BEFORE INDEPENDENT COMMISSIONERS APPOINTED BY THE SOUTHLAND REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND IN THE MATTER	of various resource consent applications for periodic openings of Waituna Lagoon Waiparera by Te Runanga o Awarua, the Department of Conversation and the Southland Regional Council (Environment Southland) (the Applicants)
Application No.	**APP – 20242456**

Evidence of John Stirling Scandrett
on behalf of Southern Star Farms
Dated: 16 July 2025

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Introduction

1. My full name is John Stirling Scandrett.

2. I have been asked by Southern Star Farms to explain the effects of submerging tile drain outlets from higher Waituna Lagoon water levels on farm drainage and soil properties. This is a more detailed explanation of what has been provided in the Southern Star Farms submission.

Qualifications and Experience

3. I am an Agricultural and Engineering Consultant and have been in sole practice since 2002. Prior to that I was a farm advisor, first employed by MAF in 1981.

4. Initially I set up Scandrett Rural Limited in 2002, which provided farm management and agricultural engineering consultancy services.

5. In 2009 I set up Dairy Green Limited to specifically offer engineering services, primarily to the dairy industry.

6. Between the two companies, I offer services in soils, pastures, stock and financial management and also the design, consenting, supply and installation, as required, for water schemes, drainage, effluent systems and latterly the creation of wetlands.

7. I hold the qualification of Bachelor of Agricultural Science with first class honours from Lincoln University.

8. (i) I have been involved in farm drainage design since 1981 and have designed drainage systems for thousands of hectares of farm land, including on the Southern Star Farms property

(ii) I have designed drainage systems for 28 school playing fields for the Ministry of Education.

(iii) I have assisted Agresearch scientists with practical drainage advice for the construction of drainage systems on farms at Edendale, Bogburn, Kelso, Tussock Creek, Woodlands Research Centre and Telford (two occasions) for the monitoring of drainage water from tile and mole systems.

(iv) I have constructed and monitored farm drainage water treatment systems for nitrogen and phosphate attenuation at two locations for NIWA within the Waituna Lagoon catchment.

(v) I currently monitor stormwater drainage, receiving waters and soil chemistry and pasture management to meet resource consent conditions for clients.

9. I worked closely with the late Bill Risk, the soil scientist who wrote the technical data sheets for Topoclimate South. Between 2008 and 2012 he assessed the physical properties of approximately 300 subsoil samples on my behalf.

10. I have been involved in resource consent applications submitted to Regional Council's for clients over the last 17 years, this has included presenting at consent hearings on behalf of clients.

Code of Conduct

11. I have read the code of conduct for expert witnesses as recorded in the Environment Court's Practice Note 2023 and believe I have complied with it in preparing this information. I confirm that the information provided is within my area of expertise. I have not knowingly omitted to consider material facts that might alter or detract from the opinions expressed.

Scope of Evidence

12. I will explain drainage in soils and specifically the effect of submerging tile drain outlets on drain performance.

13. In preparing this information I have used a tile drain map provided by Southern Star Farms, and tile drain outlet heights and drain depths provided by Southern Star Farms.

14. I have used Beacon, a mapping website provided by Environment Southland to source ground heights based on lidar data from the "Southland Contours and Elevations" page.

15. I have used a drainage nomograph from the New Zealand Agricultural Engineering Institute's "Field Drainage Guide Project Report p/16" for sourcing drain flow rates and areas drained.

16. I have used the Topoclimate Southland soil map from Beacon to locate the various soil types on the farm.

17. I have used Topoclimate Southland Soil Technical Data Sheets for a description of the various soil profiles.

18. In preparing this evidence I have read the evidence of Richard John Measures, the Waituna Lagoon s42A Hearing Report App 20242456 (1) and the Application, in particular the sections relating to drainage.

Evidence

19. A number of properties influence drainage within a soil, with soil structure being very influential. Soils are made up of sand, silt and clay sized particles and organic matter. The way the soil particles bond together determines the soil structure.

