AUDIT CHECKLIST

NZGAP

Environment Management System (EMS) Add–On

AUDIT CHECKLIST (v1.4 August 2019)

Business Details	
NZGAP Number:	xxxxx
Business Name (Legal Entity):	Operation A
Business owner (s):	Grower A
Physical address (main site):	Xyz Road, XYZ
Responsible manager:	AA
Certification Body Details	
Certification Body (tick):	AsureQuality ☑ SGS ☐
Auditor Name:	
Audit date:	

Audit Checklist for Horticulture Farm Environment Plans (FEPs)

Assessment Summary (complete after the assessment)		Total Number of Questions:
Total number of non-compliances:		53
Total number of initial Major "C" non-compliances:		15
Total number of initial Major "M" non-compliances:		25
Total number of initial Recommendations "R" not met:		13
Corrective actions to be completed before (date):		
Signature of Auditor:		
Signature of Responsible Manager:		

NEW ZEALAND GAP ENVIRONMENT MANAGEMENT SYSTEM

GAP/ Farm Environment Plan Adviser:

Adviser (s) Details (complete if an external or certified adviser has helped with the development of this EMS)					**Council Approved** (required in some regions)		
Name:	Area of expertise*	Business Name:	Phone	Email	Y	N	NA
Andrew Barber	Farm Environment Plan adviser, E&S control, Nutrient Mgmt, Irrigation	Agrilink NZ	0274 983 620	andrew@agrilink.co.nz			
Henry Stenning	Farm Environment Plan adviser, E&S control, Nutrient Mgmt, Irrigation	Agrilink NZ	0210 709 216	henry@agrilink.co.nz			

*Examples of environmental advisers are: farm environment plan adviser, nutrient management adviser, agronomist, irrigation consultant

Nutrient Budget:

Nutrient Budget Information (complete only if nutrient budget is required and has been completed)	
Nutrient budget name and version (e.g. NCheck)	
Nutrient Loss for current year (kg/ha/yr)	
Nitrogen Loss for previous year (kg/ha/yr)	
Nutrient Loss Target (kg/ha/yr)	
Nutrient Baseline (kg/ha/yr)	
Nutrient Limit (kg/ha/yr)	

Farm / Property Details

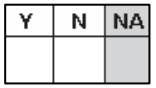
Total Area Owned (ha): _____ Total Area Leased (ha): _____

Legal Descriptions: (attach list if more space needed)

Block Name	Owned (tick)	Leased (tick)	Title Legal Description	Total Area (ha)	Effective Area (ha)
Home Block 1	X		Xyz	100	97
Block 2	X		Xyz2	20	17
Block 3	X		Xyz3	90	56
Block 4	X		Xyz4	22	13

Resource Consents held: (attach list if more space needed)

Block name	Consent type: (e.g. Water take/use, Land use, nutrient discharge)	Consent number:
Home Block 1	Water take	Xyz 123
Block 2	Water take	Xtz 124
Block 3	Water take	Xyz 125
Block 4	Water take	Xyz 126

CHECKLIST GUIDANCE	
Question Categories	Questions to achieve and maintain certification are categorised into 3 levels: 'C' – is a critical non–compliance. All 'C's must be met within 7 days of the assessment 'M' – is a major non– compliance and applicable 'M's must be met within 28 of the assessment 'R' – is a recommendation only There is no limit to the number of non-conformances that can be accumulated during an assessment, however all non- conformances must be closed out before certification is achieved. The occurrence of non-conformances may also result in follow up action such as targeted audits.
Compliance	Y = Complaint N = Non–compliance issued with comments N/A = Not applicable for this assessment. Grower must comment to explain why a question is not applicable  **"NO N/A" DENOTES A REQUIREMENT WHERE 'NOT APPLICABLE' DOES NOT APPLY**
Comments	Auditor comments are required for all Critical and Major non-conformances and these shall be reflected in the assessment report.
Assessment Report	A copy of the assessment report shall be provided to the grower after completion. A copy of the assessment report may also be provided to NZGAP. The grower shall make the previous assessment report available for the current assessment.
Implementation Guideline	This checklist is accompanied by the Environment Management System Add-on Implementation Guideline which outlines what action/evidence is required to comply with each question, and where more relevant information can be found (e.g. industry guidance).
Farm Environment Plan (FEP)	Evidence for this assessment is supported by a Farm Environment Plan which identifies the environment risks of the activity, plus the Good Management Practices (GMPs) and Best Management Practices (BMPs) in place or planned to manage and reduce risks to the environment.
NZGAP Regional Guide	A guide for NZGAP growers, NZGAP auditors, and regulators in each region. This guide demonstrates alignment of the New Zealand GAP (NZGAP) Environment Management System (EMS) add-on with Farm Environment Plan requirements of each regional and sub-regional plan.

1. Organisation and Management							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
1.1	Does top management demonstrate leadership and commitment to effectively implement this Environment Management System?	✓				Refer to Board correspondence	C
1.2	Have interested parties (e.g. community, local authority) been determined and have their relevant needs and expectations been identified?	✓					R
1.3	Has an Environment Policy Statement been established and implemented?	✓				Refer to policy.	R

2. Planning and Objectives							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
2.1	Has the scope of this assessment (i.e. current land use and location) been determined?	✓				Refer to maps.	C
2.2	Have the environmental aspects (e.g. soil management) to be covered by this EMS been determined?	✓				Refer to environmental plans.	C
2.3	Have short and long-term environmental objectives been established for the relevant environmental aspects?	✓				Refer to policy objectives.	M
2.4	Have targets been set/adopted to reduce environmental impact and enhance the surrounding environment?	✓				Refer to E&S Control Plan	M

3. Support for Implementation of the EMS							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
3.1	Has the Farm Environment Plan been prepared by an approved adviser where required by the local authority?	✓				Refer to environmental plans.	C
3.2	Is advice on nutrient, soil and irrigation management obtained from an adviser or agronomist, and can they illustrate their competence by providing evidence of appropriate training and/or qualifications? If advice is not obtained from an adviser, is the grower's experience complemented by evidence of technical knowledge?	✓			Qualified agronomists on site full time.	Refer to advisor qualifications.	C
3.3	If a nutrient budget has been prepared for the property, has it been completed by a certified nutrient management adviser where required?	✓				Nutrient report and recommendations	C
3.4	Have environmental training needs of relevant staff been identified and has training been provided or planned where necessary?	✓				Refer to staff training documents.	M
3.5	Are appropriate elements of the EMS (e.g. environmental risks, mitigations and actions) communicated to relevant staff and/or contractors?	✓					M

4. Resource Consents							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
4.1	Does the grower hold current **water extraction and use** consents, or other local authority approvals (e.g. permitted activity), where required?	✓				Refer to consents.	R
4.2	Does the business hold current **land use** consents, or other local authority approvals (e.g. permitted activity), where required?	✓				Refer to consents.	R
4.3	Does the grower hold current **discharge** consents (air/land/water) or other local authority approvals (e.g. permitted activity), where required?	✓				Refer to consents.	R

5. Property Plan (Map)							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
5.1	Has an up to date property plan (e.g. map) been prepared which details important site features as required by the local authority (Template 5A)?	✓				Refer to maps	C

6. **Soil Management**							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
Soil quality, health, structure and fertility							
6.1	Has a soil assessment been completed to determine soil quality, health, structure and fertility (Template 6A)?	✓				Refer to Template 6A.	C
6.2	Have techniques been used to maintain or improve soil quality, health, structure and fertility (Template 6B)?	✓				Refer to Template 6B.	M
Erosion and Sediment control (cultivated, bare or erosion prone soil)							
6.3	Has the risk of soil erosion and sediment loss been assessed for the property (Template 6C) and paddocks (Template 6D – cultivated or bare soil)?	✓				Refer to Template 6D.	C
6.4	Are appropriate measures implemented (or planned) and maintained to stop or control surface water entering the paddock (Template 6E)?	✓				Refer to Template 6E.	M
6.5	Are appropriate measures implemented (or planned) and maintained to reduce or minimise the risk of soil erosion (Template 6F)?	✓				Refer to Template 6F.	M
6.6	Are appropriate measures implemented (or planned) and maintained to reduce or minimise sediment loss (Template 6G)?	✓				Refer to Template 6G.	M
6.7	Are records kept for cultivations, sowing, planting, and other relevant field operations (e.g. wheel track ripping)?	✓				Refer to field records.	M
6.8	Do any newly adopted mitigations/measures meet the minimum design and operation requirements outlined in relevant industry guidance and codes of practice (e.g. sediment retention ponds)?	✓				Refer to erosion & sediment control plan.	M

7. Nutrient Management							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
7.1	Has the risk of nutrient loss been assessed for the property (Template 7A) and growing activity (Templates 7B)?	✓				Refer to Template 7B.	C
7.2	Are measures implemented (or planned) to improve nutrient uptake and minimise nutrient loss to the environment (Template 7C)?	✓				Refer to Template 7C.	M
7.3	Are fertilisers handled, stored and used to minimise the risk of spillage and contamination of the environment?	✓				See fertiliser shed	C
7.4	Is all fertiliser spreading equipment calibrated so that it can accurately deliver the recommended treatment?	✓				Refer to equipment records	M
7.5	Is there an appropriate system in place for recording the application of organic and inorganic nutrients and conditioners (including both soil and foliar applications)?	✓				Refer to nutrient management plan.	M
7.6	Is water used in nutrient solutions stored and discharged according to industry guidance local authority rules where required (Guideline for Greenhouse Nutrient Solution Discharge)?			✓	Not a greenhouse.		M
7.7	Have measures been taken to recycle nutrients where feasible and appropriate (e.g. hydroponics)?			✓	Not a greenhouse.		R

7. Nutrient Management							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
Nutrient budget: (Note: Level for questions 7.10-7.13 is "Critical" if required by resource consent or local authority rules)							
7.8	Has a current nutrient budget been prepared for the property, where required, using a tool approved by the local authority (e.g. Overseer, NCheck)?	✓			Commercial outdoor vegetable production does not use Overseer.	Refer to nutrient management plan.	R
7.9	Has an assessment of the nutrient budget been completed and has it been determined to be robust and accurate?	✓			Agronomists have reviewed budget.		R
7.10	Has a Nutrient Loss Baseline been calculated for the property where required by the local authority?						R
7.11	Does the current nutrient budget show compliance with regulatory limits (e.g. local limit or resource consent limit)?			✓	No limit is currently set	Refer to nutrient management plan.	R

8. Irrigation and Water Management							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
8.1	Has an environmental risk assessment been completed for all water uses (Template 8A)?	✓				Refer to Template 8A.	C
8.2	Are measures implemented or planned to ensure that water use is optimised and risks to the environment are minimised (Template 8B)?	✓				Refer to Template 8B.	M
8.3	Is the irrigation system assessed, maintained, calibrated and evaluated to ensure optimal performance?	✓				Refer to water metre calibration records.	M
8.4	Are appropriate records of irrigation applications kept?	✓				Refer to council submitted records.	M
8.5	Has major new irrigation infrastructure been designed and installed in accordance with industry standards and codes of practice? Have new irrigation systems been commissioned to meet the INZ Piped Irrigation System Design and Installation Codes of Practice and standards?			✓	No new major irrigation infrastructure has been added.		R
8.6	Is water used for flotation, washing and cleaning disposed of in accordance with industry guidance and local authority rules where required (e.g. Vegetable Washwater Discharge Code of Practice)?			✓	No washing		M
8.7	If identified as feasible (considering impacts on food safety), have measures been taken to collect and/or recycle water?			✓	No washing		R

9. Water Body Management							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
9.1	Has an environmental assessment of waterways, drains and point sources (e.g. waste storage) been undertaken to determine if there are any risks of contamination from the property?	✓				Refer to erosion & sediment control plan.	C
9.2	Are measures in place to protect waterways from contamination using appropriate containment, barriers, setbacks, buffers or riparian planting?	✓				Refer to erosion & sediment control plan.	M
9.3	If livestock are part of cropping rotations, are they excluded from applicable waterways where required?			✓	No livestock in this operation.		M
9.4	Are waterways and drains managed to protect and enhance biodiversity and mahinga kai values (traditional value of food resources) (Template 9A and 9B)?	✓				Refer to Template 9A and 9B.	M

10. **Environmental Actions and Continuous Improvement**							
Ref	**Question**	**Y**	**N**	**NA**	**Comment**	**Evidence Provided**	**Level**
10.1	Has an adequate environmental action plan been developed which includes short-term and long-term actions (Template 10A plus 6C, 7C and 8B)?	✓				Refer to Templates 6C, 7C and 8B.	C
10.2	Have processes been established to ensure that the actions identified in the environmental action plan are undertaken?	✓					M
10.3	Have identified actions been completed to an acceptable standard in accordance with the timelines in the environmental action plan?	✓				Refer to erosion & sediment control plan.	M
10.4	Are existing environmental mitigations managed and maintained to ensure their ongoing effectiveness?	✓				Refer to erosion & sediment control plan.	M
10.5	Have any aspirational environmental actions or enhancements been implemented (i.e. Best Management Practice)?	✓					R
10.6	Has the EMS been reviewed at planned intervals (at least annually), to support continuous improvement and ensure its continuing suitability, adequacy and effectiveness?	✓					C

11. **Assessment Summary**					
Question Reference	**Question Level (C, M, R)**	**Audit findings**	**Required Action**	**Due Date**	**Close Out Date**

FARM ENVIRONMENT PLAN

NZGAP

Environment Management System
(EMS) add-on

NEW ZEALAND GAP
ENVIRONMENT
MANAGEMENT SYSTEM

Grower Logo

Farm Environment Plan

Grower A

Prepared By: Agrilink NZ

AGRI
LINK

Overview

These templates are to be used in conjunction with the EMS Audit Checklist and Guidelines to ensure that all environmental requirements are met

Glossary:

EMS = Environment Management System
FEP = Farm Environment Plan
GMP = Good Management Practice
BMP = Best Management Practice
Y = Yes (already complete/implemented – provide evidence)
P = Partial (partially complete/implemented – agree and set date for completion)
N = No (not complete/implemented – agree and set target date for completion/implementation)
n/a = Not applicable (justify why n/a)

FEP process for each management area:

1. Assess the environmental risks
2. Identify GMPs (and BMPs if applicable) currently completed/implemented
3. Identify GMPs (and BMPs if applicable) yet to be completed/implemented and set target date for completion/implementation
4. Make progress towards GMP (and BMP if applicable)
5. Actions and improvement will be assessed during your next EMS audit

Relevant Guidelines:

- HortNZ Erosion and Sediment Control Guideline 2014
- HortNZ Code of Practice for Nutrient Management 2014
- Nutrient Management for Vegetable Crops in NZ 2019
- Good Farming Practice - Action Plan for Water Quality 2018
- Industry Agreed Good Management Practices relating to water quality 2015
- Mahinga kai guideline for Selwyn farmers 2018

5A Property Plan (Map): Features to be included on the property plan (i.e. map)

