Muriwai Golf Project

GOLF COURSE OPERATIONS AND MAINTENANCE

Date: 25 November 2021

Prepared for
The Bears Home Project Management Limited
By: NZ Sports Turf Institute & Steve Marsden Turf Services
Version 19 - Final

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1. EXECUTIVE SUMMARY

1.1 The governing bodies of golf and golf course architects have recognised the importance of designing, constructing and managing golf courses in an environmentally sustainable manner.

1.2 This ethos has been adopted by both NZ Sports Turf Institute and Steve Marsden Turf Services during the planning process (to date) for construction and proposed maintenance of the Muriwai Golf Project.

1.3 Specifically, this report documents the extensive consideration given to deliver a world class golf course that will enhance the natural landscape of the property. The existing environment will be better off under golf course management, where fertiliser inputs for turf management will be significantly less and a more environmentally focused team will help restore the degraded landscape. In particular:

(a) The vision is to create a "marquee" golf course, defined by Golf Tourism New Zealand as a golf course of high quality in its design, conditioning and service and is aspirational to play for both domestic and international visitors alike. It is a bucket list experience for those passionate about golf. As such, it will require a comparatively higher level of golf course maintenance staff (than traditionally found among most courses in New Zealand) of around 23 FTEs.

(b) Selection of grasses is based on meeting both the requirements of golf and minimising environmental impact by selecting species that use or require comparatively less water, fertiliser and agrichemicals than grasses normally used in the Auckland region.

(c) Adoption of best practice in terms of water use, by incorporating valve in head sprinkler system, weather station, the use of portable moisture sensors to quickly and effectively understand soil moisture content and then apply water directly where it's required. A state-of-the-art programmable logic computer system will ensure water use efficiency is maximised.

(d) An integrated pest management (IPM) program will form the cornerstone of the management of the golf course. IPM is a multidisciplinary, ecologically based pest management system that uses all available methods to keep pests (fauna, insects, weeds and diseases) at acceptable levels while minimising the effects on people, the environment and turf.

(e) There will be significantly less fertiliser used overall under a typical yearly golf course maintenance operation as compared with present farming practises.

(f) The golf course maintenance programme will operate safely from world class maintenance facilities; these facilities will be compliant in all regulatory aspects.

1.4 The golf course will be constructed to conform with Audubon International's Signature Sanctuary Certification. The golf course maintenance operation will have an environmental focus beyond the construction process and seek to be an industry leader with a focus on environmental best practice. (See Appendix 8).

2. GLOSSARY OF ABBREVIATIONS

2.1 **Table 1** sets out the technical terms/abbreviations used in this report.

Table 1: Glossary of technical terms/abbreviations

Abbreviation/Terms	Term
AEE	Assessment of Environmental Effects prepared by Mitchell Daysh.
CEMP	Draft Construction Environmental Management Plan prepared by McKenzie & Co.
Couch grass	Cynodon dactylon – a warm season grass species. It has many common names including Indian Doab, Bermuda grass etc.
Cool season grasses	Ryegrass, Browntop, Creeping Bentgrass, fine Fescues, Poa annua etc have a temperate / cool climate origin and have poor drought and high temperature tolerance.
Warm season grasses	Tropical grasses such as Kikuyu and Couch grass which are adapted to hot dry climates hence high drought and temperature tolerance.
Project	Means the Muriwai Golf Project as described at section 3 of the AEE.
Project Area	Means the area described in section 1 of the AEE
USGA	United States Golf Association, one of the two major governing and research bodies in the golf industry.
Golf Course Shaper	The shaper manipulates the terrain, sculpturing the land into the vision of the golf course architect, typically using a bulldozer.

3. INTRODUCTION

3.1 The Bears Home Project Management Limited (the "Applicant") is proposing the establishment of a golf resort facility of international standing including; a new 19 hole golf course, warm up fairway, 9 hole short course, practice fairway, clubhouse, sports academy, reservoir, and luxury standard short stay lodge accommodation - all located at the Muriwai Downs Farm property (the "Project").

Purpose of this report

3.2 This report forms part of a suite of technical reports prepared for the Project's resource consent application process. Its purpose is to describe the various activities, methodologies and supporting philosophies associated with the construction and maintenance of the golf elements of this Project based on our collective assessment of the site and our knowledge and experience associated with constructing and maintaining golf courses.

3.3 This report also describes the current agronomic status; specifically, soil types, fertility, drainage status, and climate of the site. This information has been used to inform; grass species selection, construction profiles and methodologies, grow-in and on-going maintenance of the turf areas for the golf course routing and layout. More detailed information is found in *NZSTI report: Muriwai Golf Project: Effect on Soils – September 2021.*

Project description

3.4 The Project is described in full within the AEE. In summary, the proposed development comprises the following key components:

(a) A 19-hole golf course, with warm up fairway;

(b) Academy range and 9 hole reversable short course;

(c) A clubhouse;

(d) A sports academy building;

(e) A Golf and Property Maintenance Complex;

(f) A luxury lodge;

(g) A new water supply and golf course irrigation and drainage systems; and

(h) Significant ecological restoration and enhancement works.

3.5 From a golf course construction perspective, the 19 hole golf course, 9 hole short course, practice fairway and sports academy will include the following:

(a) Approximately 73 Ha of maintained turf: this includes 41.1 Ha of Fairways and tees, 28.6 Ha of Secondary (naturalised) rough and 3.4 Ha of Greens;

(b) A 140,000m^3 irrigation reservoir.

3.6 From a golf maintenance perspective, the Project will involve the following:

(a) Mowing and grooming of all playing surfaces (greens, tees, fairways);

(b) Topdressing (primarily with sand);

(c) Renovation;

(d) Fertilisation;

(e) Management of pests, diseases and weeds;

(f) Irrigation;

(g) Bunkers;

(h) Course husbandry (edging, tree work, wetland management, signage, cart paths etc);

(i) Horticulture – managing areas of landscape around buildings.

Project features

3.7 Subject to further refinements at the detailed design stage, key features of the Project relevant to this report include all golf playing surfaces as set out in Table 3 (in section 7 below), specifically:

(a) Selection of grass species for the different golfing areas on the site (Figure 1);

(b) Construction methodologies and summary of typical procedure for the different golfing areas (Figure 1);

(c) Establishment (grow-in) of the new turf areas;

(d) Maintenance of the turf areas**.**

4. NEW ZEALAND SPORTS TURF INSTITUTE (NZSTI)

4.1 Founded in 1949, New Zealand Sports Turf Institute (NZSTI) is now part of the LABOSPORT Group and provides a world class turf consultancy service for both natural and synthetic surfaces to leading national and international sports organisations and other clients.

4.2 Our team of university-trained turf agronomists offer sound, independent advice and support on all aspects of the design, care and maintenance of sports turf areas including golf courses.

4.3 NZSTI are Golf New Zealand's official agronomists and since 1949 we have been visiting and advising to all affiliated NZ golf courses, particularly in the area of the latest proven and environmentally sustainable maintenance and construction techniques for golf.

4.4 NZSTI has been at the forefront of most golf course developments in NZ, including:

• Matarangi (Dunes) Golf Course	• Jacks Point Golf Club
• Gulf Harbour Golf Course	• Wainui Golf Course

• The Kinloch Club	• Rotorua Golf Course
• Millbrook Golf Course	• Kauri Cliffs Golf Course
• Royal Auckland Golf Club	• Formosa Golf Course
• The Hills Golf Club	• Windross Farm Golf Course

4.5 The Institute's philosophy is to provide the client with the best possible service, such that the turf facility fully meets both the client's expectations and environmental regulatory constraints applicable now and in the foreseeable future.

4.6 Established in 2018, Steve Marsden Turf Services provides support in the areas of golf course management, major event support, mentoring, golf course operational reviews, turf grow-in and establishment support to golf courses and others where high-quality outcomes are desired.

4.7 This report has been prepared jointly by NZSTI and SMTS.

5. SCOPE OF WORK

5.1 NZSTI was engaged by Golf Strategy Group in November 2020 to undertake preliminary site studies as well as detailed site-specific assessments. This work has involved the following:

(a) **Climatic assessment** – to determine suitability of the area for different grasses; drainage requirements/construction methodologies; and provide an estimate of water requirements for irrigation.[1]

(b) **Nutrient analysis** – sampling of topsoil's, sand's and subsoil's[2] fertility to determine:

(i) Suitability for a range of turf grasses;

(ii) Health of the soil (organic matter content, potential toxicities/deficiencies) to identify possible treatment;

(iii) Potential environmental issues (level of phosphorus and nitrogen) that may require addressing as part of the earthworks phase.

(c) **Physical analysis** of collected samples of the top and subsoils[3] were undertaken (NZSTI report: Muriwai Golf Project: Effect on Soils – September 2021) to assist in determining:

(i) Soil types that were being dealt with and how these need to be managed during the construction and subsequent maintenance processes;

[1] Based on Dargaville and Auckland Airport (2010 – 2019) weather stations on the NIWA Cliflo site. Note closer weather stations to the site were not found that could provide recent that is climate data from the last 10 years – approx.
[2] Laboratory analysis undertaken by Hill Laboratories and then assessment of fertility undertaken by NZSTI (pH, Phosphorus, Potassium, Magnesium, Sodium and Organic profile).
[3] Laboratory analysis was undertaken by NZSTI (texture, Motty tests, hydraulic conductivity after 30% compaction and Landcare (texture).
[4] Analysis of the local sand was completed by NZSTI (for Particle size distribution, hydraulic conductivity, Calcium carbonate, Moisture release assessment).
[5] The trial by NZSTI & Steve Marsden Turf Services, which is on-going, seeks to evaluate a number of earthwork procedures for effectiveness in terms of controlling the Kikuyu present.

(ii) Impact of construction on the soils ability to drain as a consequence of construction induced compaction:

(1) proposed drainage design on fairways, i.e. there is a significant risk that with these soils in an undrained state plant health would be compromised, closure and or substandard playing conditions would occur during high or sustained periods of rainfall;

(2) grass selection – given soils on this site were better than typically encountered at many Auckland turf sites this information partly contributed to the selection of Couch, i.e. its aggressive and deep root development would assist in re-establishing the soil's physical properties (structure, hydraulic conductivity);

(3) construction and maintenance methodology, for example analysis indicated these soils could regenerate structure reasonably quickly with judicious use of water, correct grass types and construction methodology.

(d) **Physical analysis** of the on-site sand was undertaken[4], to assist in determining:

(i) How the onsite sand compared with recognised UK and US standards for turf sands and therefore its potential suitability for construction of the new golf course. The sand was classified as a fine sand and didn't meet either UK or US standards for greens construction or sand carpet surfaces;

(ii) Hydraulic conductivity using the USGA methodology found the drainage rate of 206mm/hr exceeded the minimum drainage rate for greens of >150mm/hr;

(iii) Moisture release. Provides an estimate of the minimum sand depth required to ensure adequate aeration within the surface. The test showed that a minimum sand depth of 700mm is required with the on-site sand, as opposed to 200 – 300mm that would normally be required when using a medium fine graded sand.

(e) **On site hydraulic conductivity assessments** were undertaken to determine the drainage status of the local soils and the suitability of this drainage for a high-end golf course. Although the test has its limitations, it does provide an indication of how the soils drain in an 'undisturbed state' (*NZSTI report: Muriwai Golf Project: Effect on Soils – September 2021*).

(f) **Kikuyu eradication/construction trial**. Kikuyu is an undesirable weed on this golf course.

(g) **Team collaboration** – To provide the best results for the client, NZSTI adopt a collaborative approach, which resulted in:

(i) Preparing a concept report, incorporating this data, recommending grass types and proposed construction profiles for the different golfing areas (greens, surrounds, fairways and roughs);

(ii) Reviewing the grow-in and maintenance programmes for suitability and environmental impact – ongoing.

5.2 Many site visits have been undertaken between 10 November 2020 and 17 August 2021. Details of key visits are included in Appendix 12.

6. EXISTING ENVIRONMENT

6.1 The Project Site is currently managed as a farm as detailed in the Farm Operations report of DnA Lands Limited, Appendix 9 to AEE and the soil effects assessment report of NZSTI, Appendix 8 to AEE). The main characteristics noted during our assessment are summarised below.

(a) Soils on the site can be broadly divided into:

(i) Sandy loams overlying sandy clay/clay subsoils;

(ii) Silt loam overlying clay subsoils;

(iii) Fine sand.

(b) Grass species present – primarily Ryegrass and clover

These are high productive plant types, that require substantial inputs in terms of fertiliser, water etc (particularly the Ryegrass component) to perform in a golf course context. The present Ryegrass cultivars are agricultural cultivars and lack the density of turf Ryegrass cultivars. Although Ryegrass would provide a spectacular looking golf course it was ruled out by the agronomy team at the very beginning given its large environmental footprint.

(c) Weeds

The main weed of any concern from a turf perspective on the existing site is Kikuyu. In this golf course's context Kikuyu is a weed and construction/maintenance is in part geared up to eliminating this. As part of the process a trial (on-going) is underway to identify the best way of eliminating Kikuyu at the construction stage.

(d) Wetlands, a lake with associated riparian vegetation and various areas of native and exotic flora are also present in ungrazed parts of the site.

(e) Present nutrient practises

Current farm use		
Category	**Area**	**Av. Nitrogen (kg/ha/yr)**
Dairying	71ha	110
Beef & sheep	297ha	110
Note: Provided by Williamson Water & Land Advisory[3]		

Table 2. Average nitrogen applied to the property during June 2020 – May 2021

[3] Appendix 10 to the AEE.

This information has been used to inform the comparative differences in nutrient requirements between the farm and proposed golf course maintenance operation.

Note: Nutrient levels on the farm would be much higher than this as no consideration has been given to inputs from clover, cattle and sheep dung and urine.

7. TURF AREA AND TURF TYPE SELECTION

(a) Typical golf hole layout

Figure 1. Typical golf hole layout.

A typical layout of a golf hole is shown in Figure 1 and illustrates the different golfing areas detailed in this report.

(b) Individual golf course features

Figure 2. Typical golf green (LHS) & bunkers (RHS)

Figure 3. Fairway & Primary Rough (LHS); Tee (RHS)

Figure 4. Secondary (naturalised) Rough areas

(c) Description of playing areas on the golf course

Table 3. Proposed playing areas on the golf course

7.2 Selection of grasses for the fairways, primary and secondary rough on this golf course involved NZSTI evaluating all the commonly used turf grasses in the Auckland region on golf courses and developing a matrix (Appendix 1) which considered playing quality, presentational quality and potential environmental impact (i.e. requirement for fertilisers, agrichemicals and water). The outcome of the study was:

(a) Greens (Table 3) would be established in Creeping Bentgrass – This decision was determined primarily due to the playing requirements of golf greens. The other grassing options used on greens are namely:

(i) Browntop (*Agrostis capillaris*) would have similar input requirements to the Creeping Bentgrass proposed;

(ii) *Poa annua* – although the grass of choice in the Auckland region, this has been discounted due to its heavy reliance on water, fertiliser and agrichemicals.

(b) Fairways, primary rough and tees, (Table 3) would be established in Couch (*Cynodon dactylon* var Windsor green) for the following reasons:

(i) Couch's ability to provide a high-quality golfing surface;

(ii) Visually Couch's appearance would be much poorer in terms of its colour, which will be an off green - brown relative to cool season grass options (green) during winter.

Figure 5. LHS winter look of Couch & RHS winter look of cool season grasses (Browntop).

(iii) Couch would provide better overall environmental outcomes, specifically:

(1) requiring less fertiliser – approximately 75% less nitrogen than turf Ryegrass;

(2) requiring less water than cool season grasses – approximately 50%;

(3) less agrichemicals, specifically:

A. Fungicides – it is estimated that couch surfaces would require approximately 90 – 95% less fungicide applications when compared to cool season grassing options such as turf Ryegrass or Browntop;

B. Insecticides – It is estimated that couch surfaces, given its tolerance of greater insect threshold levels than cool season grasses, would require negligible use of insecticides;

C. Herbicide use on couch is considered comparable with cool season grasses (Ryegrass, Browntop or Fescues).

(iv) Couch is a strong creeping grass, which unlike Ryegrass (*Lolium perenne*) and potentially Fescues, does not require regular seeding to maintain suitable density for fairways and on tee surfaces.

