

## **PRIOR ANALYSIS AND SCHEDULING OF THE 2011 RUGBY UNION ITM CUP IN NEW ZEALAND**

### **Abstract**

This paper describes work done for the New Zealand Rugby Union (NZRU) in preparation for their most important wholly domestic competition in 2011. This competition had to be played during a shorter timescale than usual because of the 2011 Rugby Union World Cup, and the NZRU were keen to ensure that they could incorporate the format they wanted into this timescale without unfortunate consequences. In addition, they wanted to introduce a novel feature into this tournament. Thus some detailed prior experimental, or "what-if", analysis was necessary.

This paper describes this analysis and its results. As a result of this analysis, the NZRU was persuaded to abandon one of its design ideas, but was able to proceed with others, enabling them to announce the detailed format of the competition in the confidence that it would work well in practice. Subsequent scheduling of the competition in this format proved successful, and the resulting schedule is shown together with detailed analysis of its notional costs.

The paper demonstrates how important it can be for schedulers to be closely involved in tournament design in advance of the actual scheduling.

*Key words: sport, rugby, scheduling, timetabling, what-if analysis*

### **Introduction**

Sports scheduling is a growing topic in OR research, with both theoretical models and practical applications to many sports being described in the literature. A useful survey is (Kendall *et al*, 2010), and (Wright, 2009) also gives many examples.

There is still a considerable gap between the theory and the practice, although attempts are being made by some researchers to make the models more application-focused – see (Trick, 2011). Most real scheduling examples tend to be either so simple that well-established patterns can be used and models are not needed, or far too complex for the theoretical models to be usable.

This is particularly true for professional sports where there are often large numbers of stakeholders to be satisfied – not only clubs, players and administrators but also sponsors and televisioners, whose needs may be very different. Thus there may be a multiplicity of constraints and objectives, of varying levels of relative importance.

In addition, in some cases scheduling expertise may be very useful at an earlier stage, before the format of a competition has been decided, for example as in (Wright, 2010), in order to gauge the impact of different ideas. Such "what-if" exercises can help to ensure that the expectations of what might be achievable are realistic, enabling tournament organisers to announce changes with the confidence that they will not have unfortunate consequences.

Such was the case with the scheduling of the 2011 ITM Cup in New Zealand. This is the premier domestic club rugby union competition wholly within New Zealand, second in importance in the country only to Super Rugby which includes five franchise teams from each of New Zealand,

Australia and South Africa. The ITM Cup covers the whole of New Zealand from its northern tip to the far south. Although it is not a large league, with only 14 teams and 70 matches, there were a great multitude of considerations to take into account, such that no "standard" off-the-peg approach could be of any value.

### **ITM Cup 2011**

Up to and including 2009, the premier domestic competition was known as the Air New Zealand Cup, but in 2010 Independent Timber Merchants (ITM) took over the sponsorship. The format had changed slightly from year to year as the number of teams changed, and in 2010 there was just one division of fourteen teams run as a single round-robin (every pair of teams meeting just once) plus semi-finals and a final. The matches took place over weekends (between Thursday and Sunday) during the season, which ran from July 29<sup>th</sup> to November 5<sup>th</sup>. During the round-robin stages every team played a match every weekend.

However, it was clear that 2011 would have to be rather different. The World Rugby Union Cup was due to take place in New Zealand in September and October 2011, meaning that there would be much less time for the ITM Cup. Because of other commitments, the earliest possible start date was July 14<sup>th</sup>, and the final would have to be played by September 4<sup>th</sup>. Thus the entire competition would have to be completed within eight weeks.

Before any scheduling took place, the New Zealand Rugby Union (NZRU), the organisers of the competition, together with the New Zealand Rugby Players' Association (NZRPA), made the following provisional decisions:

- the same 14 teams were to take part, but split into two divisions;
- the top seven teams from 2010 would form the "Premiership" division;
- the bottom seven teams would form the "Championship" division;
- every team was to play every other team in its own division (three at home and three away);
- as far as possible, these matches would be at the reverse venue of the 2010 matches: i.e., if team A and Team B were to be in the same division in 2011, and team A had been the home team in their 2010 match, then team B would be the home team in their 2011 match;
- every team would play four "crossover" matches, i.e. against teams from the other division, two at home and two away, to be selected in a "selection event" (see below);
- there would be seven weekend rounds, in which all teams would play;
- there would be six midweek rounds, with each team playing in three and having a bye in the other three;
- all matches would carry full competition points, no matter whether the opponents were in the same division or not;
- there would be no semi-finals;
- each division would have a final;
- the winner of the Championship final would be promoted for 2012; and
- the seventh placed team in the Premiership would be relegated for 2012.