Ref	Map Features	Complete? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. map or description)	Level
		Y	P	N	n/a				
1	Property boundaries (currently owned and leased properties)	✓						Refer to map.	GMP
2	Land management units (e.g. cropped areas)	✓						Refer to map.	GMP
3	Potential critical sources (point and area) for contaminants (e.g. erosion risk, fertiliser storage)	✓						Refer to map.	GMP
4	Permanent or intermittent rivers, streams, lakes, ponds, drains and wetlands	✓						Refer to map.	GMP
5	Riparian vegetation and barriers/fences adjacent to waterbodies	✓						Refer to map.	GMP
6	Any significant areas as defined by the local authority (e.g. significant indigenous biodiversity areas, cultural landscape values management area)	✓						Refer to map.	GMP
7	The location of any spring heads, wetlands or spring-fed streams have been identified where required by the local authority	✓						Refer to map.	GMP
8	Soil maps and/or descriptions	✓						Refer to map.	GMP
9	Locations where surface water is entering and leaving each block/paddock (on cultivated land)	✓						Refer to map.	GMP
10	Environmental actions/mitigations	✓						Refer to map.	BMP
11	Other features (please specify):				✓				BMP

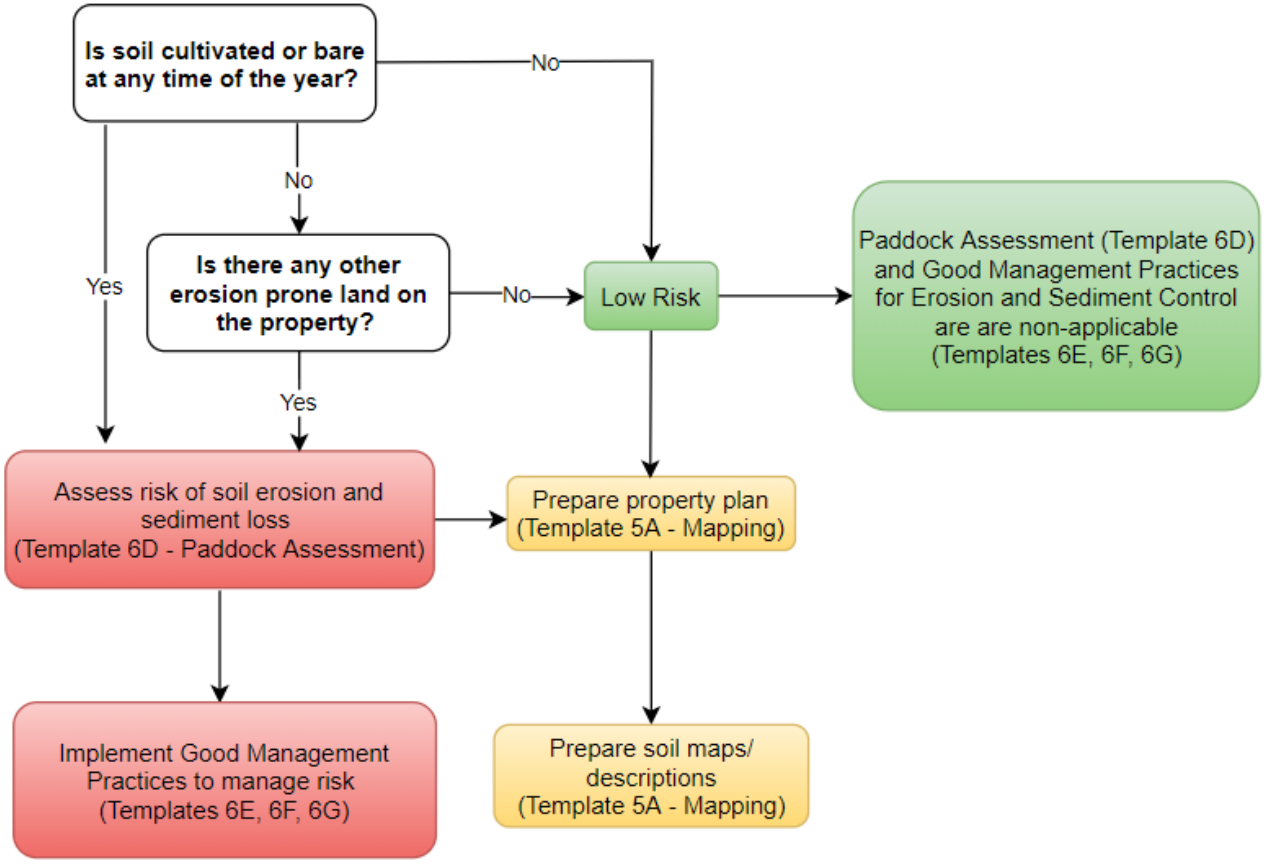
6A SOIL: Soil Quality, Health and Fertility – Assessment

Ref	Good/Best Management Practices	Complete? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Soil type, structure, texture and profile is assessed	✓						Refer to map report.	GMP
2	Soil drainage is assessed (poor/moderate/well drained)	✓						Refer to map report.	GMP
3	Soil nutrient testing is conducted on each paddock every 3 – 5 years (nitrogen, phosphorus, magnesium, potassium)	✓						Refer to soil test results.	GMP
4	Soil testing is completed using a uniform or representative collection pattern (e.g. 'W' pattern)	✓						Refer to soil test practices.	GMP
5	Soil testing is conducted on each paddock every year when a crop is going to be planted			✓			No plans to test every paddock. Testing is done in representative paddocks	Refer to soil test result history.	BMP
6	Soil testing is conducted every year based on GPS mapping			✓			Not using GPS mapping		BMP
7	Quick N test, deep N tests			✓			Will be investigating in 2019/20	Refer to Action Plan	BMP
8	Soil is assessed for compaction (e.g. using a penetrometer)			✓			Currently not conducted as compaction is not an issue.		BMP
9	Soil pH is monitored	✓						Refer to soil test results.	BMP
10	Soil Organic Matter (OM) is monitored	✓						Refer to soil test results.	BMP
11	Soil biological activity is monitored			✓			Not currently testing for.		BMP
12	Other (specify):				✓				BMP

6B SOIL: Soil Health and Fertility – Control Measures and Action Plan

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Choose appropriate crops *(for soil, climate, disease, and maximum uptake of nutrients from previous crop)*	✓					Qualified agronomists provide advice.	Refer to crop records.	GMP
2	Use cover crops to enhance soil structure and organic matter, plus absorb excess nutrients	✓						Refer to crop records.	GMP
3	Incorporate crop residues where possible	✓						photos	GMP
4	Cultivate soil when conditions appropriate	✓							GMP
5	Minimise soil tillage as much as practicable	✓							GMP
6	Minimise fallow periods between crops	✓						Refer to crop records.	GMP
7	Use crop rotation	✓						Refer to crop records.	GMP
8	Retire or actively manage marginal land to ensure soil conservation measures are in place	✓						Refer to maps	GMP
9	Use controlled trafficking			✓			Not suitable for this operation		BMP
10	Adopt new technologies *e.g.* use of sub-soil aerator will allow roots deeper into the soil			✓			Open to new ideas, but not currently testing anything new		BMP
11	Other (specify):				✓				BMP

6C SOIL: Risk of soil erosion and sediment loss – *Property Assessment*



6D. SOIL: Risk of soil erosion and sediment loss – *Paddock Assessment* *(for cultivated and bare soils)*

Paddocks assessed (names/IDs):	
Description of property slope:	(Note: <1 degree = Low erosion risk, >1 degree = Medium/High erosion risk)

Ref	Good Management Practices (for individual paddock or summary of all paddocks)	Complete? (Yes, Partial, No, n/a) Y	P	N	n/a	Date to be completed (if 'Partial' or 'No')	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. map or description)	Level
1	Identify site specific risks of this paddock (e.g. soil type, slope, proximity to waterways, critical source areas)	✓						Refer to maps. Refer to E&S Plan	GMP
2	Describe paddock management risks (e.g. paddock use, previous use, crop type, crop coverage, cultivation technique)	✓						Refer to maps. Refer to crop records.	GMP
3	Assess the risk of soil erosion prior to carrying out all field operations	✓						Refer to staff training manuals.	GMP
4	Identify where surface water is entering paddocks (map or description)	✓						Refer to maps.	GMP
5	Identify where surface water leaves paddocks (map or description)	✓						Refer to maps.	GMP
Baseline / Unmitigated Risk Level (i.e. without any GMPs in place):		**High**							
Risk Level with current practices in place (Template 6E, 6F, 6G):		**Medium**							
Risk level with GMP in place (Template 6E, 6F, 6G, 10)**:**		**Low**							
Other identified risks:									

6E. SOIL: Soil erosion and sediment loss - *Implement and maintain measures for stopping or controlling surface water entering the paddock* *(for cultivated and bare soils).*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Interception drains	✓						Field walk, photos	GMP
2	Correctly sized culverts	✓							GMP
3	Benched headlands	✓						Field walk	GMP
4	Bunds	✓						Field walk, photos	GMP
5	Grassed swales (control overland flow through the paddock)				✓		No overland flow paths across a paddock		GMP
6	Other (specify):				✓				BMP

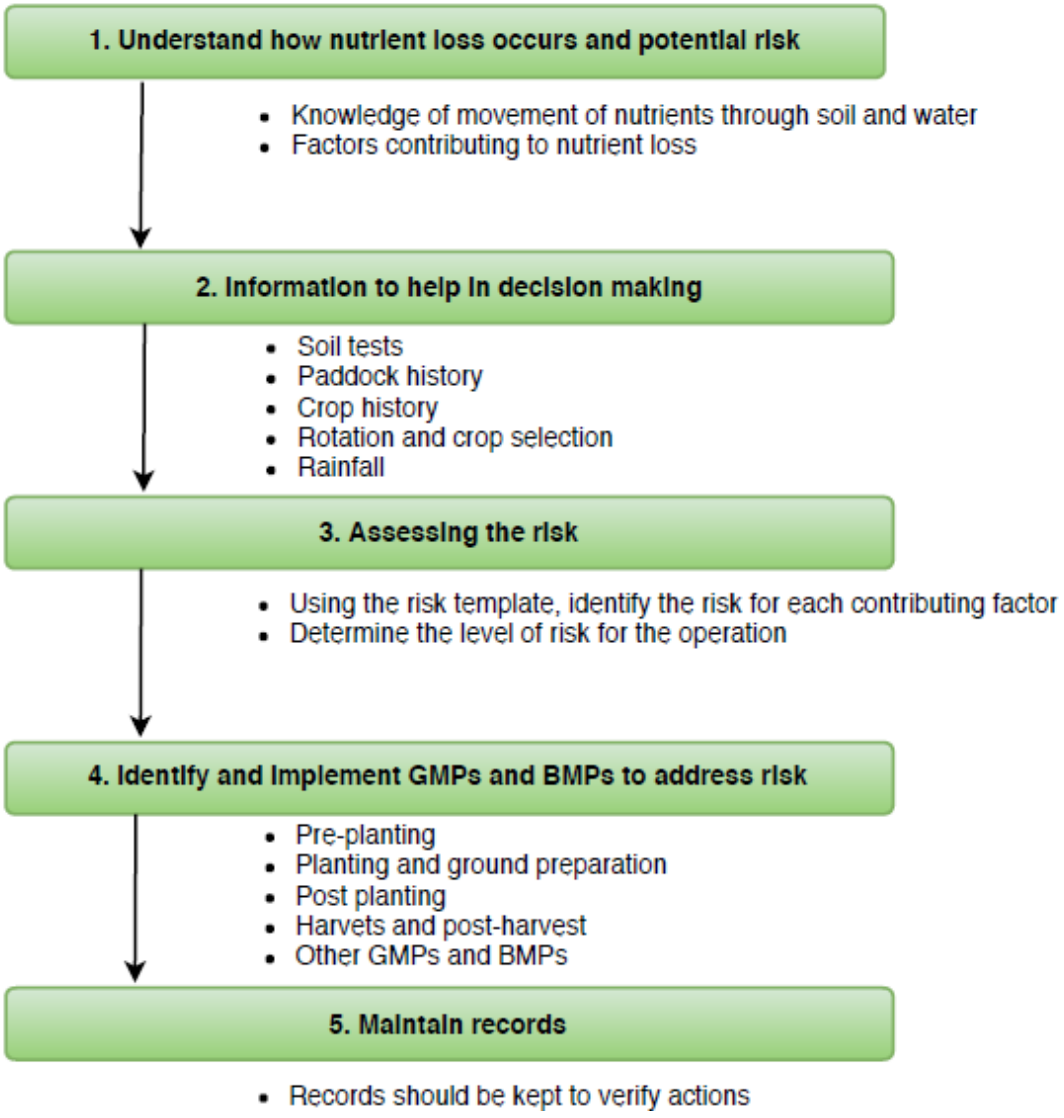
6F. SOIL: Soil erosion and sediment loss - *Implement and maintain erosion control measures to reduce or minimise the risk of soil erosion* *(for cultivated and bare soils)*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Minimise cultivation passes	✓							GMP
2	Break crops / shelter belts (wind erosion)	✓						Field walk	GMP
3	Using short row lengths (>1 degree slope) (<200m recommended)			✓			Almost all paddocks exceed 200m row lengths. Use other erosion mitigations.		GMP
4	Cover crops / break crops (>1 degree slope)	✓						Photos	GMP
5	Wheel track ripping / Wheel track dyking (>1 degree slope)	✓						Photos	GMP
6	Contour drains (>1 degree slope)			✓			Use other erosion mitigations.		GMP
7	Other (specify):				✓				BMP

6G. SOIL: Soil erosion and sediment loss – *Implement and maintain sediment control measures to manage the water and suspended solids that move off the paddock* *(for cultivated and bare soils)*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Access ways are not at the lowest point of the paddock	✓						Field walk	GMP
2	Raised access ways / Bunds	✓						Field walk	GMP
3	Vegetated buffers / Riparian margins / Hedges (attention on minimising channelising)	✓						Photos	GMP
4	Super silt fences			✓			Use other sediment control measures		GMP
5	Stabilised drains and discharge points		✓			April 2020	Reviewing all drains and discharge points. Grass drains. Create 1m grassed setbacks from drains.	See Action Plan	GMP
6	Decanting earth bunds		✓				Upgrading to SRPs		GMP
7	Sediment retention ponds		✓				Some new SRPs need to be constructed and some existing SRPs need to be enlarged. Work to be staged out to April 2022.	See Construction Plan	GMP
8	Other (specify):				✓				BMP