(v) Couch has a stronger and deeper root system than cool season grasses. When coupled with judicious watering, this root system will assist in re-establishing soil structure and drainage within the reconstructed soil profile.

(c) Secondary (naturalised) rough – the initial recommendation was for Browntop as it is slightly better adapted to the climate and soils found within the rough and site. Subsequently fine Fescue has been selected for the rough due the following benefits:

(i) It provides a visual contrast and impact with other playing surfaces;

(ii) It has a potentially better playability than long cut Browntop;

(iii) As with Browntop, Fescue has a lower requirement than other cool season grasses (Ryegrass, *Poa annua*) for fertiliser, water and agrichemical applications;

(iv) The ease with which Kikuyu can be managed.

Turf area	**Estimated size (Ha)**	**Role & description**	**Level of maintenance**
Greens	3.4Ha	This area is sown in Creeping Bentgrass (*Agrostis stolonifera*), built using a full sand profile and it is where the golfer will putt to finish a hole.	The playing expectations from this area are very high and a high standard of maintenance and inputs is required to meet this expectation.
Tees	3.8Ha	This area is established in Windsor green (*Cynodon dactylon*) and is built using a shallow layer of sand overlying a drained soil profile (sand carpet concept). This is where golfers start each hole.	The key maintenance requirement is providing a mown, smooth grassed surface. The vigour and creeping habit of Couch enables a lower level of inputs than would be expected with tees established in cool season grasses.
Fairways & Primary Rough	37.3Ha	<u>Fairways</u> This area is established in Windsor green (*Cynodon dactylon*) and is built using a shallow layer of sand overlying a drained soil profile (sand carpet concept). <u>Primary Rough</u> The surrounds (often called controlled or managed rough are simply an extension of the fairways that will be mown slightly higher and form the area between the fairway and rough)	The key maintenance requirement is providing a mown, smooth grassed surface. The vigour and creeping habit of Couch enables a lower level of inputs than would be expected with fairways & primary rough established in cool season grasses.

Turf area	Estimated size (Ha)	Role & description	Level of maintenance
Secondary (naturalised) **Rough**	28.6Ha	This is a 'naturalised area' off the intended playing route, that acts as a penalty for wayward shots, that will be established with fine Fescue (*Festuca sp*)	The intention is this is a naturalised area that would receive negligible maintenance or inputs, it would not be irrigated. It is anticipated it would be mown annually.
	73Ha		

8. GOLF COURSE CONSTRUCTION ACTIVITIES

8.1 Summary

(a) The construction timeline of the golf course will be influenced by the time of the year that works are able to commence. Ideally construction would begin in early spring, this would provide enough time for each of the main construction activities to be undertaken on the early golf holes.

(b) The new golf holes will be grassed in the summer and early autumn period where optimum growth and turf coverage can be achieved.

(c) It is anticipated that the timeline for the golf course construction will be in the order of between 500 to 750 days. As the construction of each golf hole is completed, the grow-in and establishment period of the turf grass can begin (see Section 9).

(d) Sections 8.2 to 8.9 below provide a summary of the main processes involved in golf course construction.

(e) Construction process would be staged to minimise issues with dust and silt runoff (as detailed in the draft Construction Environmental Management Plan and Dust Management Plan ("CEMP") of McKenzie & Co, Appendix 18 to AEE).

8.2 Site clearing

(a) Existing infrastructure e.g. stock watering, fencing and vegetation within the disturbance zone (as detailed in the arboriculture assessment report by Peers Brown Miller, Appendix 12 to AEE that impacts on the golf course design would be removed.

(b) Once the extent of earthworks is known, a construction erosion and sediment control management plan is proposed to protect wetlands, water ways and protected vegetation areas. Detailed methodology will be in accordance with Auckland Council and Consent requirements, and as detailed by McKenzie & Co (as detailed in the Engineering Infrastructure Report, Appendix 5 to AEE).

(c) Monitoring systems (nutrients, etc.) installed as proposed in the McKenzie & Co Infrastructure report, Appendix 5 to AEE.

8.3 **Vegetation Control**

(a) A trial is presently underway to guide the construction team as the most effective way to control the Kikuyu present on-site. The methodology considers:

(i) The number of glyphosate applications required;

(ii) Whether selective removal of the very upper topsoil profile is required and if so to what depth. Results from this trial are pending.

(b) It is envisaged the site according to the staged development plan, would be sprayed with glyphosate (360gai) at 6L/ha with a spreader sticker. All spraying would be completed by a trained operator with calibrated sprayer in accordance with NZS 8409:2004 Management of Agrichemicals:

(i) Where clover is an issue, Clopyralid (300gai) would be included within the spray tank mix;

(ii) Where Kikuyu is encountered, Urea at 10kg/ha would also be included in the tank mix.

(c) 7 – 10 days after spraying the site the dead vegetation would be stripped and removed.

(d) In accordance with best practise, provisions for a second spray have been included, in order to manage any regrowth of Kikuyu and assist in depleting the weed seed loading. The requirement for this will be guided by Kikuyu trial results and onsite observations.

8.4 **General Earthworks**

(a) An approved earthworks management plan will set out the extent of the proposed earthworks (as detailed in the CEMP of McKenzie & Co, Appendix 18 to AEE). The scope of earthworks has been determined by the golf course architect and the restrictions required to protect the unique features of the property, in particular relating to water courses and wetlands.

(b) This phase of the construction process involves the main cut and fill requirements. They create and generate the material that is needed for the shaper to create the golf course features for each golf hole that reflects the vision of the golf course architect. Detailed methodology is provided by McKenzie & Co (Appendix 18 to AEE).

(c) Shaping: Once the main cut and fill earthworks are completed, the material is then shaped into new contours by a specialist golf course shaper. Shaping is part of the construction process that brings the new golf holes to life. Once the shaping is completed, the re-spreading of topsoil can begin.

8.5 **Green Construction**

(a) The green is the most important playing surface on a golf course, as such, more time is devoted to its construction than any other, and it is also one of the most technical construction processes of the golf course.

(b) Beneath the surface of the green are various layers (sand, organic matter amendments & gravel) that work with one another to allow for the proper mixtures of air flow, moisture retention and the ability to release excess water after heavy rains.

8.6 Tee Construction

(a) Tee construction is an important process for the golf course construction, the tees are typically high areas of wear through, and so creating a healthy growing environment for the turf will ensure low on-going maintenance inputs. Tees will be constructed using a sand carpet methodology as shown in Figure 6.

8.7 Bunkers

(a) Bunkers are built and shaped into the newly created landforms, their exact location and size is set out by the golf course architect, they strongly influence the strategy and look of each golf hole.

(b) All bunkers will have drainage to ensure their playability during periods of rain.

8.8 Drainage

(a) This is a critical component in the construction process of a golf course. It not only allows golfers to play during or shortly after periods of rainfall, but it helps to create a healthier growing environment for the turf.

(b) The drainage network on a golf course can be extensive, the local climate, soil type on the property, the contours and size of the collection areas all contribute to the scale of the drainage system required. The combination of the correct sized piping, frequency of catch basin inlets and the correct fall of the finished contours will also influence the success of the golf course drainage system.

(c) All drainage installed is documented by GPS survey during installation.

9. SPECIFIC TURF METHODOLOGY

9.1 Introduction

(a) This section of the report provides a more detailed summary of how each of the different turf areas on the golf course will be constructed and established, specifically:

(i) Greens;

(ii) Fairways & primary rough;

(iii) Tees;

(iv) Secondary (naturalised) rough;

(v) Bunkers.

9.2 **Fairways, primary rough and tees**

(a) A sand carpet methodology as illustrated in Figure 6 will be used for each of these areas, but the depth of the sand carpet will vary depending on the surface.

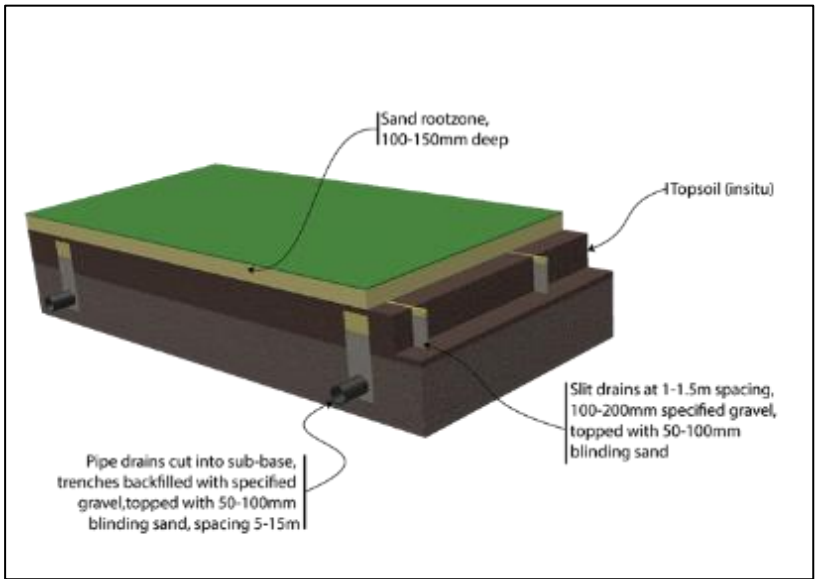


Figure 6. Cross section of the sand carpet drainage method.

(b) Trimming of soil subgrade to achieve desired smoothness and contouring specified by architect.

(c) The proposed drainage system for the fairways, tees and surrounds is a sand carpet method. This is illustrated in Figure 6. Following approval, installation of 110mm drain coil primary laterals at 15m centres (approx.) and then irrigation pipework installation commences.

(d) Deep ripping of the subgrade and relaying ideally a minimum 150mm consolidated topsoil depth.

Note: The intention is that all topsoil affected by the earthworks will remain on site.

(e) Incorporate pre-plant organic based fertilisers (Appendix 4) equivalent to: Nitrogen 25kg/ha, Phosphorus 12kg/ha and Potassium 2kg/ha.

(f) Deep ripping and final shaping of rootzone using turf equipment to minimise excessive compaction of the rootzone and partly restore natural drainage.

(g) Install slit drains at 1.5m centres and a 50mm deep sand carpet (surface).

(h) 'Plant' fairways with Windsor green couch

(i) Stolons – a higher than normal stolonising rate will be used to encourage a full cover to be established more quickly, both reducing risk of run-off and enabling less grow-in soluble fertiliser to be used.

(ii) Where excessive slopes are encountered and especially in any 'deemed sensitive area' solid turfing will be carried out to minimise erosion and run off. Turf will be secured with biodegradable stakes.

9.3 **Primary rough (surrounds)**

(a) As detailed in Table 3 the surrounds are simply an extension of the fairways and these areas transition to the Secondary (naturalised) rough. Consequently, construction of the surrounds would be as specified for the fairways but at this stage the sand depth overlying the slit drains would be less, specifically 25mm.

9.4 **Green construction (USGA methodology)**

(a) The United States Golf Association (USGA) construction methodology for greens is illustrated in Figure 7. The USGA methodology is a highly researched, proven and therefore industry standard for greens construction throughout the world, that provides a unique combination of aeration, moisture retention, and drainage, that enables quality putting surfaces to be prepared,

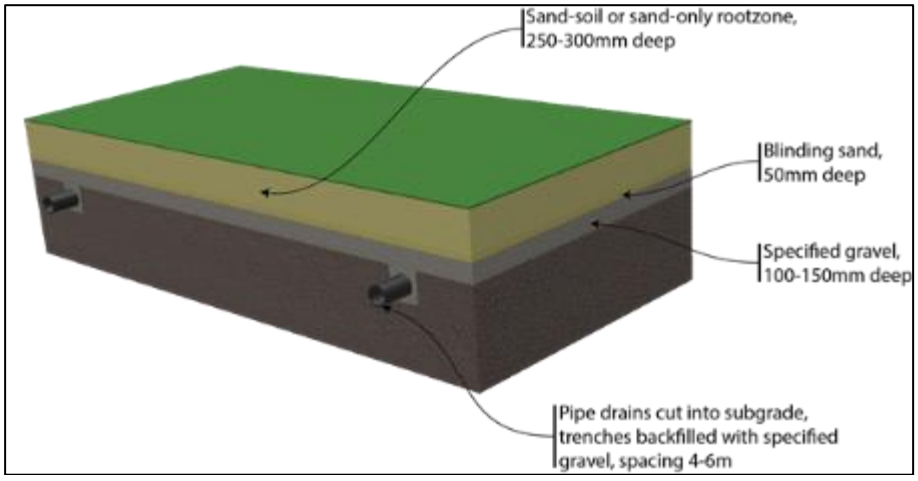


Figure 7. Cross section of a USGA profile.

(b) Excavate cavity for green and collar to approximately 400mm.

(c) Shape subgrade in accordance with Architect's requirements.

(d) Install perimeter liner.

(e) Install drainage system.

(f) Install irrigation system.

(g) Install gravel subgrade.

(h) Install blinding sand layer.

(i) Install approved amended sand profile (300mm approx.). Amending will be with organic matter. Trials are yet to be completed with environmentally more sustainable coconut fibre as opposed to peat.

(j) Complete final shaping of the sand surface.

(k) Incorporate an organic pre-plant mixture (Appendix 2) equivalent to: Nitrogen 25kg/ha, Phosphorus 12kg/ha and Potassium 2kg/ha, trace elements and wetting agent granules. Soluble nitrogen and phosphorus sources will not be used at this stage.

(l) Final shaping and approval by architect.

(m) Sowing with Creeping Bentgrass at 7g/m^2. A trial has been established nearby to assist in informing the team as to the better cultivar for the Auckland region. Key considerations are susceptibility to disease, density for playing quality and ability to minimise contamination by *Poa annua.* Results are pending.

Note; The advantage of the trial, is that all Creeping Bentgrass cultivars were developed overseas and this approach enables the best cultivar for the site to be selected.

(n) Possible hydro-seeding to prevent erosion (runoff) (as detailed in the CEMP of McKenzie & Co, Appendix 18 to AEE).

10. TEE CONSTRUCTION

10.1 A sand carpet methodology is proposed (Figure 6). In essence, the teeing ground is created in the sub-grade by the shaper, the sub-grade base will have drainage trenches installed to a depth of approx. 250mm, with 110mm perforated drainage pipe located within the trench and surrounded by a washed drainage chip.

10.2 Topsoil is spread over the tees, base fertiliser incorporated (Appendix 3), slit drains are installed and a 100mm (approx.) rootzone layer installed and blended into the adjacent surrounds reading for grassing:

(a) Secondary (naturalised) rough

(i) The area of rough is a transition from golf to farm, and it is shaped to seamlessly blend from golf into the wider natural landscape of the farm. There will not be a distinctly identifiable change that identifies where one meets the other.

(ii) The rough will be seeded in autumn with fine Fescue, and also include white clover in the sowing mix. Clover is designed to supply a ‘natural source of nitrogen during grow-in’, given its strong stoloniferous growth habit assists in reducing runoff and provides organic matter to improve soil health. The clover will be selectively removed once the fescue is adequately established:

(1) Incorporate an organic pre-plant mixture (Appendix 5) equivalent to: Nitrogen 50kg/ha, Phosphorus 24kg/ha and Potassium 4kg/ha.