The selection event was to be held in November 2010, under the media spotlight. Its purpose was to determine crossover matches – i.e. for each team the identity of the teams from the other division against which they would be playing, and whether they would be at home or away.

The plan was first to organise the teams according to seedings determined by finishing position in 2010. Thus the team ending in first place was Seed 1, right down to the team finishing last being Seed 14.

The NZRU decided that they would like the event to proceed as follows.

First, each team would have one crossover opponent determined automatically according to the seedings. Team 14 would play against Team 1, Team 13 would play against Team 2, etc. The Championship teams (seeds 14 to 8) would be the home team.

Then there would be three "Picks", for which teams would choose opponents in a prespecified order. At all stages, no team was allowed to choose an opponent against whom they were already due to play because of a previous Pick or the automatic matching. The Picks were to proceed as follows.

- Pick 1: Championship teams at home – Premiership opponents picked by Championship teams in reverse seed order (14 to 8) – all Pick 1 matches to be in the same round
- Pick 2: Premiership teams at home – Championship opponents picked by Premiership teams in seed order (1 to 7)
- Pick 3: Premiership teams at home – Premiership opponents picked by Championship teams in seed order (8 to 14)

Ideally all matches from a Pick would be played during the same round of matches, if this could be achieved without undesirable repercussions (see later).

The NZRU saw this event as a valuable marketing opportunity to generate extra interest in the competition.

### **Experimental runs**

However, during the winter months of 2010, before committing themselves to these decisions or making any official announcements as to the format, the NZRU asked us to make some experimental runs to see what the effects of these and other decisions might be. They were worried that there could be unfortunate repercussions.

In order to do this, a set of fixtures had to be assumed. The first stage was to determine home and away opponents for the intra-divisional matches. For the Premiership it was very nearly possible to do this while ensuring that matches were the reverse of 2010, but not entirely, as in two cases this would have meant that a team would not have had three home and three away matches within their division. The repeated fixtures were Waikato v Taranaki and Taranaki v Bay of Plenty.

For the Championship this was achieved rather less well, in particular because Counties Manukau had played all of the 2010 matches against 2011 Championship teams at home. Overall there were six exceptions to the reverse rule: Tasman v Otago, Manawatu v Hawke's Bay, Otago v Manawatu and Counties Manukau against each of Manawatu, Northland and North Harbour.

This set of fixtures was later treated as fixed when the scheduling was done for real.

Since the experimentation was undertaken well before the selection event took place, assumptions also needed to be made as to the crossover matches – this was done in a fairly

arbitrary manner. In addition, at this stage the clubs had not been asked for their preferences and requirements were unclear. Some preferences therefore had to be invented to enable the exercise to be undertaken.

Thus the experimental runs could only be a rough guide to what the final schedule might look like, but it was agreed that this would still give a reasonably clear idea of what features it might contain.

The approach used to come up with schedules was to treat the problem as a complex combinatorial optimisation problem. This involved treating most constraints as objectives (or soft constraints leading to notional costs when not obeyed). These and other objectives were all allocated weights according to perceived importance (though these weights were varied during the course of the experimentation). Precise details and explanations of the formulations used are given in the next section of this paper.

The problem was then solved using a variant of simulated annealing which uses subcost information to guide the search, as used by one of the authors on other related problems (Wright, 2001), with a neighbourhood structure involving Kempe Chains – see for example, (Lewis and Thompson, 2011) for a detailed explanation of these. Cooling schedules were chosen on an *ad hoc* basis, with the progress of the runs monitored to ensure that these were appropriate.

This approach was used several times from different starting solutions, ensuring that a wide variety of solutions were produced. The various solutions produced were then examined to note particular features of interest.

### **Three matches in a row?**

For example, one very important issue concerned whether it would be possible to ensure that each team plays at most three matches in a row without a bye, and, if so, what might be the likely effect. This is an issue which is extremely important in terms of player welfare and the size of squad that must be employed. Indeed, if this could not be guaranteed then the viability of the competition might be thrown into question.