7A. NUTRIENTS: Process for addressing risks of Nutrient Loss



7B. NUTRIENTS: Assessing the risk of nutrient Loss

Ref	Contributing factor	Assessing extent of risk	Level of risk *(Low, Med, High)*
1	**Soil moisture**	Applications of N when soils that are saturated - high risk. Applications when soils are not saturated – lower risk *Note*: It is important to assess the soil moisture status before an application to ensure that the potential for leaching is minimised. Use of foliar applications can reduce the risk	Low
2	**Irrigation**	Use of irrigation – high risk *Note*: Risk can be reduced by ensuring that irrigation is used to maintain soil moisture at target levels and applications of N timed accordingly.	Medium
3	**Soil type**	Light soils – High risk. Medium soils – Medium risk. Heavy soils – Low risk. If available use S-map Soil Report – contaminant management classification	Low
4	**Paddock history**	Quantities of N applied not based on fertiliser recommendations or assessment of crop residues – high risk. Applications take into account fertiliser recommendations and crop residues to ensure that appropriate levels of N are applied - lower risk	Medium
5	**Previous crop planted and residual N in the soil**	High residue crop – high risk. Crop failure or lower than anticipated yield – high risk. Removal of previous residue – lower risk	Medium
6	**Crops being grown**	Shallow root vegetables – higher risk	High
7	**Crop yield and quality**	Nitrogen is used to achieve desired yield and quality. Inappropriate or excessive use can create quality issues and increase the risk of leaching – high	Medium
8	**Intensity of cropping**	Repeated cropping – higher risk	High
9	**Topography**	Sloped ground – higher risk of run-off	High
10	**Plant uptake of nitrogen**	Low plant uptake - high risk. High plant uptake - lower risk *Note:* There are a range of factors that contribute to the plant uptake of nitrogen and hence reduce the N in the soil able to be leached – e.g. time of year, growth stage, type and form of nitrogen, rooting depth. The combination of factors need to be assessed to determine uptake for each crop.	Medium
11	**Timing of nitrogen application**	High level of base dressing at planting – high risk Applications split and matched to crop needs – lower risk	Medium
12	**Fertiliser application methods**	Broadcast application – higher risk. Application only to the row – reduced risk. Foliar applications – low risk	Medium
13	**Applications of organic manures**	Organic manures applied; but not taken into account for N balance – high risk. Taken into account for N balance – Lower risk	Low
14	**Pest and disease**	Crop failure or lower than anticipated yield due to pest and disease – high risk	Medium
15	**Animals in the rotation**	Animals included in the rotation – higher risk. No animals – lower risk	Low
16	**Ground preparation and planting methods**	Direct drilling and reduced tillage – lower risk Presence of fines post cultivation – higher risk	Medium
17	**Compaction**	Compacted soil will prevent roots being able to penetrate and access nitrogen. Compacted soil presents a higher risk.	Medium

Baseline / Unmitigated Risk Level (i.e. without any GMPs in place):	**High**
Risk Level with current practices in place (Template 7C):	**Medium**
Risk level with GMP in place (Template 7C)**:**	**Medium**

Other identified risks:

7C. NUTRIENTS: *Implement measures to improve nutrient uptake and minimise nutrient loss*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan fertiliser inputs for the crop	✓						Refer to fertiliser records.	GMP
2	Take into account any organic manures used	✓						Refer to fertiliser records soil test results.	GMP
3	Take into account any animals in the rotation				✓		No animals in rotation.		GMP
4	Manage applications of nutrients taking into account rainfall, field capacity and soil saturation levels	✓					Qualified agronomists are used.		GMP
5	Obtain advise from a nutrient advisor or agronomist	✓					Qualified agronomists are used		BMP
	Planting								
6	Nutrient applications are informed by available information or fertiliser recommendations	✓						Refer to fertiliser records.	GMP
7	Fertiliser applications are applied relative to the predicted uptake levels of the plant from planting to maturity	✓					Suggestions from 'Nutrient Management for Vegetable Crops in NZ' are followed. Fertiliser applications are managed by qualified agronomists according to crop demand, weather, soil conditions etc.		GMP
8	Improved fertiliser technology is used where appropriate (e.g. prills/coatings)		✓				Trialling the latest fertilisers available.		BMP
9	Controlled traffic farming technology is used to increase application efficiency			✓			Not being used on this operation.		BMP
10	Crop calculators are used if available and practical for local conditions			✓			Not available for crops being grown.		BMP

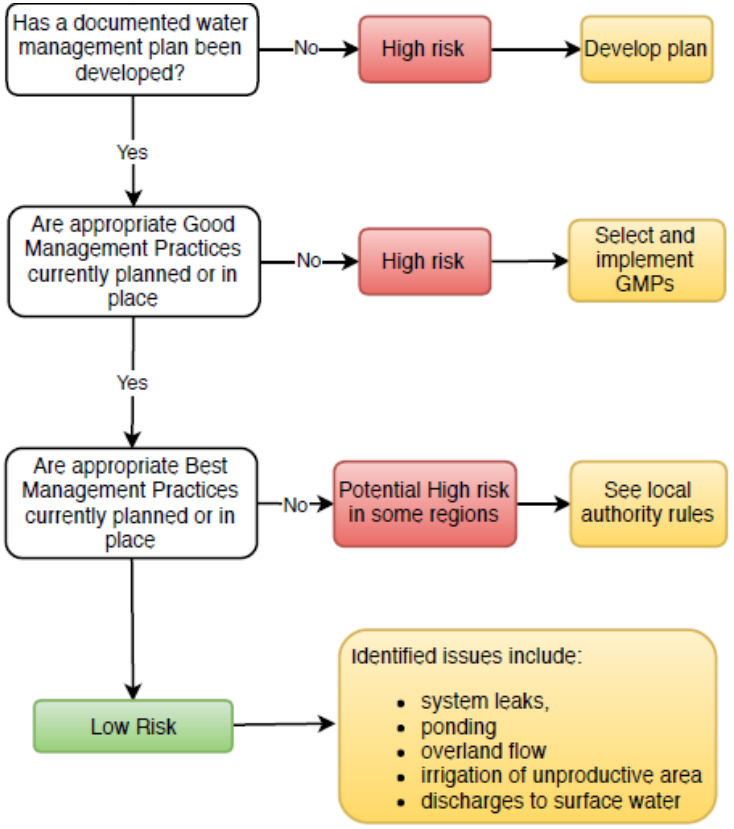
11	Other (specify):				✓		Quick N test done prior to side-dressing fertiliser applications to be trialed.	See Action Plan	BMP

7C. NUTRIENTS (*Continued*): *Implement measures to improve nutrient uptake and minimise nutrient loss*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Post-planting								
12	Side dressings are used	✓					Sidedressing is used in all crops from planting. Broadcasting is used in sowing crops on the bed surface only. Basedressing of micronutrients, phosphate, and lime is applied when needed after soil test analysis.	Refer to fertiliser application records.	GMP
13	Operators follow instructions for application, including avoiding spreading into water bodies	✓							GMP
14	GPS is used to monitor operator performance			✓			Not being used on this operation.		BMP
15	Nutrient levels are managed (and informed by soil tests) according to rainfall / irrigation, and will match likely yield and quality goals	✓					Follow agronomists' recommendations.	Refer to fertiliser application records.	BMP
16	Leaf tests are conducted		✓				Leaf tests are conducted only to diagnose nutritional deficiencies.		BMP
	Harvest/Post-harvest								
17	As much harvestable crop as possible is removed	✓							GMP
18	Crop residues are incorporated where possible	✓						Photos	GMP
	Other:								
19	Spreadmark accredited contractors are used	✓							BMP

20	AIRCARE™ accredited aerial operators are used if applicable			✓			No aerial fert application			BMP
21	Machinery is upgraded to be more efficient/accurate	✓								BMP
22	Other (specify):									BMP

8A. WATER and IRRIGATION: Assessing the environmental risk of water use



8B. WATER and IRRIGATION: Water use – *Implement measures to improve water use efficiency and minimise risk of nutrient loss*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan irrigation requirements	✓					According to season and crop demand.		GMP
2	Develop long-term irrigation plan	✓						Refer to irrigation consents	GMP
	Post-planting								
3	Volumes applied informed by relevant factors (e.g. Plant growth/ soil type/ water holding capacity and climatic conditions)	✓					Track rainfall.		GMP
4	Water is applied to maintain soil moisture between the wilting point and field capacity where possible	✓							GMP
5	Irrigation applied allows achievement of the yield target for fertiliser applied	✓							GMP
6	Water use is metered	✓					Telemeter is installed in each bore.	Refer to water metre records.	GMP
7	Irrigation efficiency is measurable at greater than 80%			✓			Currently don't use a bucket test to determine this.		BMP
8	Irrigation scheduling is undertaken using a crop model or tied into a soil moisture monitoring system		✓				Use tensiometers in representative paddocks	Photos	BMP
9	On site soil moisture monitoring is conducted		✓				Use tensiometers in representative paddocks	Photos	BMP
10	Irrigation is variably applied within the paddock to maximise efficiency			✓			Adjust for crop, but not within crop. Use big gun irrigators.		BMP
11	Highly automated irrigation systems that allow more frequent applications of less water are used to maximise efficiency			✓			Use big gun irrigators, which are setup manually.		BMP
	Other:								
12	Non-irrigation water is used efficiently (e.g. wash water)	✓							GMP

13	Other (specify)				✓				BMP

9A MAHINGA KAI and BIODIVERSITY: Assessment

(Checklist question 9.4) Mahinga kai species largely relate to indigenous plant, bird and fish species and their ecosystems and habitats. Mahinga kai includes things such as species, natural habitats, materials and practices used for harvesting food, and places where food or resources are, or were, gathered. This includes:

- All waterways, drains (with water), wetlands, and springs
- Native vegetation and riparian areas
- Areas with specific mahinga kai species and their habitats.

Ref	Mahinga kai and biodiversity assessment	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	On-farm mahinga kai values have been identified (e.g. map of native vegetation, waterways, wetlands)	✓						Refer to maps	GMP
2	Any key risks to mahinga kai have been identified (e.g. clearance of vegetation, drain maintenance)	✓						Field walk	GMP
3	Ways to enhance on-farm biodiversity have been identified	✓						Refer to maps	GMP
4	Other (specify):				✓				BMP

9B MAHINGA KAI and BIODIVERSITY: *Implement measures to protect and enhance Mahinga kai values and biodiversity*

Ref	Mahinga kai and biodiversity assessment	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Mahinga kai values are considered when implementing other environmental actions (e.g. erosion and sediment control, riparian areas)	✓						E&S Plan	GMP
2	Native vegetation and/or habitats are protected	✓						Photos	GMP
3	Waterway, drain management and vegetation clearance is carried out following good management practice	✓						Photos / Field walk.	GMP
4	Planting of native vegetation in shelterbelts or riparian areas			✓					BMP
5	Constructed wetlands developed for treating contaminants (e.g. nutrient run-off) to promote biodiversity and enhance mahinga kai values			✓			No wetlands		BMP
6	Pests are managed according to local authority rules	✓							BMP
7	Other (specify): (e.g. Local council requirements				✓				BMP

10A ENVIRONMENTAL ACTION PLAN: Other Actions

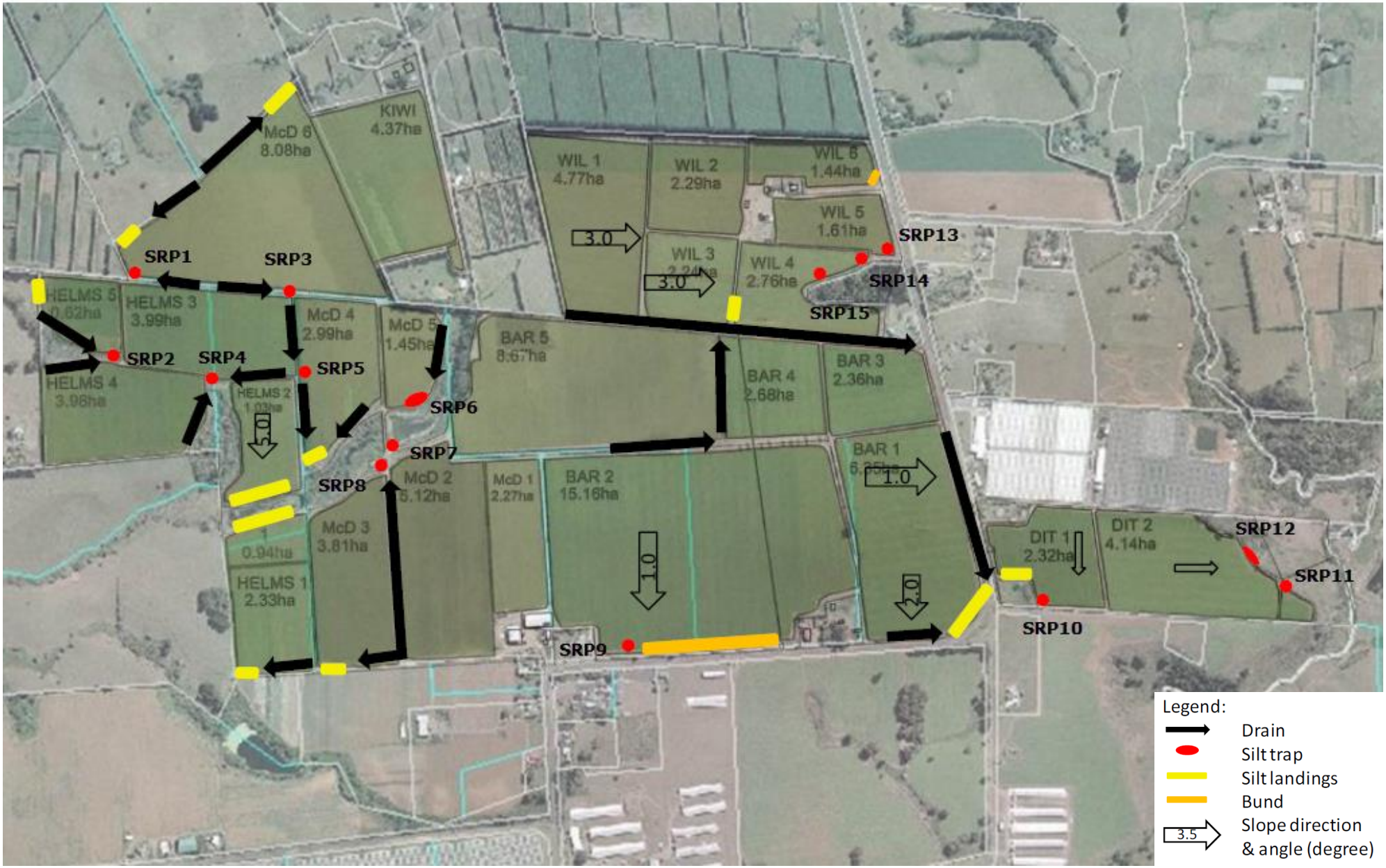
Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsible	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
1	6A Soil Health	Investigate the use of Quick-N test and deep N tests		AA	1/5/2020		
2	6G 5	Reviewing all drains and discharge points for stability. Sow grass in drains. Create 1m grassed setbacks from drains.		AA	1/4/2020		
		See farm specific E & Sediment Control Plan for E & S specific actions and construction schedule.					