20. A well-structured soil will have many relatively small sized aggregates with well defined pore spaces in between them. Pore spaces that range in size from 0.2 microns up to 30 microns hold plant available water. Pores larger than 30 microns are called macropores. Macropores are normally full of air. When a soil is saturated the macropores fill with water. The water that fills macropores is sometimes called gravitational water.

21. Gravitational water will naturally drain down the soil profile, provided it has somewhere to drain to. At least 90% of the drainage that occurs in a soil profile is through the macropores.

22. The effects of having the macropores full of water rather than air for any length of time are significant. Once the air in the macropores is displaced by water, plant roots start to be affected as they require free air to survive. Any oxygen that is dissolved in water is used quickly and the soil will become anaerobic.

23. The 'Draining of Farm Lands' Bulletin No 18, Massey College, specifically lists the effects of excess water in the soil. A summary is as follows:

- The exclusion of air due to excess water prevents plant roots obtaining oxygen, it inhibits soil mineralisation and can cause denitrification, reducing plant growth.
- The plant rooting depth is limited by the height of the water table.
- Wet soils are slow to warm up, a water logged soil requires about 2.5 times more heat as a dry soil to warm the same amount.
- Under saturated conditions, soil structure can be lost. The risk of pugging by stock increases significantly. Pugging reduces pasture production.
- Earthworms are critical for creating macropores, they don't function in water logged soils.
- Waterlogged soils result in a loss of productive pasture species and the ingress of weeds.
- Fertiliser losses increase, e.g., overland flow and subsequent soil particle movement can remove phosphate.
- Animal health problems increase on poorly drained soils.

24. The number of references documenting the reduction in pasture performance due to waterlogging is very limited. Published in the Journal of Agricultural Science (2003), 141, 241–248, copyright, 2003 Cambridge University Press DOI: 10.1017/S0021859603003502, is a paper titled "The effects of waterlogging on growth, photosynthesis and biomass allocation in perennial ryegrass (Lolium perenne L.) genotypes with contrasting root development", N.M. MCFARLANE, T.A.CIAVARELLA and K. F. SMITH. This was an Australian pot plant experiment conducted when temperatures were in the order of 20 degrees Celsius which resulted in 3 of 4 cultivars exhibiting a reduction in root and shoot biomass 14 to 21 days after waterlogging commenced. By 28 days the reduction was up to 70%. The decline in root and leaf growth typically started after 7 days of waterlogging.

25. The soil types on the property rely on drainage to be fully productive. Otanomomo and Invercargill soils are both organic soils created under a high water table.

26. The water table needs to be held at least 0.4 m below the ground surface level for these soils to be productive, as it does for inorganic based soils.

27. Titipua soils are formed from alluvial silts and are poorly drained because of their place in the landscape, typically low-lying areas next to waterways.

28. Tisbury soils are formed from wind blown silts and also developed under a high water table, caused by a low permeability subsoil.

29. Tiwai soils are formed from windblown silt overlying silt bound gravels. An iron pan in the upper subsoil also limits drainage.

