An Evaluation of the Extrapolatory Method of Soil Mapping

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An Evaluation of the Extrapolatory Method of Soil Mapping

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TABLE OF CONTENTS

LIST OF TABLES

page

continued ...

LIST OF TABLES (concluded)

page

LIST OF FIGURES

page

1.0 INTRODUCTION

Similar field procedures for mapping soils have been used in Alberta for the last 15 years or more. The need to investigate alternative (and more rapid) procedures for mapping soils is apparent in view of the increasing demand for soil and land information and the decreasing availability of financial and human resources to support conventional soil survey.

Several alternative methods for conducting soil inventory have been proposed and tested (Burrough 1986; Meijerink 1988; Pike 1988; Band 1989; Su, Ransom and Kanamasu 1989; Turchenek, Dietzler and Howitt 1990; Nikiforuk, Fawcett and MacMillan 1993). A review of the literature on methods of soil mapping and techniques for evaluating soil map utility and accuracy was conducted by the Alberta Research Council (1992). The review identified ten methods with potential for increasing the speed of soil mapping in Alberta. This study evaluates one of the mapping methods (extrapolatory) in terms of **map accuracy**[1] and compares this method to SIL3 1:50 000 soil mapping. Two other methods, top-down and landscape, were examined in an earlier report (Nikiforuk, Fawcett and MacMillan 1993).

1.1 Hypothesis

The extrapolatory mapping method is a viable alternative (in terms of accuracy) to SIL3 1:50 000 mapping.

1.2 Approach

The approach used in this study had three distinct components (Figure 1). The map compilation component involved the selection and mapping of areas using traditional SIL3 1:50 000 and extrapolatory mapping methods. Concurrent with map compilation was the collection of the independent (unbiased) sample data set which was used for evaluation of soil mapping. Evaluation and analysis of the data occurred upon completion of the soil mapping and collection of the sample data set.

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[1] Items in bold are defined in the glossary of terms, page 10.

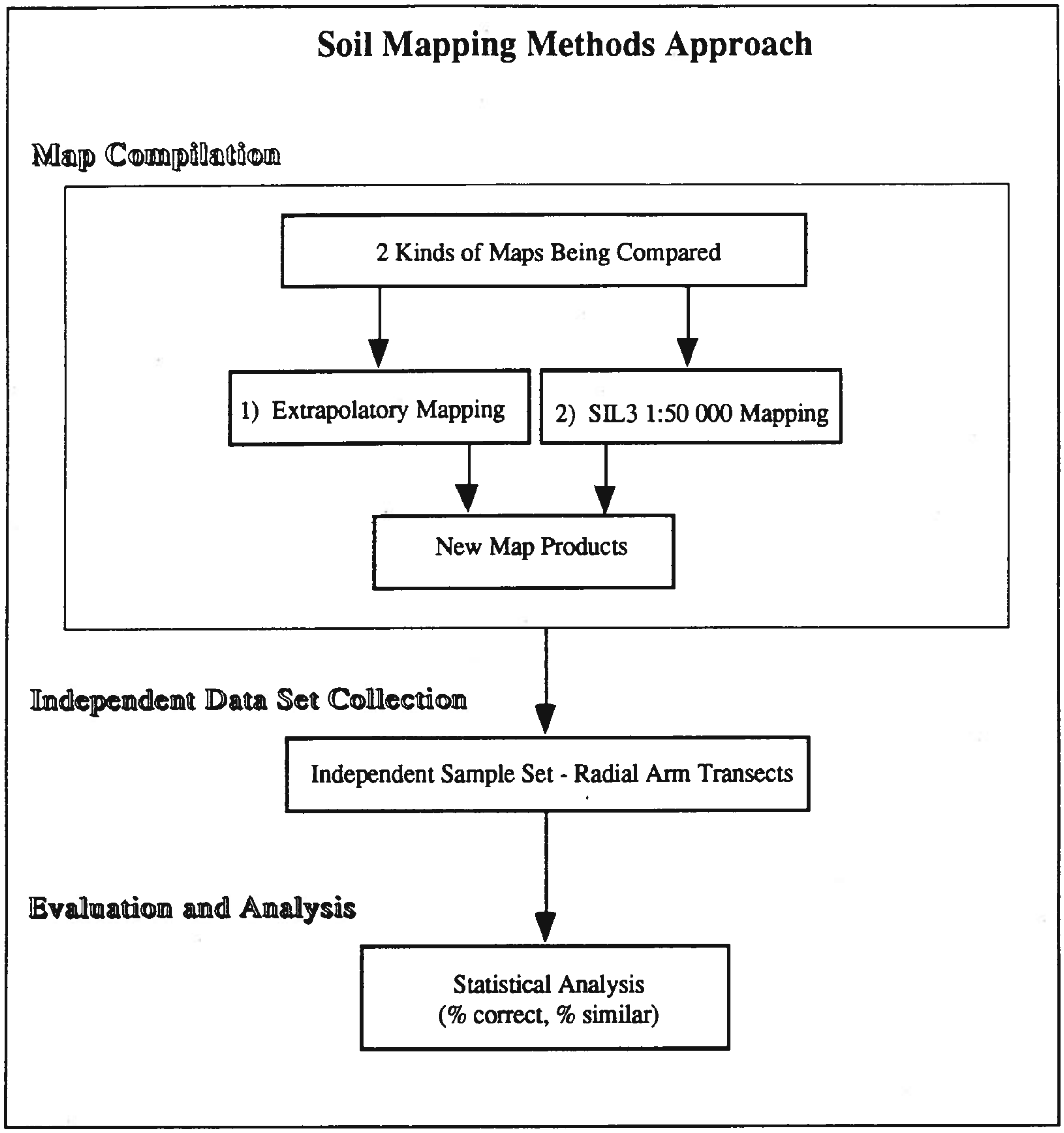

Figure 1. Approach

Nine **mapping districts** within the County of Forty Mile were defined in a separate project (ARC internal unpublished report). Five of these mapping districts were selected for evaluation (Table 1) because they each had areas mapped using the extrapolatory method and areas mapped using the SIL3 1:50 000 method. The remaining four mapping districts had not been mapped using the extrapolatory method.