MAPS

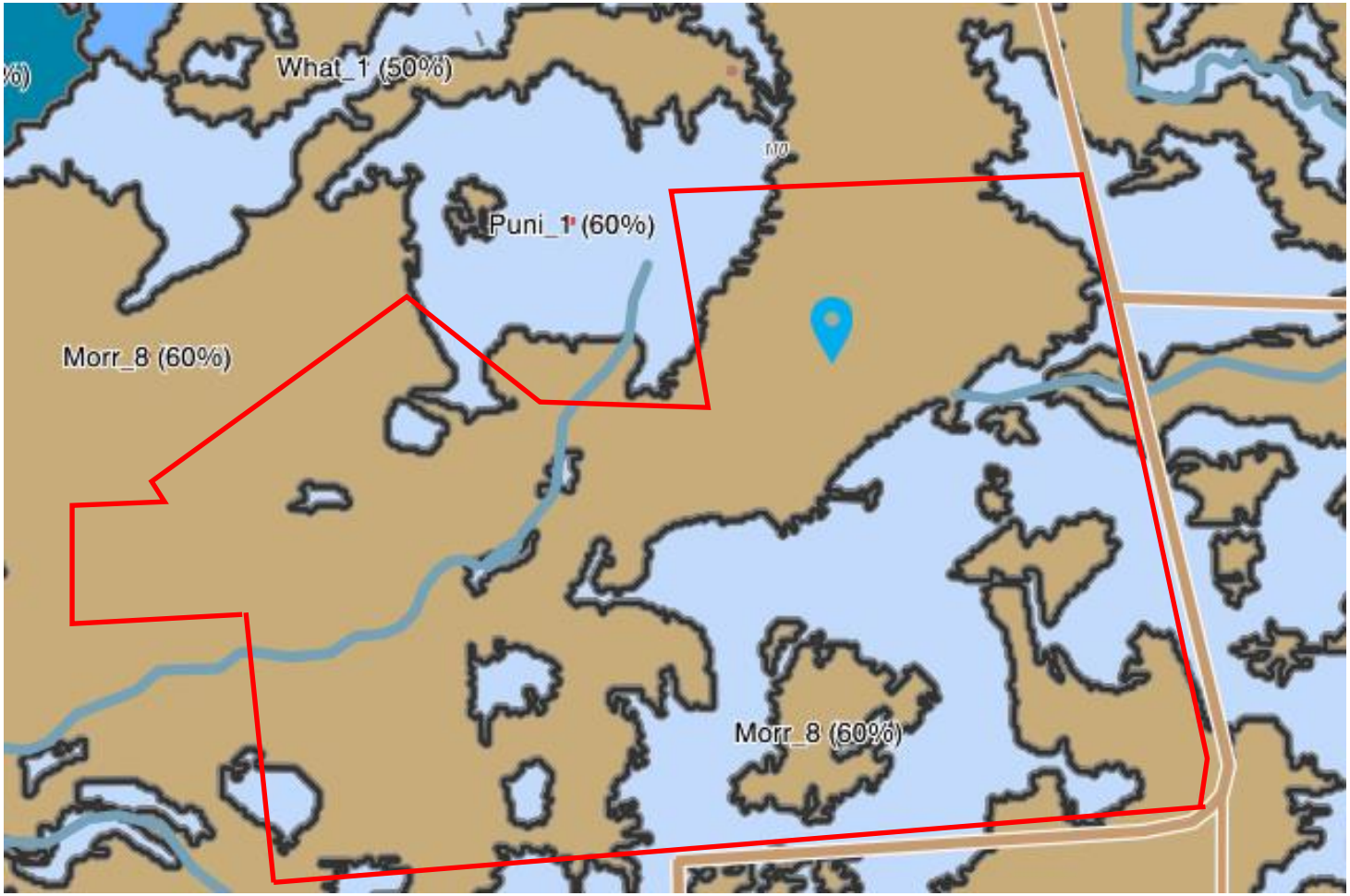
Grower Logo

Property Maps

Grower A

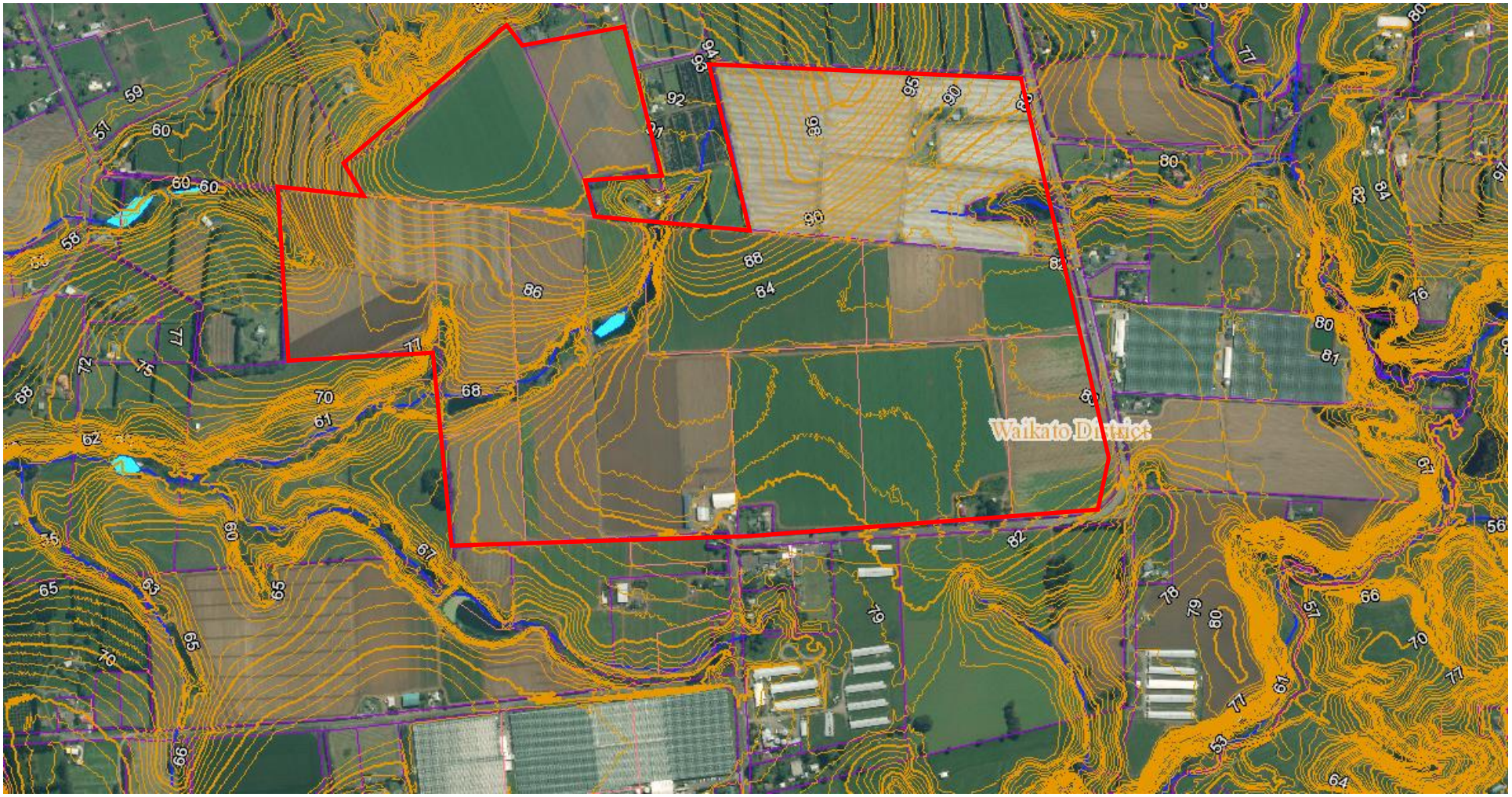

KIWI
4.37ha
McD 6
8.08ha
WIL 1
4.77ha
WIL 2
2.29ha
WIL 6
1.44ha
WIL 5
1.61ha
WIL 3
WIL 4
2.76ha
SRP1
SRP3
SRP13
SRP14
SRP15
3.0
3.0
HELMS 5
HELMS 3
3.99ha
McD 4
2.99ha
McD 5
1.45ha
BAR 5
8.67ha
BAR 4
2.68ha
BAR 3
2.36ha
SRP2
SRP4
SRP5
SRP6
HELMS 4
3.96ha
HELMS 2
1.03ha
5.0
SRP7
SRP8
McD 2
5.12ha
McD 1
2.27ha
BAR 2
15.16ha
BAR 1
1.0
McD 3
3.81ha
0.94ha
HELMS 1
2.33ha
1.0
2.0
DIT 1
2.32ha
DIT 2
4.14ha
SRP12
SRP11
SRP10
SRP9
Legend:
Drain
Silt trap
Silt landings
Bund
3.5
Slope direction
& angle (degree)

Home Block 1

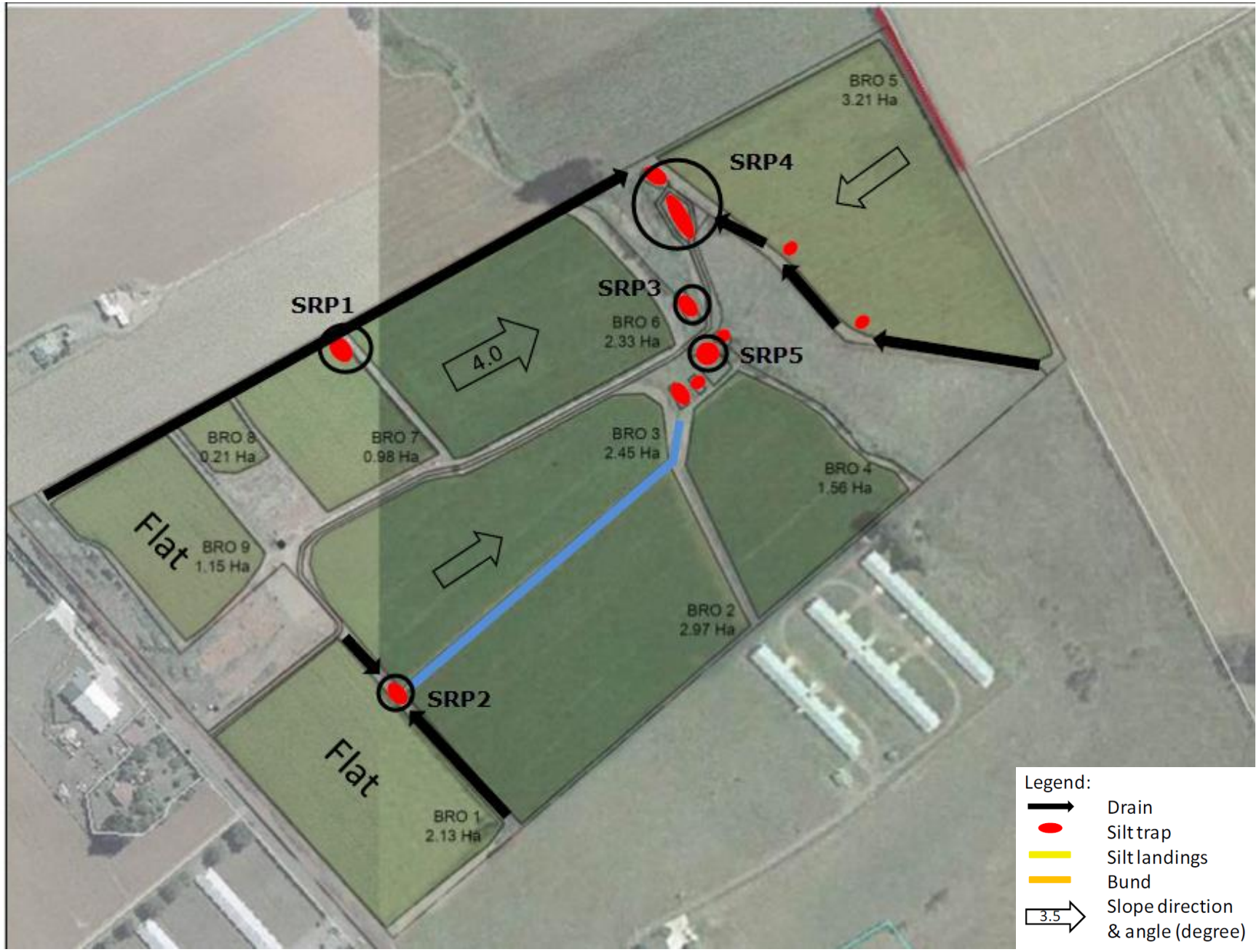


Home Block 1. S-Map

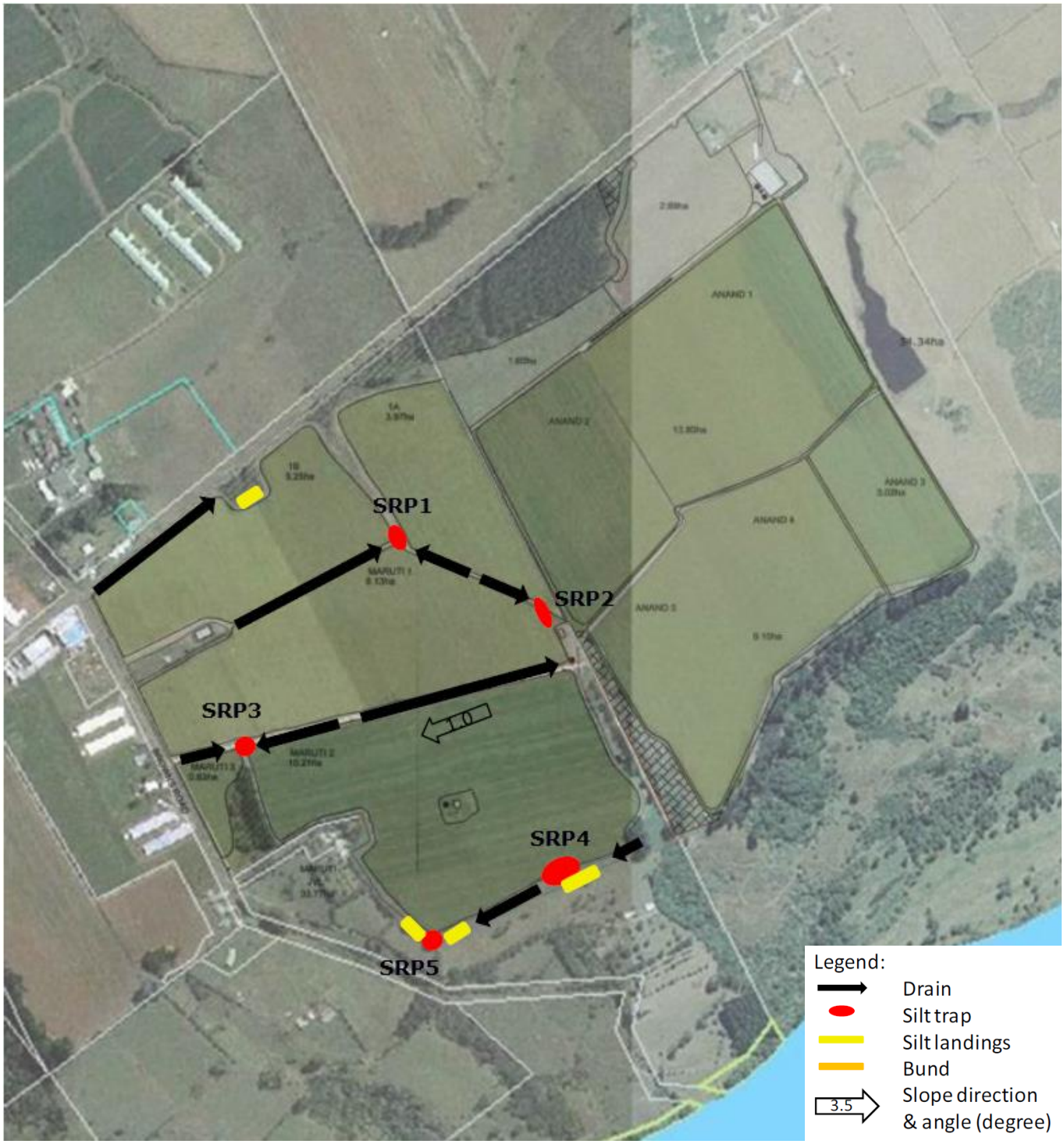
The soil type according to Landcare Research S-map reports is Punif and Morrinsvillef Clay. The Punif soil has more drainage limitations than the Morrinsvillef soil.



