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Implementing Farm Scale Soil Mapping Protocols – workflow demonstrated with case study

Envirolink Grant: 1932-HBRC240

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Implementing Farm Scale Soil Mapping Protocols – workflow demonstrated with case study

Contract Report: LC3587

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Summary

Project and Client

- Project: Implementing Farm Scale Soil Mapping Protocols – workflow demonstrated with case study
- Client: Regional and unitary councils and Land Monitoring Forum, funded by Envirolink Regional Council Advice number 1932-HBRC240

Objectives

The purpose of this project work was to: i) demonstrate and test the use of the Soil Mapping Guidelines; ii) provide example case studies to assist with uptake and application and; iii) as part of the process, identify and make improvements to and clarification of the Soil Mapping Guidelines, and incorporate these into an updated document that would replace the current version on the Envirolink website.

Methods

- Consult with regional authorities (i.e. regional and unitary councils); soil survey professionals; and the wider soil science community.
- Gather feedback and testing with real case studies.
- Update the NZ Soil Mapping Guidelines document based on findings.
- Dissemination of the work.

Results

- The New Zealand soil mapping protocols and guidelines document (Grealish et al. 2017), currently available on the Envirolink website, has been updated based on the findings of this work. Additionally, workflows and case study examples have been included as new Appendices.
- The updated document (Version 2) will be provided to the LMF at the next meeting (end of September 2019), and endorsement sought that it should be made available for use, such as replacing the existing document on the Envirolink site.

Recommendations

- Councils should refer people who are generating a soil map to use the soil mapping guidelines.
- Clients and users should take into account that these are guidelines to establish consistency and are currently at the proposed stage for testing.
- A follow-up project in 2 years should be conducted to update, evaluate, and advise on use of the guidelines.
- Other gaps to work on have been identified: i) update of the Soil Description Handbook to fit with current soil mapping; ii) education on New Zealand soil classification and the S-Map soil classes; iii) training to soil surveyors and council members on the use of the soil mapping guidelines.

1 Introduction

This project (Envirolink Regional Council Advice number 1932-HBRC240) builds on the earlier Envirolink Tools 2016 Farm-scale Soil Mapping project (C09X1606) that prepared the document – *New Zealand Soil Mapping Protocols and Guidelines* (Grealish et al. 2017). This is available on the Envirolink website. This work linked a range of technical methods within a decision-support framework and made recommendations on standards for collecting soil information at farm scale, e.g. soil description, soil mapping, observation density, map scale, measurements required, level of expertise, and level of detail needed.

All councils that require soil mapping to be provided to them according to standards (from farm to regional scale) are linked to this work via the Land Monitoring Forum (LMF). The guidelines document was prepared to help provide consistent farm-scale soil information, to enable councils to assess whether soil map information provided is appropriate. A workshop presentation was given to the Land Monitoring Forum (LMF) members, and one of the outcomes from that meeting was to implement a trial case study example that would test the workflow and practical operations of the protocol, as well as provide a modelled, worked example to offer clarity to councils on the operations.

Additionally, the soil mapping protocols and guidelines set-out in the first report are proposed protocols and guidelines, presented to stimulate feedback and discussion among the wider soil science community, rather than to be the final word on the matter. Following the release of the report, the intention was to 'road-test' the proposed protocols and guidelines for 1–2 years, then review and update them based on the information gained from practical testing and feedback.

The purpose of this project work was to: i) demonstrate and test the use of the Soil Mapping Guidelines; ii) provide example case studies to assist with uptake and application and; iii) as part of the process, identify and make improvements to and clarification of the Soil Mapping Guidelines, and incorporate these into an updated document that would replace the current version on the Envirolink website.

2 Background

The Soil Mapping Protocol tool was developed to provide a nationally consistent approach for the preparation of soil maps, by identifying criteria and minimum standards to be satisfied. The guidelines were published as an Envirolink Tools report, primarily to assist councils with the needs for farm-scale soil information, and to inform the farming sector and industry organisations.

The need for the Protocols arose because there are a range of sources for soil information, produced using a variety of methods, with varying degrees of fitness for purposes. Soil maps may be provided at any nominal scale, with no indication of the accuracy or uncertainty for the mapping. For example, at least four different field description handbooks are currently in use. The Protocols document assisted by providing guidance and standards.