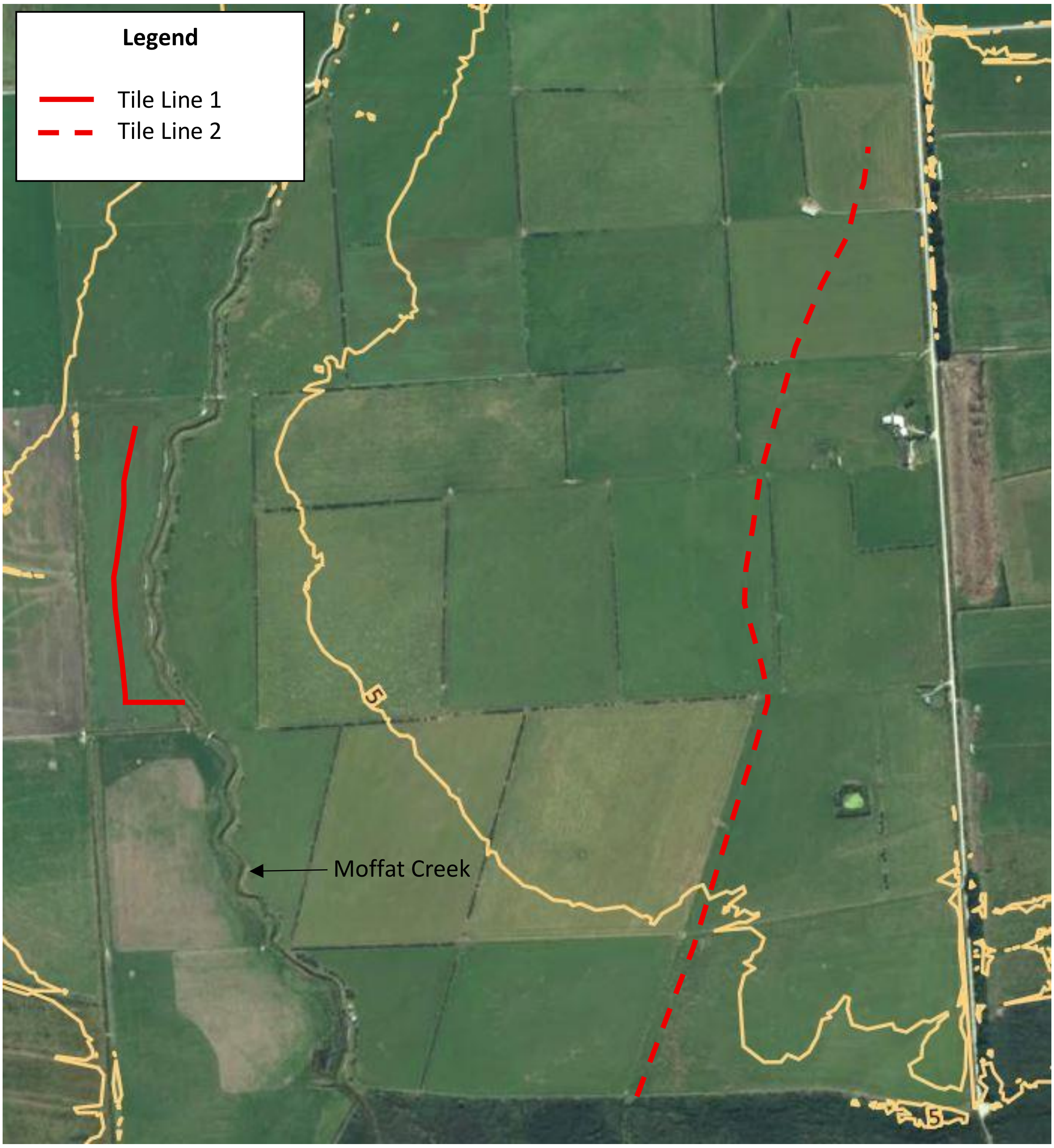
30. Lateral water movement in these soils is slow. The soil texture in parts of the farm would suit mole draining. Mole draining is a technique where a mole plough is pulled through the soil and it creates drainage channels 0.45m deep at 1.8m spacing. However, the mixed nature of the soil types on farm means tile drainage has to be the main drainage method.

31. Tile drains are typically installed at a depth of 1.0 to 1.5m, although they may need to be deeper when passing through ditch banks and ridges. I understand the tile drains on the Southern Star Farms property are routinely up to 2.0m depth. Subject to the amount, depth and type of gravel in the soil profile, tile drains may need to be as close as 20 m apart to achieve adequate drainage.

Tile Drain Map

32. The following tile drain map shows the tile drains at the Southern Star Farms Property. It is out of date as more drains have been installed. However, it gives an indication of the degree of subsurface drainage that has been installed to make the soils productive.

33. I have selected two tile lines, one in a low-lying area, tile line 1 and one that rises to a much higher area of the farm, tile line 2, to show the effects of the tile outlet being submerged by a rise in the lagoon water level. The location of the tile drains is labelled on the following map. The map also shows the 5.0 m a.s.l. contour line. Tile Line 1 uses 100 mm corrugated plastic drain pipe and Tile Line 2 uses a combination of 150 mm and 100 mm corrugated plastic drain pipe. Both Tile Line 1 and Tile Line 2 have branch lines, I have just shown the main line for clarity.