In fact, it didn't take much analysis to show that this would be possible. With every team playing in every odd-numbered round from 1 to 13 (representing the seven weekends before the final weekend), each team would in addition need to play in three even-numbered rounds from 2 to 12, representing the midweek rounds. To ensure that a team did not play more than three matches in a row meant that it should not play in consecutive midweek slots. This could be achieved by any of the following combinations: {2,6,10}, {2,6,12}, {2,8,12} or {4,8,12}.

Given also that it was considered important that every midweek round should involve at least three matches in total, in particular that rounds 4 and 10 should involve at least three matches, this meant that six teams would have to play in rounds {2,6,10}, six teams would have to play in rounds {4,8,12}, with the remaining two playing in any one of the four possible combinations.

In the absence of other constraints, it is easy to construct possible schedules that meet these criteria. However, we were asked to go further: to examine not only the feasibility but also the likely implications of this constraint in terms of the other most important requirements as conceived at that stage, where a requirement is a criterion that must be obeyed if at all possible. The requirements were:

- (R1) every team should have a home match in one of the first three rounds;
- (R2) every team should have a home match in one of the last three rounds;
- (R3) every midweek round should have either three or four matches;
- (R4) every team should have either three or four weekend home matches; and
- (R5) no team should at any stage have played two more matches than another team.

Several possible schedules were produced which fully satisfied these requirements and so it was agreed that we could regard the preference not to have more than three matches in a row without a bye as a requirement (R6).

These requirements were modelled as soft rather than hard constraints, but with penalties sufficiently high as to ensure that they were always satisfied completely. For the penalties used for the final runs see Appendix 1.

### **Crossover rounds**

Another area of experimentation concerned the crossover matches. The NZRU were keen to have full rounds of crossover matches. Clearly there could not be as many as four such rounds; because there was an odd number of teams in each division, and there was a requirement for every team to play in each of the seven weekend rounds, there would need to be at least one crossover match in every weekend round. However, it was possible to have up to three full crossover weekend rounds, and the experimentation was designed to look at the implications, in terms of not only the requirements R1 to R5 listed above, but also in terms of "general" preferences (see below).

As well as requirements (already listed above) which have to be met, there are always a number of preferences to be considered when constructing a schedule. Here we divide them into "general" and "specific" preferences. General preferences refer to those applying across all teams, in contrast to specific preferences which apply only to particular teams.

At the investigatory stage, no specific preferences were assumed, though it was recognised that several would need to be recognised later when the actual scheduling was to take place. The following were the general preferences considered to judge the outcome of the experimental runs concerning crossover rounds, and also when the scheduling actually took place (though further general preferences were added later):

- (G1) No team should have a run of three consecutive weekend homes;
- (G2) No team should have a run of three home matches in consecutive rounds;
- (G3) No team should have a run of four rounds without a home match – ideally no team should have run of three rounds without a home match;
- (G4) No team should have a run of three weekend rounds without a home match;
- (G5) No team should have a bye in each of two consecutive midweek rounds;
- (G6) No team should have three consecutive crossover matches;
- (G7) No team should have a pattern of home-away-home at any stage; and
- (G8) No team should have a pattern of away-home-away at any stage.

G7 and G8 were an attempt to mitigate some of the worst features of travelling, although travel was also considered in a more precise way later.

These preferences were in many cases conflicting, such that no schedule could possibly satisfy all of them. Thus weights were attached to the preferences when solving this problem (using the

technique described later) in accordance with their approximate relative importance, but these weights were varied in order that several different schedules could be produced. These were discussed with the NZRU to assess their acceptability. For the penalties used for the final runs see Appendix 1.

The experimental runs showed clearly that much better schedules could be produced if there were no requirement for crossover rounds, but that acceptable schedules could probably be produced with one or two full crossover rounds, though with a caveat that we were not using the actual crossover matches and that further preferences also had the potential to undermine this.

However, with three crossover rounds, the runs showed that it would be impossible to produce a satisfactory schedule even in the absence of any further criteria to consider. Typically a number of teams would have potentially unacceptable runs of home matches and/or runs without a home match. This situation could only get worse once further preferences, some of which were likely to be very important (e.g. not clashing with international matches), were incorporated.