(b) Transition areas

(i) There will be transition areas between the golf course and ‘farm’, these will be constructed and sown in the same way as the naturalised rough. Planning by the agronomic team and wider group has recognised that in some places, these areas will

adjoin the wetlands and therefore pose a potential risk. The main risks envisaged are silt and nutrients entering the wetland. Planning by the agronomy group has identified the following strategies to avoid this risk:

(1) Silt management systems (fences, silt socks etc) as identified by McKenzie & Co (Appendix 18 to AEE). would stay in situ until a mature turf cover is established.

(2) Areas immediately adjacent to waterways/ wetlands would be 'opened up in small sections' and each section completed before opening up the next section.

(3) Immediately adjacent to wetlands/water systems mature Fescue or Couch turf as opposed to seed and which is a minimum 2.0m wide would be installed and secured with biodegradable stakes. The turf would not be mown for a significant period, the longer grass will provide additional filtration of any runoff that might occur. The turf type in each area will be determined by the golf course architect to ensure it fits within the grassing strategy of the golf course.

(4) Seeding (above the turfed area) would be hydroseeded (including a tackifier) to secure the seed/seed bed in situ.

(5) Coconut fibre matting would also be used as a mulch, pinned to the surface and keyed into the ground to reduce the risk of erosion and runoff,

(6) White clover has been used as a 'nurse crop' in the seed mix to provide additional stability whilst the grass establishes and a natural source of nitrogen i.e. fixation from the atmosphere by the clover.

(c) Bunkers

(i) Bunkers are built and shaped into the newly created landforms. Their exact location and size is set out by the golf course architect, and they strongly influence the strategy and look of each golf hole.

(ii) The sub-grade of the bunker will have drainage trenches installed to a depth of approx. 250mm, with 110mm perforated drainage pipe located within the trench and surround by a washed drainage chip.

(iii) Bunker construction methods have improved in recent years; they are now constructed to accommodate a bunker liner that sits between the soil profile and the sand layer. This liner helps to hold sand on the sloping bunker face during periods of heavy rain and also keeps the sand from becoming contaminated with silts from the sub-grade profile within the bunker.

Figure 8. Drainage and liner installation process in a bunker.

11. IRRIGATION

11.1 Theoretical Irrigation Demand

(a) Irrigation demands provided below are based on a desk top study of climate data (Table 4) for the area, soil type and proposed grasses. They provide a comparative indication of water use by cool and warm season grasses.

Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (ave mm/mth)	60.9	55.4	82.8	97.9	125.8	127.5	123.9	129.8	117	65.9	55.6	86	**1169.3**
Evapotranspiration (ave mm/mth)	170.7	130.2	112.2	68.1	40	26.6	31.1	45.5	76.2	113.3	139	161	**1114.4**
Moisture deficit (ave mm/mth)	-109.8	-74.8	-29.4	29.8	85.8	100.9	92.8	84.3	40.7	-47.4	-83.8	-75	**54.9**
Theoretical water requirement (m^3/ha) for cool season grasses	1100	750	300							480	840	750	**4,220**
Theoretical water requirement (m^3/ha) for warm season grasses	1100	750										375	**2,225**
Notes: The theoretical desk top study does not allow for inefficiencies of an irrigation system and application, establishing new turf, site specific features such as wind run, rainfall that are expected to differ slightly from the NIWA Auckland Airport site. An indicative allowance for inefficiencies detailed would be between 30 – 50% of the theoretical water demand.													

Table 4. Average rainfall and evapotranspiration data for Auckland Airport 2010 – 2019.[4]

[4] Sourced from the National Institute of Water and Atmospheric Research https://cliflo.niwa.co.nz/

(b) A more detailed irrigation demand consumptive use estimate (CUE) was performed by Prevost Stamper Irrigation (**PSI**) based on local climatic conditions. See Appendix 9.

(c) Weather data and specifically evapo-transpiration data was ascertained from the Kumeu Weather Station as the closest source. Relevant data from this weather station is presented below in Table 4.

Stats: Combined

Station	Year	Stats Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
26492	2006	34	-	-	-	-	-	21.9	24.0	36.5	57.6	86.2	113.3	127.7	-
26492	2007	34	128.1	107.7	93.8	49.1	33.6	26.5	24.7	43.6	56.5	93.0	98.7	117.2	872.5
26492	2008	34	145.3	106.3	93.3	52.2	31.7	26.9	25.2	40.7	60.2	95.1	122.1	125.4	924.4
26492	2009	34	140.3	101.3	97.8	53.9	32.2	23.1	26.9	50.6	59.8	89.0	105.5	133.4	913.8
26492	2010	34	143.9	110.2	101.4	55.0	34.5	-	-	-	70.3	102.7	113.1	125.5	-
26492	2011	34	140.8	106.5	-	-	-	-	-	-	-	-	-	-	-

Table 5: Kumeu Weather Station Data

(d) PSI provided a detailed CUE showing the expected monthly demands based on historical weather data. They also performed a demand based on the grow-in requirements for both warm and cool season grasses.

(i) The CUE indicated that the system will have a much larger demand during the grow-in of the course but the daily peak demand can be managed by spreading the grow-in over a longer period. Warm season turfgrass varieties such as Windsorgreen will have less of a demand than cool season varieties based on the crop coefficient of each species.

(ii) Peak daily watering will apply in the summer months and approach 5mm a day with grow-in requirements between 15-18mm a day until the grass is established. Winter months will not require much (if any) irrigation.

(e) Water needs for the golf course will vary. The primary indicator of the volume of water required is based on the total amount of irrigated turf and type of turf. Based on the current design plans, the golf course will have 3.4 hectares of cool season turf and 41.1 hectares of warm season couch grass for playable golf areas. As part of the consumptive use estimate Prevost Stamper Irrigation developed, once established, the golf course will have a peak demand period each January where the daily peak demand will be 2.15 million litres per day. This will then reduce until the low demand month of July where the system will require a daily amount of .29 million litres per day.

(f) For planning purposes, the water demand will be greater during the grow-in of the golf course as the turf requires the roots to remain moist until they have grown to an acceptable depth to sustain themselves long term. During this period, the irrigation must be run for a short cycle each hour during the day to maintain moisture levels. The peak demand during the grow-in period is at the end of construction when most of the course has been established and the last few holes are grown in. On projects where water supply is a major

issue, then the number of holes that can be grown in at a time will dictate the construction schedule. We have provided an estimate for a situation where the final six holes are grown in at once and another estimate with only three holes grown-in. For each scenario, we have calculated with the remaining turf areas having already been established. Under this six-hole grow-in scenario, we calculate a demand of 3.91 million litres per day while the three-hole scenario requires 3.03 million litres per day. Each of these scenarios assumed a worst case condition where grow-in is occurring in January, the peak demand month. If the grow-in occurs in a lower demand month, then the water quantities will be reduced proportionally.

11.2 Golf Course irrigation System

(a) The irrigation system is yet to be designed and will be developed through the detailed design stage in accordance with industry best practise, such that water efficiency is optimised as the primary goal. This will be achieved through hardware and software as well as operational methodologies.

(b) The design of the irrigation system will provide the detailed requirements for pumps including any necessary transfer or booster pumps, pipe routing, pipe sizes, valve and sprinkler locations and all electrical components.

(c) The design will be developed with a fully interactive hydraulic model to test the system for peak demand scenarios. This will ensure the system is designed to meet the necessary pressure and flow requirements throughout the network as well as ensuring that the system is not overdesigned.

(d) The sprinkler head layout will be designed utilizing the software SPACE programming to analyze the best sprinkler head and nozzle selection for maximum uniformity across the irrigated areas. The sprinklers will be spaced out to account for site specific wind conditions. Part circle and full circle sprinklers will be used to accurately apply water to the different turf needs as well as site specific conditions including sun/shade, high/low and varying soil conditions.

(e) The greens will have sprinkler heads spaced “back-to-back” part-circle heads (See Figure 11) to allow for the specific watering differences between the greens and the surrounds, with each sprinkler on an individually controlled basis. The exact placement of sprinklers cannot be confirmed until the site is formed.

(f) The system will be controlled by a central computer system with the latest software version from one of the major irrigation manufacturers (such as Toro or Rain Bird). The central computer system will operate each sprinkler head on the golf course individually for maximum control of the water application. The irrigation system will be either a two-wire style or a satellite system, this has yet to be determined. Both types of systems will achieve maximum efficiencies. The central computer will be programmed to operate at night when wind is at its lowest levels to ensure peak uniformity.

(g) Irrigation in the fairways will utilise full-circle heads with coverage extending to the limits of the primary rough, including the fairways. A “feathering” of the irrigation coverage will allow for the Secondary (naturalised) rough areas to blend into the golf course, eliminating any need for permanent irrigation of these naturalised rough areas on the perimeters of the golf holes.

(h) Portable moisture meters like the Field Scout TDR350 (See Figures 9 and 10.) will be used to allow maintenance staff to more accurately understand volumetric moisture content on all playing surfaces across the golf course. These portable devices provide instant data allowing for more informed decision making with regard to water use.

Figure 9. Field Scout TDR350 Moisture Meter.

(i) The system will be capable of operating heads on a “cycle and soak” basis depending on the soil conditions. This allows time for the irrigation water to percolate through the soil without having run off that can cause erosion or wasted water.

(j) Quick couplers (a hand watering hose connection) will be located with a minimum of 1 at each green as well as at all tee complexes and bunkers. Quick couplers will also be spaced along the perimeter of the golf holes to allow for hand watering as required in areas of the Secondary (naturalised) rough.

(k) A weather station with rain gauge will be utilised to monitor site specific weather data. This can be used to operate the central computer directly for automation based on the daily evapo-transpiration rates. It also acts as a rain stop feature to prevent watering of the golf course during a rain event.

(l) The computer will be programmed based on the peak flow characteristics of the pump station and hydraulic network to minimize power requirements.

(m) High density polyethylene pipe (HDPE) pipe shall be used for all mainlines and sub-mainlines for ease of installation and durability over time.

Figure 10. Field Scout TDR350 Screen Read Out.

(n) Quick coupling valves (QCV) shall be installed at select intervals through the course to allow for specific hand watering of localised dry spots, thus reducing the need to operate the system as a whole for very small areas. This is particularly useful on greens.

(o) Individual head control of all sprinkler heads on the property will allow for the operation based on specific sun/shade situations, slope differences and exposure to morning/evening sun.

(p) Isolation valves will be located at all key mainline intersections to allow for selective isolation in the event of a damaged pipe, reducing excessive water wastage.

Figure 11. QCV and greens 'back to back' sprinklers.

11.3 Cart paths & maintenance paths

(a) Cart paths or maintenance paths are used to provide all weather access across the golf course throughout the year. They eliminate damage to turf in areas of high traffic from golf carts as well as from golf course maintenance vehicles such as mowers and tractors.

(b) The golf course architect will look to hide the paths as much as possible, as they can detract visually from the overall look of the golf course. (As detailed in the golf course and site layout plan of Golf Course Designers Ltd, Appendix 2 to AEE)

(c) The design of the paths is yet to be finalised. An overarching goal is to minimise the length of paths. It is envisaged the total length of cart paths will be approximately 9,510m^2 (as detailed in the infrastructure report of McKenzie & Co, Appendix 5 to AEE).

(d) A hard impermeable surface such as concrete has a greater life expectancy and is not subject to erosion or break up. Paths can also be used to control and direct water run-off and reduce erosion during the period of turf establishment. This is in addition to other erosion and sediment control strategies that will be adopted as part of the project (CEMP, Appendix 18 to AEE).

Figure 12. Cart / maintenance path installation.

12. GROW-IN PHASE

12.1 Grow-in is the process whereby once the sand or soil turf surfaces (tees, greens, fairways etc) are formed and normally signed off by the architect, the turf area is sown. stolonised or turfed and is then managed (fertiliser, water, topdressing) to establish a mature, dense turf cover (Figure 13). Typically, the process takes approximately 16 weeks and is deemed complete once the turf surface is ready for play.

Figure 13. Process of grow-in takes seedlings (LHS) to a mature, playable turf cover (RHS).

12.2 Grassing and turf establishment ("Grow-In")

(a) Fertiliser Use:

(i) Soil & tissue testing would be completed during the grow-in to determine nutrient requirements.

(ii) Fertiliser plan for establishment of the different turf areas is presented in Appendices 2, 3, 4, 5 & 6).

(iii) Monitoring of water quality will be undertaken as advised by Williamson Water & Land Advisory (Appendix 10 to AEE).

(b) Agrichemical Use:

(i) Controlling diseases

(1) Greens - A preventative fungicide programme would be run for 12 weeks after sowing to protect against the turfgrass disease Damping off. Thereafter a curative fungicide programme when a disease issue is identified would be implemented. In the humid Auckland climate, the main diseases are likely to be Brown patch, Dollar spot and Leaf spot.

(2) Fairways, primary rough, tees – Disease is not expected to be an issue on the Couch grass.

(3) Secondary (naturalised) rough – given the secondary rough is not irrigated, seeding will be undertaken during autumn. This coupled with low seeding rates; means disease within the fine Fescue is considered a very low risk.

(ii) Pests

(1) Insect pests are not expected to be an issue on any surface during grow-in.

(iii) Herbicides

(1) Greens - the main weeds that may be encountered are rogue *Poa annua* plants. These will be hand weeded during the grow-in period.

(2) Fairways, primary rough, tees – the main weed issues that are anticipated are:

A. Kikuyu – spot spray with glyphosate.

B. Annual summer grasses – generally these are a very minor issue in the Auckland region and can be managed with hand weeding, or spot spraying with an appropriate (dependant on the weed) selective herbicide treatment. In the event of a serious annual summer grass issue which hasn't been recognised on this site to date (i.e. over 2 summers) the pre-emergent herbicide Oxadiazon is an option.

Note: the higher-than-normal staffing levels found on a high-end golf course such as here, means a localised or surgical approach to all (disease, weed, insect) pest control can be undertaken. This differs substantially from the normal broadacre approach which requires the use of more agrichemicals.

(3) Secondary (naturalised) rough – Given an autumn sowing and inclusion of clover in the seeding mix, selective weed control is not expected during the grow-in phase. Kikuyu is likely to be the main issue, and this would be controlled by spot spraying with Haloxyfop.

(iv) Wetting agents

(1) On greens, tees and fairways a preventative wetting agent programme is anticipated to manage dry patch. A preventative approach (monthly applications during November – March) will be carried out on the greens, collars, tees and fairways.

(2) On the other sand surfaces a curative approach would be adopted.

(v) Irrigation

(1) As discussed in section 11 above, establishing turf, be it with stolons or seed will have a high requirement for water during the establishment phase.

(2) The critical requirements in terms of irrigation during establishment can be summarised as follows:

A. Unlike established turf, stolons/seedlings have very shallow root systems (if at all initially) and require very frequent watering during day light hours. Although dependent on climatic conditions at the time, watering can be required up to 4 – 6 watering events/hour to keep the surface constantly moist.

B. Unlike irrigation carried out on established turf, which is based on maintaining target moisture levels throughout a typical 75 – 120mm deep rootzone, newly establishing turf requires lighter watering to keep the surface 25mm (approx.) moist.

C. As the seedlings/stolons mature and root depth increases, watering frequency and volumes used will gradually decline. Typically, this gradual reduction in water use commences 3 – 4 weeks after germination or stolonising.

13. ONGOING MAINTENANCE ACTIVITIES AND STAFFING

13.1 Overview of golf maintenance activities

(a) The main focus for golf course maintenance is on delivering high quality playing surfaces in an environmentally sustainable way for the enjoyment of those who like the game of golf. Golf course turf is not a production crop for harvest, or to generate excessive yield for farm stock. Excessive turfgrass growth significantly increases operating costs, is not environmentally responsible and it is not a sustainable model.