34. Paragraphs 35 to 41 refer to Tile Line 1.

35. A photograph of the outlet of Tile line 1 into Moffat Creek is shown below. It was taken on the 8th July 2025. The Lagoon level was 1.8m a.s.l at the time. Tile Line 1 discharges into the tributary at 1.3m a.s.l., so it can be presumed the tile drain outlet is at least 0.5m below water level at this time. The photo was taken looking upstream.

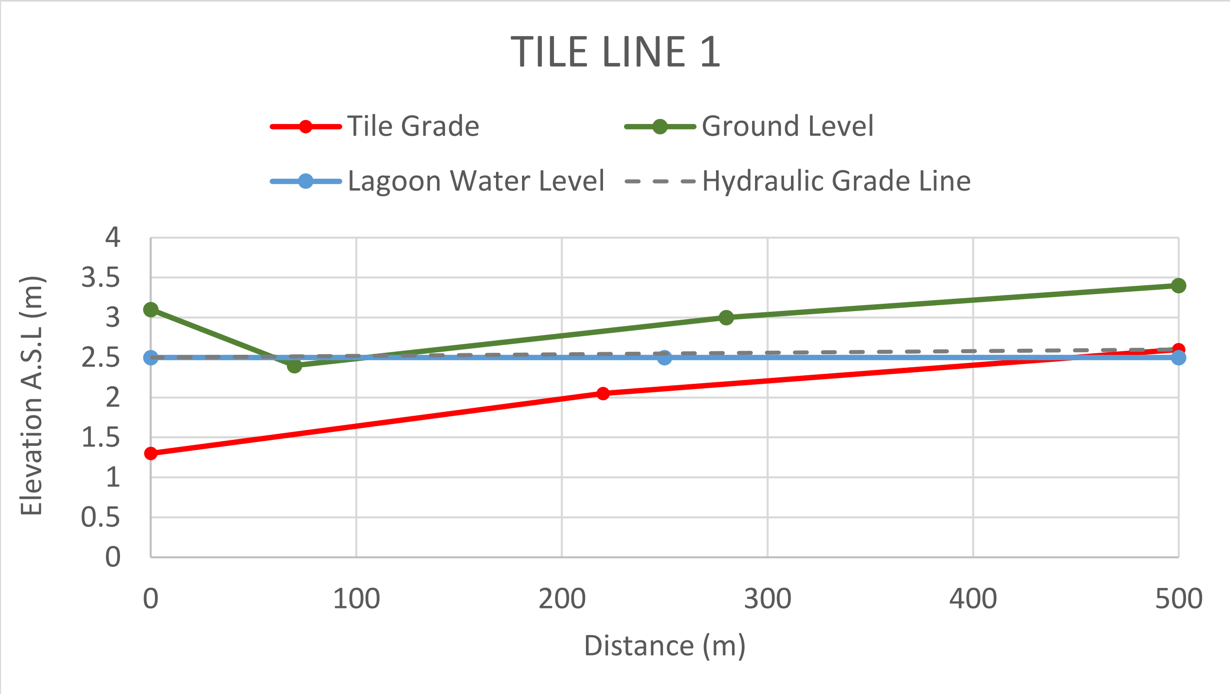
Tile Line 1 drains the paddock on the left of Moffat Creek, the discharge point is approximately 40m to the north of where the photo was taken.

36. Tile Line 1 discharges at 1.3 m a.s.l. It is approximately 500 m long and will finish at 1.0 m deep assuming a grade of 0.33 m fall per 100 m distance for 200 m and then 0.2 m fall per 100 m for 280 m. The ground level at the end of the drain is assumed to be 3.4m a.s.l. It is generally accepted that a drainage pipe should have a minimum of 0.8m cover over it to avoid damage from heavy vehicles e.g., fertiliser trucks.