Since the NZRU were keen to incorporate crossover rounds as part of their marketing strategy, it was therefore agreed that we would aim in practice to have two crossover rounds, with some flexibility as to which rounds they should be, though the NZRU decided that they should not be either Round 1 or Round 13 (the final round). The fixtures chosen in Pick 1 would form one crossover round and the fixtures chosen in Pick 2 would form the other crossover round.

### **Selection event**

After the NZRU had officially announced the format for the competition, the selection event took place in November 2010 via a web conference, and the matches for Pick 1, Pick 2 and Pick 3 were determined. The tactics used by the teams to pick their opponents were very interesting and varied from Pick to Pick.

In Pick 1 it was clear that the Championship teams were choosing local opponents, presumably to maximise interest and the number of fans from both teams attending the match. In Pick 2, it appeared that the Premiership teams were using the exact opposite criterion, mainly choosing teams based a very long way away – for example, the first two picks were Canterbury choosing Northland and Waikato choosing Otago. Presumably the Premiership teams thought that these teams would be the easiest to beat because they would have to travel a long way. Finally, in Pick 3, it appeared that the Championship teams were choosing to travel to Premiership opponents partly on the basis of whom they thought they might be able to beat; the top three Premiership teams were the last three to be chosen in Pick 3.

The event generated a fair amount of media interest, both before and after the event, and in general the views were positive (Rugby Heaven, 2010a), (Rugby Heaven, 2010b), (Manawatu Standard, 2010).

Full details of the crossover matches picked are given in Appendix 2.

### **Further preferences**

The final stage before the scheduling could begin to take place was to obtain all further preferences. Five further general preferences were added at this stage, as follows.

- (G9) There should be no more than one crossover match in each of rounds 1, 11 and 13
- (G10) Each midweek round should involve at least two teams from each division
- (G11) Travel should be kept "reasonable" as far as possible (see below)
- (G12) Each weekend round apart from the first should contain at least one "backwards flexible" match, preferably two (see below)
- (G13) Each weekend round apart from the last should contain at least one "forwards flexible" match, preferably two (see below)

The notional travel cost was determined not just by distance but, more importantly, by the proximity of major airports. Most travel between venues was to be conducted at least partly by air, with the distance travelled on an aeroplane being less important than distances travelled to get to and from the airports. The precise cost matrix used is given in Appendix 3.

Flexibility was required because of the TV schedules. Since "weekend" could mean any day from Thursday to Sunday and "midweek" could mean either Tuesday or Wednesday, it was absolutely vital that a team playing on Thursday should not be playing in the previous midweek round (backwards flexibility) and also important (though not as vital, since there are two clear days between Sunday and Wednesday) that a team playing on Sunday should not be playing in the subsequent midweek round (forward flexibility).

At least one game needed to be offered to the TV company each weekend round that they could schedule on a Thursday. Preferably there would be a choice of two such matches. Likewise at least one match, preferably two, needed to be offered to the TV company for televising on a Sunday.

In addition to these general preferences, twenty-one specific preferences were taken into account. Some were specified by the NZRU to avoid venue clashes with Test Matches (between New Zealand and other nations) or to keep certain grounds free in the run-up to the World Cup. Others were requests made by the clubs themselves. These preferences are listed in Appendix 4, labelled S1 to S21.

Other preferences were initially introduced by the NZRU but later withdrawn. One such included a preference to spread out the "big" matches, and others related to the Ranfurly Shield (a challenge shield held by one team at a time and surrendered to the opposition if the holders lose a match regarded as a Ranfurly Shield Challenge).

### **Final schedule**

Many runs were made and inspected carefully before a selection of possible schedules was presented to and discussed with the NZRU, who eventually selected one of them as the schedule they wished to implement.

The schedule selected is shown in Table 1. The fourteen teams are presented in finishing order from the previous season. Each row represents one team's matches – each column represents a round. Where an entry is blank, that team has a bye during that round. Otherwise the opposing team is shown. A plus sign means that the team for that row is at home; a minus sign means that this team is away. Premiership teams are shown in capitals; Championship teams in lower case. The square brackets around rounds 7 and 9 show that these are the full crossover rounds.