(b) The maintained areas (approx. 72 Ha) of turfgrass are summarised in Table 2 and presented again as follows:

(i) Greens: 3.4Ha Tees: 3.8Ha Fairways & Primary: 37.3Ha Secondary Rough: 28.6Ha

13.2 A range of maintenance activities are required to maintain and prepare quality golfing surfaces and include:

(a) Mowing and grooming of all playing surfaces (greens, tees, fairways)

(i) Regular mowing depending on seasonal growth patterns is required to prepare quality golfing surfaces. As an indication of mowing frequencies:

(1) Greens would typically be mown 3 – 6x/week;

(2) Tees would be mown 2 – 3x/week during October – April. Thereafter mowing will be negligible;

(3) Fairways & Primary rough would be mown 1 – 3x/week during October – April. Thereafter mowing will be negligible;

(4) Secondary rough is expected to be mown once a year.

(b) Topdressing (primarily with sand) of key playing surfaces such as greens (2 to 4 weekly all year) and tees (3 – 4 weekly from December until March) to manage surface quality and control organic matter accumulation.

(c) Renovation (the management of turfgrass organic matter) is normally completed once, sometimes twice a year, once specified organic matter levels are exceeded (control organic matter, maintain infiltration, aeration required for healthy turf growth) of greens, tees and fairways.

(d) Fertilisation (as required for turfgrass health & in conjunction with the IPM program – Appendix 6)

(i) Greens: N - 93kgs/Ha/Year P - 4kgs/Ha/Year K - 67kgs/Ha/Year;

(ii) Tees: N - 105kgs/Ha/Year P - 18kgs/Ha/Year K - 110kgs/Ha/Year;

(iii) Fairways/Primary: N - 58kgs/Ha/Year P - 24kgs/Ha/Year K - 52kgs/Ha/Year;

(iv) S. Rough: N – 25kgs/Ha/Year P – 12kgs/Ha/Year K – 2kgs/Ha/Year.

(e) Management of pests, diseases and weeds

(i) An integrated pest management (IPM) plan will provide an important tool that will guide the course maintenance activities. The IPM plan will be developed specifically for the property. It is a multi-disciplinary, ecologically based pest management system that will minimise the use of agrichemicals, thereby reducing the risk of chemical run-off and water pollution.

(ii) An effective IPM program is based on tolerating a level of pest damage that does not significantly reduce the level of acceptable turf quality.

(iii) The IPM will utilise all available methods to keep pests at acceptable levels and requires:

(1) Understanding the course conditions and characteristics;

(2) Surveying pest species and knowing their life cycles;

(3) Defining pest damage thresholds;

(4) Develop a monitoring and record keeping program;

(5) Develop and implement pest control strategies.

(f) Irrigation – the monitoring of moisture levels within the turf surfaces, scheduling and delivery of irrigation and the upkeep and maintenance of the irrigation system.

(g) Bunkers – grooming is the process of raking the bunker surface and is usually completed daily.

(h) Course husbandry

(i) Edging is the process of keeping all cart paths and other paving edges defined; keeping bunker edges defined, controlling ingression of Couch into cool season grassed areas.

(ii) Tree work - this is a generic term that refers to planting, weeding around trees, gardens, formative pruning of trees (safety, tree shaping etc).

(iii) Wetland management – in accordance with the approach outlined in the Ecology Report and Wetland Restoration Plan (Appendix 11 to AEE).

(iv) Signage - cleaning, placing signs. Moving ropes to manage traffic etc.

(v) Cart paths – cleaning, repairs, traffic management on exit points.

(i) Horticulture and landscaping upkeep – managing areas of landscape around buildings.

(j) Equipment – the equipment used to maintain the golf course and surrounding areas will be selected to assist in delivering high quality maintenance standards. All staff operating this equipment will be trained and inducted in its use with an individual SOP (Safe Operating Procedure) developed for each equipment item. Some examples of this technology:

(i) Greens will be cut and rolled with electric equipment.

(ii) The majority of utility vehicles will be electric, with just a few diesel utility vehicles required where additional payload and capacity is needed.

(iii) Fairway mowers will be hybrid drive system with in-line motor generator.

(iv) Primary rough mowers will be light weight diesel mowers.

(v) Turf type tractors will operate as an extension of the existing farm tractor fleet.

13.3 Staff levels are anticipated to be in the order of 23 FTE during peak periods, this is typically from late spring to early autumn.

13.4 These staffing numbers will allow for the delivery of world class playing surfaces, operating an effective IPM program, working closely with Audubon International and ensuring the wider property environment is carefully managed.

13.5 Staff will include a Golf Course Superintendent, Assistant Golf Course Superintendent, Foreman, Irrigation Technician, Turf Equipment Mechanics, Horticulturists, Gardeners, Qualified Greenkeepers, Apprentice Greenkeepers, Groundspersons, and an Office Assistant.

14. GOLF AND PROPERTY MAINTENANCE COMPLEX (SEE APPENDIX 10)

14.1 The Golf and Property Maintenance Complex (GPMC) will provide a world class facility that will support the needs of the golf course and the wider non-farm areas of the property. It will provide a safe and compliant facility for all staff who will operate from this area.

14.2 The floor plan of the GPMC can be seen in Appendix 10. The GPMC will act as storage for the golf course maintenance equipment, along with the mechanical workshop in the Equipment Store/Workshop.

14.3 Fertilisers and agrichemicals will be stored in the Chemicals/Fertiliser Store which is part of the ESD Wash Down facility. A dedicated Fuel Area for diesel and unleaded fuels will provide safe fuel storage. Sand bins will provide covered storage for sand, gravel and mulch. A green waste/compost area will allow for a central location to manage this material.

14.4 A Bulk Store building will hold operational goods for both the GPMC and for those of the wider property. A GCM Office Building for administration of the golf course operation. An Operations

building will house staff for building maintenance, laundry, housekeeping, garden/landscape, accounting, HR, administration and IT. It also provides sufficient car parking for all staff and visitors, and good access for the delivery of goods.

Figure 14. Golf Equipment Store (LHS) & Fertiliser Store (RHS).

Figure 15. Administration (LHS) & Material Bays (RHS).

14.5 Hazardous substances storage and handling

(a) All hazardous substances will be stored in accordance with the guidelines set out by the relevant regulatory authorities (Auckland Council) including permitted activity rules and standards and under the Auckland Unitary Plan. The handling (including delivery of) and mixing of agrichemicals will be done so within a fully contained environment, eliminating any risk of non-containment. The compliance process will involve but not be limited to implementation of; training of staff, record keeping, signage, emergency plans, bunded and segregated storage, safe operating procedures, PPE etc.

(b) Additionally, the golf course will aim to store the minimal amount of agrichemicals possible. The typical purchase process and hence storage requirements for agrichemicals would involve:

(i) Sufficient fungicide/insecticide on hand to complete treatment of the greens/tees should a problem arise. Once this is used, it would be replaced.

(ii) Purchasing herbicide slightly in advance of application, so that storage time is reduced.

(iii) Residue amounts of unused product is inevitable and these would be safely stored in the purpose-built chemical shed until they are next required.

(c) Agrichemicals will be stored in a purpose built above ground, ventilated shed (room) in accordance with Auckland Council. NZS 8409:2004 Management of Agrichemicals and Health & Safety at Work (Hazardous substances) Regulations 2017.

(d) Fuel storage of diesel and unleaded fuels would be stored in above ground tanks in accordance with the Hazardous Substances Regulations. Both fuel storage tanks will be made by a registered tank manufacturer. Diesel fuel will be stored in a WorkSafe approved double skin tank, and the unleaded fuel tank will be stored within a 110% concrete bunded structure.

(e) It is anticipated that storage of approximately 3000L of diesel and 1000L of unleaded fuels would be required.

(f) The storage of gravel, topdressing sand and mulch will be held in 3 x 65m^2 covered material bays (see Figure 15). A dedicated area for green waste, / rubbish / recycling of 1 x 70m^2 covered storage area will form part of the facilities.

14.6 Wash down (vehicle washing area) **See Figure 16 & 17, and Appendix 7**.

(a) A dedicated vehicle wash down area will house a four (4) hose ESD biological wash water recycling system. This system is designed to decontaminate wastewater from the washing of industrial equipment and also agrichemical rinse-ate from spraying equipment treating up to 9000 litres per day. The decontaminated water from this system would then go into an approved-on site wastewater system.

(b) It is an environmentally friendly wash water recycle system that employs a biological remediation process that uses biological agents to remove or neutralise contaminants from polluted soil or water.

(c) See Appendix 7 for the indicative layout of this system (PDF).

Figure 16. ESD Waste 2 water equipment wash down in use.

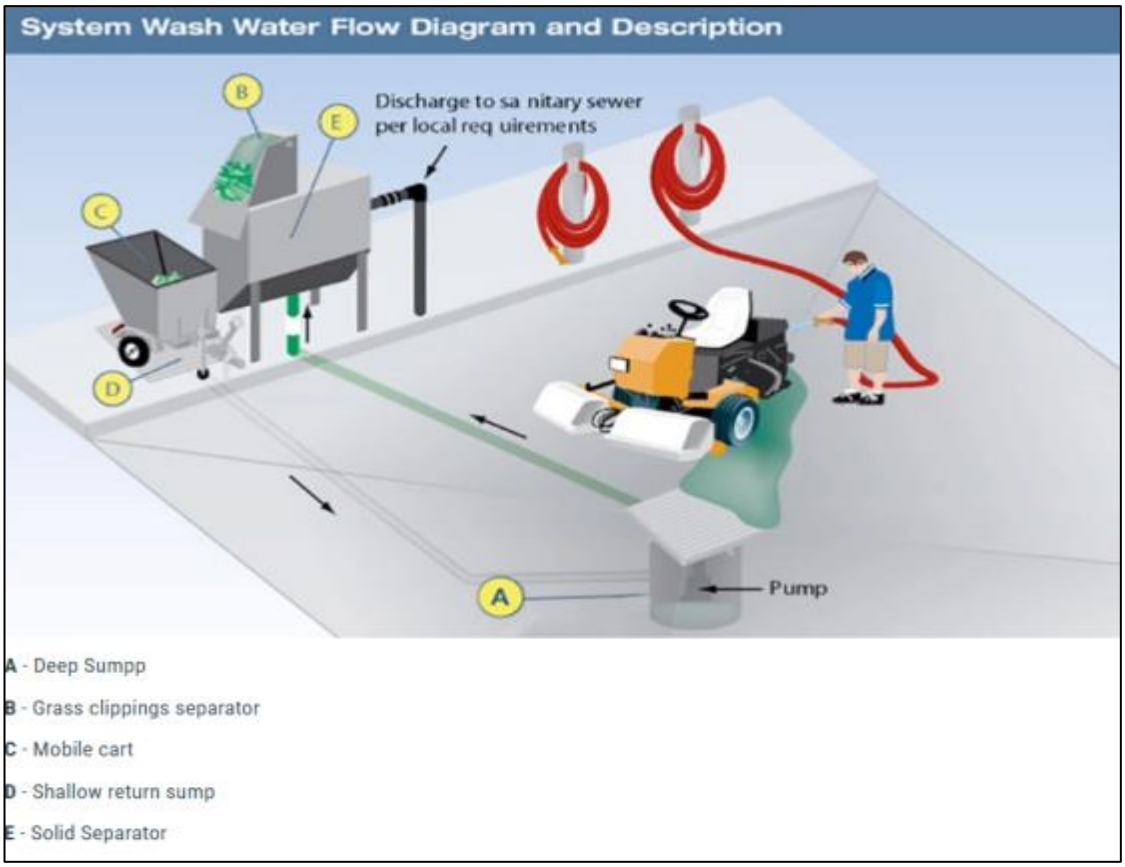


Figure 17. The ESD Waste 2 water equipment wash down system

14.7 Fertiliser Use:

(a) Proposed fertiliser programmes required to maintain the different turf areas on this golf course are detailed in Appendix 2, 3, 4, 5 and 6.

(b) Approach to fertiliser and key considerations:

(i) Unlike horticulture or agriculture where the objective is to maximise growth (production), turf is about fertilising for density and playing quality. Consequently, much lower fertiliser inputs can be used.

(ii) The higher anticipated staffing levels of 23 FTE will enable a 'trickle feeding fertiliser approach", i.e. spraying on small amounts of nutrient (e.g. 5 – 10kg actual Nitrogen/ha/application) is possible. This is highly desirable in turf as it minimises flushes of growth which would compromise playing quality; and the potential for leaching and run-off.

(iii) To assist with maintaining the pure surfaces demanded by turf and to manage environmental concerns, fertiliser application is concentrated when the desired grass is actively growing (growth potential for a grass). An example of growth potential when scheduling nitrogen for Creeping Bentgrass in the Auckland region is presented in Table 6.

(iv) With the exception of potassium, established turf doesn't have a large requirement for other nutrients. Best practise guidelines would be followed, whereby additional nutrients other than nitrogen and potassium are based on soil test and tissue test results and a grass specific database.

Growth potential:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Average monthly temp (^{0}C)	20.4	20.8	19.4	17.1	14.5	12.3	11.3	12	13.3	14.8	16.5	19.1
Key	Optimum growing season for Creeping Bentgrass – most nitrogen should be concentrated in these months.											
	Growth of creeping bent grass is slowing, minimal nitrogen is recommended.											
	Negligible growth by Creeping Bentgrass, no nitrogen is recommended.											

Table 6. Growth potential of Creeping Bentgrass in Auckland and impact on timing of fertiliser applications.

(v) It is proposed that a monitoring programme of water quality would be undertaken. It is anticipated this would involve: testing water quality when it enters and leaves the property and also drainage discharge from the select turf areas (as set out in the Water Effects Summary Report, Appendix 10 to AEE).

(vi) Detailed records would be maintained around soil test results and fertiliser applications so fertiliser use can be constantly fine-tuned with time.

(vii) To minimise the use of fertiliser (particularly nitrogen) grass selection has been critical in choosing low fertility requiring grasses (Fescue & Couch) at the outset of this project.

14.8 Agrichemical Use

(a) Approach for agrichemicals

(i) Recognising the perceived concerns around agrichemicals, the first management strategy has been to select grasses which are known to be less susceptible to disease and pest problems, namely Couch and fine Fescue. Creeping Bentgrass depending on the cultivar selected is considered to have medium susceptibility to some diseases.

(ii) All spraying will be completed by trained staff (min Basic Growsafe™) or equivalent in accordance with best practise and laws detailed in the Auckland Unitary Plan and NZS 8409:2004 Management of agrichemicals.

(iii) Staffing levels will, unlike normal broadacre treatment options, allow for a surgical or localised control approach in most instances.

(iv) An integrated pest management programme will be adopted, setting out:

(1) Threshold levels for pest and disease problems encountered on this golf course, that can be developed and fine-tuned over time.

(2) Regular scouting programmes, when pest or disease problems are expected.

(3) A focus on (as much as is possible) spot treating problems (e.g. Kikuyu, *Poa annua* etc.) rather than a broadacre control approach (unless required).

(4) With the exception of December – February (on the greens) all spraying for disease and pests will be based on curative rather preventative approach.

(5) The agrichemical selection will be based around managing resistance, effectiveness and lowest toxicity.

(6) Accurate records, to better allow problems to be forecasted and hence management plans refined to reduce the incidence/severity of disease issues.

14.9 Irrigation: (normal golf course maintenance operations)

(a) The importance and therefore effective use of water has been incorporated into the management/development of the golf course from the outset of the project as follows:

(i) Greens will be constructed using a perched water table concept, which effectively creates a water reservoir within the greens.

(ii) Organic matter levels will be maintained within grass specific target limits, thereby optimising infiltration.

(iii) Dry patch is a consequence of the sand systems used in turf. Scouting programmes, wetting agents, managing organic matter, renovation, and topdressing are all critical programmes to prevent and manage this issue, thereby reducing wastage of water.

(iv) Watering will be based around using a soil moisture meter and predetermined upper/lower levels for starting/stopping watering. An active monitoring programme such as this can assist in making substantial savings in water use. Based on NZSTI experience at least 20% savings in water use are commonly achieved with active management of irrigation.