Councils indicated they would like to incorporate the Soil Mapping Protocol into their advice and regulatory processes but identified before implementation that they require demonstration and testing. It was determined that assistance with preparation of workflows, testing of the Protocols within a council, and demonstration of application via actual worked case studies to provide them with an approach to follow is required to assist with uptake.

If used widely, the Soil Mapping Protocol greatly improves consistency and repeatability between soil maps and support the use of this information by various models (OVERSEER® Nutrient budget model, industry developed tools, and regional council requirements for farm environment management plans). It enables much more reliable and consistent auditing of soil information quality, decisions by regulatory authorities and provide a common set of guidelines for primary sector organisations investing in farm-mapping support tools and databases, as well as end-user tools and models.

Many regional councils require farm plans to be prepared for intensive farming activities (e.g. Environment Canterbury's Land & Water Regional Plan, Hawke's Bay Regional Council's Tukituki Catchment Plan Change 6, and Horizons Regional Council One Plan). Primary sector organisations, such as Dairy NZ, are taking the initiative to promote and support the uptake of farm plans and are looking for technical information and guidance, such as farm-scale soil mapping guidelines, to assist landowners and ensure compliance with regulatory requirements. In many areas, farm-scale soil mapping currently proceeds in an ad hoc manner, and, even within a catchment, farm mapping might vary widely in quality and be undertaken during a range of time periods by different agencies and individuals – all of which can easily lead to inconsistent and unreliable results.

A goal in the recent 'Regional Council Research Science and Technology Strategy' (RCRST) is 'to facilitate science uptake'. This project will support the goal of implementing the MPI report on 'Future requirements for soil management in New Zealand', and potentially may be of use for consideration in the recent National Policy Statement on High Performance Land. Therefore, the proposed work is well beyond 'business as usual' for Hawke's Bay Regional Council and other councils. All councils will benefit by having a clearer understanding of the Protocols and demonstrated workflow from case studies to assist them with implementation.

The advice will in time lead to the implementation of farm-scale soil mapping standards and with this rigour improvement of farm soil maps. These soil maps underpin land use planning and consents, nutrient budgets and water quality, and development of environmental management plans.

3 Objectives

The purpose of this project work was to: i) demonstrate and test the use of the Soil Mapping Guidelines; ii) provide example case studies to assist with uptake and application; and iii) as part of the process, identify and make improvements to and clarification of the Soil Mapping Guidelines, and incorporate these into an updated document that would replace the current version on the Envirolink website.

Outputs from this work were to be disseminated and advice provided to councils by the following approaches:

1 A report that documents the workflow, providing guidance notes to assist implementation, and describing worked case study examples.

2 An agenda item at the next Land Monitoring Forum, advising council of the project and seeking input.

3 Presentation (oral) at the New Zealand Society of Soil Science Conference in December 2018.

4 A half-day workshop/presentation to the Land Monitoring Forum, in conjunction with their next available meeting once the project is completed.

4 Methods

The approach to obtain information and direction included:

- To evaluate how the soil mapping guidelines could be used within the council process.
    - In depth meetings held with staff who use soil information, provide advice, and/or deal with consent process. These were conducted as separate meetings in the region and included: Hawke's Bay Regional Council (February 2019), Waikato Regional Council (August 2019), and Marlborough District Council (February 2019).
    - Ad hoc discussions and phone calls with staff from other councils (March through to August 2019).
    - Agenda item for at the Land Monitoring Forum (March 2019) advising councils of the project and seeking input.
    - Agenda item for the next Land Monitoring Forum (expected end of September 2019).
- Case study examples that applied the soil mapping guidelines. There were insufficient funds in this project to conduct a real practical application from start to finish. Therefore, we had to utilise work that had been conducted, apply the guidelines and develop up practical case study. Rather than one case study we invested time to work up multiple case studies across a range of map scales and land use applications.
    - A private soil survey consultant who conducted work in the Marlborough region used the guidelines, conducted the field work, and generated a soil map. Mapping was conducted at farm to regional scale. The consultant then provided feedback to us on the applicability of the guidelines, highlighting what worked and what did not work.
    - Manaaki Whenua – Landcare Research pedologist retrospectively applied the guidelines to work conducted in the Hawke's Bay region. Mapping was conducted at regional scale. Feedback was provided on the benefits and limitations.