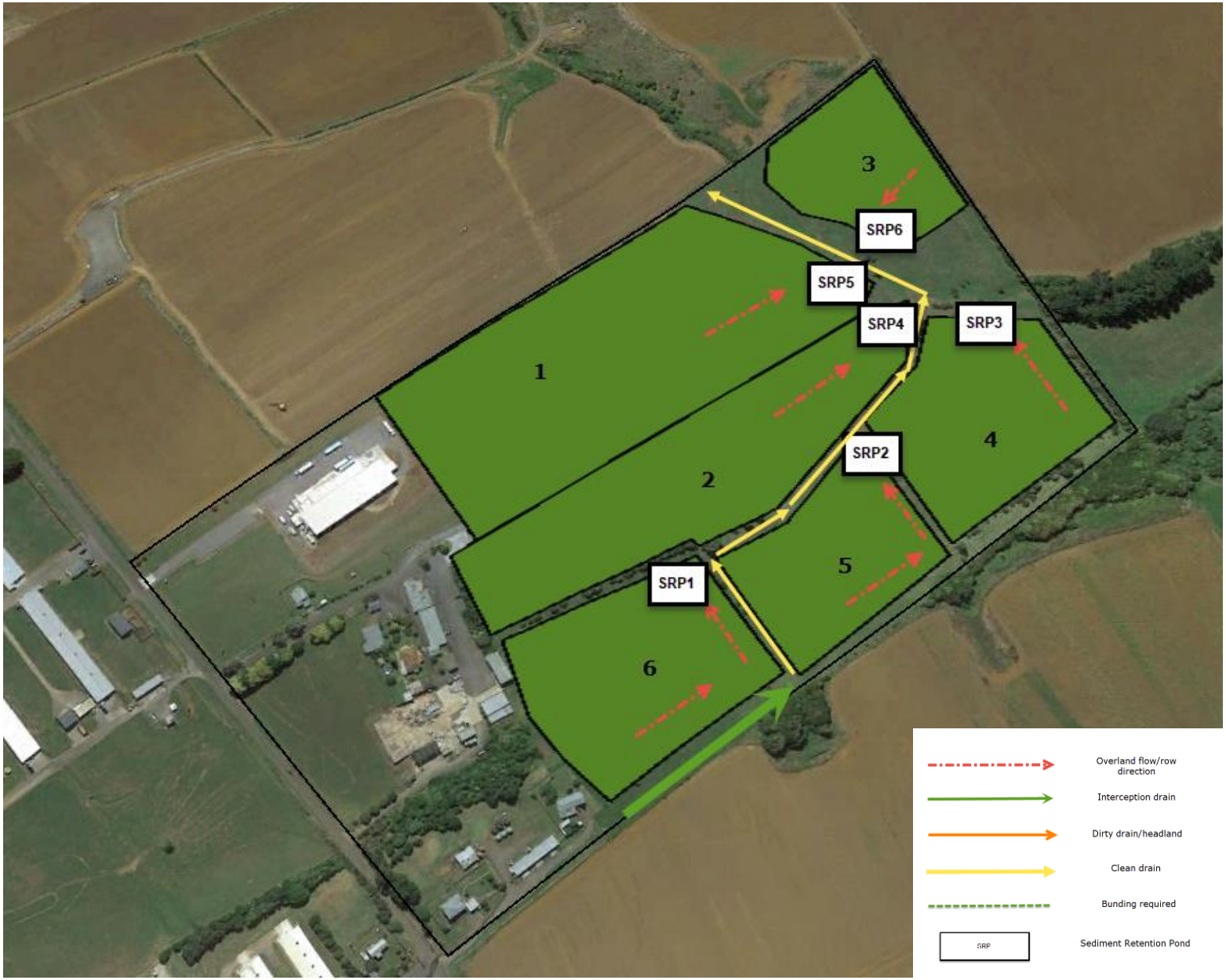
Home Block 1. Contour Map


BRO 5
3.21 Ha
SRP4
SRP1
SRP3
BRO 6
2.33 Ha
4.0
SRP5
BRO 8
0.21 Ha
BRO 7
0.98 Ha
BRO 3
2.45 Ha
BRO 4
1.56 Ha
Flat
BRO 9
1.15 Ha
BRO 2
2.97 Ha
SRP2
Flat
BRO 1
2.13 Ha
Legend:
Drain
Silt trap
Silt landings
Bund
3.5
Slope direction
& angle (degree)

Block 2


SRP1
SRP2
SRP3
SRP4
SRP5
Legend:
Drain
Silt trap
Silt landings
Bund
3.5
Slope direction
& angle (degree)

Block 3


3
SRP6
SRP5
SRP4
SRP3
1
4
SRP2
2
5
SRP1
6
Overland flow/row direction
Interception drain
Dirty drain/headland
Clean drain
Bunding required
SRP
Sediment Retention Pond

Block 4

E&S CONTROL PLAN (1 EXAMPLE - HOME BLOCK)

Erosion & Sediment Control Plan

Home Block 1

August 2019

Prepared by Andrew Barber & Henry Stenning for:

Grower A

AGRI LINK

EMPOWERING SUSTAINABLE GROWTH

Erosion & Sediment Control Plan

Home Block 1

August 2019

Prepared by Andrew Barber & Henry Stenning

Agrilink New Zealand

Prepared for Grower A

Contents

1 Business details

Business name: Grower A

NZGAP number: x

2 Property details

Location address: X

Local authority name: Waikato Regional Council

Land area: 100 ha

Legal description: X

Certificate of title: X

3 Advisor details

Advising business: Agrilink NZ

Primary advisor name: Andrew Barber, BHort (tech) Hons

Secondary advisor name: Henry Stenning, BSc

Area of expertise: Erosion and sediment control

Phone: 027 498 3620

Email: andrew@agrilink.co.nz

4 Maps and property description

The property is located at _____. The total area used for cropping of Home Block 1 is approximately 100 ha with a cropping area of 96 ha. Home Block 1 is divided into 25 paddocks, outlined in Table 1.

The soil type according to Landcare Research S-map reports is Morrinsville*f* Clay, a moderately well drained soil.

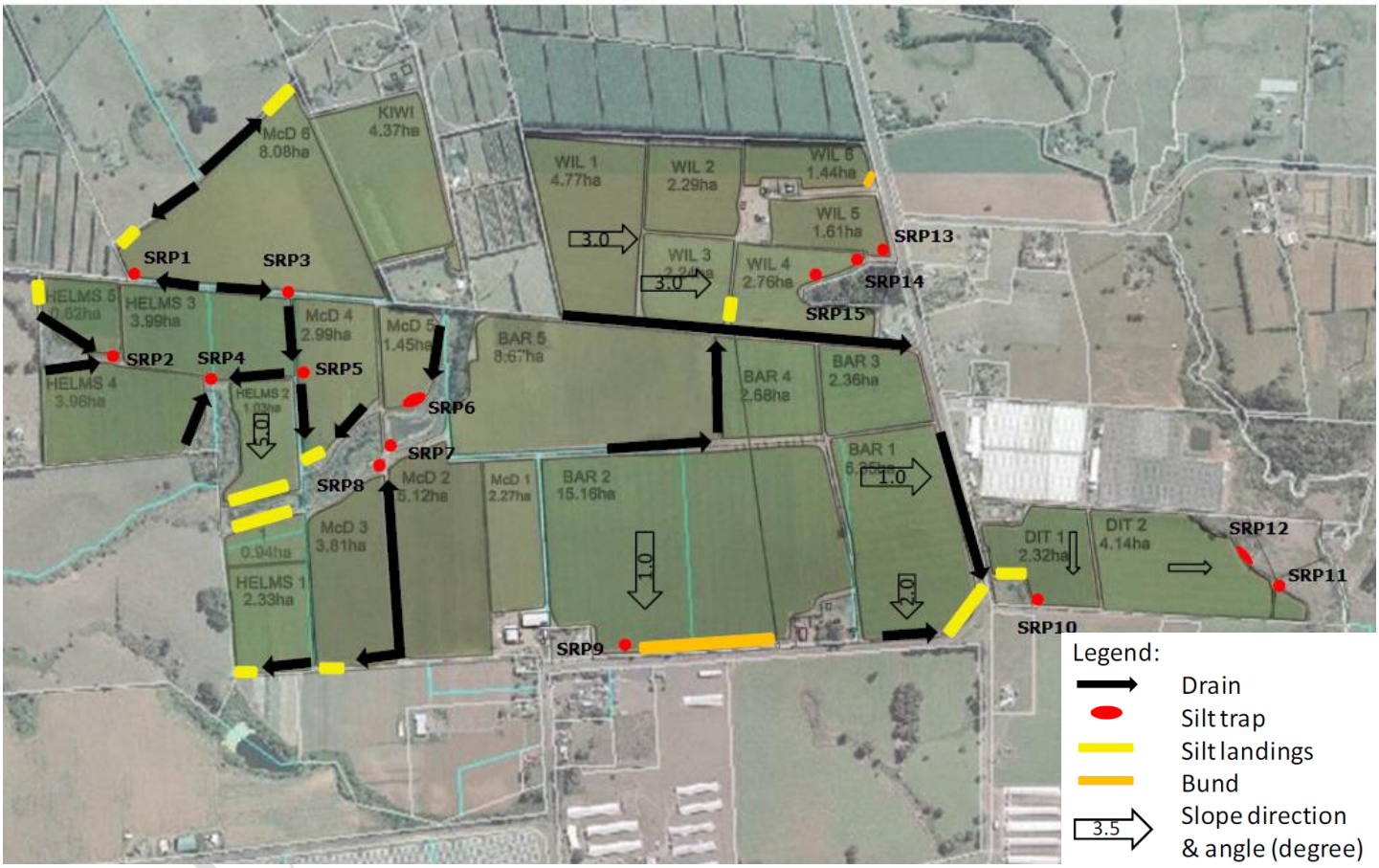


Figure 1. Site map with legend.

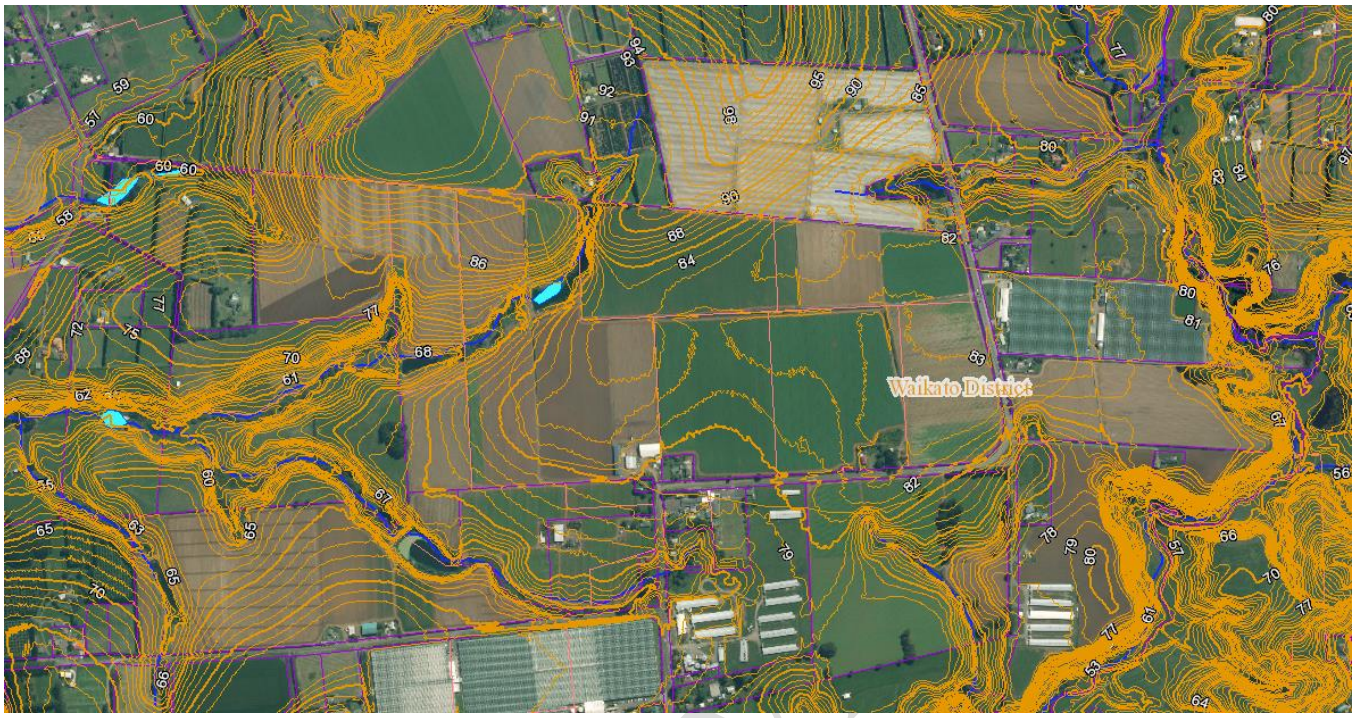


Figure 2. 1m contour map

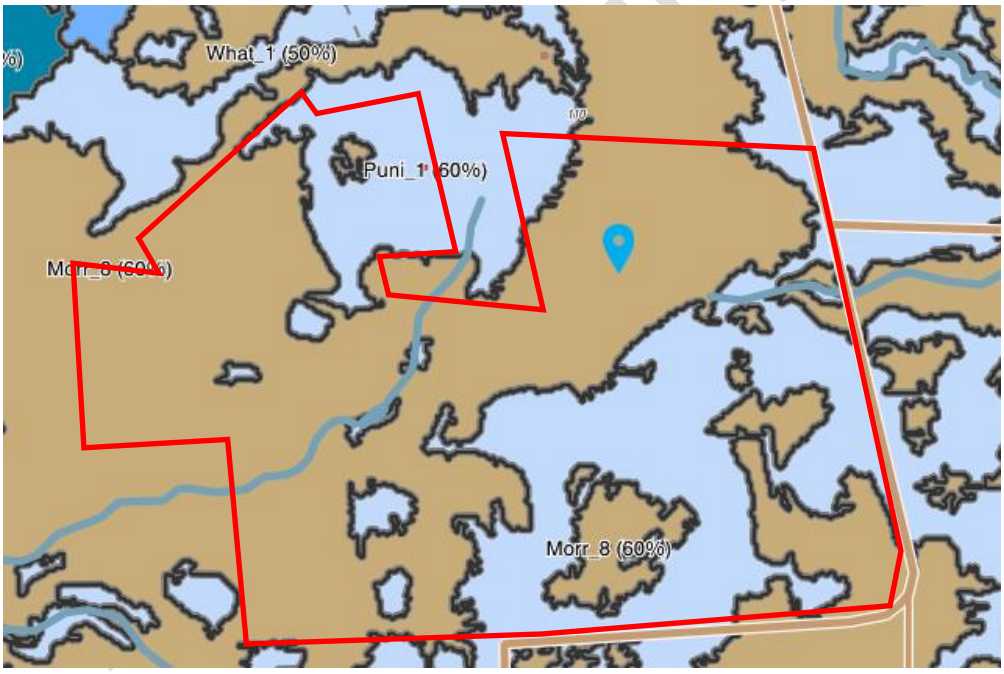


Figure 3. Soil map from S-maps (Landcare Research)

The drain direction and area of the paddocks, as well as Sediment Retention Pond (SRP), Bund, and Silt Landing (i.e. buffer strip) locations prior to implementation of the action plan are shown on the map (Fig.1).

