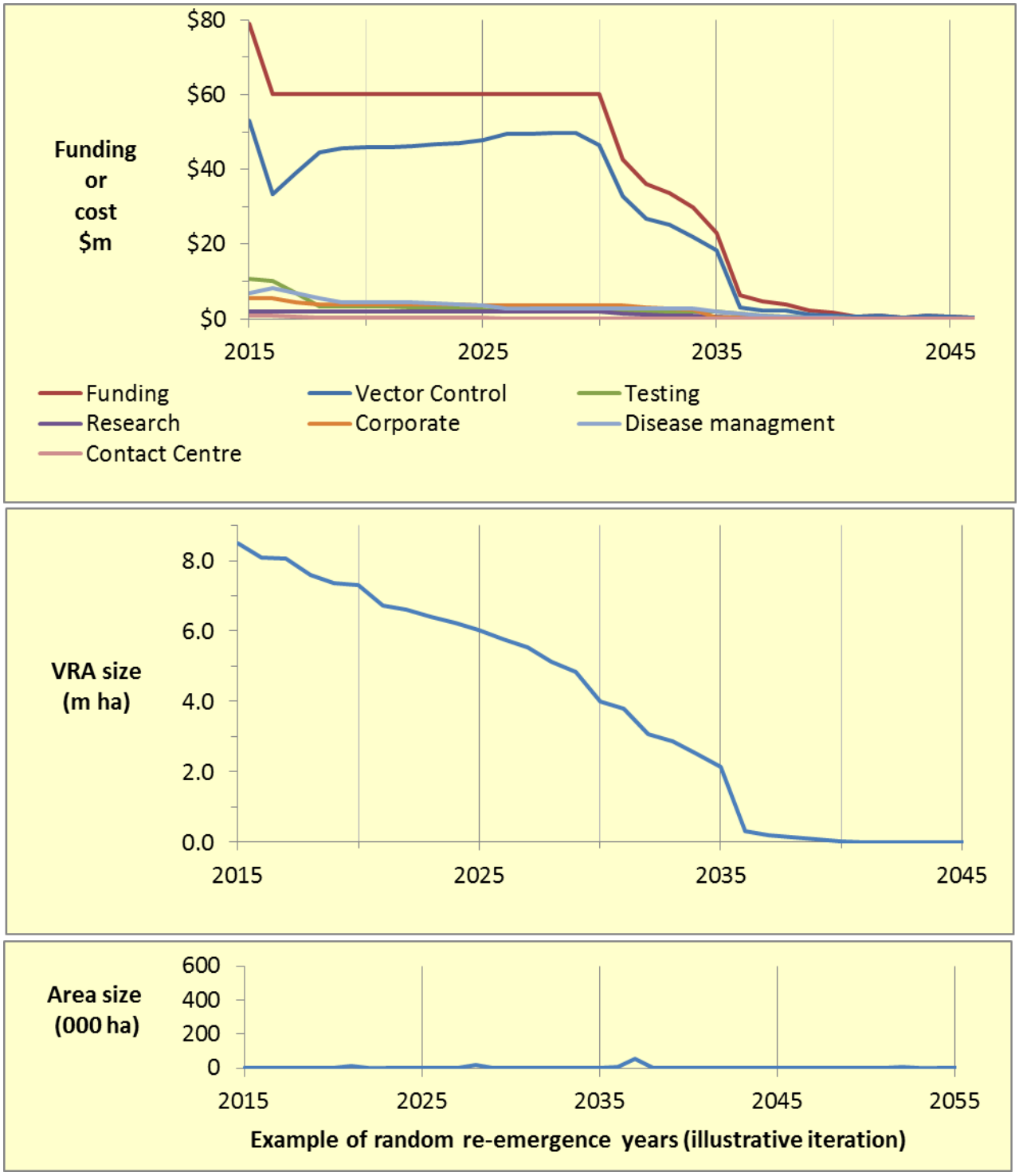

Figure 2 Cost and funding projections and timelines for TB freedom and biological eradication of TB under an initial funding cap of $60m p.a

Cost projections for containment

The scenario modelled assumed;

- TB in wildlife would be contained within the five large areas in which all or most VCZs had a PoF of <0.8 in 2015.
- TB would be eradicated as soon as possible from the VCZs outside those areas with PoF ≥ 0.8 and from any isolated remnant VRA <400,000 ha and any large-VRA outliers <30km across.
- Within the five large contained areas, current VCZ were designated as 'Boundary', 'Farmland buffer', ' I-herd Suppression', and 'Unmanaged'. The costs of managing these were assumed to be 80%, 40%, 20%, and 0% respectively of the $9.16/ha/y eradication cost assumed above.
- Non vector costs were assumed to decline somewhat and then remain static.

Vector control costs begin to reduce immediately because there is little initiation of management in previously unmanaged areas. The decline plateaus at an in-perpetuity cost of $21m p.a. Total vector control costs to 2046 (30 years) are similar to those for eradication ($760m) but total funding costs increase to $1,420m assuming static testing and disease costs. If testing costs are halved over the next five years, total funding cost is reduced to $1,360m.