15. AUDUBON INTERNATIONAL SIGNATURE SANCTUARY CERTIFICATION (ENVIRONMENTAL MANAGEMENT AUDUBON INTERNATIONAL TOOL) APPENDIX 8

15.1 Golf courses around the country (and the world) are now better environmental stewards than they were in the past. The New Zealand Golf Course Superintendents Association (NZGCSA) has had a strong focus on providing education and recognition through industry leadership.

15.2 Organisations such as Audubon International and the Golf Environment Organisation (GEO) both provide a framework of on course programmes for golf course superintendents to implement, manage and record the environmental work they undertake.

15.3 Audubon International engages with people and organisations to assist in good environmental stewardship and sustainable resource management through education and certification programs. These programs can be of benefit to both the golf course construction phase, and also the ongoing operations of the golf course.

15.4 Audubon International is guided by three (3) overarching goals:

(a) **Facilitate Best Practices** – assist in creating model developments that protect the environment, and also meet desired economic and social outcomes, by emphasising eco design, construction and sustainable resource management.

(b) **Drive Change** – document and publicise the environmental, economic and social outcomes of model sustainable developments to inspire change in others.

(c) **Offer New Solutions** – identify existing government or economic policy barriers that hinder the establishment of more sustainable new developments, as well as alternatives to overcome these barriers.

15.5 Implementing Audubon International Signature Sanctuary Certification will further strengthen the commitment to environmental best practice.

15.6 One of the many benefits of the program is the focus it has on the engagement with local community groups. Council, local environmental groups, bird watchers, schools and others can benefit with involvement. Monitoring wildlife activity, enhancing wildlife habitats, restoring degraded landscapes through revegetation are some of the opportunities local community groups can assist.

15.7 Engagement with Audubon International at this early stage of the golf course construction will be a first in New Zealand.

www.audubooninternational.org

Figure 18. Audubon International Signature Sanctuary Program for golf courses is a great way for to engage with local community groups like schools.

16. BALL RETREVIAL (SEE APPENDIX 11)

16.1 A golf ball retrieval program will form part of the golf course maintenance operation. The golf ball retrieval program will allow for both a monthly and an annual retrieval process to be carried out in conjunction with ecology support for the wetlands.

16.2 A monthly program will be implemented without physical entry within the wetlands. This will be undertaken by using a golf ball retrieval tool, removing golf balls that can be seen within approximately 3 metres of the shoreline.

16.3 An annual program will be implemented in late summer to allow for a more extensive and widespread approach to golf ball retrieval from within the wetlands. At this time of the year, it is expected that the wetlands will be dry ground (except for the main wetland below the waterfall) and any wetland birds will have finished breeding.

17. CONCLUSION

17.1 In conclusion this reports illustrates the ethos and planning that has been adopted by both NZ Sports Turf Institute and Steve Marsden Turf Services during the planning process (to date) and proposed maintenance of the golf course, specifically:

(a) Selection of grasses is based on meeting both the requirements of golf and minimising environmental impact by selecting species that use or require comparatively less water, fertiliser and agrichemicals.

(b) As a "marquee" golf course with comparatively high staffing levels (anticipated at 23 FTEs), it will be possible, in most cases, to 'surgically' manage disease, pest and weed issues relative to the normal broad acre approach.

(c) Adopt best practice in terms of water use, by incorporating valve in head sprinkler system, weather station, mobile moisture sensors and scouting programmes with a moisture meter all in conjunction with state-of-the-art programmable logic computer systems to ensure water use efficiency is maximised.

(d) An integrated pest management (IPM) program will form the cornerstone of the management of the golf course. IPM is a multidisciplinary, ecologically based pest management system that uses all available methods to keep pests (insects, weeds and diseases) at acceptable levels while minimising the effects on people, the environment and turf.

(e) There will be significantly less fertiliser used under a typical yearly golf course maintenance operation as compared with present farming practices, specifically:

Fertiliser Use on the Muriwai Property							
Current farm use			**Proposed Nutrient Use - Maintenance of the Golf Course**				
Category	**Area**	**Av. Nitrogen (kg/ha/yr)**	**Category**	**Area**	**Nitrogen (Kg/ha/yr**	**Phosphorus (kg/ha/yr)**	**Potassium (kg/ha/yr**
Dairying	71ha	110	**Greens**	3.4ha	93	4	67
Beef & sheep	297Ha	110	**Tees**	3.8ha	105	18	110
			Fairways & Primary Rough	37.3ha	58	24	52
Note: Provided by Williamson Water & Land Advisory			**Secondary (naturalised) Rough**	28.6ha	25	12	2
			Average	**73**	**49.4**	**18**	**36.2**

(f) The golf course maintenance operation will operate safely from world class maintenance facilities; these facilities will be compliant in all regulatory aspects.

17.2 The golf course will be constructed to conform to the requirements of Audubon International's Signature Sanctuary Certification. The on-going golf course maintenance operation will have an environmental focus, one that follows the values, standards and guidelines set out by Audubon International.

APPENDIX 1: GRASSING SELECTION MATRIX

Grass Selection Matrix for Fairways & Rough Muriwai Golf Club- New								
Key (0 V.poor... 5 excellent)		Excellent			Poor to average			Poor/not at all
Category	Parameter	Browntop	Chewing fescue	Red Fescue	Ryegrass	Kikuyu	Cynodon	Comment
Climate	Rainfall (with irrigation)	5	1	1	5	5	5	In absence of haloxyfop, fescue will be swamped by other grasses in the Auckland climate. A similar situation is expected with Couch.
	Humidity (November - March)	3	2	2	1	5	5	
	Temperature	4	4	4	4	3	2	Winter temperatures can depending on the season cause some level of dormancy on warm season grasses during July - August.
Playing quality	Leaf finness	4	5	5	3	g	3	
	Density	5	5	5	3	3	5	
	Winter turf quality (dormancy)	5	5	5	5	3	2	
	Playing quality	5	5	5	3	3	5	
	Creeping growth habit	5	0	5	0	5	5	
Agronomics	Mowing requirement	5	5	5	2	1	2	Growth regulators are essential on ryegrass, Kikuyu and Couch
	Ease of Poa annua control	3	5	5	5	0	5	Resistance to paclobutrazol, haloxyfop and ethofumesate well established in NZ.
	Ease of Kikuyu control	4	5	5	4		2	
	Disease susceptibility	3	3	3	1	5	4	
	Adaptability to exg soils							
	Sand area (with irrigation)	5	5	5	3	5	5	
	Soil area (without sand capping)	4	0	0	5	4	3	
	Establishment							
	Window for sowing/establishment	4	3	3	5	3	2	Fescues are sensitive to winter temperatures for germination & establishment.
	Speed of establishment	2	2	2	5	5	5	
	Pest damage	4	4	4	3	4	4	Earthworms are more of an issue on non spreading coarse textured grasses like ryegrass. Black beetle main pest.
	Wear recovery (with irrig)	3	1	1	0	4	3	Couch and fescue will have limited winter recovery and both are prone to wear.
Sustainability	Requirement for fertiliser	4	5	5	0	5	4	
	Requirement for agrichemicals	3	3	3	0	5	4	
	Requirement for water	2	2	2	1	3	5	
Total score		82	70	75	58	76	80	

APPENDIX 2: MURIWAI DOWNS FERTILISER USE

Greens – Creeping Bentgrass: Pre-plant, Grow-in and Maintenance

Muriwai Downs

Greens Pre-Plant Fertiliser Requirements

Greens grass species	Area	
Creeping Bentgrass	3.4	Ha

No.	Product Details	Date of Application	Rate kg/Ha	Proposed Actual kg/Ha Applied N	P	K	Accumulative Actual kg/Ha Applied N	P	K
1	Bio Boost Organic 5-2.4-.4	Pre-plant	500	25	12	2	25	12	2
2	SandAid Organic	Pre-plant	500	0	0	0	25	12	2
3	Andersons A-Tep Micronutrients	Pre-plant	300	0	0	0	25	12	2
4	Restore Wetting Agent Granules	Pre-plant	300	0	0	0	25	12	2
	Total						**25**	**12**	**2**

Notes:
Once soil tests are carried out additional soil ammendments may be required.

Muriwai Downs

Greens Grow-in Fertiliser Requirements

Greens grass species	Area		Grow-in
Creeping Bentgrass	3.4	Ha	24 weeks

No.	Product Details	Date of Application	Rate kg/Ha	Proposed Actual kg/Ha Applied N	P	K	Accumulative Actual kg/Ha Applied N	P	K
1	Andersons 12-1-10	Week 1	150	20	2	15	20	2	15
2	Andersons 12-1-10	Week 3	150	20	2	15	40	4	30
3	Rooster Booster 4-2.5-2	Week 4	500	20	13	10	60	16	40
4	Andersons 12-1-10	Week 6	150	20	2	13	80	18	53
5	Andersons 12-1-10	Week 8	150	20	2	13	100	20	66
5	Andersons Humic DG	Week 9	200	0	0	0	100	20	66
5	Andersons 12-1-10	Week 10	150	20	2	15	120	22	81
6	Andersons 12-1-10	Week 12	150	20	2	15	140	24	96
7	Andersons 12-1-10	Week 13	150	20	2	15	160	26	111
8	Andersons 12-1-10	Week 18	15	20	2	15	180	28	126
9	Andersons Humic DG	Week 24	200	0	0	0	180	28	126
	Sub-Total						**180**	**28**	**126**

Notes:
Once soil tests are carried out additional soil ammendments may be required.
The above applications commence after seed germination.

Greens Maintenance Fertiliser Requirements

Greens grass species	Area		Maintenance
Creeping Bentgrass	3.4	Ha	52 weeks

No.	Product Details	Date of Application	Rate kg/Ha	Proposed Actual kg/Ha Applied N	P	K
1	Various products	Weeks 1-52	Various rates	93	4	67
	Sub-Total					

Notes:
Once soil tests are carried out additional soil ammendments may be required.
The above applications commence after seed germination.

APPENDIX 3: MURIWAI DOWNS FERTILISER USE

Tees – Windsorgreen Couch: Pre-plant, Grow-in and Maintenance

Muriwai Downs

Tees Pre-Plant Fertiliser Requirements

Tees grass species	***Area***	
Windsorgreen Couch	*3.8*	***Ha***

					Proposed Actual kg/Ha Applied			***Accumulative Actual kg/Ha Applied***		
No.	***Product Details***	***Date of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Bio Boost Organic 5-2.4-.4*	*Pre-plant*	*500*	*25*	*12*	*2*	*25*	*12*	*2*
2	*Restore Wetting Agent Granules*	*Pre-plant*	*300*	*0*	*0*	*0*	*25*	*12*	*2*
3	*Dolemite - EzySpread granular*	*Pre-plant*	*500*	*0*	*0*	*0*	*25*	*12*	*2*
	Total						***25***	***12***	***2***

Notes:
Once soil tests are carried out additional soil ammendments may be required.

Muriwai Downs

Tees Grow-in Fertiliser Requirements

Tees grass species	***Area***		***Grow-in***
Windsorgreen Couch	*3.8*	***Ha***	*24 weeks*

					Proposed Actual kg/Ha Applied			***Accumulative Actual kg/Ha Applied***		
No.	***Product Details***	***Date of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Nitrophoska Blue 12-5-14*	*Week 1*	*160*	*19*	*8*	*22*	*19*	*8*	*22*
2	*Nitrophoska Blue 12-5-14*	*Week 3*	*160*	*19*	*8*	*22*	*38*	*16*	*44*
3	*Nitrophoska Blue 12-5-14*	*Week 5*	*160*	*19*	*8*	*22*	*57*	*24*	*66*
4	*Black Urea 46-0-0*	*Week 8*	*100*	*46*	*0*	*0*	*103*	*24*	*66*
5	*Bio Boost Organic 5-2.4-.4*	*Week 12*	*500*	*25*	*12*	*2*	*128*	*36*	*68*
6	*Black Urea 46-0-0*	*Week 13*	*100*	*46*	*0*	*0*	*174*	*36*	*68*
7	*Black Urea 46-0-0*	*Week 16*	*100*	*46*	*0*	*0*	*220*	*36*	*68*
8	*Nitrophoska Blue 12-5-14*	*Week 20*	*160*	*19*	*8*	*22*	*239*	*44*	*90*
	Total						***239***	***44***	***90***

Notes:
Once soil tests are carried out additional soil ammendments may be required.
The above applications commence after stolons strike.

Muriwai Downs

Tees Yearly Maintenance Fertiliser Requirements

Tees grass species	***Area***	
Windsorgreen Couch	*3.8*	***Ha***

						Proposed Actual kg/Ha Applied			***Accumulative Actual kg/Ha Applied***		
No.	***Product Details***	***Timing of Application***	***Type of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Iron - Magnesium - S of A*	*Spring*	*Foliar*	*20*	*4*	*0*	*0*	*4*	*0*	*0*
2	*Iron - Magnesium - S of A*	*Spring*	*Foliar*	*20*	*4*	*0*	*0*	*8*	*0*	*0*
3	*Bio Boost Organic 5-2.4-.4*	*Spring*	*Granular*	*500*	*25*	*12*	*2*	*33*	*12*	*2*
4	*Dolemite*	*Spring*	*Granular*	*500*	*0*	*0*	*0*	*33*	*12*	*2*
5	*Potash 0-0-40*	*Autumn*	*Granular*	*120*	*0*	*0*	*48*	*33*	*12*	*50*
6	*Iron - Magnesium*	*Winter*	*Foliar*	*0*	*0*	*0*	*0*	*33*	*12*	*50*
7	*Iron - Magnesium*	*Winter*	*Foliar*	*0*	*0*	*0*	*0*	*33*	*12*	*50*
8	*Iron - Magnesium*	*Winter*	*Foliar*	*0*	*0*	*0*	*0*	*33*	*12*	*50*
9	*Andersons Nutri DG 12-1-10*	*Summer*	*Granular*	*200*	*24*	*2*	*20*	*57*	*14*	*70*
10	*Andersons Nutri DG 12-1-10*	*Summer*	*Foliar*	*200*	*24*	*2*	*20*	*81*	*16*	*90*
11	*Andersons Nutri DG 12-1-10*	*Summer*	*Granular*	*200*	*24*	*2*	*20*	*105*	*18*	*110*
	Total							***105***	***18***	***110***

APPENDIX 4: MURIWAI DOWNS FERTILISER USE

Fairways & Primary Rough – Windsorgreen Couch: Pre-plant, Grow-in and Maintenance

Muriwai Downs

Fairways and Primary Pre-Plant Fertiliser Requirements

Fairways and Primary Rough grass species	***Area***	
Windsorgreen Couch	*37.3*	***Ha***

				Proposed Actual kg/Ha Applied			Accumulative Actual kg/Ha Applied		
No.	***Product Details***	***Date of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Bio Boost Organic 5-2.4-.4*	*Pre-plant*	*500*	*25*	*12*	*2*	*25*	*12*	*2*
2	*Dolemite - EzySpread granular*	*Pre-plant*	*1000*	*0*	*0*	*0*	*25*	*12*	*2*
	Total						***25***	***12***	***2***

Notes:
Once soil tests are carried out additional soil ammendments may be required.

Muriwai Downs

Fairways & Primary Rough Grow-in Fertiliser Requirements

Fairways and Primary Rough grass species	***Area***		***Grow-in***
Windsorgreen Couch	*37.3*	***Ha***	*24 weeks*

				Proposed Actual kg/Ha Applied			Accumulative Actual kg/Ha Applied to Date		
No.	***Product Details***	***Date of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Nitrophoska Blue 12-5-14*	*Week 1*	*160*	*19*	*8*	*22*	*19*	*8*	*22*
2	*Nitrophoska Blue 12-5-14*	*Week 3*	*160*	*19*	*8*	*22*	*38*	*16*	*44*
3	*Nitrophoska Blue 12-5-14*	*Week 5*	*160*	*19*	*8*	*22*	*57*	*24*	*66*
4	*Black Urea 46-0-0*	*Week 9*	*100*	*46*	*0*	*0*	*103*	*24*	*66*
5	*Bio Boost Organic 5-2.4-.4*	*Week 12*	*500*	*25*	*12*	*2*	*128*	*36*	*68*
6	*Black Urea 46-0-0*	*Week 13*	*100*	*46*	*0*	*0*	*174*	*36*	*68*
7	*Black Urea 46-0-0*	*Week 16*	*100*	*46*	*0*	*0*	*220*	*36*	*68*
8	*Nitrophoska Blue 12-5-14*	*Week 20*	*160*	*19*	*8*	*22*	*239*	*44*	*90*
	Total						***239***	***44***	***90***

Notes:
Once soil tests are carried out additional soil ammendments may be required.
The above applications commence after stolons strike.