An independent (unbiased) sample set was collected for each area and the maps were evaluated against this sample set. The result was an evaluation of the maps produced by the extrapolatory method in comparison to those produced by conventional SIL3 1:50 000 mapping. The benefit of applying both methods to the same geographic areas (mapping districts) was that comparisons between methods reflected differences in mapping methods and not differences in variation arising from geographical location of soils and landforms.

Table 1. The major soils, surficial geology, and general landform of the five mapping districts evaluated in this project.

Mapping District	Dominant Soils (Significant Soils)	Surficial Geology	Landform
Burdett	Chernozemics	discontinuous lacustrine blanket to veneer over till	level to undulating
Conquerville	Chernozemics (Gleysolics)	till blanket (>5m) over bedrock	undulating
Etzikom	Chernozemics (Solonetzics and Gleysolics)	end moraine	hummocky and ridged
Legend	Chernozemics	draped moraine interspersed with lacustrine and fluvial materials	undulating and inclined
Pakowki	Chernozemics	fluvial and aeolian materials	undulating, hummocky and ridged
	Gleysolics, Solonetzics, and Regosolics	lacustrine materials	level to gently undulating

The soil mapping component of the study was conducted by 3 different mappers. Each mapper applied both mapping methods to similar townships in each of the five districts. Thus, each mapping method had examples produced by all three mappers. In addition, each area was correlated by the project supervisor to ensure that map appearance and legend content did not vary significantly between districts and between methods. This minimized the possibility that analysis of map accuracy tested mapper skill rather than method success.

1.3 Mapping Methods

Procedures applied in the traditional SIL3 1:50 000 soil mapping method involved office compilation of data and extensive field verification of soil lines and map unit content. Field verification required 6 to 10 days per township. A detailed description of this method is provided in Appendix A.

Extrapolatory mapping was based primarily on developing soil-landscape models through SIL3 1:50 000 mapping of selected townships and then applying those models to adjacent areas. The extent to which these models could be applied was dependent upon how similar the landscapes mapped using the SIL3 1:50 000 were to the landscapes in surrounding areas. The amount of field effort required to conduct extrapolatory mapping was 2 to 4 days per township. A detailed description of this mapping method is provided in Appendix A.

1.4 Field Testing

Upon completion of initial pretyping and field verification of soil lines, legends were compiled and analysis of data was initiated. The relative accuracy of soil map legends was evaluated by comparing the soils predicted to occur within map units to an independently collected data set (Appendix B). A modified **radial arm transect** sampling approach was used to collect the independent data set. The radial arm transect method is an extension of the line transect method first documented by Wilding (1985). It differs from the **line transect** method in that sampling points are not selected on a unidirectional line. Rather, the distance and direction along a number of lines originating from a central starting point were randomly chosen.

Sampling for determination of the actual soil composition was conducted by randomly selecting 8 locations within each mapping district, of which four locations were within extrapolatory mapped areas and four locations were within SIL3 1:50 000 mapped areas. A standard transect design was applied at each sampling location. The transect design consisted of four radial arms. The direction of each arm and distances between observations on each arm were randomly selected. Each transect had 17 sample sites. Information gathered at each site included soils and landform data (Appendix C). A detailed description and justification for use of this sampling method is provided in Appendix A.

1.5 Statistical Evaluation

The measures "**percent correct**" (Marsman and de Gruijter 1986) and "**percent similar**" (Alberta Research Council 1992) were used to measure map and legend accuracy. These provided a means of assessing the relative accuracy of a series of maps produced by different methods and were used in view of their ease of application and interpretation. "Percent correct" was a measure of **exact match** between the soils predicted by a given map and legend to occur in a given polygon and the soils observed to occur in an independent sample data set. The second measure, "percent similar", allowed for the evaluation of how closely similar soils predicted by the soil map legends were to the observed soils. Both methods are described in detail in Appendix A. These two measures of accuracy were summarized for both mapping methods (Appendix D). Accuracy results were tested for significant differences at the 95% confidence level.

The study evaluated whether soils that were observed in the field were predicted by the soil map legend (**non-proportional** test); and whether soils that were observed were found in the proportions in which they were predicted to occur (**proportional** test).

2.0 RESULTS AND DISCUSSION

This section examines how the two mapping methods compared to one another with respect to predicted soils versus soils information collected during the independent sampling.

The study showed that the SIL3 1:50 000 mapping method had the higher accuracy of the two methods even though the calculated accuracies were almost identical (Table 2). Accuracies were determined for soil series data only in "percent similar" and "percent correct" evaluations (Table 2, Appendix D) because it was considered the most important data represented on soils maps. The results showed that there was no statistically significant difference (95% confidence level) between mapping methods.

Table 2. Overall accuracy results for Extrapolatory and SIL3 1:50 000 mapping in the County of Forty Mile.

	Extrapolatory Mapping	SIL3 1:50 000 Mapping
Percent Correct (P)	66.8%	69.4%
Percent Correct (NP)	75.0%	75.6%
Percent Similar	92.3%	92.9%

P - proportional
NP - non-proportional

Tests for determining differences in accuracy due to mapper skill were not conducted. The degree of influence that mappers had upon the accuracy of the soil maps could not be determined because only one mapper applied one technique to any one location within each mapping district. Several mappers would have had to apply the same mapping method to the same location to determine the degree of influence that a mapper had upon map legend accuracy. Averaging the accuracy levels of the soil maps and legends compiled by all the mappers resulted in determination of map accuracy due to mapping method and not due to differences caused by mapper skills or complexity of geographic areas (Valentine, Lord, Watt, and Bedwany 1971).

2.1 Percent Correct

Results in this study ranged from 67% correct for extrapolatory mapping on a proportional (P) basis up to 76% correct for SIL3 1:50 000 mapping on a non-proportional (NP) basis. These results are comparable to those reported by other authors (Table 3).

Table 3. Accuracy results of selected previous studies.