    - Private soil survey consultant retrospectively applied the guidelines to work targeted at soil information for a farm dairy effluent assessment, then provided feedback as to applicability.
    - Farm environment planning consultant from the Hawke's Bay provided input on how they would obtain soil information if needed for input into farm plans, then retrospectively applied the guidelines to obtain information. They identified parts of the guidelines that needed to be clarified or explained better for those who do not have a soil survey background but would wish to use the guidelines.
    - Manaaki Whenua – Landcare Research pedologist applied the guidelines to work in Marlborough region where an existing mapped area was being evaluated and updated. The focus here was on the process of using the guidelines.
- Engaging the wider soil science community.
    - Oral presentation, 'Farm-scale soil mapping protocols for New Zealand', was given by Gerard Grealish at the New Zealand Society of Soil Science conference (3–6 December 2018).
    - Special Feature Article in the New Zealand Soil News (February 2019, Issue 1 Vol 67), 'Soil mapping protocols and guidelines; implications of the recent New Zealand soil mapping protocols and guidelines' The article raised awareness, identified areas that may be of concern to address, and stimulated discussion.
    - Article in the New Zealand Soil News (August 2019): 'New Zealand soil mapping protocols and guidelines – a land monitoring forum perspective'. Again, the article provided a link to the document on the Envirolink website and requested that feedback be provided.
- Updating the New Zealand soil mapping protocols and guidelines document.
    - Primary purpose of this project was to road-test the guidelines, update where necessary, and included worked examples to clarify.
    - Based on practical applications of the guidelines in real case studies and feedback received.
    - Document to be made available at the next LMF meeting (expected end of September 2019). For discussion and agreement that it should replace the existing document on the Envirolink website. Making the latest information available to the public and for application to soil mapping.

5 Results

The following addresses each of the project objectives and the deliverable results achieved.

1 A report that documents the workflow, providing guidance notes to assist implementation, and describing worked case study examples.

The New Zealand soil mapping protocols and guidelines document (Grealish et al. 2017) currently available on the Envirolink website has been updated based on the findings of this work. The document has been revised and updated where needed. Additionally, workflows and case study examples have been included as new Appendices.

The updated document (Version 2) will be provided to the LMF at the next meeting (end of September 2019), and endorsement sought that it should be made available for use, such as replacing existing on Envirolink site.

A summary of conclusions from feedback and changes include:

- Document is best used as a guidance tool to support policy implementation. It should not be used in regulation; however, this may come once there has been more robust testing and understanding of how to apply and the implication. This document brings together the science to guide, practicalities of implementation need to be considered over a period.
- The soil mapping protocols and guidelines set- out in the report are intended to be proposed protocols and guidelines that have been presented to stimulate feedback and discussion among the wider soil science community, rather than to be the final word on the matter. Therefore, they should continue to have a proposed status.
- All concluded that such a document is necessary and that this does/seems to fit what is needed.
- All had no issue with the document structure, how information was set out, or what was provided. Only minor clarifications were requested and some reformatting of tables, e.g. Table 3 to add more utility.
- Science-wise, the most contentious issue was the number of observations specified for a survey area and adjusted for scale. Some believe the guidance and numbers specified were necessary and observable evidence absolute; a few believe that experience, professional capability, and soil landscape complexity should be the drivers rather than a prescriptive approach; however, this approach was not taken as it is harder to evaluate.
- The number of site observations required will have a major influence on the soil mapping effort, and hence on the cost to farmers and acceptance of the use of the guidelines. Therefore, we need to be careful, and further investigation of this point is required.
- Some people wanted an accreditation system in place to identify professional soil surveyors and their capabilities. While this would be of benefit, the few numbers of soil surveyors and the cost to implement such a system would be onerous. There is real concern from clients that with the uplift in soil map requirements people not qualified will enter the soil map consultant market. Accreditation is a valid suggestion that should be investigated.
- There is concern that guidelines later turn into rules, and a risk that this then negates the soil surveyor's knowledge and expertise to generate an improved product or more cost-effective product.
- Councils have few (or no) people with experience and knowledge about soil maps and characterisation, and certainly this expertise is not working in the regulation or consent areas. There is therefore a risk of a regimented tick box approach to satisfy. The subtlety of soil spatial variation is then not considered.