The schedule fully met all the requirements R1 to R6, but there were many cases of preferences not being met. Full details are in Appendix 1.

Round	1	2	3	4	5	6	[7]	8	[9]	10	11	12	13
(CN)Canterbury	-AK		+SL	-WL	+mn		-ts	+WK	+nl		+TN	-BP	-ot
(WK)Waikato	-SL		+TN	-BP	+ts		-cm	-CN	+ot		-mn	+WL	+AK
(AK)Auckland	+CN	+ot	-WL		-TN	+SL	-nh		+cm	-ts	+BP		-WK
(WL)Wellington	-TN		+AK	+CN	-BP		-hb	+nl	+mn		+SL	-WK	-nh
(TN)Taranaki	+WL		-WK	-nl	+AK		-mn	+BP	+ts		-CN	-SL	+hb
(BP)Bay of Plenty	-cm		+nh	+WK	+WL		-nl	-TN	+hb		-AK	+CN	-SL
(SL)Southland	+WK	-hb	-CN		+cm	-AK	-ot		+nh		-WL	+TN	+BP
(hb)Hawke's Bay	-mn	+SL	+ot		-nh	+ts	+WL		-BP		+cm	-nl	-TN
(cm)Counties Manukau	+BP	+mn	-ts		-SL	-ot	+WK		-AK	+nh	-hb		+nl
(nl)Northland	+ts		-mn	+TN	+ot		+BP	-WL	-CN		-nh	+hb	-cm
(nh)North Harbour	-ot	+ts	-BP		+hb	-mn	+AK		-SL	-cm	+nl		+WL
(ts)Tasman	-nl	-nh	+cm		-WK	-hb	+CN		-TN	+AK	+ot		+mn
(mn)Manawatu	+hb	-cm	+nl		-CN	+nh	+TN		-WL	-ot	+WK		-ts
(ot)Otago	+nh	-AK	-hb		-nl	+cm	+SL		-WK	+mn	-ts		+CN

**Table 1 – schedule chosen by NZRU**

### **What happened next?**

The format was well accepted, with the fans reportedly enjoying the constant stream of matches condensed into a short period. To allow for the inconvenience of midweek matches, the NZRU provided additional funding for hotels, and also allowed teams to field eight rather than seven reserves for each match, with two reserve prop forwards rather than just one, since there was less recovery time between matches.

The Premiership saw Waikato finish in first place, with Canterbury second despite having had to play many of their home matches away from their usual ground because of earthquake damage in Christchurch. Canterbury then defeated Waikato in the final to win the Cup. Southland finished bottom and were therefore relegated to the Championship for the 2012 season.

The Championship saw Manawatu finish top after their match against Otago in Dunedin had had to be postponed because of snow to a midweek date just after Round 13. This gave them less time to prepare for the final, which they then lost to second-placed Hawke's Bay who were duly promoted to the Premiership for the 2012 season.

Without the World Cup to consider, the 2012 competition could have returned to the previous format, but the success of the 2011 competition persuaded the NZRU to operate a slightly modified form of the 2011 format, this time with eight weekend rounds and every team playing just two midweek matches.



## Conclusion and reflections

This paper has described the scheduling of the 2010 ITM Cup. It has concentrated on issues of problem experimentation, formulation and implementation rather than the specific solution technique since these issues formed the difficult and most interesting part of the overall task.

The scheduling was complex and difficult for various reasons, including World Cup and TV requirements, but a very satisfactory outcome was achieved, with the client very happy to accept one of the recommended schedules. An important feature was the frequent interaction between the analysts and the client. An important conclusion from the work is that good professional sports competition design requires a detailed understanding of the likely scheduling consequences **before** finalising the design.

Without such prior analysis, it is possible that the NZRU would have found it difficult to convince themselves and others that it would be possible to ensure that no team would play in more than three consecutive rounds. This could have jeopardised the entire tournament, perhaps leading to a truncated tournament whereby only inter-divisional matches were played, and only at weekends, with consequent reductions in income from sponsors, televisers and spectators, as well as dissatisfaction on the part of teams' supporters and criticism from the media.

In addition, without an analysis of the crossover possibilities, it is quite possible that the NZRU would have announced in advance that there would be three crossover rounds, which would almost certainly have led to either highly undesirable consequences for clubs in terms of their patterns of home matches or a humiliating climb-down and loss of credibility on the part of the NZRU. Alternatively they might have decided that they would not incorporate crossover rounds at all, thus missing out on what they regarded as a good marketing opportunity.