Authors and Date	Reported Accuracy
Amos and Whiteside 1975	36%
Bascomb and Jarvis 1976	60%
Beckett and Burrough 1971	53%
Beckett and Webster 1971	50%
Fawcett, MacMillan, Turchenek, and Howitt 1991	P - 68%; NP - 75%
MacMillan 1982	74%
MacMillan, Bennett, and Brierley 1985*	65-70% (Soil Survey) 80% (Land Classification)
Marsman and de Gruijter 1986	64-70%
Powell and Springer 1965	74%
Selby and Moon 1987	57%
Turchenek, Dietzler, and Howitt 1990	70%
Nikiforuk, Fawcett, and MacMillan 1993	P - 43% to 54% NP - 54% to 69%

* compared the accuracy of an interpretation (suitability for irrigation) made from two maps.

There was a minor decrease in accuracy from SIL3 1:50 000 to extrapolatory soil inventory products for both P and NP tests (Table 2, Appendix D). The accuracy increased 6 to 8% from P to NP evaluations for each individual mapping method. This increase was not statistically significant for either method. Due to the nature of the tests however, this increase was not unexpected. A P evaluation is much more stringent than a NP evaluation and higher accuracy levels were expected.

There was an increase in accuracy of 3% from the extrapolatory to SIL3 1:50 000 mapping method when using a proportional evaluation for exact match accuracy. A t-test of the means showed that this was not a statistically significant increase. The results of the NP accuracy test showed that the SIL3 1:50 000 method was less than 1% better at identifying the soil series present than the extrapolatory method. This was not a statistically significant difference.

2.2 Percent Similar

The results in Table 2 show that there was less than 1% difference between SIL3 1:50 000 and extrapolatory mapping in a "percent similar" comparison. Both mapping methods had 'percent similar' results of over 92%. These were very similar to results reported by Nikiforuk, Fawcett, and MacMillan (1993) who found "percent similar" results of 86% to 91%.

The degree of map accuracy increased by 20% to 25% when the data were analyzed using **similarity matrices**. This was attributed to the way in which comparisons of soils were made. The similarity matrix (SM) concept stated that if there was not complete agreement between the map legend and an observed soil, the legend was not wrong but rather was mostly right. Conversely, the "percent correct" comparison assumed that unless there was total agreement between the soil legend and the ground truth data, the soil map and legend were wrong.

One consideration that should be remembered when analyzing the "percent similar" results of this test is that the similarity values were relative and not absolute. The importance of the results is how they relate to one another and whether or not there is a significant difference between them. The reason for this was that the SM values assigned for subgroup, drainage, texture, and parent material were based on an agricultural viewpoint and adjusted to reflect the ease with which soil properties could be identified in the field.

The absolute value of "percent similar" results can be adjusted up or down depending upon the values used in the SM. The relationship between any two numbers would remain constant if the same SM values were used consistently. For example, if every SM value were reduced by 10 points, as an arbitrary penalty for not having an exact match, all of the totals and percentages would be reduced accordingly. Their relative relationship would not be changed.

The relationships between the methods may change if a different interpretation or an alternative set of arbitrary rules is used to determine the SM values. For example, by using agricultural interpretations as the basis for determining the SM values, a comparison between glaciolacustrine and till parent materials returns a value of 90/100 (Table A-4). The same comparison may result in a value of 60/100 if engineering interpretations are used as the basis for determining the SM values (Andriashek, pers. comm. 1992). By using engineering interpretations as the basis for determining SM values, the weighting given to subgroup classification would decrease and the weighting given to parent material would increase. Consequently, the relationships between the accuracies of each mapping method may change.

The cause(s) of inaccuracies contained in the soil map can also influence the relationship between two "percent similar" accuracy results. A minor difference in texture is not considered as important as a minor difference in drainage. For example, Site A is predicted to be moderately fine textured but found to be medium textured and Site B is predicted to be moderately well drained but found to be imperfectly drained. In both cases, there is a difference of one texture or drainage class. For Site A, if all other factors are equal, the difference in texture would result in a SM value of 95/100. For Site B, if all other factors are equal, the difference in drainage would result in a SM value of 90/100. Therefore, a one class difference in texture results in a 5% 'error' but a one class difference in drainage results in a 10% 'error'.

2.3 Relationship Among Observed Accuracy and Mapping Districts

An evaluation of "percent similar" and "percent correct" results showed that some mapping districts had higher observed accuracies than others (Table 4). Differences in accuracy were related to complexity of soils and parent materials. For example, soil mappers produced soil maps that were less accurate for soils found on fluvioeolian landscapes dominated by Chernozemic, Solonetzic and Regosolic soils (Pakowki), than for soils found on morainal landscapes dominated by Chernozemic soils (Conquerville and Etzikom). The observed accuracies of the five mapping districts tested in this study are presented in Table 4.

The reasons for the differences in observed accuracy in different mapping districts may be due to soil taxonomy or parent materials. For example, in districts with significant Gleysolic, Solonetzic and Regosolic soils, the decreased accuracy may be a result of the variability and the high degree of spatial unpredictability associated with these soils. In areas dominated by fluvioeolian and lacustrine deposits, decreased accuracy may be a result of the spatial variability in the type and texture of parent materials.

Table 4. Accuracy results for five soil mapping districts in the County of Forty Mile.

Mapping District	Extrapolatory Mapping			SIL3 1:50 000 Mapping		
	Percent Correct		Percent Similar	Percent Correct		Percent Similar
	P	NP		P	NP	
Burdett	58.8%	67.6%	95.1%	54.4%	58.8%	92.9%
Conquerville	70.6%	73.5%	94.6%	89.7%	91.2%	99.0%
Etzikom	86.8%	97.1%	98.9%	77.9%	86.8%	98.3%
Legend	73.5%	86.8%	95.1%	69.1%	75.0%	94.4%
Pakowki	44.1%	50.0%	77.9%	55.9%	66.2%	80.0%

3.0 CONCLUSIONS

There was no statistically significant difference in map accuracy between the extrapolatory and SIL3 1:50 000 methods (95% confidence). The conclusion is that the soil and landscape models developed through SIL3 1:50 000 mapping can be confidently applied to similar landscapes.

The results indicated a relationship between complexity of landscape and soils and map accuracy. Certain landscapes were mapped with higher observed accuracies than others. We concluded that more time should be spent defining and investigating mapping districts that were mapped with the lowest accuracies and less time should be spent investigating areas for which mappers have the greatest confidence. For example, till landscapes dominated by Chernozemic soils have well defined soil-landscape models, therefore not much time should be spent testing soil-landscape models in these areas. Conversely, fluvioeolian and lacustrine landscapes and landscapes which contain Solonetzic and Regosolic soils are more complex, variable and have less understood soil-landscape models. Consequently more effort should be spent defining models and delineating map units in these areas.