In the appendices are examples of one of the case studies (Appendix 1); and one of the user's comments on improvements to consider (Appendix 2).

2 An agenda item at the next Land Monitoring Forum, advising council of the project and seeking input.

Satisfied at the March 2019 LMF meeting.

3 Presentation (oral) at the New Zealand Society of Soil Science Conference in December 2018.

Satisfied by 'Farm-scale soil mapping protocols for New Zealand, an oral presentation given by Gerard Grealish at the New Zealand Society of Soil Science conference (3–6 December 2018).

4 A half-day workshop/presentation to the Land Monitoring Forum, in conjunction with their next available meeting once the project is completed.

Requested to be included at the next Land Monitoring Forum meeting, expected end of September 2019.

6 Conclusions

This project work has successfully delivered, by road-testing the soil mapping guidelines and generating an improved updated document that will be made available after the next LMF meeting end of September 2019.

The project has brought together science, stimulated conversation in the soil science community, and linked a range of technical methods within a decision support framework and made recommendations on standards for collecting soil information at farm scale. Work remains to test and apply the guidelines to ensure they are appropriate and feasible.

7 Recommendations

Councils should refer people who are generating a soil map to use the soil mapping guidelines. But clients and users should take into account that these are guidelines to establish consistency and currently are at the proposed stage for testing. Therefore, any concerns or lessons learnt are referred to the LMF chairman to forward onto MWLR authors to consider in the next update.

A follow-up project in 2 years should be conducted to update, evaluate, and advise on use of the guidelines

Other gaps to work on have been identified: i) update of the Soil Description Handbook to fit with current soil mapping; ii) education on New Zealand soil classification and the S-Map soil classes; iii) training to soil surveyors and council members on the use of the soil mapping guidelines.

8 Acknowledgements

This work was jointly funded by Envirolink Regional Council Advice number 1932-HBRC240; Manaaki Whenua – Landcare Research; and various council members throughout New Zealand who provided input, in particular those from HBRC, WRC, and MDC.

9 References

Grealish G 2017. New Zealand soil mapping protocols and guidelines. Palmerston North: Manaaki Whenua – Landcare Research. http://www.envirolink.govt.nz/assets/Envirolink/Tools/R12-4-New-Zealand-soil-mapping-protocols-and-guidelines.pdf

Appendix 1 – Case study (an example)

The following text is lifted directly from the subconsultants report.

New Zealand soil mapping guidelines

Case Study: MDC soil mapping

August 2019

Contents

Introduction

As part of the development of the New Zealand Soil mapping Guidelines (New Zealand soil mapping protocols and guidelines, Envirolink Grant: C09X1606) a subsequent Envirolink Grant has been funded to provide case studies that will test the practicalities of the guidelines in various mapping situations. This case study is based on regional scale soil mapping project for Marlborough District Council in June and July 2019.

The purpose of the case study is to test the "workability" of the guidelines. The workflow process provided in Figure 1 of the guidelines is used as a general guide to assesses the soil mapping project against Tables 1, 2, 3 and 4 in Grealish (2017). Comments are provided on what works well and what does not, and suggestions/ recommendations for improvements are provided.

Case study details

The soil mapping was contracted with specific requirements to provide soil map field data for S-map in the Rai, Pelorus and Kaituna Valleys at a minimum scale of 1;50,000. The following sections from the project plan accompanying the contract provide the details specified.

Project Objective

To improve the current soil map information (FSL) of the Rai Pelorus and Kaituna Valleys, including better resolution (~1:20,000-1:50,000 map scale) and improved soil data for S-Map. The work area is shown in Figure 1. The area within the polygon that is "valley floor" (0-10 degrees slope) is 112 km^2 (11,200 ha).