37. Assuming the 100 mm tile outlet wasn't submerged, the drain would have a potential flow rate of 2.2 L/sec and service an area of 2.2 ha assuming 10 mm rainfall had to be drained each day. That provides a drainage width of 22 m each side of the tile, which isn't unreasonable in peat ground.

38. At a lagoon level of 2.5 m a.s.l. the grade available for water flow in the tile would drop to 0.1 m fall per 500 m i.e., effectively zero grade. Water would back up the drain a minimum of 450 m to equate to the lagoon water level and the remainder of the tile would fill with water during a drainage event because there was effectively no gradient for flow. Any rainfall that the drain was trying to remove would build up in the soil profile and lead to ponding above the drain and especially on either side of the drain. The head of water in the soil would create some flow, but this would be minimal and only have a very small effect on the soil directly above the drain.

39. The effect of submerging a tile drain outlet is to reduce the available hydraulic gradient and slow the flow of water within the drain potentially for the full length of the drain. The following graph depicts this scenario with a Lagoon water level of 2.5 m a.s.l.



40. Effectively while the lagoon water level is at 2.5 m a.s.l. there is no drainage for the area serviced by this drain or any other drains in the same situation. That is despite the ground level being above lagoon water level by up to 0.9 m.

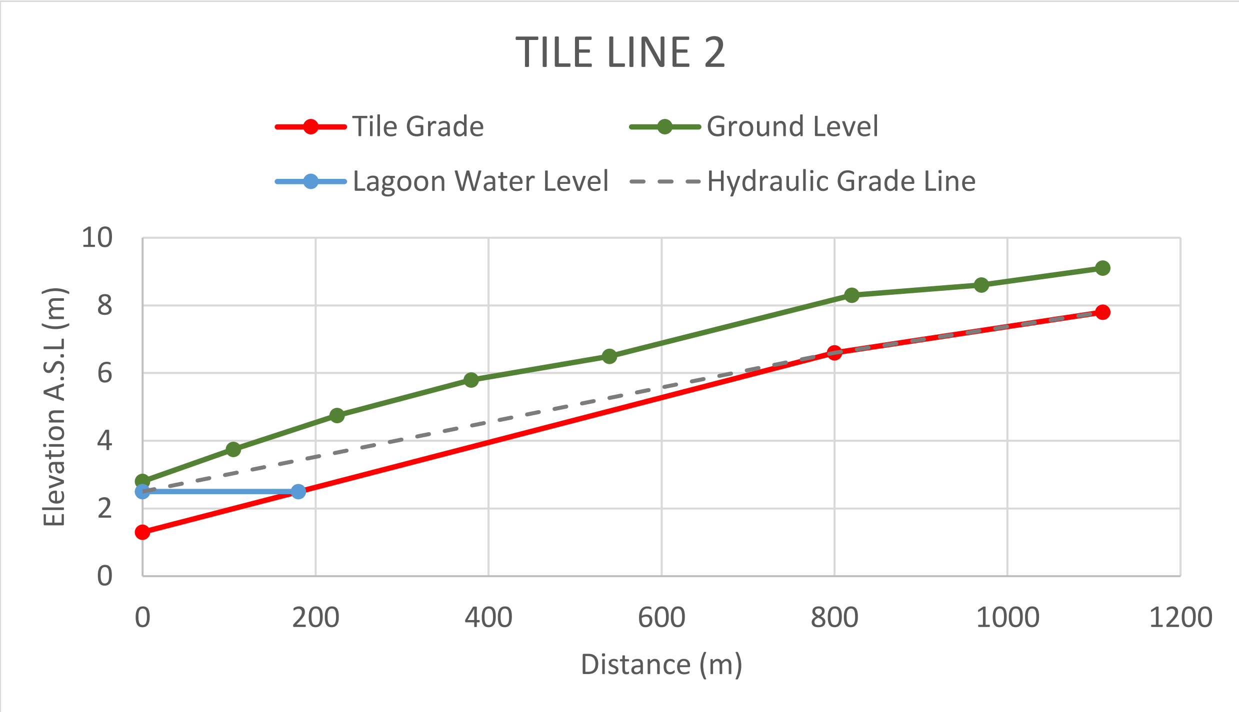
41. The soil serviced by the drain would be waterlogged for the length of time the drain was submerged plus the length of time it took to drain the gravitational water from the profile. Assuming there was no rainfall once the tile had effective outfall I expect it would take up to 10 days to drain the profile adequately, i.e. to a depth of 0.4m 20m from the drain, assuming there was good soil structure to start with.