Based on these conclusions we conclude that the extrapolatory mapping method is a viable alternative to SIL3 1:50 000 mapping.

4.0 GLOSSARY OF TERMS

Exact Match: In this project, an exact match between an observed and a predicted soil means that the soil texture, parent materials, internal drainage, subgroup classification, series name, and soil phase were all the same.

Line Transect: A method of locating a given number of site inspections in the landscape. Line transects are unidirectional and usually have an equal spacing between site inspections. Line transects may or may not be directionally biased, depending on the orientation of the transect.

Map Accuracy: A measure of the degree of correlation between what the soil map and legend predict will be found in the landscape and what is actually observed to occur in the landscape (i.e. ground truth data). Usually expressed as a percentage value.

Mapping Districts: Areas of similar geomorphology, landforms, and soils. They are defined in terms of surficial geology, bedrock geology, soil distribution, and landform.

Non-proportional: A non-proportional comparison only considers what soils were found or predicted. It does not consider how much of each soil was found or predicted.

Percent Correct: The number of exact matches between an independent sample data set and a soil map and legend, expressed as a percentage.

Percent Similar: A measure of how closely related the soil map and legend is to the ground truth data, expressed as a percentage.

Proportional: A proportional comparison considers both what soils were found or predicted as well as how much of each soil was found or predicted.

Radial Arm Transect: Radial arm transects are an extension of the line transect, and contain two or more "arms" which are independent of directional bias. Multiple sample sites are located on each arm.

Similarity Matrices: A relative measure of comparison of the soil properties associated with one soil to the soil properties associated with another soil.

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6.0 PERSONAL COMMUNICATION

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APPENDIX A: METHODS

This appendix outlines and describes the methods used throughout this project. The two mapping methods (SIL3 1:50 000 and extrapolatory), the selection of sample size, the sampling method used, and the analysis techniques employed (accuracy as measured by percent correct and percent similar) are described. A short introduction and background is provided along with the specific procedures used to accomplish each of the above. A short description of the rationale and procedures used in creating similarity matrices is also provided.

1.0 SIL3 1:50 000 METHOD

The soil mapping program in Alberta evolved from reconnaissance mapping to SIL3 1:50 000 standards. This evolution was a result of a recognized need to update existing mapping in terms of the current state of knowledge and gaps or inconsistencies in existing mapping.

Some of these soil surveys were targeted for specific uses (for example, deep plowing interpretations in the County of Paintearth (Wells and Nikiforuk 1988)). However, the majority of these surveys were aimed at a generalized user audience that included farmland assessment, soil conservation planning, deep plowing, grazing land management, pipeline construction and pipeline reclamation. Each soil survey tended to have many uses. For example, the soil survey of the County of Warner (Kjearsgaard et al. 1986) provided irrigation ratings, that were comparable to ratings assigned specifically by irrigation specialists. However, the soil survey had broader application than thematic irrigation maps. Interpretive information also provided in the survey report included erosion potential and agriculture capability.

The procedures used in the production of an SIL3 1:50 000 soil inventory product for the County of Forty Mile were as follows:

1. **Definition of objectives, requirements and ongoing reviews.**

   Steps in the survey plan included identification of the project, project definition and objectives, schedule and resource requirements, project management details, survey operations (including mapping strategies, correlation responsibilities, sampling strategy, interpretations and report format), resource allocation (including manpower), scheduling and public information and feedback.

   The project plan was revisited during the course of the survey to ensure that the objectives and requirements were being met.

2. **Compilation of existing data, preliminary field studies and initial stratification.**

   During this stage background information on climate, surficial and bedrock geology, hydrogeology, hydrology, topography, vegetation and soils was collected. Compilation of the background information provided the pedologists with a regional overview of the area to be mapped. The information was also used to develop preliminary map unit concepts. This step was conducted both in the office and by field visits to the project area.

3. **Development of an initial mapping legend.**
The initial map legend was developed using a combination of two different approaches. First, the map legend was adapted from published (or existing) soils maps. This approach saved time and enhanced correlation during the preliminary field study step. Second, the legend was supplemented and further developed based on observations made during preliminary field studies. This approach was time consuming but the extra time spent on legend development using this method was needed to reach the level of confidence felt necessary for SIL3 1:50 000 mapping.

4. **Field mapping.**
Mapping was conducted using 1:31 000 scale black and white aerial photographs and 1:30 000 color infrared aerial photographs. Initial stereoscopic examination of the photos was carried out in the office followed by a general field reconnaissance. This was followed by more intensive photo interpretation and ground truthing. During mapping, attempts were made to traverse all roads and trails in the townships. Occasional traverses by foot were made where necessary to verify soil and landscape conditions in areas without vehicle access. Soils were examined to the 1 metre depth using a shovel and hand auger. Soil inspections were done at an intensity of approximately one recorded inspection per quarter section (65 hectares). Each recorded inspection was supplemented by information obtained from several inspections to determine the local distribution and variability of different soils associated with each inspection site.

As the survey progressed,the initial mapping legend underwent repeated revision. Soil and topography lines were determined along the lines of the traverse and projected between them using landscape features and stereoscopic examination of aerial photographs. These boundaries were drawn on a field map consisting of an aerial photograph of the township enlarged to a 1:30 000 scale. Map delineations were identified with the appropriate map unit symbol.

5. **Interim correlation and remapping.**
As the townships were mapped (step 4), each completed township was compared, checked and correlated with those of adjoining townships. The purpose of the

correlation exercise was to verify polygon boundaries and to ensure that map unit concepts were applied consistently and uniformly across the project area. The process involved re-driving roads to check boundary placements and making additional soil and landscape inspections.

After the townships were mapped and correlated, legend compilation was started. Map units were consolidated and map unit names changed accordingly. The philosophy of consolidation is that a balance must be achieved between cartographic simplicity and landscape detail (Hole and Campbell 1985). Map unit consolidation is a process used to reduce the number of map units (in a mapped area) to a workable number. In the process, map units that are only slightly different may be amalgamated. Those that occupy minor areas can be added to similar map units. The consolidation process often caused a redefinition of the remaining map units.