Figure 1: Rai, Pelorus and Kaituna Valley soil map area.

Tasks

Project tasks were specified in the project plan associated with the contract:

1. Collate existing soil information and compare the existing soil families identified against S-Map Family criteria.
2. Verification of the described soil families in the field, checking alignment with S-Map criteria for Family level according to
3. Soil observation points (~200-300 soil auger and soil pit descriptions as required) that can be used to verify a LIDAR based Digital Soil Map approach for S-Map.
4. Determination of where soil families change in the landscape (preliminary soil map boundaries) so this can be applied to the LIDAR dataset.
5. Needs to:

    a) Be done to the NZ soil protocols
    b) facilitate upload of polygons to S-Map.
    c) be as fine scale as feasible (say 1:20,000)

Available soil map information

The General soil survey of the South Island in 1968[1] and two soil characterisation studies Gray (2012)[2] and Gray (2013)[3] provided the available soil map information for the area.

The soil map boundaries for the area were of little use as that mapped the entire area as a single soil map unit consisting of two soils. Collectively, there were 30 soil profile descriptions with full soil morphological, chemical and physical characterisation. S-map Family and Sibling criteria data were incomplete.

[1] Soil Bureau (1968) General Survey of the Soils of South Island, New Zealand. *Soil Bureau Bulletin 27*. NZDSIR, Government Printer, Wellington.
[2] Gray, C (2012) Soil Properties in the Rai/Pelorus Catchment. *MDC Technical Report No: 12-005*. Marlborough District Council, Blenheim.
[3] Gray, C (2013) Soil Properties in the Havelock/Kaituna and Linkwater Districts. *MDC Technical Report No: 13-002*. Marlborough District Council, Blenheim.

Assessment against Guidelines

The workflow provided in Figure 1 of Grealish (2017) was applied in this case study.

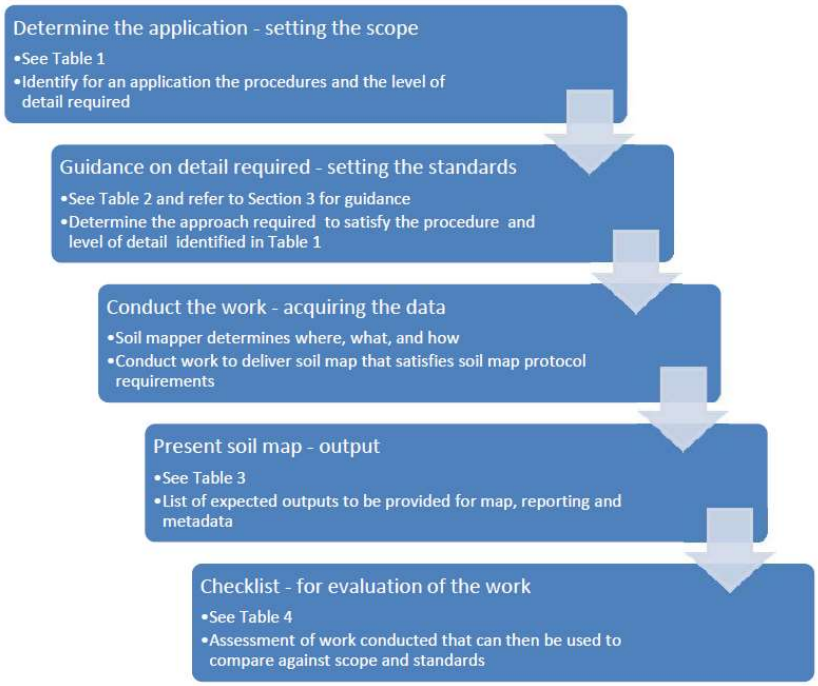

Figure 1. Presents a workflow and identifies protocol tables that provide standards and guidance.

Informing the project plan and contract

This section covers comments related to the application and level of detail guidance provided in **Table 1**.

Table 1 provided good guidance for scoping the soil mapping project and the project plan. The contract specifications could be based on Table 2 of Grealish (2017), shown Figure 2.