If aerial 1080 poisoning of possums is banned and replaced with current ground control methods and costs, it is assumed there would be a four-fold increase in vector control cost in the relatively small number of 'aerial' VCZs used to either prevent TB spread out of VRA or minimise TB possum movement from deep forest to farmland. This would increase the in-perpetuity vector control cost of containment from$21m p.a. to $35m p.a.

Summary

The Discounted Future Costs (DFC) of the above scenarios are broadly similar (Table 1).

Table 1 Summary of total vector control and NPMP costs for two capped eradication scenarios and one containment scenario, (truncated at 50 years for the containment scenario). Discounted Future Costs were calculated using an 8% discount rate from 2016.

	Vector control		Total NPMP	
	Total	DFC	Total	DFC
Eradication ($70m p.a. cap; SR = 0.95)	$834	$499	$1090	$654
Eradication ($60m p.a. cap; SR = 0.95)	$833	$450	$1,092	$604
Containment (SR = 0.95)	$1,307	$363	$1821	$562

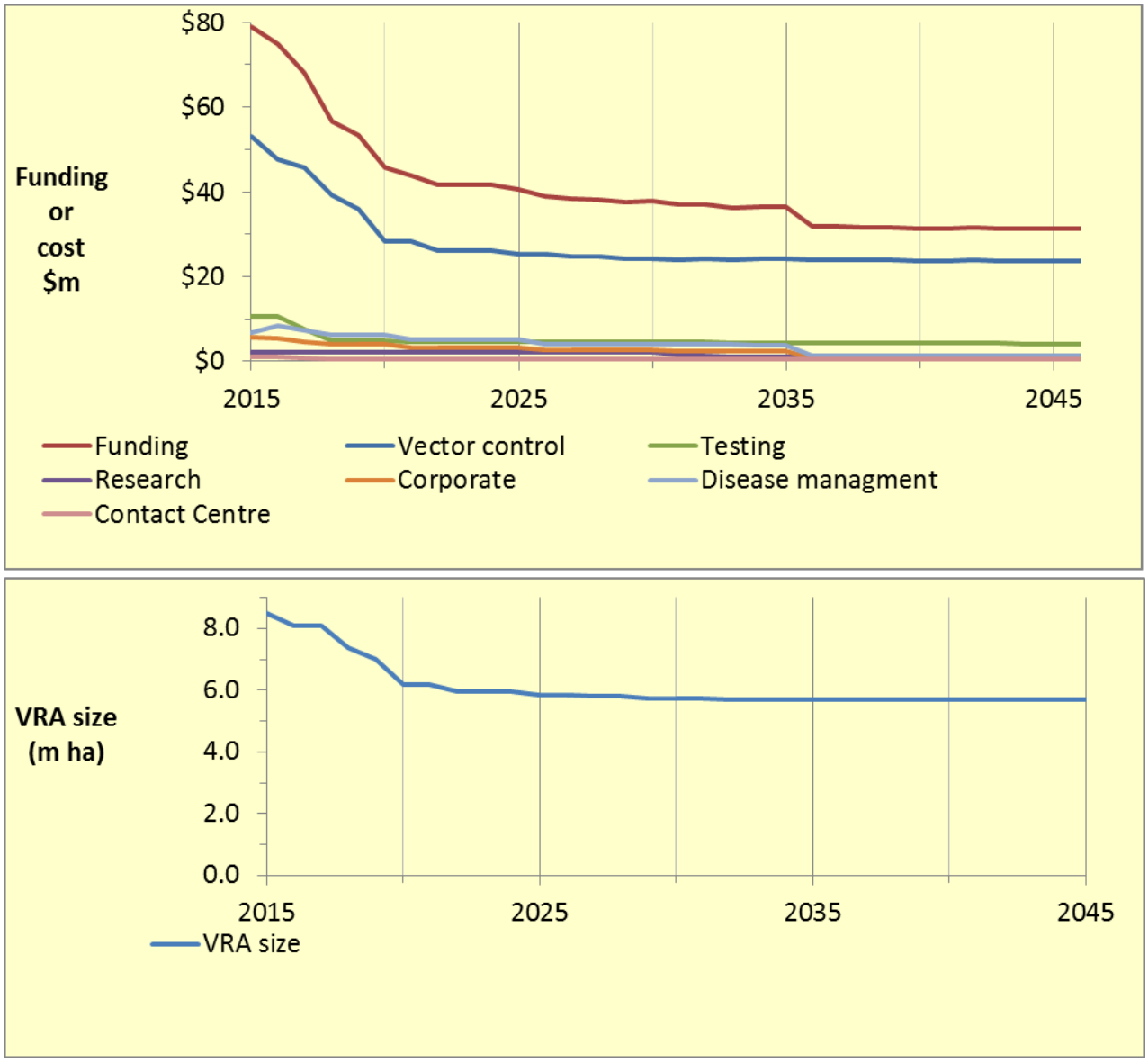

Figure 2. Cost and funding projections and timelines for containment of TB with five major VRA after eradication from all VCZs with current PoF ≥ 0.8 and from small remnant VRA (<400,000 ha) and isolated outliers with PoF< 0.8.