6. **Final correlation and report writing.**
After all field data was gathered, checked and correlated, the soil boundaries and accompanying map unit symbols were transferred to 1:50 000 scale, mylar topographic base maps or aerial photograph mosaics. A final correlation ensured that a uniform and consistent map had been produced for the project area. Finally, the soil survey information was compiled and a report was written that summarized and described the soils in the mapped area. The survey report was written after the correlated maps had been compiled.

2.0 EXTRAPOLATORY METHOD

The extrapolatory mapping method used soil-landscape models developed by SIL3 1:50 000 mapping in selected representative areas and extrapolated those models to adjacent areas with similar landscapes. Time consuming pedon investigations were reduced and supplanted by visual confirmation of landscape attributes and boundaries.

The extrapolatory method recognises that there is a strong and consistent relationship between soils and landscapes and that delineation of landscapes is the most effective way to differentiate soils. Successful sub-division to the level of land systems relies on a systematic procedure for top-down stratification of the overall area into 'mapping districts'. Mapping districts are landscapes with a characteristic 'signature' or pattern that is recognizable both on imagery and on the ground. It is assumed that the development of a thorough understanding of soil-landscape relationships, expressed as models of map unit concepts, can be achieved through detailed legend building and mapping in a limited number of representative areas. Once developed, these models can be extrapolated to adjacent areas of similar landscapes using a much lower intensity of time-consuming ground truth observation. The model hypotheses represent an enhancement of the knowledge base founded on an analysis of previous data and observations combined with pedologist inference developed from an examination of landscape patterns. The hypotheses can be applied with confidence to adjacent portions of 'mapping districts'.

There are three main differences between extrapolatory mapping and SIL3 1:50 000 mapping. These are: 1) extrapolatory mapping proceeds at a faster rate of progress (2-4 days/twp vs. 6-10 days/twp for SIL3 1:50 000 mapping); 2) field site examinations are reduced from about 90-150 sites per twp to less than 20 sites in extrapolatory townships; and 3) extrapolatory mapping conducts correlation and edge matching concurrently with air photo interpretation and field verification.

The procedure used to map the County of Forty Mile using the extrapolatory mapping method was as follows:

1. The County was sub-divided into 'mapping districts' on the basis of existing environmental information in combination with a pedologist's familiarity with the region.

2. Conceptual models of soil-landscape relationships were developed through a review of information from existing, older surveys and air photo interpretation.

3. 'Representative' areas within 'mapping districts' were selected to test and revise initial map unit concepts.

4. Conventional SIL3 mapping of selected 'representative' areas was conducted and map unit concepts and legends were revised accordingly.

5. A working legend and soil-landscape map unit concepts were finalized and adopted.

6. The soil-landscape models were applied to extrapolatory areas to delineate strongly and moderately contrasting polygons.

7. Initial map unit symbols were assigned to all polygons in extrapolatory areas and initial descriptions were developed for these map units.

8. Weakly contrasting and problematic soil map units were identified for special attention during field verification in extrapolatory areas.

9. All extrapolatory areas were checked to verify map unit boundaries and field test legend concepts (< 20 pedon investigations or catenary sequence transects per twp, some only examine surface texture, depth of Ah, or degree of solonetzic development).

10. Polygon boundaries, map unit names and map unit descriptions were finalized from air photo interpretation and field verification notes.

3.0 SAMPLE SIZE

The intensity of data collection (that is, the number of observation sites) depends on the objective of the project (Miller, McCormick, and Talbot, 1980). If the objective is to produce a soil map or survey product, then the most efficient sampling size will be determined by the scale at which mapping is conducted, complexity of the landscape and the experience of the soil surveyor. If the objective is to evaluate the accuracy of a soil inventory product, then a more rigorous approach is needed for the selection of sample size.

The number of sample points needed for a statistically valid estimation of map accuracy varies with the testing procedure used and the degree of confidence desired. For most tests, sample sizes of less than 30 result in unreliable statistical inferences while a sample size greater than 50 is not likely to provide an increased statistical benefit equal to the increased cost of data collection (Forbes, Rossiter, and Van Wambeke, 1985). Hay (1979) recommended a minimum sample size of between 50 and 100 in order to minimize the influence of asymmetrically distributed errors. These estimates were based on ten or more observation points at each sampling location, a number suggested by Steers and Hajek (1979).

In this project, five mapping districts were mapped using both extrapolatory and SIL3 1:50 000 methods of producing soil inventory products. Eight transects were located in each mapping district, four in extrapolatory mapped areas and four in SIL3 1:50 000 mapped areas, giving a total of 40 samples or transects for the study. This satisfied the criteria that the optimum sample size be between 30 and 50. However, only 20 transects were located within the areas mapped using each method. The sample size for estimating the accuracy of extrapolatory mapped areas and SIL3 1:50 000 mapped areas was therefore 20 transects. This is less than the recommended minimum sample size but was considered adequate for this study.

In order to determine the number of observations needed on a single transect, binomial probabilities as outlined by Edmonds and Crouch (1991) were used (Howitt and Moran 1991). This procedure was based on binomial statistical theory and the formula "np>5 where n is the number of samples, p is the probability of success and 5 defines a limit of statistical reliability. If a probability of 30% soil series composition is a polygon (p = 0.30) is selected, then n = (5/0.3) or 17 observations" (Howitt and Moran 1991). This number of observations satisfied the criteria that ten or more observations be located on each transect. These calculations resulted in 17 observations per polygon, 340 observations per mapping method, and 680 observations (40 transects) over the entire project area.

4.0 RADIAL ARM TRANSECTS

Radial arm sampling (Wilding, 1985) is essentially an extension of the line transect procedure for selecting multiple observation sites at a given sampling location. It is independent of directional bias and was recommended if the intention of the sampling scheme was to obtain multiple sites within minimum sized delineation areas but without reference to any given polygon boundaries. The resultant sample set is applied with equal relevance to evaluate any number of superimposed maps produced by any method of mapping.