Table 2. Summary of the levels of detail applied to each procedure (see Section 4 for explanations)

Procedure	Level of detail <<< Increasing – Decreasing >>> High (H)	Medium (M)	Low (L)
Site density (read in context of map scale)	Total of 1 observation per 1 cm^2 of published map area	Total of 1 observation per 2 cm^2 of published map area	Total of 1 observation per 4 cm^2 of published map area
Site distribution (representativeness)	Explicit (repeatable, reproducible, statistical)	Knowledge-based (environmental gradients, transect, catena, stratified)	Free survey (relies on surveyor judgement)
Soil characterisation (information collected to provide evidence)	Measured (soil properties determined by analysis in the field or laboratory)	Detailed morphological descriptions (for pedotransfer functions and determining NZSC)	Soil type identification (limited description to identify a soil type or soil property)
Mapping method (how soil was mapped)	Described explicitly, numerical or diagrams	Narrative description	No information, accept surveyor judgement
Provider (soil surveyor)	Proven experience and approved	Proven experience	Gaining experience
Review (checked by peer)	Desktop review and site visit	Desktop review	Not required, acknowledge information sources

Figure 2: Additional information used for setting the contract requirements based on the detail provided in Table 2 (Grealish, 2017).

Site density and map scale

The initial project plan specified collecting soil observations to support as fine as 1:20,000 scale mapping. The number of observations to meet mapping at 1:20,000 and 1:50,000 scale was estimated (Table 1). This information was useful to determine the number of observations (and scale) that were required, could be achieved and to set expectations.

Table 1: Estimating the number of observations to meet mapping at 1:20,000 and 1:50,000 scale.

Item	Required details	Required details	Actual details
Map scale	1:20,000	1:50,000	~1:45,000
Area of survey (hectares)	11200	11200	11200
Number of (observations)	1456	224	250
Minimum area (ha/observation)	8	50	45
Site density (observations/ha)	0.13	0.02	0.022
Level of detail met	M	M	M

Procedure information required to satisfy a level of detail

This section covers comments related to the level of detail and conducting the work guidance provided in **Table 2**.

1. General
    a. Was helpful for setting contract specifications.
    b. Adding reference to sub-sections would assist.
2. Site density (4.1):
    a. This was useful to determine the nominal scale for the soil mapping.
3. Site distribution (4.2):
    a. There was enough descriptive information to determine the level of detail.
    b. The description for the low level of detail did suggested that using surveyor judgement (which could be interpreted as mapping experience) was not as good as an inexperienced mapper using a grid method. I think the additional notes should highlight that free survey does not use accepted pedological methods and constructs (e.g. catena, soil-landscape modelling concepts) to select soil observation locations; differentiating it from Medium level of detail.
4. Soil characterisation (4.3):

a. For medium level of detail, it was unclear to what level of NZSC classification. We assumed that Family and Sibling criteria had to be collected at all sites (because for Low level of detail it was optional), and additional soil description information as well.
b. Detailed soil morphological descriptions were interpreted as being full soil profile descriptions using pits or cuttings.
c. For some low level of details observations, the GPS location was not always possible as they were distant soil observations. For these an estimated point was placed on the Tablet in the field.
d. The difference between high and medium reads to be only optional analyses.
e. NaF and pH are often required for NZSC classification – should these be optional if there are no measured sites?
f. More than half of the sites in the project were medium level of detail for soil characterisation. Many of the other sites were for the purpose of determining the soil map unit boundary or the proportion of the soils in a soil map unit. Having enough "mapping" site observations is as important as having many soil characterisation sites. This does not seem well captured in the soil characterisation section.
g. The project made use of Soil quality sites that had full soil profile descriptions and additional measurements to meet S-map Online input. This is an example of where two objectives can be met.

5. Mapping method (4.4):
    a. No comments; this could be interpreted and met.
6. Provider:
    a. Some of these seemed difficult to meet at first. More detail, including relevant examples could be provided to assist the assessor. Maybe add level of tertiary qualification and discipline (especially for High level of detail).
    b. Given there is only CPSS that is a relevant formal certification, I agree that NZSSS and regional authority lists for approved soil surveyors should be used. These have potential to be developed further, and regularly updated through groups like the Land Monitoring Forum. A possibly template approach has been set up by MPI for providing ESC mapping for the NES Plantation Forestry.
7. Reviewer:
    a. Important to have review but the High level of detail required for our project does add additional cost to the soil mapping. An estimated 5-10% additional cost would be required for a full desktop and field review.
    b. Some additional guidance for the review process would be useful.
    c. Although not related to this case study a High level of detail for Review is required for High Class soil mapping. It is very unlikely that a review of the work will be undertaken by the client. However, often in a hearing situation a review will be undertaken by opposing parties – often meeting the requirements of a High level of detail for Review.