Table 1 describes the current overland flow situation. Priority rankings of paddocks are shown in Table A2 in the appendix.

Table 1. Paddock descriptions

Paddock name	Land use	Paddock area (ha)	Water origin	Water destination
KIWI	Cropping – Outdoor vegetables	4.37	Direct rainfall only.	Neighbouring property
McD1	“”	2.27	Direct rainfall only.	Neighbouring property
McD2	“”	5.12	Direct rainfall only.	Half enters SRP8, half is diverted to silt landing at bottom of McD3.
McD3	“”	3.81	Direct rainfall only.	Half enters SRP7, half is diverted to silt landing at bottom of paddock.
McD4	“”	2.99	Direct rainfall only.	Silt landing at bottom of paddock.
McD5	“”	1.45	Direct rainfall only.	SRP6.
McD6	“”	8.08	Direct rainfall only.	Silt landings at top of paddock.
HELMS1	“”	2.33	Direct rainfall only.	Silt landing at bottom of paddock.
HELMS2	“”	1.03	Direct rainfall only.	Half diverts to silt landing at top of paddock, half is diverted to silt landing at bottom of paddock.
HELMS3	“”	3.99	Direct rainfall only.	SRP4 and SRP5.
HELMS4	“”	3.98	Direct rainfall only.	SRP2.
HELMS5	“”	0.62	Direct rainfall only.	SRP2.
BAR1	“”	6.35	Direct rainfall only.	Silt landing at bottom of paddock.
BAR2	“”	15.16	Direct rainfall only.	SRP9.
BAR3	“”	2.36	Direct rainfall only.	Adjacent drains.
BAR4	“”	2.68	Direct rainfall only.	Adjacent drains.
BAR5	“”	8.67	Direct rainfall only.	Adjacent drains.

Paddock name	Land use	Paddock area (ha)	Water origin	Water destination
DIT1	“”	2.32	Direct rainfall only.	Silt landing/SRP10.
DIT2	“”	4.14	Direct rainfall only.	SRP11 or SRP12.
WIL1	“”	4.77	Direct rainfall only.	Drain leading to SRP14.
WIL2	“”	2.29	Direct rainfall only.	Drain leading to SRP14.
WIL3	“”	2.24	Direct rainfall only.	WIL4 then SRP15.
WIL4	“”	2.76	Direct rainfall and water from WIL3.	SRP15.
WIL5	“”	1.61	Direct rainfall only.	SRP16.
WIL6	“”	1.44	Direct rainfall only.	SRP16.

5 Implement control measures for stopping or controlling water entering that paddock

See FEP NZGAP Template 6E.

6 Implement erosion control measures to keep soil on the paddock

See FEP NZGAP Template 6F.

7 Implement sediment control measures to manage the water and solids that move off the paddock

See FEP NZGAP Template 6G.

8 Action Plan

1. Upgrade all existing and new snorkels to comply with Table 6.
2. Ensure all drains running alongside paddocks are stabilised, with bunds installed as required to ensure overland flow from the paddocks does not enter the clean drain.
3. Ensure that there is at least a 1-2m setback from all clean drains to prevent soil entering from cropping activities.
4. Progressively grass all drains by April 2020.
5. Ensure all Silt Landings/Buffer Strips are maintained, with careful attention being paid to preventing ponding and channelisation. Construct 4 new Silt Landings in the locations specified in figure 4 with these factors taken under consideration.
6. Dig out all existing SRPs at the earliest opportunities and ensure all emergency spillways are level and stabilised. Stabilise all spillways with geotextile cloth.
7. Construct new SRPs/modify existing SRPs to the dimensions specified in Table 5 and in the locations specified in Figure 4. Stabilise all spillways with geotextile cloth.

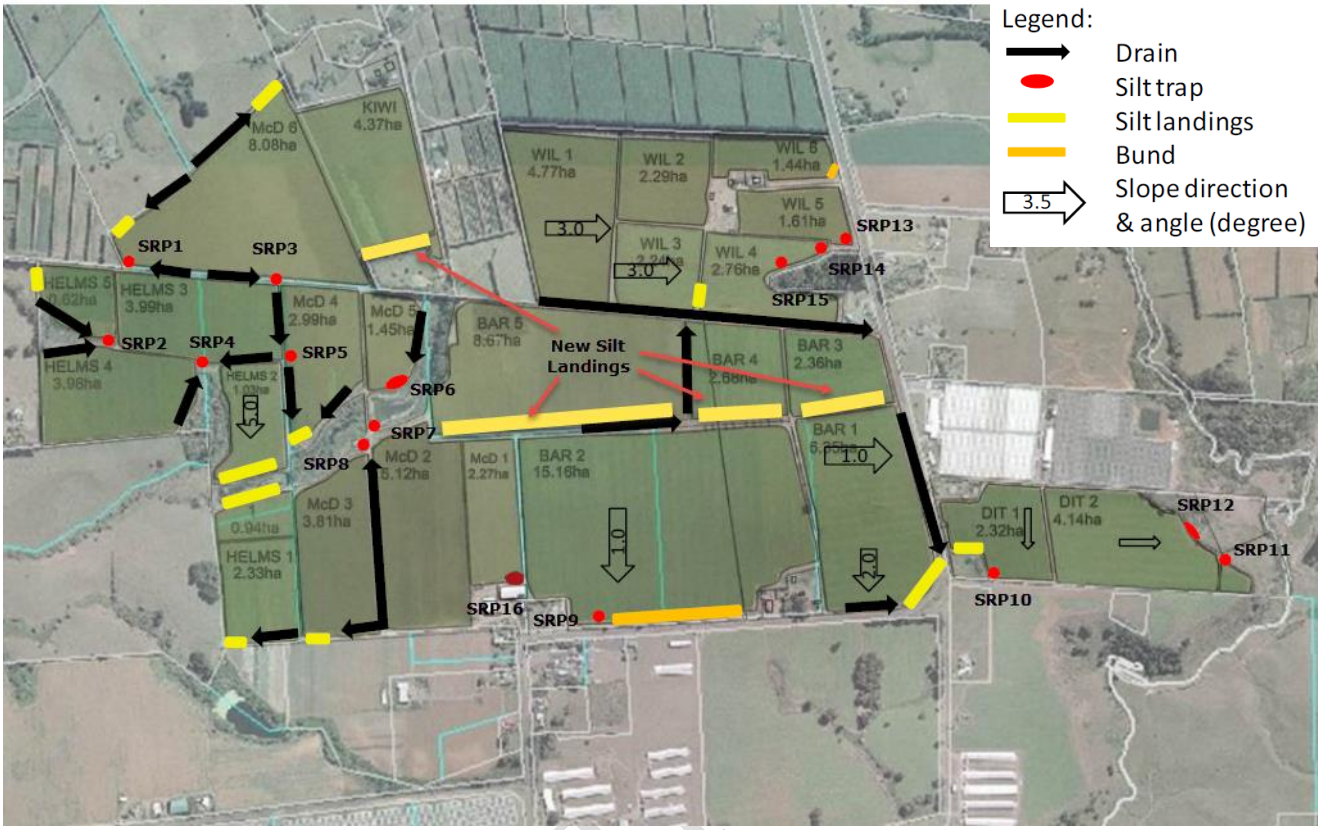


Figure 4. Site map with legend following implementation of action plan

Table 2. Sediment Retention Pond sizes

SRP	Catchment area (ha)	Catchment paddocks	Current volume (m^3)*	Required volume (%)	Required volume (m^3)	Potential dimensions (m)**		Spillway width (m)
						3:1	5:1	
1	3.1	Part of McD6	160	0.5%	155	Completed	Completed	4.7
2	4.6	HELMS4, HELMS5	230	0.5%	230	Completed	Completed	7.0
3	5.0	Part of McD6	220	0.5%	250	24 x 8	32 x 6	7.5
4	3.0	HELMS3	160	0.5%	150	Completed	Completed	4.5
5	-	Part of drain system leading from SRP3	-	-	-	-	-	-
6	1.45	McD5	80	0.5%	72.5	Completed	Completed	2.2
7	4.8	Part of McD2	250	0.5%	240	Completed	Completed	7.2
8	2.5	Part of McD3	125	0.5%	125	Completed	Completed	3.8
9	12.2	Part of BAR2	900	1.0%	1,220	54 x 16	70 x 13	22.7
10	2.32	DIT1	118	0.5%	116	Completed	Completed	3.5
11	2.5	Part of DIT2	125	0.5%	125	Completed	Completed	3.8
12	1.64	Part of DIT2	90	0.5%	82	Completed	Completed	2.5
13	3.05	WIL5, WIL6	100	0.5%	153	20 x 6	25 x 5	4.6

14	4.9	WIL2, part of WIL1	250	0.5%	245	Completed	Completed	7.4
15	4.2	WIL4, part of WIL3	210	0.5%	210	Completed	Completed	6.3
16†	2.27	McD1	N/A	0.5%	114	18 x 5	22 x 4	3.4

*Assuming a standard 0.5:1 batter and with depths being estimates, the real volumes of the ponds will differ slightly from the figures given in this table.
**Assuming standard 0.5:1 batter and 1.5m depth
† SRP needs constructing

Table 3. Sediment Retention Pond snorkel sizes and quantity for Home Block 1*

SRP	Hole size (mm)	Total number of snorkels	Total number of holes per snorkel	Number of lines of holes per snorkel	Number of holes per line	Distance between holes (mm)
1	10	1	24	4	6	182
	12	1	15	3	5	220
2	10	1	40	5	8	138
	12	1	24	3	8	138
3	10	1	21	3	7	158
	12	1	14	2	7	158
4	10	1	20	4	5	220
	12	1	12	4	3	365
5	10	0	0	0	0	0
	12	0	0	0	0	0
6	10	1	36	6	6	175
	12	1	25	5	5	210
7	10	1	40	5	8	138
	12	1	32	4	8	138
8	10	2	30	5	6	175
	12	1	40	5	8	138
9	10	2	30	5	6	175
	12	1	40	5	8	138
10	10	1	20	4	5	220
	12	1	12	4	3	365
11	10	2	30	5	6	175
	12	1	40	5	8	138
12	10	1	24	4	6	182
	12	1	15	3	5	220
13	10	1	40	5	8	138
	12	1	24	3	8	138
14	10	2	30	5	6	175
	12	1	40	5	8	138
15	10	1	24	4	6	182
	12	1	15	3	5	220
16	10	1	24	4	6	182
	12	1	15	3	5	220

*Based on a 1.5m tall snorkel.
**Note – the bottom 30% of the snorkel shouldn't have any perforations in order to allow sediment to settle. Start drilling from the distance between holes from the top of the snorkel (e.g. the first hole is 200mm from top of snorkel where the distance between the holes is 200mm)

8.1 Construction schedule

Table 4. Construction schedule for Home Block 1.

Action	Date
Dig out all existing SRPs, level and stabilise emergency spillways	April 2020
Stop cultivating within 1m of all clean drains and investigate stabilising if required	April 2020
Construct SRP16	April 2021
Complete all enlargements to existing SRPs	April 2022
Stabilise all emergency spillways with geotextile cloth	April 2022
Upgrade all snorkels	April 2022

8.2 Maintenance schedule

- Ensure SRPs are dug out and maintained every 6 months – 1 year, or more frequently depending on if they have filled up.
- Ensure snorkel and spillways are working correctly with an inspection every 6 months or after every large rainfall event.
- Ensure that bunds have not been penetrated by water channels with an inspection every 6 months or after every large rainfall event.
- Ensure culverts remain unblocked with an inspection every 6 months or after every large rainfall event.
- Ensure all drains, including interception drains are clear, with an inspection every 3 months or after every large rainfall event.