The procedure used to design the radial arm transect used in this project was as follows:

1) A starting point was selected. In this case, a random grid coordinate corresponding to the intersection points of a cartesian coordinate system overlaying the entire map area was used. This starting point became sample point number 1.

2) A number between 0 and 359 was randomly selected to represent a compass azimuth bearing (Figure A-1).

3) A transect arm from the starting point 200m along the previously defined direction was measured (Figure A-1).

4) Three other transect arms at randomly chosen directions from the initial starting point were defined by repeating steps 2 and 3 (Figure A-1).

5) A random 2 digit number from 00 to 99 was selected. This was used to compute the location of sample point #2 as xx% of the distance along transect arm A (Figure A-1).

6) Step five was repeated until 4 sample points were located along transect arm A. This was continued until four points were identified along each of the 4 radial arms (Figure A-1). The result was 17 sample points, randomly selected along four radial arms (Table A-1).

This procedure was used to design a standard radial arm transect which was then used at all 40 sampling locations. For this project, eight sampling locations (four transects in each of the SIL3 1:50 000 and extrapolatory mapped areas) in each of five mapping districts were randomly selected as per step 1 above. Sampling locations were rejected if the centre point fell within 200m of a polygon boundary. This 200m buffer zone was used in order to ensure that the radial arm transects would be entirely within the selected polygons.

The radial arm transect described above was designed to sample the minimum sized delineation recommended for 1:50 000 scale map products by the Mapping Systems Working Group (1981). Each arm of the radial arm transect could have been up to 200m in length. The transect could have had a potential diameter of 400m. An area with a diameter of 400m is slightly larger than 12.5 ha, the minimum sized delineation recommended by the Mapping Systems Working Group (1981).

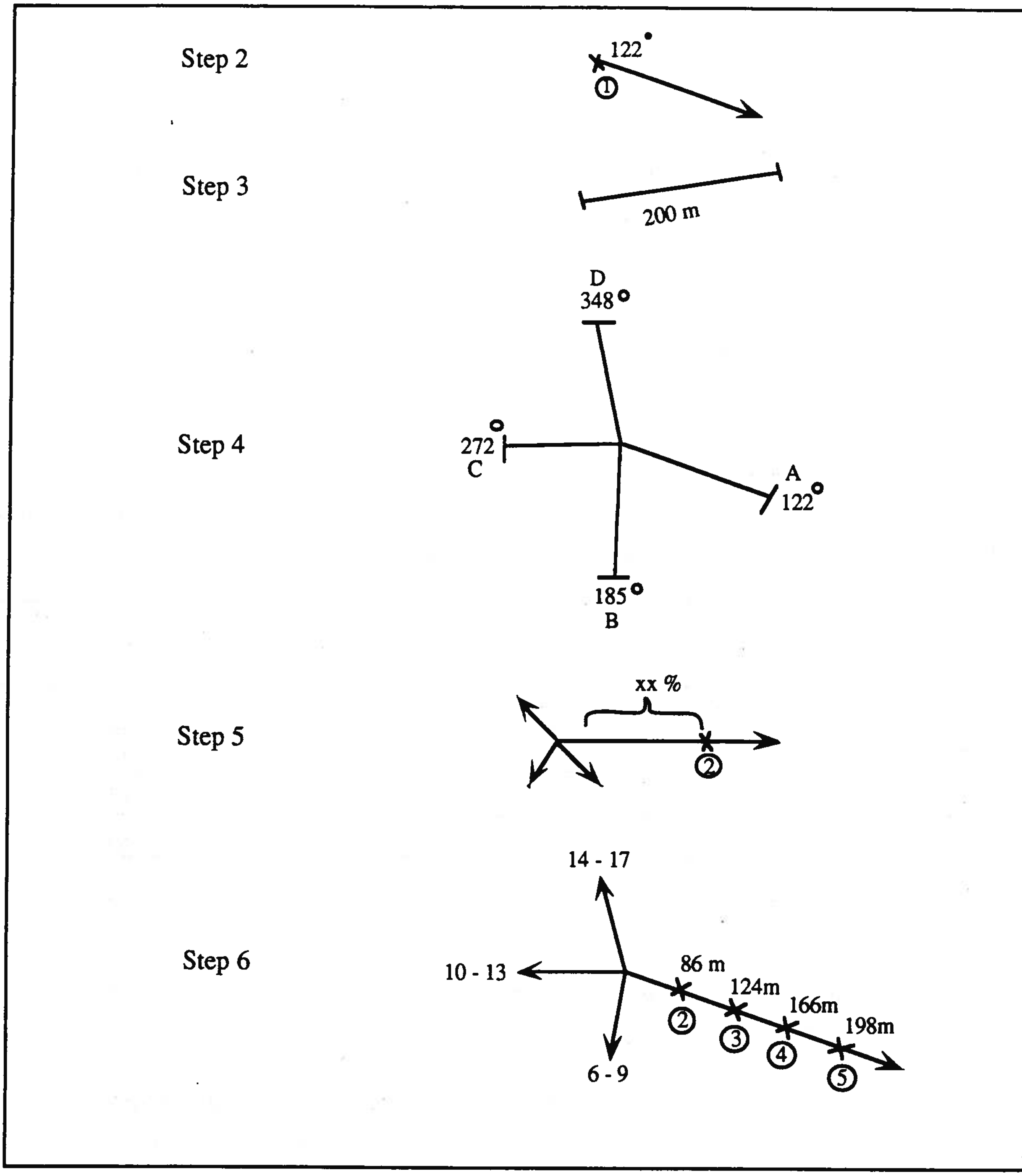

Figure A-1. Steps in the design of a radial arm transect (adapted from Wilding 1985).

Table A-1. Distance and compass azimuth of sample points from the centre of each radial arm transect.