While the exercise was very successful in practice, it is not clear whether the experimental phase of the task could have been carried out in a rather more structured fashion. For example, should greater care have been taken to try to assess the circumstances under which the presence of two crossover rounds would or would not have caused serious problems? Could some kind of experimental design principle have been of value here?

With the ever-increasing importance of television and marketing considerations, it is likely that more professional sporting competitions will want to experiment with unorthodox competition formats. Thus there may be increasing demand for the sort of "what-if" exercises undertaken here.

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## **Appendix 1 – Notional costs**

The notional cost relating to each requirement and preference is shown below for the schedule detailed in Table 1. The number in brackets is the penalty cost for any incidence of non-observation. These costs were determined according to the perceived relative importance of each requirement and preference and modified according to the actual outcomes achieved, but there was inevitably a great deal of arbitrariness about the precise numbers.

Where a requirement or preference was not met by more than one unit, the general rule, unless otherwise stated, was that the penalty was multiplied by the square of the amount by which the number was missed. Thus, for example, for R3, a midweek round with only one match would have incurred a cost of  $4 * 80 = 320$ .

### **Requirements**

R1 (50) – every team should have a home match in one of the first three rounds – fully met – cost 0

R2 (50) – every team should have a home match in one of the last three rounds – fully met – cost 0

R3 (80 for too few, 20 for too many) – every midweek round should have either three or four matches – fully met – cost 0

R4 (180 for too few, 60 for too many) – every team should have either three or four weekend home matches – fully met – cost 0

R5 (15) – no team should at any stage have played two more matches than another team – fully met – cost 0

R6 (200) – no team should have more than three matches in a row without a bye – fully met – cost 0

### **General Preferences**

G1 (3) – No team should have a run of three consecutive weekend homes – fully met – cost 0

G2 (42) – No team should have a run of three home matches in consecutive rounds – not met for Bay of Plenty – cost 42

G3 (34 if four, 2 if three, 6 if the same team has three twice) – No team should have a run of four rounds without a home match – ideally no team should have run of three rounds without a home match – 34 for three teams, 6 for two teams, 2 for eight teams) – total cost 130

G4 (9 if the last three weekends, 1 otherwise) – No team should have a run of three weekend rounds without a home match – 9 for Northland, 1 for Auckland – total cost 10

G5 (5) – No team should have a bye in each of two consecutive midweek rounds – not met for Southland and Hawke's Bay – cost 10

G6 (2) – No team should have three consecutive crossover matches – not met for four teams – total cost 8

G7 (1) – No team should have a pattern of home-away-home at any stage – not met for five teams – cost 5

G8 (1) – No team should have a pattern of away-home-away at any stage – not met for six teams – cost 6

G9 (16) – There should be no more than one crossover match in each of rounds 1, 11 and 13 – met for rounds 1 and 11, but not met for round 13 – cost 16

G10 (20) – Each midweek round should involve at least two teams from each division – not met for rounds 4, 8 and 10 – cost 60

G11 (3 multiplied by matrix entries (see Appendix 3) – no cost if to or from a bye) – total cost 456

G12 (350 if none, 7 if one) – Each weekend round apart from the first should contain at least one "backwards flexible" match, preferably two – always at least one backward flexible match, but only one for rounds 3, 7 and 13 – cost 21

G13 (350 if none, 7 if one) – Each weekend round apart from the last should contain at least one "forwards flexible" match, preferably two – always at least one forwards flexible match, but only one for rounds 1, 5 and 11 – cost 21

### **Specific Preferences**

S1 (80) – Canterbury not to be at home in round 7 – met – cost 0

S2 (200) – Canterbury not to be at home in round 12 – met – cost 0

S3 (200) – Canterbury not to be at home in round 13 – met – cost 0

S4 (200) – Auckland not to be at home in round 7 – met – cost 0

S5 (200) – Auckland not to be at home in round 12 – met – cost 0

S6 (200) – Auckland not to be at home in round 13 – met – cost 0

S7 (200) – Wellington not to be at home in round 5 – met – cost 0

S8 (200) – Wellington not to be at home in round 12 – met – cost 0

S9 (200) – Wellington not to be at home in round 13 – met – cost 0

S10 (100) – Taranaki not to be at home in round 3 – met – cost 0

S11 (20) – Taranaki not to be at home in round 13 – not met – cost 20

S12 (200) – Bay of Plenty to be at home in round 3 – met – cost 0

S13 (120) – Bay of Plenty to play against Wellington in round 3 – not met – cost 120