9 Appendix

Appendix 1 – Site pictures

No pictures for this site (example farm)

Appendix 2 – Erosion and phosphate loss rates

Table A1. Estimated baseline soil erosion and phosphate loss

Paddock	Average slope (Max slope)	Erosion (t/ha/yr)	Total erosion (t/yr)	Phosphate (kgP/ha/yr)	Phosphate (kgP/yr)
KIWI	4.3° (5.7°)	65	284	141	616
McD1	4.3° (5.7°)	65	148	141	320
McD2	4.7° (5.7°)	70	358	152	777
McD3	6.0° (6.8°)	90	343	195	743
McD4	4.3° (5.7°)	60	179	130	389
McD5	3.9° (4.6°)	55	80	119	173
McD6	4.3° (5.7°)	85	687	184	1,489
HELMS1	5.2° (5.7°)	75	175	163	379
HELMS2	5.2° (5.7°)	75	77	163	167
HELMS3	4.3° (5.7°)	85	339	184	735
HELMS4	4.3° (5.7°)	85	338	184	733
HELMS5	5.0° (5.7°)	105	65	228	141
BAR1	3.5° (4.6°)	45	286	98	620
BAR2	3.5° (4.6°)	45	682	98	1,479
BAR3	2.8° (4.1°)	35	83	76	179

Paddock	Average slope (Max slope)	Erosion (t/ha/yr)	Total erosion (t/yr)	Phosphate (kgP/ha/yr)	Phosphate (kgP/yr)
BAR4	3.1° (3.9°)	40	107	87	232
BAR5	1.1° (3.2°)	20	173	43	376
DIT1	1.0° (2.1°)	15	35	33	75
DIT2	1.0° (3.9°)	15	62	33	135
WIL1	5.6° (7.9°)	110	525	238	1,138
WIL2	2.5° (3.9°)	25	57	54	124
WIL3	4.0° (4.5°)	60	134	130	291
WIL4	1.0° (2.5°)	40	110	87	239
WIL5	1.0° (2.1°)	25	40	54	87
WIL6	2.5° (3.9°)	60	86	130	187
Total (t)		**55**	**5,450**	**0.122**	**11.8**

Table A2. Erosion estimates for Home Block 1 site

	Unmitigated erosion (t/ha/yr)	Level of sediment loss with current practice (t/ha/yr)*				Level of sediment loss with enhanced practice (t/ha/yr)	
		Total erosion (t/ha/yr)	Suspended sediment reduction (%)	Priority ranking	Risk assessment	Total erosion (t/ha/yr)	Suspended sediment reduction (%)
KIWI	65	65.0	0%	1	High	12.2	20%
McD1	65	65.0	0%	2	High	0.5	83%
McD2	70	3.2	83%	15	Medium	3.2	83%
McD3	90	4.1	83%	11	Medium	4.1	83%
McD4	60	8.9	20%	8	Medium	8.9	20%
McD5	55	0.3	83%	25	Low	0.3	83%
McD6	85	2.1	83%	18	Medium	2.1	83%
HELMS1	75	3.5	20%	17	Medium	3.5	20%
HELMS2	75	3.7	20%	12	Medium	3.7	20%
HELMS3	85	1.1	83%	21	Medium	1.1	83%
HELMS4	85	1.1	83%	22	Medium	1.1	83%
HELMS5	105	1.8	83%	19	Medium	1.8	83%
BAR1	45	3.9	20%	14	Medium	3.9	20%
BAR2	45	11.7	60%	7	High	0.6	91%
BAR3	35	35	0%	4	High	4.9	20%
BAR4	40	40	0%	3	High	5.6	20%
BAR5	20	20	0%	5	High	3.9	20%
DIT1	15	0.8	83%	23	Low	0.8	83%
DIT2	15	0.8	83%	24	Low	0.8	83%

	Unmitigated erosion (t/ha/yr)	Level of sediment loss with current practice (t/ha/yr)*				Level of sediment loss with enhanced practice (t/ha/yr)	
		Total erosion (t/ha/yr)	Suspended sediment reduction (%)	Priority ranking	Risk assessment	Total erosion (t/ha/yr)	Suspended sediment reduction (%)
WIL1	110	14.1	50%	6	High	14.1	50%
WIL2	25	1.4	83%	20	Medium	1.4	83%
WIL3	60	3.9	83%	12	Medium	3.9	83%
WIL4	40	2.1	83%	16	Medium	2.1	83%
WIL5	25	3.7	75%	13	Medium	0.9	83%
WIL6	60	5.7	75%	9	Medium	1.5	83%
Total sediment	**56**	**12.4**	**52%**			**3.5**	**63%**
Total P**	**0.122**	**0.027**				**0.008**	

*Silt landings/buffer strips are assumed to reduce suspended sediment load by about 20%.

** P of 2.2 kgP/t (Don't Muddy The Water - Final Report)

NUTRIENT MANAGEMENT PLAN

Nutrient Management Report

Operation A

August 2019

Prepared by Andrew Barber & Henry Stenning for:

Grower A

AGRI LINK

EMPOWERING SUSTAINABLE GROWTH

Nutrient Management Report

Example Farm

August 2019

Prepared by Andrew Barber & Henry Stenning

Agrilink New Zealand

Prepared for Operation A

Contents

1 Business details

Business name: COMMERCIAL VEGETABLE PRODUCTION

NZGAP number: x

2 Property details

Local authority name: Waikato District

Block Name	Owned (tick)	Leased (tick)	Title Legal Description	Area (ha)
HOME BLOCK 1	✓		xyz	100
BLOCK 2	✓		Xyz	20
BLOCK 3	✓		Xyz	90
BLOCK 4	✓		xyz	22
TOTAL				**232 ha**

3 Advisor details

Advising business: Agrilink NZ

Primary advisor name: Andrew Barber, BHort (tech) Hons

Secondary advisor name: Henry Stenning, BSc

Area of expertise: Commercial Vegetable Production – Resource use: nutrients, water, and soil

Phone: 027 498 3620

Email: andrew@agrilink.co.nz

4 Maps and property description

This Soil Management Report covers the 4 properties described above.

The total area used for cropping is approximately 205 ha.

The main soil type according to Landcare Research S-map reports is a clay, Punif and Morrinsville*f*, a Typic Orthic Granular Soil. The Punif soil has more drainage limitations than the Morrinsvillef soil. With medium nitrogen leaching vulnerability and low relative runoff potential.

The farm maps can be found in the separate map document.

See the S-Map factsheet for a full description.

Punif — **Mottled Orthic Granular Soil**

Puni_1a.1 (60% of the mapunit at location (1773330, 5877152), Confidence: High)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Clay
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		50 - 65 %
Drainage class		Imperfectly drained
Aeration in root zone		Moderately limited
Permeability profile		Moderate
Depth to slowly permeable horizon		
Permeability of slowest horizon		
Profile available water	(0 - 100cm or root barrier) (0 - 60cm or root barrier) (0 - 30cm or root barrier)	
Dry bulk density, topsoil		
Dry bulk density, subsoil		
Depth to hard rock		
Depth to soft rock		
Depth to stony layer class		

Key chemical properties

Topsoil P retention	

Morrinsville*f* — **Typic Orthic Granular Soil**

Morr_8a.1 (60% of the mapunit at location (1773209, 5877413), Confidence: High)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Clay
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		50 - 70 %
Drainage class		Moderately well drained
Aeration in root zone		Unlimited
Permeability profile		Moderate
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Moderate (4 - 72 mm/h)
Profile available water	(0 - 100cm or root barrier) (0 - 60cm or root barrier) (0 - 30cm or root barrier)	Moderate (111 mm) Moderate (67 mm) Moderate (34 mm)
Dry bulk density, topsoil		1.08 g/cm³
Dry bulk density, subsoil		1.26 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (46%)

5 Risk assessment

See FEP Risk assessment from NZGAP Template 7B.

5.1 Rainfall, runoff and drainage

As with the rest of the country, peak rainfall occurs in winter, from May to August. November to March remain relatively dry (Figure 2). As shown in Figure 2, seasonal rainfall can differ greatly from the long-term average, with large rainfall events in January and February 2018 and extremely dry periods in November and December 2017. This rainfall pattern will have played a role in nutrient application decision making.

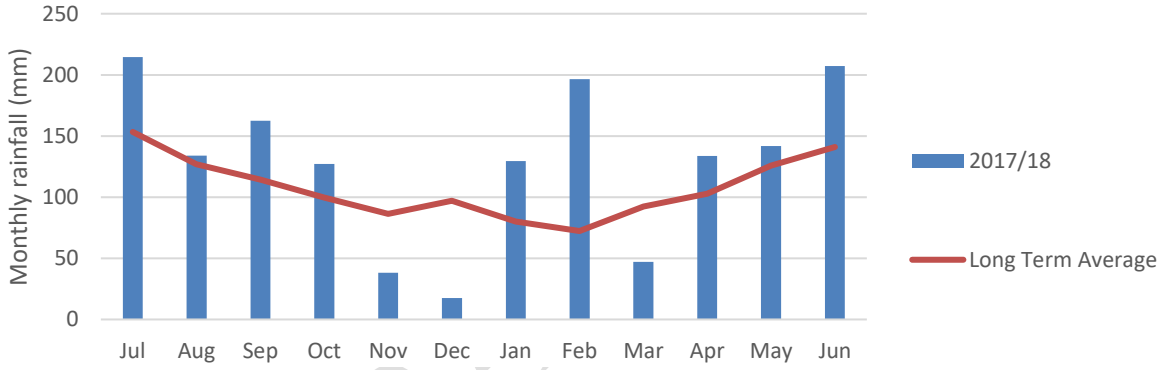


Figure 2. Long term average monthly rainfall for Farm 1 Virtual Climate Station Network (VSCN) compared to the 2017/18 seasons monthly rainfall.

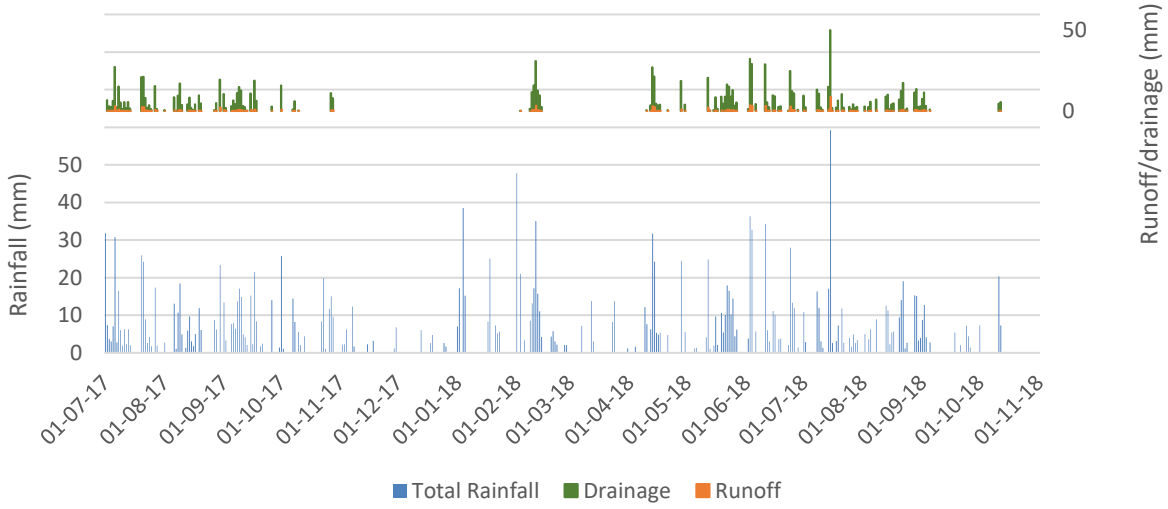


Figure 3. Modelled runoff and drainage for Farm 1 for the 2017/18 season as compared to rainfall.

6 Guidelines

The *Code of Practice for Nutrient Management* by Horticulture NZ is a resource of best-practice advice for managing vegetable crop nutrition in a New Zealand context. The COP is reflected in the NZGAP Templates and is being used to benchmark and track industry performance.

Our assessment of appropriate nutrient inputs has been informed by long term practice, nutrient management advice from a certified nutrient management adviser, and the more recent *Nutrient Management for Vegetable Crops in New Zealand* (Reid & Morton, 2019). The guideline crop nutrient use values given in this document can be tailored based on location, yields, and soil nutrient levels at the start of the crop. Note the figures in this guideline are crop nutrient use, and do not account for any nutrient losses, they are not fertiliser input recommendations.

7 Management Practices

See FEP NZGAP Template 7C.

8 References

- Reid, J., & Morton, J. 2019. Nutrient Management for Vegetable Crops in NZ. Prepared by Plant & Food Research. Prepared for the Vegetable Research & Innovation Board, and the Fertiliser Association of NZ.
- Horticulture New Zealand, 2014. Code of Practice for Nutrient Management, version 1.0. www.hortnz.co.nz

9 Information Tables For Home Block 1

Note the following records the other Blocks 2, 3, and 4 can be found in the crop, fertiliser and property records held in the office.

Paddock Area For Home Block 1

Paddock name	Paddock area (ha)
LIMS1	0.91
LIMS2	1.03
LIMS3	3.56
LIMS4	2.92
BHA1	1.66
BHA2	2.49
BHA3	1.59
BAV1	2.36
BAV2	0.86
DEED1	1.47
DEED2	2.54
BOR1	2.71
BOR2	1.76
BOR3	1.69
MATAJI	2.13
MATA1	4.26
BIL1	1.69
BIL2	2.04
BIL3	1.23
BIL4	1.23
BIL5	2.57
BIL6	5.30
Total cropped area	**48.00**
Total farm area	**100.00**

Soil Test Results For Home Block 1

Paddock name	pH	Olsen P (mg/L)	QT Ca (%BS)	QT K (%BS)	QT Mg (me/100g)	QT Na (me/100g)	ASC (estimated)	Total N (%)	Potentially available N (kg/ha)
LIMS1	6.1	158	13	30	38	5	55	21	42
LIMS2	6.4	151	12	26	36	5	55	23	42
LIMS3	6.4	158	14	22	38	5	55	21	42
LIMS4	5.9	158	16	20	35	4	55	21	44
BHA1	6.1	175	17	23	38	5	55	21	56
BHA2	6.4	175	15	25	38	8	55	20	21
BHA3	6.3	158	13	28	28	7	55	20	15
BAV1	6.3	156	14	29	35	6	55	20	47
BAV2	6.7	175	15	26	35	7	55	20	24
DEED1	6.3	132	14	22	32	5	55	21	25
DEED2	5.9	170	11	24	29	4	55	23	45
BOR1	6.3	151	15	21	35	6	55	20	43
BOR2	6.9	158	10	21	35	2	55	20	58
BOR3	5.9	151	11	26	38	2	55	22	67
MATAJI	6.8	170	11	29	38	5	55	22	68
MATA1	6.1	151	17	29	35	4	55	21	21
BIL1	5.8	132	14	27	35	3	55	22	29
BIL2	6.3	155	12	24	33	8	55	22	18
BIL3	6.4	151	13	23	34	5	55	21	40
BIL4	5.6	154	13	24	33	8	55	22	36
BIL5	5.9	175	14	25	32	9	55	21	46
BIL6	6.3	175	11	26	36	4	55	24	25