Sample point no.	Distance from centre	Radial arm	Compass azimuth
1	0 m	-	-
2	86 m	A	122°
3	124 m	A	122°
4	166 m	A	122°
5	198 m	A	122°
6	6 m	B	185°
7	46 m	B	185°
8	70 m	B	185°
9	141 m	B	185°
10	60 m	C	272°
11	80 m	C	272°
12	140 m	C	272°
13	190 m	C	272°
14	56 m	D	348°
15	58 m	D	348°
16	112 m	D	348°
17	156 m	D	348°

By using the radial arm transect method of sampling, several advantages were gained. These were:

a) After the initial centre point had been located, all subsequent points were located quickly and easily using simple compass and pace methods.

b) The radial design removed the threat of directional bias in the samples. The geometry of the radial arm transect approach minimized the likelihood of samples being influenced by periodicity or systematic variation in the landscape. The spokes of the transect radiated out from the central point at oblique angles to one another. Thus, even if one arm had paralleled a linear feature, the other arms would have been at some oblique angle to the feature and would have sampled different portions of the landscape. The geometry of the transect also protected against the biased sampling of repeating concentric patterns. In the unlikely event that the central point of the transect had coincided with the centre of a concentric pattern, the random placement of sample points along each radial arm would have ensured that samples did not capture the periodicity. The samples were drawn at different intervals along each arm and therefore could not have consistently sampled the same repeating portion of the landscape.

c) The scheme produced a cluster of sample points in relatively close proximity. This provided some assurance that there were sufficient points within any given polygon superimposed over the sample data to enable proportions of soils or soil properties to be assessed on a per polygon basis. (It was necessary to have a series of unbiased sample points within the same delineation of a polygonal map unit if there was to be any attempt to assess whether the soils or soil properties described for the map unit occurred in the proportions described.)

d) The method gave every point in the a project area an equal chance of being sampled. As such, the sample data was representative of the entire population of soils in the sampled area and was used to provide a valid data set for comparing two or more different polygon maps of the same area produced by different techniques and people.

Along with the above advantages, certain limitations were also imposed upon the project by using the radial arm transect for collecting field data. These were:

a) Operationally there was some backtracking in going to and returning from sample points.

b) The method did not guarantee that samples would be taken from all portions of an overlain polygon nor that these samples represented the full extent of any overlain polygon.

c) The portion of the delineation represented by the transect is small relative to the overall size of the average delineation. Some radial arm transects might not be characteristic of or encompass all of the soil and landscape variability within a map unit. Conversely, some transects may find a higher degree of variability than described because of their spatial scale.

5.0 SIMILARITY MATRICES

The similarity matrix concept was developed as a method for assessing the relative degree of similarity between the soils predicted to occur in any given map unit and the soils observed to occur at selected sampling locations within that map unit.

It has long been recognized that the utility of a soil survey is not inexorably linked to its taxonomic purity. Hudson (1990) argued that most users had been successful in interpreting soil map units as if they were uniform areas of homogeneous soil as described in the legend and concluded that soil maps functioned well in practice despite the theoretical shortcomings associated with taxonomic impurity.

Byrd (1991) agreed with Hudson (1990) that people who use soil survey maps don't worry about supposed 'deficiencies' resulting from taxonomic impurity because the maps work for them. Schellentrager (1990) argued that evaluation of the accuracy of soil survey map units was hindered by the emphasis placed on taxonomic purity relative to interpretive success. He noted that "statistical analysis of a map unit's taxonomic composition assists in the definition and description of the map unit; it does not improve our assessment of the accuracy of soil interpretations of that map unit". He concluded that "a method of evaluating the accuracy and reliability of those soil properties used in rating a map unit for a specific use must be developed" (Schellentrager, 1990). He suggested that one possible solution would be "to improve the concept and definition of similar and contrasting (dissimilar) soils by defining similarity or contrast on the basis of fundamental soil properties (that is, depth, texture, coarse fragments and so on)". Map units could be tested and described in terms of the degree of similarity of each of the observed soils to each of the predicted soils.

Other investigators have recognized that evaluation of soil map accuracy in terms of binary (right/wrong) assessments is too stringent a test. For example, Marsman and de Gruijter (1986) recognized, as a limitation of their procedure, the fact that "all deviations from the (expected) class are equally weighed, regardless of their type or extent".

The similarity matrix method of evaluating the accuracy of soil maps and legends assumes that many of the soils encountered when testing a given map unit polygon are similar, in some greater or lesser degree, to one or more of the soil series used to name or describe the map unit. The method seeks to systematically appraise and quantify this similarity and assumes that a relative "degree of similarity" can be manually estimated for all combinations of classes for all important soil attributes. The degree of similarity between any two classes for any given attribute can be stored in and read from a 'similarity matrix' constructed for that attribute. A further assumption is that an overall similarity of observed to predicted soil can be computed as some arithmetic average or cross product of the individual soil property similarities. A final assumption is that the relative degree of similarity between predicted and observed soils computed for any given map unit or entire soil map provides an effective indication of the likely utility of that map unit or map for making the interpretations required of it.

The degree to which one class is deemed to be similar to another class is strictly arbitrary and so is subject to criticism. Measures of absolute similarity should not be relied upon for judgments, but relative degrees of similarity between different types of maps may prove useful and reliable.

In this project, soil texture, parent material (PM), internal drainage, subgroup classification, and salinity were selected as the soil properties and characteristics to be tested. The approaches used in creating similarity matrices for this project are outlined below.

For internal drainage (Table A-7) and soil texture (Table A-2), similarity ratings were determined by deducting ten points for each class difference between the two classes to be compared. This approach was possible because both soil textural classes and internal drainage classes can be ranked in a logical manner (Moon, Hall, and Selby, internal memorandum, 1987). For example, a moderately well drained soil in comparison to a poorly drained soil would receive a similarity rating of 80/100 for drainage.

For soil PM (Table A-3), similarity ratings were assigned based on differences from an agricultural perspective and on ease of recognition in the field. This approach was used because soil parent materials cannot be logically ranked (for example, 1 to 10) and point deductions given accordingly. For example, fluvial (FLUV) materials can be equally similar to both glaciolacustrine (GLLC) and till (TILL), and were given the same similarity rating in comparison. When the ranking system was applied, a FLUV versus GLLC and FLUV versus TILL comparison did not receive the same rating.

Assigning similarity ratings to subgroup classifications posed a slightly different problem in that point deductions had to be consistent within different orders and different great groups. To achieve consistency, separate tables were set up for subgroup characteristics (Table A-4) and Solonetzic properties (Table A-5). Point deductions were given for each of the comparisons within these categories. In addition, point deductions were given for soil zone differences and presence or absence of salinity (not applicable in Solonetzic comparisons). The point deductions assigned for subgroup characteristic differences were considered to be cumulative when determining subgroup classification similarity ratings (for example, a comparison between a saline O.B soil and a non-saline R.B soil would receive point deductions for both the Orthic versus Rego difference and the saline versus non-saline difference) (Table A-6).