S14 (120) – Bay of Plenty not to be at home in round 7 – met – cost 0

S15 (20) – Bay of Plenty not to be at home in round 13 – met – cost 0

S16 (20) – Southland not to be at home in round 13 – not met – cost 20

S17 (20) – North Harbour not to be at home in round 13 – not met – cost 20

S18 (40) – Tasman to have only one home match in the first five rounds – met – cost 0

S19 (200) – Manawatu to be at home in round 1 – met – cost 0

S20 (120) – Manawatu to play against Hawke's Bay in round 1 – met – cost 0

S21 (160) – Otago to have two home matches in the final four rounds – met – cost 0

## **Appendix 2 – Crossover matches**

The automatic crossover matches pre-determined by seeding were:

- Otago v Canterbury (14 v 1)
- Manawatu v Waikato (13 v 2)
- Tasman v Auckland (12 v 3)
- North Harbour v Wellington (11 v 4)
- Northland v Taranaki (10 v 5)
- Counties Manukau v Bay of Plenty (9 v 6)
- Hawke's Bay v Southland (8 v 7)

The numbers in brackets indicate the seeding positions. Thus, for example, Otago were seed 14 and Canterbury seed 1. The seeding positions were determined by the finishing order in the 2010 competition.

For **Pick 1**, Championship teams (playing at home) selected a Premiership opponent in reverse seeding order (14 to 8):

- Otago v Southland
- Manawatu v Taranaki
- Tasman v Canterbury
- North Harbour v Auckland
- Northland v Bay of Plenty
- Counties Manukau v Waikato
- Hawke's Bay v Wellington

For **Pick 2**, Premiership teams (playing at home) selected a Championship opponent in seeding order (1 to 7):

- Canterbury v Northland
- Waikato v Otago
- Auckland v Counties Manukau
- Wellington v Manawatu
- Taranaki v Tasman
- Bay of Plenty v Hawke's Bay
- Southland v North Harbour

For **Pick 3**, Championship teams (playing away) selected a Premiership opponent in seeding order (8 to 14):

- Taranaki v Hawke's Bay
- Southland v Counties Manukau
- Wellington v Northland
- Bay of Plenty v North Harbour
- Waikato v Tasman
- Canterbury v Manawatu
- Auckland v Otago

### Appendix 3 – Travel Cost Matrix used

The notional travel costs pertaining to journeys undertaken by teams were taken from the matrix below. Note that these are not very closely related to actual distances, but more to convenience of travel. Thus journeys to and from locations close to major airports tend to have a lower notional cost than other journeys.

	CN	WK	AK	WL	TN	BP	SL	hb	cm	nl	nh	ts	mn	ot
Canterbury	*	2	2	1	2	2	2	2	2	5	2	1	2	1
Waikato	2	*	1	1	2	1	5	2	1	3	1	3	2	4
Auckland	2	1	*	1	1	1	4	1	1	1	0	2	1	3
Wellington	1	1	1	*	1	1	3	1	1	3	1	2	1	2
Taranaki	2	2	1	1	*	2	5	2	1	3	1	3	1	4
Bay of Plenty	2	1	1	1	2	*	5	1	1	3	1	4	2	4
Southland	2	5	4	3	5	5	*	5	5	10	4	4	5	1
Hawke's Bay	2	2	1	1	2	1	5	*	2	3	1	3	1	4
Counties Manukau	2	1	1	1	1	1	5	2	*	3	1	4	2	4
Northland	5	3	1	3	3	3	10	3	3	*	1	5	4	5
North Harbour	2	1	0	1	1	1	4	1	1	1	*	2	1	3
Tasman	1	3	2	2	3	4	4	3	4	5	2	*	3	3
Manawatu	2	2	1	1	1	2	5	1	2	4	1	3	*	4
Otago	1	4	3	2	4	4	1	4	4	5	3	3	4	*