Muriwai Downs

Fairways & Primary Yearly Maintenance Fertiliser Requirements

Fairways & Primary grass species	***Area***	
Windsorgreen Couch	*37.3*	***Ha***

					Proposed Actual kg/Ha Applied			Accumulative Actual kg/Ha Applied		
No.	***Product Details***	***Timing of Application***	***Type of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Iron - Magnesium - S of A*	*Spring*	*Foliar*	*20*	*4*	*0*	*0*	*4*	*0*	*0*
2	*Iron - Magnesium - S of A*	*Spring*	*Foliar*	*20*	*4*	*0*	*0*	*8*	*0*	*0*
3	*Bio Boost Organic 5-2.4-.4*	*Spring*	*Granular*	*500*	*25*	*12*	*2*	*33*	*12*	*2*
4	*Dolemite*	*Spring*	*Granular*	*500*	*0*	*0*	*0*	*33*	*12*	*2*
5	*Potash 0-0-40*	*Autumn*	*Granular*	*120*	*0*	*0*	*48*	*33*	*12*	*50*
6	*Iron - Magnesium*	*Winter*	*Foliar*	*0*	*0*	*0*	*0*	*33*	*12*	*50*
7	*Iron - Magnesium*	*Winter*	*Foliar*	*0*	*0*	*0*	*0*	*33*	*12*	*50*
8	*Iron - Magnesium*	*Winter*	*Foliar*	*0*	*0*	*0*	*0*	*33*	*12*	*50*
9	*Bio Boost Organic 5-2.4-.4*	*Summer*	*Granular*	*500*	*25*	*12*	*2*	*58*	*24*	*52*
	Total							***58***	***24***	***52***

Notes:
The above applications are subject to growth and performance of the turf.

APPENDIX 5: MURIWAI DOWNS FERTILISER USE

Secondary Rough – Fine Fescue: Pre-plant, Grow-in and Maintenance

Muriwai Downs

Secondary Roughs Pre-Plant Fertiliser Requirements

Secondary Roughs grass species	***Area***	
Fine Fescue Blend	*28.6*	***Ha***

					Proposed Actual kg/Ha Applied			***Accumulative Actual kg/Ha Applied***		
No.	***Product Details***	***Date of Application***	***Rate kg/Ha***	***Method of Application***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Bio Boost Organic 5-2.4-.4*	*Week 1*	*1000*	*Vicon Spreader*	*50*	*24*	*4*	*50*	*24*	*4*
	Total							***50***	***24***	***4***

Notes:
Once soil tests are carried out additional soil ammendments may be required.

Muriwai Downs

Secondary Roughs Grow-in Fertiliser Requirements

Secondary Roughs grass species	***Area***		***Grow-in***
Fine Fescue Blend	*28.6*	***Ha***	*16 weeks*

				Proposed Actual kg/Ha Applied			***Accumulative Actual kg/Ha Applied***		
No.	***Product Details***	***Date of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Bio Boost Organic 5-2.4-.4*	*Week 1*	*500*	*50*	*24*	*2*	*50*	*24*	*2*
2	*Bio Boost Organic 5-2.4-.4*	*Week 6*	*500*	*50*	*24*	*2*	*100*	*48*	*4*
3	*Bio Boost Organic 5-2.4-.4*	*Week 12*	*500*	*50*	*24*	*2*	*150*	*72*	*6*
	Total						***150***	***72***	***6***

Notes:
The above applications commence after seed germination, and are all applied subject to growth and turf cover.
Applications will likely be made to weak isolated areas following early establishment.

Muriwai Downs

Secondary Roughs Yearly Maintenance Fertiliser Requirements

Secondary Roughs grass species	***Area***	
Fine Fescue	*28.6*	***Ha***

					Proposed Actual kg/Ha Applied			***Accumulative Actual kg/Ha Applied***		
No.	***Product Details***	***Timing of Application***	***Type of Application***	***Rate kg/Ha***	***N***	***P***	***K***	***N***	***P***	***K***
1	*Bio Boost Organic 5-2.4-.4*	*Spring*	*Granular*	*500*	*25*	*12*	*2*	*25*	*12*	*2*
	Total							***25***	***12***	***2***

Notes:
The above applications are subject to growth and performance of the turf.

APPENDIX 6: MURIWAI DOWNS FERTILISER USE SUMMARY

Greens, Tees, Fairways, Primary and Secondary Rough: Pre-plant, Grow-in and Maintenance Fertiliser

Muriwai Downs 73 Ha

Fertiliser Summary	3.4Ha Greens Actual / Ha			3.8Ha Tees Actual / Ha			37.3Ha Fairways & Primary Actual / Ha			28.6Ha Secondary Rough Actual / Ha		
Area	**N**	**P**	**K**	**N**	**P**	**K**	**N**	**P**	**K**	**N**	**P**	**K**
Pre-plant	25	12	2	25	12	2	25	12	2	50	24	4
Grow-in	180	28	126	239	44	90	239	44	90	150	72	6
Yearly Maintenance	93	4	67	105	18	110	58	24	52	25	12	2

Notes:

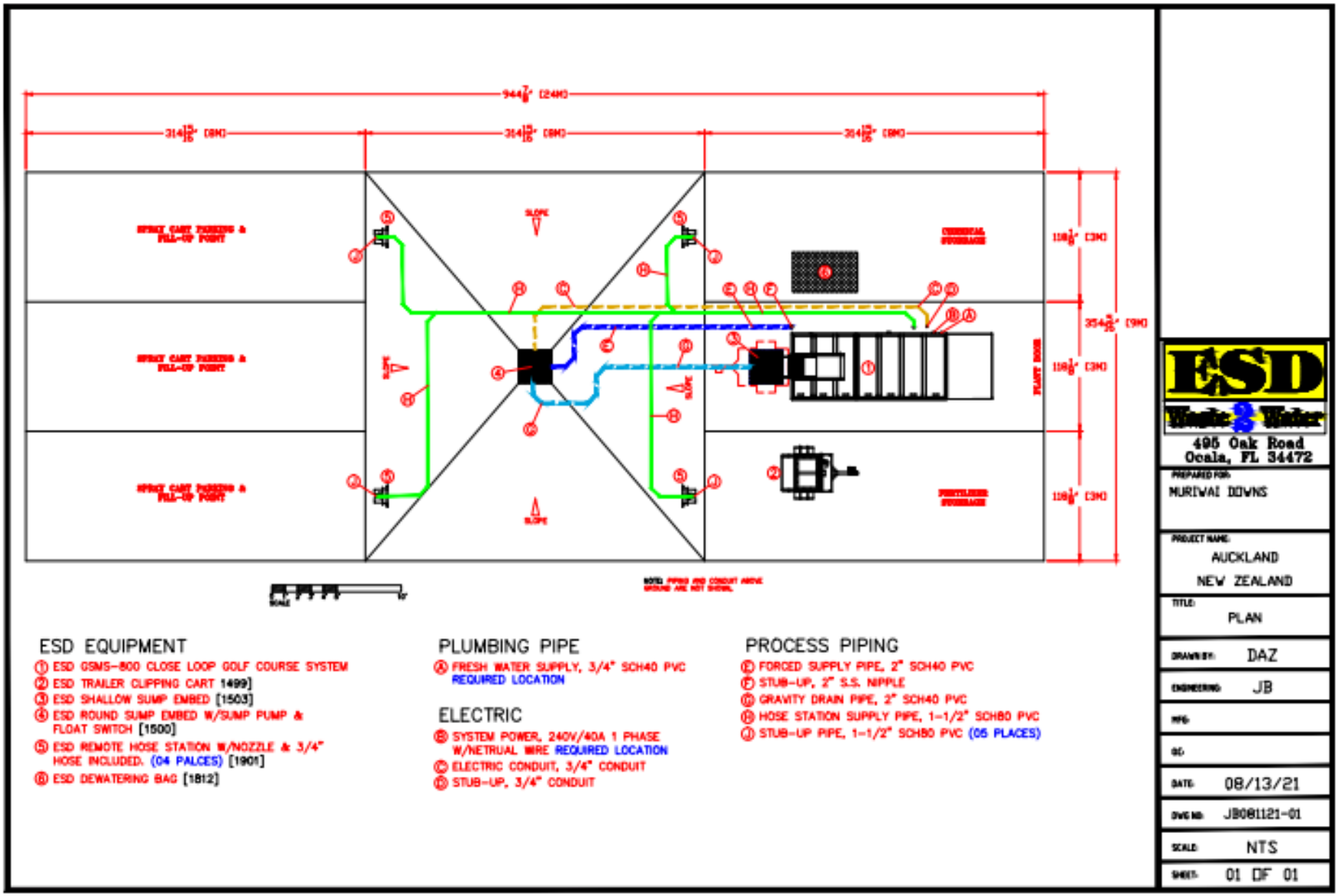
Pre-plant NPK	Nutrient applied prior to grassing each of the above areas.
Grow-in NPK	Nutrient applied during the turf grow-in or establishment phase.
Yearly Maintenance NPK	Nutrient applied for all turf areas over a typical 12 month maintenance period.

Yearly Maintenance NPK fertiliser applications applied over 73Ha of turf including greens, tees, fairways/primary rough and secondary rough

Area	Annual Amount, Kg/Ha			Total Area (Ha)	Annual / Area (Kg)		
	N	**P**	**K**		**N**	**P**	**K**
Greens	93	4	67	3.4	316	12	228
Tees	105	18	110	3.8	401	68	418
Fairways & Primary Rough	58	24	52	37.3	2178	895	1940
Secondary Rough	25	12	2	28.6	715	343	57
Totals				73	3610	1319	2643

Average amount of nurient/Ha applied to the golf course	N	P	K
	49.4	18.0	36.2

APPENDIX 7: ESD WASTE2WATER VEHICLE WASH DOWN FILTRATION SYSTEM



APPENDIX 8: AUDUBON SIGNATURE SANCTUARY PROGRAM

Audubon International

Fact Sheet

Signature Sanctuary Certification

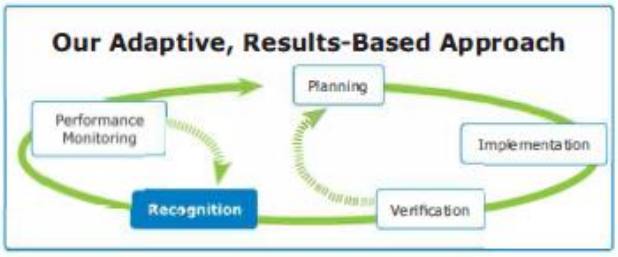
What is Signature Sanctuary Certification?

Audubon International's Signature Sanctuary Certification is our elite, customizable certification created to help landowners, managers, and developers follow comprehensive sustainable resource management principles while planning, developing and managing properties. By working closely with planners, architects, managers, and key stakeholders, Signature Sanctuary Certification helps landowners and developers design their golf course or community for the environment so that both economic and environmental objectives are achieved and sustained in the long-term.

Collier's Reserve, Naples, Florida
First certified Signature Sanctuary in the world –1994!

How does it work?

Signature Sanctuary Certification begins where minimum environmental compliance leaves off, offering a "beyond compliance" approach, continues through construction, grand opening, and long-term management. In addition to minimum certification standards, each project is given the opportunity to work towards three (bronze/silver/gold) different levels of certification. The program is flexible and adaptable to the member, but generally involves:



- **Initial Site Assessment-** An on-site assessment is conducted by the Director of Signature and Classic Certifications, and the project team to evaluate existing natural resources and how the resources may be impacted by the development project.
- **Natural Resource Management Plan (NRMP)-** The site-specific plan serves as a guide for the construction and management of the member's property focusing on wildlife management, habitat enhancement, waste management, energy efficiency, water quality and conservation, integrated pest management, chemical/petroleum storage and usage practices, and the maintenance facility.
- **Environmental Audit-** Once construction is complete, Audubon International will complete a final audit with the project team and assess compliance with program and site-specific requirements for long-term management in accordance with Signature Sanctuary Certification standards.
- **Certification-** To become certified, a project must implement the approved NRMP, meet the minimum certification standards and site-specific requirements set forth by Audubon International, and pass the final on-site environmental audit.
- **Recertification-** Demonstrating continued maintenance of certification criteria, implementation of the NRMP, and Outreach and Education activities are necessary for recertification .Project staff will submit an annual update describing progress in certification focal areas. Site vists are conducted every third year by the Director of Signature & Classic Certifications.

What is the cost?

$9,500 to register which includes two site visits (excluding expenses), All labor through certification, and first year membership fee*. There is a $950 membership fee each year thereafter and an $800 recertification site visit fee every three years.*

**Base fee for a single 18-hole golf course in North America. International and multi-part projects will receive a customized proposal.*
**Additional site visits are available at the expense of $800/day plus travel expenses*

"We have always shared Audubon International's philosophy that nature and golf can coexist in a shared environment. We worked hand in hand to achieve this balance and found in many cases that the Audubon International habitat requirements enhanced the beauty and intrigue of the golf experience. For example, the restoration of the dunes will stabilize them from serious wind erosion, restore valuable wildlife habitat, and serve as one of the key aesthetic backdrops for the golf course. It's certainly a win-win situation for everyone."

- J. Drew Rogers, ASGCA, Oitavos Dunes, Cascais, Portugal

Oitavos Dunes ranked #55 Golf Course in the World!

For more information, please contact:

Kat Findlay, Director of Signature and Classic Sanctuary Programs
120 Defreest Drive
Troy, NY 12180
Ph: (518) 874-4661

Kat@auduboninternational.org

To download this fact sheet and more, visit: www.auduboninternational.org

Audubon International

Fact Sheet

Audubon International and Signature Sanctuary Certification

Audubon International (AI) is a 501(c)(3) not-for-profit organization headquartered near Troy, New York. AI works with partners to deliver high-quality environmental education and to facilitate the sustainable management of land, water, wildlife, and other natural resources in all places people live, work, and play.

AI, which has been in existence for over 30 years, works with a wide range of interested partners, including golf courses, developers, ski areas, resorts, agriculture producers, small businesses, large corporations, academic institutions, fellow not-for-profits, community associations, local governments, and state and federal agencies. Through education, technical assistance, environmental certification, and public recognition, AI facilitates the implementation of natural resource management practices that ensure land, water, wildlife, and other natural resources are sustainably used and conserved. Utilizing a set of award-winning environmental education and certification programs, AI is able to positively impact environmental health at multiple geographic scales, including individual properties, communities, and eco-regions.

Audubon International...

- Engages people and organizations in good environmental stewardship and sustainable resource management though education and certification programs.
- Works with land owners, developers, planners, and architects to design and build new developments in concert with the natural landscape, water resources, and significant environmental features of the site to be developed.
- Spearheads sustainable community initiatives and collaborative strategic planning with local governments and communities.
- Leads a partnership with the golf industry, universities, and other organizations focused on improving the nature of the game of golf and serving as a model for change in other business sectors.
- Educates the general public about the need for all citizens to practice good environmental stewardship and contribute to a more sustainable future.