Inspection check list – requirements for a soil map output

This section covers comments related to presenting the soil map information output guidance provided in **Table 3**.

8. General
    a. This could be formatted as a tick box check list in Appendix 3.
9. Map format:
    a. Can be either or both. If hard copy only, has reduced interoperability – some disadvantage in Table 1 – e.g. integration into S-map Online.
10. Map base:
    a. No comments
11. Map information:
    a. Scale, northing etc.
    b. Disclaimers and acknowledgements should be provided.
    c. Information was interpreted as background soil map information and base data layers (e.g. DEM).
12. Soil variation:
    a. No comments
13. Map legend:
    a. No comments
14. Survey scope:
    a. No comments
15. Methods:
    a. Laboratory where measurements were done, and include methods used and chain of custody.
16. Results:
    a. Sites in a geodatabase (marking on a map manually is not as accurate).
    b. Include mention of sites with full soil profile descriptions.
    c. The explanation of review process may not be clear and there is no guidance for addressing if the findings identify issues.
    d. As mentioned later in this case study (with reference to Table 4), does review process include validation (which is more internal checking and part of the mapping methods but not explicitly recognised in the guidelines).
17. Interpretation and conclusion:
    a. No comments

Self-assessment summary list of work conducted

This section covers comments related to the check list and self-assessment guidance provided in Table 4. The work level conducted was assessed using Table 4 in Grealish (2017). The completed assessment is provided in Figure 3.

Table 4. Self-assessment list; providing a summary of the work level of detail conducted

Procedure	Item	Details	Level of Detail
Background			
	Survey title	MDC soil mapping for S-map	
	Location: nearest town and region	Blenheim	
	Date survey conducted	June / July 2019	
	Surveyors name and organisation	Landsystems / MDC	
	Client	MDC	
	Application soil map was prepared for	S-map input / Regional	
Site density			H (M) L
	Land use	landuses in "valley floor"	
	Map scale	1:50,000	
	Total number of sites	No. of sites: 250	
	Area of survey	11,200 ha	
	Site density	0.022 sites/ha	
Site distribution			H (M) L
	Site selection approach	Statistical / (Knowledge) / Free survey	
	Base data used and source (e.g. aerial photos, LIDAR, geology, EM, soil map)	DEM, aerial photos, geology, soil descriptions (soil walkovers + transects)	
	Site distribution shown on a map	(Yes) / No	
Soil characterisation			(H) M L
	Measured data	No. of sites: 30	12% (0-5)
	Detailed morphology	No. of sites: 30 profiles 110 auger description	56 % (10-30)
	Soil type identification	No. of sites: 110 soil observations	44% (65-95)
	Results provided and methods to obtain them identified	(Yes) / No	
Mapping method			H (M) L
	Map provided as GIS compatible digital data	(Yes) / No	
	Map provided as hardcopy	Yes / (No)	
	Soil map descriptive legend provided (includes map unit composition, soil types, proportion and location of soil types)	(Yes) / No some mapunit % composition	
	Models (numerical or diagrams) describing soil landscape relationship provided	(Yes) / No diagrams	
	Written text describing process to construct soil map provided	(Yes) / No	
Provider			H (M) L
	Surveyor satisfies proven experience requirement	(Yes) / No	
	Surveyor has approved status	Yes / (No)	
Review			H (M) L
	Who conducted the review	TBC	
	Desktop assessment conducted	(Yes) / No	
	Site visit assessment conducted	Yes / (No)	

Figure 3: Completed self-assessment summary list of work conducted (from Grealish 2017).