42. Paragraphs 42 to 45 refer to Tile Line 2. Tile Line 2 also discharges at 1.3 m a.s.l. It is approximately 1.2 km long, starts as a 150 mm plastic corrugated pipe for 800 m before reducing to a 100 mm plastic corrugated pipe. The grade available for the first 800 m of the drain, starting at the outlet is 0.66 m/100 m and this reduces to 0.4/100 m for the remainder of the drain.

43. Assuming the outfall wasn't submerged, a 150 mm tile on a 0.66 % grade will flow at 6.8 L/sec and is capable of draining 10 mm rainfall per day from an area of 5.8 ha. The area potentially serviced by this drain could be as much as 20 ha so it will be fully loaded even at lower rainfall coefficients. Realistically it could be expected to drain up to approximately 3.0 mm rainfall on the catchment per day.

44. At a lagoon water level of 2.5 m a.s.l. the grade available drops to 0.51 m fall per 100 m and the expected flow rate would drop to 5.9 L/sec and the area drained at 10 mm rainfall per day would drop to 5.0 ha.

Potentially the full area drained by this tile would be affected by any reduction in outfall, in this case potentially by 13 %. That is despite the land area starting at 2.8 m a.s.l and finishing at over 9.0 m a.s.l. The following graph depicts this scenario.



45. The examples above illustrate the higher the lagoon water level the greater the reduction in the hydraulic gradient available within tile drains and the slower the drainage.

46. There is a further effect of a reduction in hydraulic gradient. The flow rate in tile drains needs to run above a minimum velocity if they are to stay clean and any soil particles entering them are to be flushed through.

47. For silt-based soils I have observed that generally a minimum velocity of 0.4 m/sec is required to keep the pipe clean.

48. For 100 mm corrugated plastic drain pipe, the minimum grade required is 0.4 %, i.e. 1:250 gradient.

49. For Tile Line 1 the hydraulic gradient is marginal at 0.33 % when the outlet is not submerged, any increase in lagoon water level will significantly increase the risk of silting.

50. For 150 mm corrugated plastic drain pipe the minimum grade required is 0.2 %, i.e. 1:500 gradient. For Tile Line 2 the hydraulic gradient available at a lagoon water level of 2.5 m a.s.l is 0.51 %, but I expect there will be branch drains off this mainline that will have a gradient below the minimum required, particularly in the flatter parts of the catchment where 100mm drain pipes are used and these potentially would be subject to silting. The effect of a submerged outlet is small in this case, but not zero.

51. Further, soil loses its strength when saturated for any length of time and the risk of soil particle movement into the drain increases, so the flushing velocity may need to be higher compared to the normal operation of the drain at higher Lagoon water levels.

Conclusion

52. When tile drain outlets are submerged there is a reduction in the potential flow within the drain compared to if it wasn't submerged.

53. When tile drains are submerged for their full length, there is no flow within the drain and no subsurface drainage is achieved.

54. There will be drains in the low-lying areas adjacent to the Lagoon that will be mostly if not fully submerged at a lagoon water level of 2.5 m a.s.l.

55. If tile drains servicing higher areas of land have an outlet that gets submerged by high Lagoon water levels their performance will be reduced in proportion to the reduction in the hydraulic gradient within the drain.

56. When a tile has a submerged outlet the area that has impeded drainage is significantly greater than just the area within 1.0m in height of the water level at the outlet.

57. Drains that are submerged are at a higher risk of silt accumulation and higher maintenance can be expected.

References

Soil Science, R G McLaren & K C Cameron
The Draining of Farm Lands, Bulletin No 18, Massey College
Field Drainage Guide, New Zealand Agricultural Engineering Institute, Project Report P/16