AI is guided by the following three overarching goals:

1. Facilitate Best Practices - Assist in creating model developments that protect the environment, and also meet desired economic and social outcomes, by emphasizing eco-design, construction, and sustainable resource management.
2. Drive Change - Document and publicize the environmental, economic, and social outcomes of model sustainable developments to inspire change in others.
3. Offer New Solutions - Identify existing governmental or economic policy barriers that hinder the establishment of more sustainable new developments, as well as alternatives to overcome these barriers.

Audubon International: What is Signature Sanctuary Certification?

- In existence for over twenty-five years (est. 1993), AI's Signature Sanctuary Certification is a comprehensive environmental education and conservation assistance program created to help landowners and managers follow comprehensive sustainable resource management principles when developing and then managing properties.

- It is a voluntary membership program that provides a framework, technical assistance, and environmental education for many types of development projects, and recognizes landowners and developers who are committed and dedicated to incorporating a high level of environmentally responsible actions in their projects.

- The program focuses on decisions that will positively impact bio-diversity, ecological restoration, and sustainability with the economic agenda associated with a proposed development—offering a "beyond compliance" approach to new developments.

- Through Signature Sanctuary Certification, AI offers comprehensive planning and educational services to help proposed developments protect natural resources both on and off site during planning, construction, and long-term management of the project.

- By working closely with planners, architects, managers, and key stakeholders, Audubon International helps to ensure that biodiversity conservation, environmental quality, and sustainable management are built into the project and continue after construction is completed.

- The program is premised on a cooperative agreement of all parties to voluntarily incorporate an environmental ethic and address environmental issues and concerns not only before and during construction of the project, but for the long-term management of the completed project.

- All members must develop and implement a Natural Resource Management Plan (NRMP) which is based on the AI's *Principles for Sustainable Resource Management*. The NRMP provides guidance, information, and a means for documenting the natural resources of the property itself; short and long-term environmental impacts of the project; strategies for protecting wildlife and conserving natural resources; and incorporating Best Management Practices for the life of the development.

- To become certified, the project must pass a final audit conducted by AI and meet the minimum requirements applicable to AI's Signature Sanctuary Certification, as well as any additional site-specific requirements established by AI. Monthly progress reports are required during construction. Annual reports are required, and recertification site visits are required periodically to retain *Certified Signature Sanctuary* designation.

APPENDIX 9: IRRIGATION CONSUMPTIVE USE ESTIMATE

IRRIGATION CONSUMPTIVE USE ESTIMATE BY GRASS TYPE
Muriwai Downs Farm
August 2021

Overall Development - Creeping Bentgrass Greens

Turf Area (hectares)	3.44

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Cool Season Turf Crop Coefficient	0.94	0.86	0.74	0.75	0.69	0.6	0.61	0.64	0.75	1.04	0.95	0.88
Creeping Bentgrass Adjustment	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	7.10	5.27	3.75	2.03	1.18	0.84	0.80	1.51	2.43	5.15	5.89	5.74
Total Daily Water Requirement for Turf (liters)	244,279	181,376	128,890	69,698	40,700	29,048	27,495	51,997	83,471	177,091	202,472	197,347
Total Monthly Water Requirement for Turf w/o Rain (liters)	7,572,663	5,078,529	3,995,581	2,090,938	1,261,708	871,433	852,352	1,611,895	2,504,118	5,489,827	6,074,155	6,117,749
Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	2,614,400	2,339,200	2,545,600	2,958,400	3,818,400	4,162,400	4,609,600	4,265,600	3,646,400	3,061,600	2,820,800	3,405,600
Usable Monthly Rainfall (66%) (liters)	1,725,504	1,543,872	1,680,096	1,952,544	2,520,144	2,747,184	3,042,336	2,815,296	2,406,624	2,020,656	1,861,728	2,247,696
Total Monthly Water Requirement for all Turf including Rain (liters)	5,847,159	3,534,657	2,315,485	138,394	0	0	0	0	97,494	3,469,171	4,212,427	3,870,053
Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	509	378	269	145	85	61	57	108	174	369	422	411
Annual Water Requirement w/o rain (liters)	43,520,947											
Annual Water Requirement with rain (liters)	23,484,840											
Minimum Size Pump Required for normal peak demand (LPM)	509											
One Month storage capacity for Peak Demand (liters)	7,572,663											

Overall Development - Windsorgreen Couch Fairways, Roughs and Tees

Turf Area (hectares)	41.083

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Warm Season Turf Crop Coefficient	0.71	0.71	0.62	0.54	0.58	0.55	0.55	0.54	0.76	0.72	0.79	0.68
Windsorgreen Couch Adjustment	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	4.63	3.76	2.71	1.26	0.86	0.67	0.62	1.10	2.12	3.08	4.23	3.83
Total Daily Water Requirement for Turf (liters)	1,903,058	1,544,452	1,113,815	517,591	352,867	274,637	255,696	452,505	872,410	1,264,535	1,736,612	1,572,863
Total Monthly Water Requirement for Turf w/o Rain (liters)	58,994,804	43,244,655	34,528,250	15,527,743	10,938,868	8,239,105	7,926,587	14,027,657	26,172,288	39,200,577	52,098,349	48,758,742
Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	31,223,080	27,936,440	30,401,420	35,331,380	45,602,130	49,710,430	55,051,220	50,942,920	43,547,980	36,563,870	33,688,060	40,672,170
Usable Monthly Rainfall (66%) (liters)	20,607,233	18,438,050	20,064,937	23,318,711	30,097,406	32,808,884	36,333,805	33,622,327	28,741,667	24,132,154	22,234,120	26,843,632
Total Monthly Water Requirement for all Turf including Rain (liters)	38,387,572	24,806,604	14,463,312	0	0	0	0	0	0	15,068,423	29,864,230	21,915,110
Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	3,965	3,218	2,320	1,078	735	572	533	943	1,818	2,634	3,618	3,277
Annual Water Requirement w/o rain (liters)	359,657,625											
Annual Water Requirement with rain (liters)	144,505,251											
Minimum Size Pump Required for normal peak demand (LPM)	3,965											
One Month storage capacity for Peak Demand (liters)	58,994,804											

Total Development Flow and Storage Requirements

Flow Required (LPM)	4,474	3,595	2,589	1,224	820	633	590	1,051	1,991	3,003	4,040	3,688
Total Daily Water Requirement (liters)	2,147,338											
Annual Water Requirement w/o rain (liters)	403,178,572											
Annual Water Requirement with rain (liters)	167,990,090											
Minimum Size Pump Required for normal peak demand (LPM)	4,474											
One Month storage capacity for Peak Demand (liters)	66,567,468											

PREVOST STAMPER IRRIGATION

IRRIGATION CONSUMPTIVE USE ESTIMATE BY GRASS TYPE
Muriwai Downs Farm
August 2021

Golf Course - Creeping Bentgrass Greens

Turf Area (hectares)	1.62

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Cool Season Turf Crop Coefficient	0.94	0.86	0.74	0.75	0.69	0.6	0.61	0.64	0.75	1.04	0.95	0.88
Creeping Bentgrass Adjustment	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	7.10	5.27	3.75	2.03	1.18	0.84	0.80	1.51	2.43	5.15	5.89	5.74
Total Daily Water Requirement for Turf (liters)	115,039	85,415	60,698	32,823	19,167	13,679	12,948	24,487	39,309	83,398	95,350	92,937
Total Monthly Water Requirement for Turf w/o Rain (liters)	3,566,196	2,391,633	1,881,640	984,686	594,176	410,384	401,398	759,090	1,179,265	2,585,326	2,860,503	2,881,033

Rainfall

50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	1,231,200	1,101,600	1,198,800	1,393,200	1,798,200	1,960,200	2,170,800	2,008,800	1,717,200	1,441,800	1,328,400	1,603,800
Usable Monthly Rainfall (66%) (liters)	812,592	727,056	791,208	919,512	1,186,812	1,293,732	1,432,728	1,325,808	1,133,352	951,588	876,744	1,058,508
Total Monthly Water Requirement for all Turf including Rain (liters)	2,753,604	1,664,577	1,090,432	65,174	0	0	0	0	45,913	1,633,738	1,983,759	1,822,525

Flow and Storage Requirements

Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	240	178	126	68	40	28	27	51	82	174	199	194
Annual Water Requirement w/o rain (liters)	20,495,330											
Annual Water Requirement with rain (liters)	11,059,721											
Minimum Size Pump Required for normal peak demand (LPM)	240											
One Month storage capacity for Peak Demand (liters)	3,566,196											

Golf Course - Windsorgreen Couch Fairways, Roughs and Tees

Turf Area (hectares)	29

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Warm Season Turf Crop Coefficient	0.71	0.71	0.62	0.54	0.58	0.55	0.55	0.54	0.76	0.72	0.79	0.68
Windsorgreen Couch Adjustment	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	4.63	3.76	2.71	1.26	0.86	0.67	0.62	1.10	2.12	3.08	4.23	3.83
Total Daily Water Requirement for Turf (liters)	1,343,346	1,090,210	786,228	365,362	249,084	193,863	180,493	319,418	615,824	892,620	1,225,853	1,110,265
Total Monthly Water Requirement for Turf w/o Rain (liters)	41,643,729	30,525,886	24,373,080	10,960,849	7,721,617	5,815,886	5,595,283	9,901,956	18,474,706	27,671,220	36,775,604	34,418,215

Rainfall

50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	22,040,000	19,720,000	21,460,000	24,940,000	32,190,000	35,090,000	38,860,000	35,960,000	30,740,000	25,810,000	23,780,000	28,710,000
Usable Monthly Rainfall (66%) (liters)	14,546,400	13,015,200	14,163,600	16,460,400	21,245,400	23,159,400	25,647,600	23,733,600	20,288,400	17,034,600	15,694,800	18,948,600
Total Monthly Water Requirement for all Turf including Rain (liters)	27,097,329	17,510,686	10,209,480	0	0	0	0	0	0	10,636,620	21,080,804	15,469,615

Flow and Storage Requirements

Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	2,799	2,271	1,638	761	519	404	376	665	1,283	1,860	2,554	2,313
Annual Water Requirement w/o rain (liters)	253,878,031											
Annual Water Requirement with rain (liters)	102,004,534											
Minimum Size Pump Required for normal peak demand (LPM)	2,799											
One Month storage capacity for Peak Demand (liters)	41,643,729											

Total Golf Course Flow and Storage Requirements

Flow Required (LPM)	3,038	2,449	1,764	830	559	432	403	716	1,365	2,033	2,753	2,507
Total Daily Water Requirement (liters)	1,458,385											
Annual Water Requirement w/o rain (liters)	274,373,360											
Annual Water Requirement with rain (liters)	113,064,255											
Minimum Size Pump Required for normal peak demand (LPM)	3,038											
One Month storage capacity for Peak Demand (liters)	45,209,925											

PREVOST STAMPER IRRIGATION

IRRIGATION CONSUMPTIVE USE ESTIMATE BY GRASS TYPE
Muriwai Downs Farm
August 2021

Warm Up Range - Creeping Bentgrass Greens

Turf Area (hectares)	0.225

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Cool Season Turf Crop Coefficient	0.94	0.86	0.74	0.75	0.69	0.6	0.61	0.64	0.75	1.04	0.95	0.88
Creeping Bentgrass Adjustment	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	7.10	5.27	3.75	2.03	1.18	0.84	0.80	1.51	2.43	5.15	5.89	5.74
Total Daily Water Requirement for Turf (liters)	15,978	11,863	8,430	4,559	2,662	1,900	1,798	3,401	5,460	11,583	13,243	12,908
Total Monthly Water Requirement for Turf w/o Rain (liters)	495,305	332,171	261,339	136,762	82,525	56,998	55,750	105,429	163,787	359,073	397,292	400,143

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	171,000	153,000	166,500	193,500	249,750	272,250	301,500	279,000	238,500	200,250	184,500	222,750
Usable Monthly Rainfall (66%) (liters)	112,860	100,980	109,890	127,710	164,835	179,685	198,990	184,140	157,410	132,165	121,770	147,015
Total Monthly Water Requirement for all Turf including Rain (liters)	382,445	231,191	151,449	9,052	0	0	0	0	6,377	226,908	275,522	253,128

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	33	25	18	9	6	4	4	7	11	24	28	27
Annual Water Requirement w/o rain (liters)	2,846,574											
Annual Water Requirement with rain (liters)	1,536,072											
Minimum Size Pump Required for normal peak demand (LPM)	33											
One Month storage capacity for Peak Demand (liters)	495,305											

Warm Up Range - Windsorgreen Couch Fairways, Roughs and Tees

Turf Area (hectares)	2.335

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Warm Season Turf Crop Coefficient	0.71	0.71	0.62	0.54	0.58	0.55	0.55	0.54	0.76	0.72	0.79	0.68
Windsorgreen Couch Adjustment	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	4.63	3.76	2.71	1.26	0.86	0.67	0.62	1.10	2.12	3.08	4.23	3.83
Total Daily Water Requirement for Turf (liters)	108,163	87,781	63,305	29,418	20,056	15,609	14,533	25,719	49,584	71,871	98,702	89,395
Total Monthly Water Requirement for Turf w/o Rain (liters)	3,353,038	2,457,860	1,962,453	882,537	621,723	468,279	450,517	797,278	1,487,532	2,228,010	2,961,070	2,771,260

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	1,774,600	1,587,800	1,727,900	2,008,100	2,591,850	2,825,350	3,128,900	2,895,400	2,475,100	2,078,150	1,914,700	2,311,650
Usable Monthly Rainfall (66%) (liters)	1,171,236	1,047,948	1,140,414	1,325,346	1,710,621	1,864,731	2,065,074	1,910,964	1,633,566	1,371,579	1,263,702	1,525,689
Total Monthly Water Requirement for all Turf including Rain (liters)	2,181,802	1,409,912	822,039	0	0	0	0	0	0	856,431	1,697,368	1,245,571

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	225	183	132	61	42	33	30	54	103	150	206	186
Annual Water Requirement w/o rain (liters)	20,441,559											
Annual Water Requirement with rain (liters)	8,213,124											
Minimum Size Pump Required for normal peak demand (LPM)	225											
One Month storage capacity for Peak Demand (liters)	3,353,038											

Total Warm Up Range Flow and Storage Requirements												
Flow Required (LPM)	259	208	149	71	47	36	34	61	115	174	233	213
Total Daily Water Requirement (liters)	124,140											
Annual Water Requirement w/o rain (liters)	23,288,132											
Annual Water Requirement with rain (liters)	9,749,196											
Minimum Size Pump Required for normal peak demand (LPM)	259											
One Month storage capacity for Peak Demand (liters)	3,848,343											

IRRIGATION CONSUMPTIVE USE ESTIMATE BY GRASS TYPE
Muriwai Downs Farm
August 2021

Academy Range - Creeping Bentgrass Greens

Turf Area (hectares)	0.245

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Cool Season Turf Crop Coefficient	0.94	0.86	0.74	0.75	0.69	0.6	0.61	0.64	0.75	1.04	0.95	0.88
Creeping Bentgrass Adjustment	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	7.10	5.27	3.75	2.03	1.18	0.84	0.80	1.51	2.43	5.15	5.89	5.74
Total Daily Water Requirement for Turf (liters)	17,398	12,918	9,180	4,964	2,899	2,069	1,958	3,703	5,945	12,613	14,420	14,055
Total Monthly Water Requirement for Turf w/o Rain (liters)	539,332	361,698	284,569	148,919	89,860	62,064	60,705	114,801	178,346	390,991	432,607	435,712

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	186,200	166,600	181,300	210,700	271,950	296,450	328,300	303,800	259,700	218,050	200,900	242,550
Usable Monthly Rainfall (66%) (liters)	122,892	109,956	119,658	139,062	179,487	195,657	216,678	200,508	171,402	143,913	132,594	160,083
Total Monthly Water Requirement for all Turf including Rain (liters)	416,440	251,742	164,911	9,857	0	0	0	0	6,944	247,078	300,013	275,629