Comments on Table 4 usability

1. General
    a. The table was easy to follow, although as a standalone form it could be reformatted to provide more space for comments and clear completion of scoring, as well as an overall score and comments section. Keeping the form to a single page , or at least a two sided page is the preferred option.
2. Background:
    a. A row for consent number/file number could be added for council use.
    b. Numbering "application soil map was prepared for" and link directly to Table 1.
3. Site density:
    c. Add in a row with minimum area (ha/observation) may assist the assessor:

Area of survey (hectares)	11200	11200
Number of (observations)	224	250
Minimum area (ha/observation)	50	45
Site density (observations/ha)	0.02	0.022

4. Site distribution:
    a. There is a lot to cover in this section. A separate row for use of soil windows, transects, soil grid, minimum sites per paddock type of detail would be useful and clearer separated from base data used.
5. Soil characterisation:
    a. Additional clarity around what is a detailed soil morphological description (does this mean a soil pit description?) and maybe check the % balance of sites.
    b. Does the % balance of site types affect the site density requirement?
    c. Is it worth adding a separate item for soil profile descriptions using pits or cutting – where full morphology (based on Milne et al, 1995) is completed?
6. Mapping method
    a. The value of having a separate item for hard copy map is a bit confusing as a GIS map can be made into a hard copy map. A hardcopy map only is of limited future use beyond the report it is in (as are non-georectified electronic map images).
    b. This section may be better tiled "Mapping outputs"
7. Provider
    a. OK as is, with recognition and comment that most providers in New Zealand will not have approved status (that currently available is CPSS). Maybe note that the NES SQP for contaminated land and others such as nutrient management and resource management certification do not qualify as approved.
8. Reviewer
    a. The importance of review is acknowledged. However, reviewing (especially in the field) does add cost to the project, and can add time to complete the project if reviewers are not available. For this project a subset of sites was reserved for validation. Can this be added in?

Additional comments

- Attaching completed forms in Appendix 3 would be useful to provide metadata guidance.
- There are additional options for review and approved provider.
- Providing the information required in Appendix 3 required about one hour.

Appendix 2 – Feedback (an example)

The following text is lifted directly from the subconsultants report.

General comments

- It's a well written document with a clear purpose and instructions that can be followed
- It would be wonderful if it could be backed by a certification system for people carrying out this work, or qualifications/rankings I can check before I hire someone
- It could also be supplemented with a detailed Geospatial Mapping Standards like there is for the ETS so that maps are standardised across the country

Feedback on the New Zealand Soil Mapping Protocols and Guidelines – Self assessment list

- Background "Survey Title"
    - I would call this "Project name" or something a bit more generic as survey title made me think you were looking for a legal description off the Certificate of Title for the property
    - Do you need contact details for the surveyor and the reviewer in case this is audited?
- Site density "Land use"
    - Are people supposed to put a tick under H/M/L for each item, or do you want them to enter the number of sites, ha etc? The data recording method expected isn't quite clear to me sorry
    - Would this be used to infer the answer in "application soil map was prepared for" in the previous section? Is it necessary?
- Soil characterisation
    - Could these be ordered by increasing robustness, e.g.: if 100% of samples are "soil type identification" then it's a "low" category
- Mapping method
    - Could this be ordered by increasing level of desirability and usefulness in the modern world, e.g.: a hardcopy is a bare minimum and could be first, GIS is preferable so is second, etc…
    - Is there any benefit in including geolocated photos to help evidence the assessment?
    - How would the location of soil types appear on a legend rather than on a map?
- Provider
    - Does there need to be a little more information collected here if I'm assessing whether this survey will meet the needs the client wants me to use it for, e.g.: they could indicate whether they meet the low/med/high skill category.
    - Could this be a simple l/m/h classification in the Surveyor's name and organisation question in the background section as it's one of the first things I'm going to want to know is how qualified was the person who did the survey.
- Review
    - None of the categories seem to require peer review or other checking. Is this optional? Is it part of a separate audit/approval process?
    - Are we assuming this has been released to the world because the reviewer approved it, or provided feedback for improvements that were then incorporated? As this question currently stands, it's possible I could have someone review my work, they could say it's completely wrong, but I could still give this form to the customer with my original incorrect work and have "yes" checked here truthfully