Home Block 1 Crop Rotation Summary

Paddock	Crop	Crop growth period		Total area in crop (hectares)	Residual management E.g. incorporated, grazed
		Planting (Date)	Harvest (Date)		
LIMS1, LIMS2, LIMS3, LIMS4, BHA1, BHA2, BHA3	Potatoes	26/08/18	01/03/19	4.0	Incorporated
	Potatoes	06/10/18	01/03/19	1.04	Incorporated
	Potatoes	18/07/17	23/02/18	3.5	Incorporated
	Onions	09/08/17	23/02/18	8.5	Incorporated
	Mustard Greens	02/11/16	15/01/17	8.5	Incorporated
	Potatoes	10/12/15	18/07/16	2.0	Incorporated
	Potatoes	17/12/15	18/07/16	2.0	Incorporated
	Mustard Greens	17/12/14	10/01/15	8.71	Incorporated
	Lettuce	02/05/14	01/09/14	6.9	Incorporated
	Potatoes	01/01/14	28/10/14	8.52	Incorporated
BAV1, BAV2, DEED1, DEED2	Onions	02/08/18	19/02/19	6.2	Incorporated
	Lettuce	03/05/18	30/09/18	6.99	Incorporated
	Onions	04/08/16	04/03/17	7.0	Incorporated
	Potatoes	12/07/16	01/12/16	7.0	Incorporated
	Potatoes	08/09/15	04/02/16	7.0	Incorporated
	Onions	15/08/14	27/02/15	7.7	Incorporated
BIL1, BIL2	Potatoes	22/07/18	21/12/18	3.6	Incorporated
	Broccoli	04/05/18	21/08/18	9.47	Incorporated
	Onions	25/08/18	10/03/19	7.39	Incorporated
	Potatoes	13/12/17	27/05/18	10.5	Incorporated
	Lettuce	15/05/16	29/08/16	7.6	Incorporated
	Broccoli	10/05/16	29/08/16	1.22	Incorporated
	Onions	24/07/16	10/02/17	9.7	Incorporated
	Potatoes	03/12/15	27/09/16	7.7	Incorporated
	Barley	10/09/15	31/03/16	9.7	Incorporated
	Potatoes	23/01/15	10/09/15	7.6	Incorporated
	Lettuce	01/01/14	01/05/14	4.2	Incorporated
	Onions	19/08/14	28/02/15	7.0	Incorporated
	Potatoes	13/11/13	28/03/14	10.3	Incorporated
	Potatoes	01/01/14	28/10/14	13.89	Incorporated
BOR1, BOR2, BOR3, MATAJI	Potatoes	04/08/18	06/01/19	5.2	Incorporated
	Potatoes	04/04/17	28/12/17	1.6	Incorporated
	Mustard Greens	17/12/16	30/04/17	6.76	Incorporated
	Potatoes	11/01/16	27/06/16	6.0	Incorporated
	Lettuce	18/03/15	01/07/15	5.4	Incorporated

	Potatoes	01/05/15	28/10/15	1.3	Incorporated
	Onions	19/08/14	28/02/15	6.7	Incorporated
	Potatoes	23/06/14	27/11/14	6.8	Incorporated
MATA1, BIL3, BIL4, BIL5, BIL6	Potatoes	10/11/16	24/10/17	6.8	Incorporated
	Onions	13/08/16	27/02/17	6.8	Incorporated
	Potatoes	13/11/14	28/03/15	6.8	Incorporated

Home Block 1 Nutrient Records for 2018-19

Paddock	Area	Fertilisers applied	Quantity (kg/ha)	N:P:K Ratio	Crop (Variety)	Seeding Date
LIMS1, LIMS2, LIMS3, LIMS4, BHA1, BHA2, BHA3	14.2	HYDRO-COMPLEX	150	12:5:14	Onion (ELK)	23/06/18
		NPS	300	16:20:0		
		CAN	600	27:0:0		
BAV1, BAV2, DEED1, DEED2, BIL1, BIL2	2.4	12.8.8	1000	12:8:8	Potatoes (ALMERA)	21/07/18
		BASE GREEN	800	12:5:14		
		CAN	500	27:0:0		
	0.8	12.8.8	1000	12:8:8	Potatoes (ALMERA)	12/08/18
		BASE GREEN	800	12:5:14		
		CAN	350	27:0:0		
	2.1	12.8.8	1000	12:8:8	Potatoes (ALMERA)	12/08/18
		BASE GREEN	700	12:5:14		
		CAN	300	27:0:0		
	1.6	8.8.8	1000	8:8:8	Potatoes (ALMERA)	12/09/18
		BASE GREEN	750	12:5:14		
		CAN	450	27:0:0		
	4.1	8.8.8	1000	8:8:8	Potatoes (AG)	16/11/18
		BASE GREEN	700	12:5:14		
BOR1, BOR2, BOR3 MATAJI	8.3	HYDRO-COMPLEX	150	12:15:14	Onion (RED 903S)	25/07/18
		NPS	300	16:20:0		
		CAN	500	27:0:0		
MATA1, BIL3, BIL4, BIL5, BIL6	14.6	8.8.8	1000	8:8:8	Potatoes (ML)	05/10/18
		BASE GREEN	700	12:5:14		

WATER MANAGEMENT PLAN

Water Management Plan

Commercial Outdoor Vegetable Operation

August 2019

Prepared by Andrew Barber for:

Grower A

AGRI LINK

EMPOWERING SUSTAINABLE GROWTH

Water Management Plan

Commercial Outdoor Vegetable Operation

August 2019

Prepared by Andrew Barber for:

Grower A

Contents

AGRI LINK

EMPOWERING
SUSTAINABLE
GROWTH

1.0 INTRODUCTION

This water management plan describes the water used in the growing operation. At all the sites, except for the Yard, water is used for irrigation purposes. The Yard water includes washing and grading.

The water use covers the 12-month period between June 2017 and May 2018 and is updated annually at the end of the irrigation season. The next update will be completed in July 2019.

2.0 INVENTORY OF WASHING & IRRIGATED SITES

Table 1 shows the full inventory of farms with access to irrigation water and their water use.

Table 1 Location of Irrigation Water Use and Quantity Applied

Location	Farm ID	Water source	Irrigated area[a]	Total Water Use (mm)	% of total water use
1	1a	Aquifer - deep (confined)	-	-	-
1	1b	Aquifer - deep (confined)	23.1	98	10%
2	2a	Aquifer - deep (confined)	49.6	31	3%
2	2b	Irrigation Dam	49.6	26	6%
2	2c	Irrigation Dam	30.3	72	7%
3	3a	Aquifer - deep (confined) and stream	44.4	-	12%
4	4a	Aquifer - deep (confined)	19.9	65	4%
4	4b	Aquifer - deep (confined)	17.1	155	17%
5	5a	Stream	51.7	68	13%
5	5b	Aquifer - deep (confined)	29.8	-	11%
5	5c	Aquifer - deep (confined)	30.1	-	9%
2	2d	Aquifer - deep (confined)	16.0	79	7%
Total			**361.6**	**94**	**100%**

a Some farms have more irrigated area than total farm size due to double cropping

The main Yard has washing facilities. Water is taken from the same bore used for irrigation at 1b.

The washing discharge water is passed through a series of sediment detention ponds.

3.0 CROP WATER DEMAND AND IRRIGATION APPLICATION

Crop water demand can be estimated based on the crop type, growth stage, and the evapotranspiration rate.

Irrigation demand can be calculated the same way, less effective rainfall. The quantity applied per pass should be sufficient to return the soil moisture back to or just below field capacity.

Table 2 shows the monthly water use at each of the Grower A irrigated sites. This season was wetter than average but not significantly (Figure 2). This is mostly due to rainfall being dramatically above average at the start of 2018, with most other months of the irrigation season being below the long-term average (Figure 1). The range of predicted irrigation demand varies between early sown onions through to later planted potatoes. Each site should be less than the maximum of these 2 figures. Total irrigation use was 94 mm, which is a 150% increase on last season's total (2016/17 which was the 8th driest in the last 30 years – Figure 3).

Overall irrigation is well below predicted demand, and there were no occasions where sites went over predictions on various months.

It is recommended that more intensive monitoring of water use, the climate and ideally the soil moisture be conducted next season. Electronic water meters could be used that would allow for improved monitoring and management.

4.0 CONCLUSIONS

The 2017/18 season was slightly wetter than average (Figure 3) and was 15% drier than the previous season (2016/17). This is reflected in a 150% increase in irrigation use between 2016/17 and 2017/18.

Overall water use was less than predicted by the irrigation demand model.

Table 2. Water use per month and total seasonal use (mm)

Farm ID	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Total	As % of total
Yard														
1b	0	0	0	0	0	39	31	6	1	20	0	0	98	**10%**
2a	0	0	0	0	0	10	21	0	0	0	0	0	31	**3%**
2b	0	0	0	0	0	10	11	1	0	2	0	0	26	**6%**
2c	0	0	0	0	0	24	22	16	9	1	0	0	72	**7%**
3a	-	-	-	-	-	-	-	-	-	-	-	-	-	**12%**
4a	0	0	0	0	0	35	22	7	0	0	0	0	65	**4%**
4b	0	0	0	0	0	51	79	0	0	16	9	0	155	**17%**
5a	0	0	0	0	0	6	31	18	13	0	0	0	68	**13%**
5b	-	-	-	-	-	-	-	-	-	-	-	-	-	**11%**
5c	-	-	-	-	-	-	-	-	-	-	-	-	-	**9%**
2d	0	0	0	0	0	19	26	8	9	17	0	0	0	**7%**
Total	**0**	**0**	**0**	**0**	**0**	**27**	**46**	**7**	**6**	**6**	**1**	**0**	**94**	**100%**
Predicted irrigation demand														
Onion – September planting	0	0	0	0	41	124	41	0	0	0	0	0	206	
Potato – November planting	0	0	0	0	35	108	82	0	82	0	0	0	308	

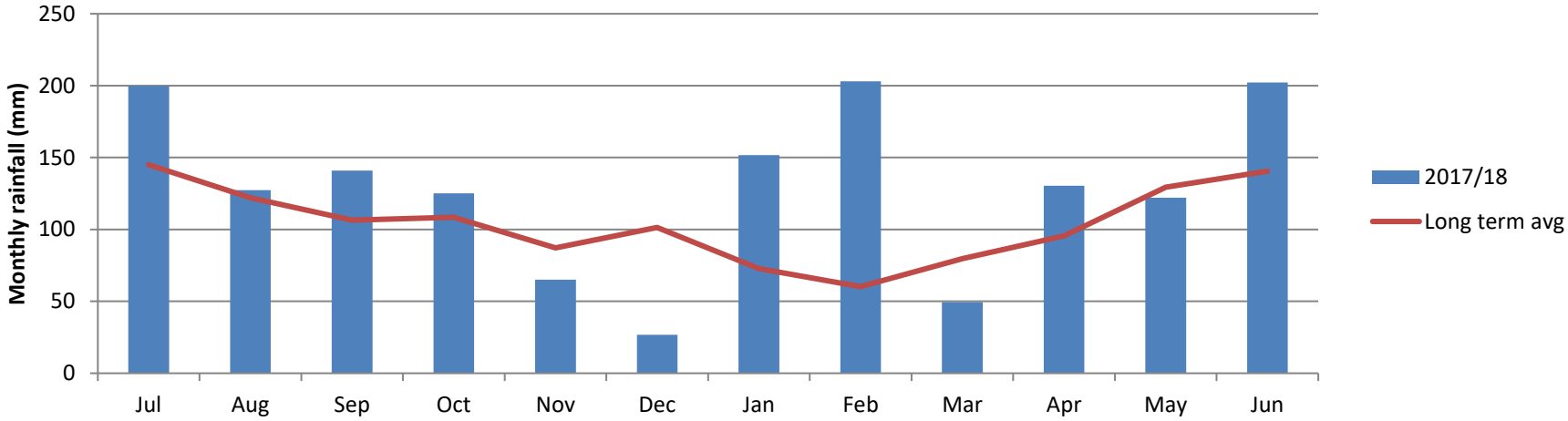


Figure 1. Monthly Rainfall at Yard (mm) July 2017 to June 2018 with long term average

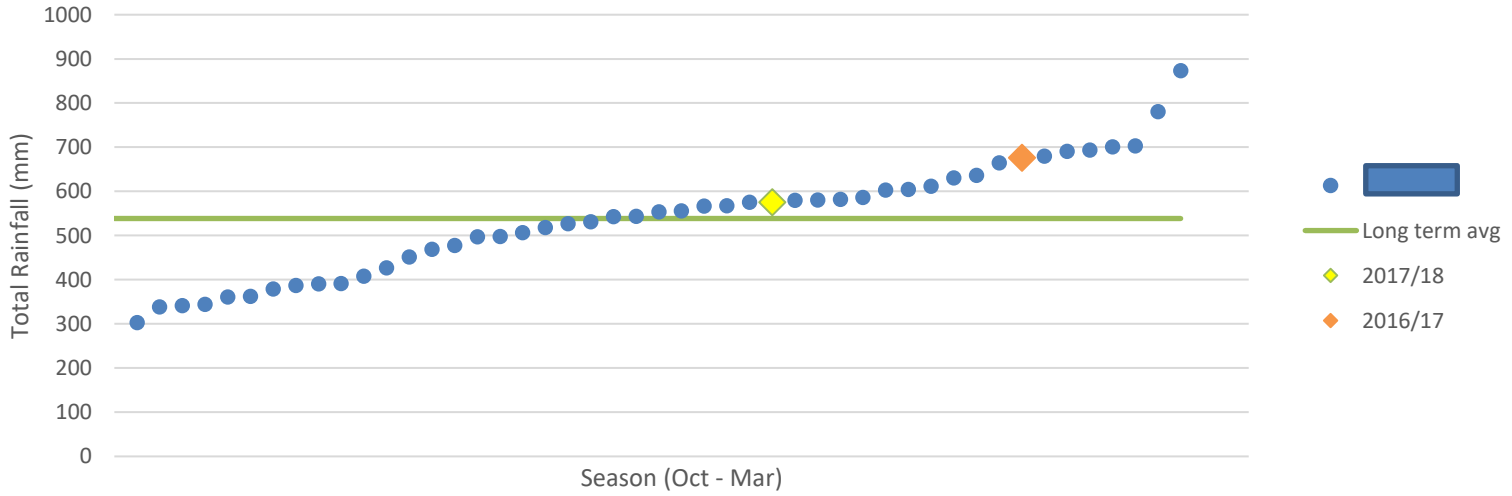


Figure 2. 2017/18 October to March rainfall at Yard compared to past seasons

Table 3 Monthly water use in cubic meters for 2017/2018 season

Site	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	**Total**
1b	0	0	0	0	0	14,781	11,895	24,10	573	7,829	0	0	**37,488**
2a	0	0	0	0	0	4164	8729	0	0	0	0	0	**12,893**
2b	0	0	0	0	0	9,782	10,682	1,363	0	1,957	0	0	**23,784**
2c	0	0	0	0	0	9,114	8,634	6,378	3,565	366	0	0	**28,057**
3a	0	0	0	0	0	13,902	30,944	0	0	0	0	0	**44,846**
4a	0	0	0	0	0	7,984	5,020	1,591	0	0	0	0	**14,595**
4b	0	0	0	0	0	21,120	32,856	0	0	6,490	3,806	0	**64,272**
5a	0	0	0	0	0	4,485	22,143	12,895	9,111	0	0	0	**48,634**
5b	0	0	0	0	0	8,918	21,215	2,684	8,548	0	0	0	**41,365**
5c	0	0	0	0	0	7,897	24,885	0	0	2,093	498	0	**35,373**
2d	0	0	0	0	0	6,549	9,121	2,920	3,115	6,147	0	0	**27,852**
Total applied	**0**	**0**	**0**	**0**	**0**	**108,696**	**186,124**	**30,241**	**24,912**	**24,882**	**4,304**	**0**	**379,159**