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	36	27	19	10	6	4	4	8	12	26	30	29
Annual Water Requirement w/o rain (liters)	3,099,602											
Annual Water Requirement with rain (liters)	1,672,612											
Minimum Size Pump Required for normal peak demand (LPM)	36											
One Month storage capacity for Peak Demand (liters)	539,332											

Academy Range - Windsorgreen Couch Fairways, Roughs and Tees

Turf Area (hectares)	4.963

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Warm Season Turf Crop Coefficient	0.71	0.71	0.62	0.54	0.58	0.55	0.55	0.54	0.76	0.72	0.79	0.68
Windsorgreen Couch Adjustment	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	4.63	3.76	2.71	1.26	0.86	0.67	0.62	1.10	2.12	3.08	4.23	3.83
Total Daily Water Requirement for Turf (liters)	229,897	186,576	134,553	62,527	42,628	33,177	30,889	54,665	105,391	152,761	209,790	190,008
Total Monthly Water Requirement for Turf w/o Rain (liters)	7,126,822	5,224,137	4,171,158	1,875,817	1,321,462	995,319	957,565	1,694,600	3,161,723	4,735,595	6,293,701	5,890,262

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	3,771,880	3,374,840	3,672,620	4,268,180	5,508,930	6,005,230	6,650,420	6,154,120	5,260,780	4,417,070	4,069,660	4,913,370
Usable Monthly Rainfall (66%) (liters)	2,489,441	2,227,394	2,423,929	2,816,999	3,635,894	3,963,452	4,389,277	4,061,719	3,472,115	2,915,266	2,685,976	3,242,824
Total Monthly Water Requirement for all Turf including Rain (liters)	4,637,381	2,996,743	1,747,229	0	0	0	0	0	0	1,820,329	3,607,725	2,647,438

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	479	389	280	130	89	69	64	114	220	318	437	396
Annual Water Requirement w/o rain (liters)	43,448,161											
Annual Water Requirement with rain (liters)	17,456,845											
Minimum Size Pump Required for normal peak demand (LPM)	479											
One Month storage capacity for Peak Demand (liters)	7,126,822											

Total Academy Range Flow and Storage Requirements												
Flow Required (LPM)	515	416	299	141	95	73	68	122	232	345	467	425
Total Daily Water Requirement (liters)	247,295											
Annual Water Requirement w/o rain (liters)	46,547,763											
Annual Water Requirement with rain (liters)	19,129,457											
Minimum Size Pump Required for normal peak demand (LPM)	515											
One Month storage capacity for Peak Demand (liters)	7,666,154											

PREVOST STAMPER IRRIGATION

IRRIGATION CONSUMPTIVE USE ESTIMATE BY GRASS TYPE
Muriwai Downs Farm
August 2021

Short Course - Creeping Bentgrass Greens

Turf Area (hectares)	0.65

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Cool Season Turf Crop Coefficient	0.94	0.86	0.74	0.75	0.69	0.6	0.61	0.64	0.75	1.04	0.95	0.88
Creeping Bentgrass Adjustment	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	7.10	5.27	3.75	2.03	1.18	0.84	0.80	1.51	2.43	5.15	5.89	5.74
Total Daily Water Requirement for Turf (liters)	46,157	34,272	24,354	13,170	7,690	5,489	5,195	9,825	15,772	33,462	38,258	37,289
Total Monthly Water Requirement for Turf w/o Rain (liters)	1,430,881	959,606	754,979	395,090	238,404	164,660	161,055	304,573	473,162	1,037,322	1,147,733	1,155,970

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	494,000	442,000	481,000	559,000	721,500	786,500	871,000	806,000	689,000	578,500	533,000	643,500
Usable Monthly Rainfall (66%) (liters)	326,040	291,720	317,460	368,940	476,190	519,090	574,860	531,960	454,740	381,810	351,780	424,710
Total Monthly Water Requirement for all Turf including Rain (liters)	1,104,841	667,886	437,519	26,150	0	0	0	0	18,422	655,512	795,953	731,260

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	96	71	51	27	16	11	11	20	33	70	80	78
Annual Water Requirement w/o rain (liters)	8,223,435											
Annual Water Requirement with rain (liters)	4,437,542											
Minimum Size Pump Required for normal peak demand (LPM)	96											
One Month storage capacity for Peak Demand (liters)	1,430,881											

Short Course - Windsorgreen Couch Fairways, Roughs and Tees

Turf Area (hectares)	3.585

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Warm Season Turf Crop Coefficient	0.71	0.71	0.62	0.54	0.58	0.55	0.55	0.54	0.76	0.72	0.79	0.68
Windsorgreen Couch Adjustment	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	4.63	3.76	2.71	1.26	0.86	0.67	0.62	1.10	2.12	3.08	4.23	3.83
Total Daily Water Requirement for Turf (liters)	166,065	134,773	97,194	45,166	30,792	23,965	22,313	39,487	76,129	110,346	151,541	137,252
Total Monthly Water Requirement for Turf w/o Rain (liters)	5,148,027	3,773,631	3,013,017	1,354,988	954,552	718,964	691,693	1,224,087	2,283,856	3,420,735	4,546,225	4,254,803

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	2,724,600	2,437,800	2,652,900	3,083,100	3,979,350	4,337,850	4,803,900	4,445,400	3,800,100	3,190,650	2,939,700	3,549,150
Usable Monthly Rainfall (66%) (liters)	1,798,236	1,608,948	1,750,914	2,034,846	2,626,371	2,862,981	3,170,574	2,933,964	2,508,066	2,105,829	1,940,202	2,342,439
Total Monthly Water Requirement for all Turf including Rain (liters)	3,349,791	2,164,683	1,262,103	0	0	0	0	0	0	1,314,906	2,606,023	1,912,364

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	346	281	202	94	64	50	46	82	159	230	316	286
Annual Water Requirement w/o rain (liters)	31,384,577											
Annual Water Requirement with rain (liters)	12,609,871											
Minimum Size Pump Required for normal peak demand (LPM)	346											
One Month storage capacity for Peak Demand (liters)	5,148,027											

Total Short Course Flow and Storage Requirements												
Flow Required (LPM)	442	352	253	122	80	61	57	103	191	300	395	364
Total Daily Water Requirement (liters)	212,223											
Annual Water Requirement w/o rain (liters)	39,608,012											
Annual Water Requirement with rain (liters)	17,047,413											
Minimum Size Pump Required for normal peak demand (LPM)	442											
One Month storage capacity for Peak Demand (liters)	6,578,908											

PREVOST STAMPER IRRIGATION

IRRIGATION CONSUMPTIVE USE ESTIMATE BY GRASS TYPE
Muriwai Downs Farm
August 2021

Nursery - Creeping Bentgrass and Fescue

Turf Area (hectares)	0.7

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Cool Season Turf Crop Coefficient	0.94	0.86	0.74	0.75	0.69	0.6	0.61	0.64	0.75	1.04	0.95	0.88
Creeping Bentgrass/Fescue Adjustment	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	7.10	5.27	3.75	2.03	1.18	0.84	0.80	1.51	2.43	5.15	5.89	5.74
Total Daily Water Requirement for Turf (liters)	49,708	36,908	26,228	14,183	8,282	5,911	5,595	10,581	16,985	36,036	41,201	40,158
Total Monthly Water Requirement for Turf w/o Rain (liters)	1,540,949	1,033,422	813,054	425,482	256,743	177,326	173,444	328,002	509,559	1,117,116	1,236,020	1,244,891

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	532,000	476,000	518,000	602,000	777,000	847,000	938,000	868,000	742,000	623,000	574,000	693,000
Usable Monthly Rainfall (66%) (liters)	351,120	314,160	341,880	397,320	512,820	559,020	619,080	572,880	489,720	411,180	378,840	457,380
Total Monthly Water Requirement for all Turf including Rain (liters)	1,189,829	719,262	471,174	28,162	0	0	0	0	19,839	705,936	857,180	787,511

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	104	77	55	30	17	12	12	22	35	75	86	84
Annual Water Requirement w/o rain (liters)	8,856,007											
Annual Water Requirement with rain (liters)	4,778,892											
Minimum Size Pump Required for normal peak demand (LPM)	104											
One Month storage capacity for Peak Demand (liters)	1,540,949											

Nursery - Windsorgreen Couch (Tees and Fairways)

Turf Area (hectares)	1.2

Turf Requirements	January	February	March	April	May	June	July	August	September	October	November	December
ETo per day (mm)	4.67	3.79	3.13	1.67	1.06	0.87	0.81	1.46	2	3.06	3.83	4.03
Warm Season Turf Crop Coefficient	0.71	0.71	0.62	0.54	0.58	0.55	0.55	0.54	0.76	0.72	0.79	0.68
Windsorgreen Couch Adjustment	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Irrigation System	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Scheduling Coefficient and Contingency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Adjusted Water Required for Turf (mm)	4.63	3.76	2.71	1.26	0.86	0.67	0.62	1.10	2.12	3.08	4.23	3.83
Total Daily Water Requirement for Turf (liters)	55,587	45,112	32,534	15,118	10,307	8,022	7,469	13,217	25,482	36,936	50,725	45,942
Total Monthly Water Requirement for Turf w/o Rain (liters)	1,723,189	1,263,140	1,008,541	453,552	319,515	240,657	231,529	409,736	764,471	1,145,016	1,521,749	1,424,202

Rainfall												
50% Probability Monthly Rainfall (mm)	76	68	74	86	111	121	134	124	106	89	82	99
Total Rainfall (liters)	912,000	816,000	888,000	1,032,000	1,332,000	1,452,000	1,608,000	1,488,000	1,272,000	1,068,000	984,000	1,188,000
Usable Monthly Rainfall (66%) (liters)	601,920	538,560	586,080	681,120	879,120	958,320	1,061,280	982,080	839,520	704,880	649,440	784,080
Total Monthly Water Requirement for all Turf including Rain (liters)	1,121,269	724,580	422,461	0	0	0	0	0	0	440,136	872,309	640,122

Flow and Storage Requirements												
Nightly Water Window (hours)	8	8	8	8	8	8	8	8	8	8	8	8
Flow Required (LPM)	116	94	68	31	21	17	16	28	53	77	106	96
Annual Water Requirement w/o rain (liters)	10,505,298											
Annual Water Requirement with rain (liters)	4,220,877											
Minimum Size Pump Required for normal peak demand (LPM)	116											
One Month storage capacity for Peak Demand (liters)	1,723,189											

Total Short Course Flow and Storage Requirements												
Flow Required (LPM)	219	171	122	61	39	29	27	50	88	152	192	179
Total Daily Water Requirement (liters)	105,295											
Annual Water Requirement w/o rain (liters)	19,361,304											
Annual Water Requirement with rain (liters)	8,999,769											
Minimum Size Pump Required for normal peak demand (LPM)	219											
One Month storage capacity for Peak Demand (liters)	3,264,138											

PREVOST STAMPER IRRIGATION

APPENDIX 10: GOLF AND PROPERTY MAINTENANCE COMPLEX

APPENDIX 11: DRAFT GOLF BALL RECOVERY PLAN FRAMEWORK

MURIWAI DOWNS
Standard Operating Procedure

Golf Ball Retrieval from Wetlands & Lake Ōkaihau

PURPOSE AND SCOPE
To provide a safe and effective method to retrieve golf balls from the wetlands and Lake Ōkaihau. Advise golfers using discreet signage along the margins of the wetlands where they adjoin golf holes to KEEP OUT of these sensitive areas. Retrieval of golf balls visible from the shoreline using the telescopic ball scoops is permitted. Golf ball retrieval beyond the shoreline will be undertaken with the guidance of the consulting ecologists.

FREQUENCY
Wetlands – monthly, on a monthly basis staff will scout an area between 3-5m from the shorelines to retrieve any golf balls visible without entering the wetland. Wetlands – once/year, in late summer when the wetlands are expected to be dry. This time of year will allow for a more widespread approach to the retrieval of golf balls whilst also avoiding bird breeding season. Lake Ōkaihau – monthly, it is anticipated that retrieval of golf balls in this area will be a simple process, covering an area of approximately 5m from the shoreline.

PROCEDURE	
1	The yearly wetland golf ball retrieval is to be undertaken in late summer only.
2	Notify the golf clubhouse (1 day prior) to advise that golf ball retrieval work is planned, identify areas of work (holes #s), start times and expected finish times.
3	A sign is to be placed on the tee of the hole where the golf ball retrieval work is being undertaken to advise golfers of this work.
4	Staff member/s will work areas of the wetland in a sweeping motion to provide a thorough pass over the wetland. Staff will carry a hessian bag (or similar) to place any golf balls found. Staff will carry a 2-way radio (securely!) during this process.
5	Any personnel within the lake whilst retrieving golf balls must wear a life jacket, and be harnessed to a buddy on the shoreline. A 2-way radio must be used by the person on the shoreline.
6	
7	
8	
9	
10	

APPENDIX 12: KEY SITE VISITS MADE BY NZSTI AND STEVE MARSDEN TURF SERVICES

Key visits and meetings by NZSTI	Key Visits and meetings by SMTS

• November 2020 Initial site familiarisation visit by NZSTI (David Ormsby, Alex Glasgow) & Steve Marsden. First samples collected.
• November 2020 Climatic assessment (Andrew Mitchell).
• November 2020 laboratory assessment of soil samples (Brendan Hannan, Andrew Mitchell).
• December 2020 site visit (Alex Glasgow/Everett Darlington) – in situ hydraulic conductivity assessment, establish weed contamination trial.
• December 2020 visit to Finelawn re contract growing of Couch and Daltons responsible sand supplies (David Ormsby, Steve Marsden).
• January 2021 preparation of *Golf Course Development Concept Report* – summarising findings, recommended grass types and construction profiles.
• February 2021 NZSTI complete testing of sands and amendments for the trial green.
• May 2021 site visit (Alex Glasgow, Steve Marsden) to establish construction method/Kikuyu control trial.
• Phone link (Alex Glasgow) with project team and Kyle Phillips regrassing options.
• July 2021 Landcare complete textural analysis of soils.
• July/August – site visit by Alex Glasgow to complete hydraulic conductivity assessments and more soil sampling.
• August 2021 preparation of Effect on Soils report (Andrew Mitchell, Alex Glasgow, David Ormsby).
	• Work closely with Golf Strategy Group (GSG) to provide support for the project in areas of golf course construction, golf course establishment and golf course maintenance.
	• Providing assistance and advice to the project in the areas of the golf course planning. This assistance (with others) is relative to turfgrass selection, irrigation design, golf feature construction (greens, tees, bunkers etc.), golf course maintenance operations and environmental stewardship.
	• In consultation with Golf Strategy Group, recommend and engage highly regarded specialists, such as:
	  ○ The New Zealand Sports Turf Institute (NZSTI), to assist with turfgrass selection and agronomy,
	  ○ Prevost Stamper Irrigation (PSI), to assist with irrigation design,
	  ○ Audubon International, to assist with both golf course construction and golf course maintenance environmental best practice, and
	  ○ FineLawn, to grow the Windsorgreen Couch turfgrass.
	
	Specifically SMTS (including visits identified with NZSTI) has:
	• Wetlands Summit with the project team on the 19th January 2021 to understand the impact the onsite wetlands and the golf course.
	• Meet with a potential turfgrass supplier of Windsorgreen Couch on the 12th March 2021 with FineLawn (a Hamilton based Turf Farm).

Key visits and meetings by NZSTI	Key Visits and meetings by SMTS
	• Meet on site with Kyle Phillips, and via Zoom to discuss grassing selection. • In February 2021, the establishment (off site) of a root zone sand and Creeping Bentgrass trial site was undertaken to review potential golf green grass types and the sand rootzone options. • August 2021 Workshop, meet with the project team (Zoom). Discuss the extent of earthworks and the works within the earthworks envelope (particularly where they are close to sensitive areas such as wetlands and SEAs etc). Are there any red flags with the proposed activity.