Subgroup classification differences based on drainage (Gleyed subgroups) were not assigned point deductions because this was already done in the drainage similarity category. Soils belonging to the Gleysolic Order were given a 50 point deduction in comparison to other soil Orders (in this study, Chernozemic, Regosolic and Solonetzic soils). Additional points were then deducted based on profile characteristic differences.

The similarity between soil series was calculated after the similarity matrices for texture, PM, drainage and subgroup classification were completed. This was accomplished using the following formula:

$$\text{Similarity (Series)} = \frac{(\text{texture} + \text{PM})}{2} \times \text{drainage} \times \text{subgroup} \times \text{salinity}$$

An average of texture and PM was used in the formula because the two soil properties are closely associated. By using texture and PM individually within the formula, the effect would have been to double penalize any differences and give unwarranted weight to the effect of texture and PM upon a similarity rating between two soil series. The subgroup rating for soils of the Gleysolic Order was assumed to be independent of internal drainage, as were the gleyed subgroups. For example, an O.HG was considered to have the same profile characteristics as an O.B soil and so no points were deducted beyond the automatic 50 in a comparison between the two. As well, a GLE.B soil was considered equal to an E.B soil as far as subgroup similarity ratings were concerned. Final similarity ratings for series, encountered in the study were summarized (Tables A-8 to A-11) and used to determine percent similarity for predicted versus observed soils.

Table A-2. Similarity matrix for textural classes[1].

	Very coarse	Mod. coarse	Medium	Mod. fine	Fine	Very fine
Very coarse	100	90	80	70	60	50
Mod. coarse		100	90	80	70	60
Medium			100	90	80	70
Mod. fine				100	90	80
Fine					100	90
Very fine						100

[1] Textural classes as defined in The System of Soil Classification for Canada (Canada Department of Agriculture 1974).

Very coarse = LS, S
Moderately coarse = SL, fSL
Medium = L, SiL, VFSL
Moderately fine = SCL, CL, SiCL
Fine = C, SiC, SC
Very Fine = HC

Table A-3. Similarity matrix for parent material[1].

	EOLI	FLEO	GLFL	FLUV	FLLC	LACU	GLLC	GLTL	TILL	RESI
EOLI	100	99	99	75	70	60	60	50	50	40
FLEO		100	99	95	85	70	60	50	50	40
GLFL			100	99	99	60	80	50	70	60
FLUV				100	99	95	70	50	70	60
FLLC					100	99	99	70	70	60
LACU						100	99	99	90	60
GLLC							100	99	90	60
GLTL								100	99	60
TILL									100	95
RESI										100

[1] Parent materials as defined in the CanSIS Manual for describing soils in the field (Expert Comittee on Soil Survey 1982).

EOLI = eolian
GLFL = glaciofluvial
FLLC = fluviolacustrine
GLLC = glaciolacustrine
TILL = morainal (till)
FLEO = fluvioeolian
FLUV = fluvial
LACU = lacustrine
GLTL = lacustro-till
RESI = residual

Criteria used to derive Subgroup similarity matrix

Soil Order: 50 point deduction for Gleysolic soil order vs. other soil orders. (Applied in combination with subgroup point deductions.)

Subsoil: Bt vs. Bnt (SS, SZ) = 20 point deduction
Bt vs. Bnt (SO) = 10 point deduction

Salinity: 30 point deduction (does not apply for Solonetzic soils)

Table A-4. Subgroup point deductions[1].

	Orthic	Rego	Calcareous	Eluviated	Solonetzic
Orthic	0	15	10	5	10
Rego		0	10	10	30
Calcareous			0	30	30
Eluviated				0	5
Solonetzic					0

[1] Classification as described in The Canadian System of Soil Classification (Agriculture Canada Expert Committee on Soil Survey 1987).

Table A-5. Solonetzic soil point deductions[1].

	Orthic	Eluviated	Solonetzic	Solod	Solodized Solonetz	Solonetz
Orthic	0	5	10	30	50	40
Eluviated		0	5	25	45	35
Solonetzic			0	15	35	25
Solod				0	20	20
Solodized Solonetz					0	5
Solonetz						0

[1] Classification as described in The Canadian System of Soil Classification (Agriculture Canada Expert Committee on Soil Survey 1987).

Table A-6. Similarity matrix for selected soil subgroups in the Brown soil zone[1].

	R.B	E.B	CA.B	SZ.B	B.SS	B.SO	B.SZ	O.LG	R.G	O.R	O.HR
O.B	85	95	90	90	50	70	60	45	35	70	75
R.B	100	90	90	70	35	55	45	40	50	85	90
E.B		100	70	95	55	75	65	50	40	75	80
CA.B			100	70	40	60	50	20	40	75	80
SZ.B				100	65	85	75	45	20	60	65
B.SS					100	80	95	30	20	25	25
B.SO						100	80	40	30	45	45
B.SZ							100	35	25	30	30
O.LG								100	90	30	30
R.G									100	50	45
O.R										100	85

[1] Abbreviations and classification as described in The Canadian System of Soil Classification (Agriculture Canada Expert Committee on Soil Survey 1987).

Table A-7. Similarity matrix for drainage classes[1].

	Rapid[2]	Well	Mod. Well	Imperfect	Poor[3]
Rapid	100	90	80	70	60
Well		100	90	80	70
Mod. Well			100	90	80
Imperfect				100	90
Poor					100

[1] Drainage classes as defined in the CanSIS Manual for describing soils in the field (ECSS 1982).
[2] Includes the drainage class "very rapid".
[3] Includes the drainage class "very poor".

Table A-8. Similarity matrix for soil series[1] in the County of Forty Mile.

	BLP	CVD	EXP	ANO	RAM	RIR	BUT	ORN	PLS
MAB	57	48	86	88	68				
CFD	59	55	86	90	74				77
CHN		56	90	90	77				74
BVL		86	77	88			95	67	77
TAB		82	73			85			76
BUT					85	79	100	69	
MYS							50	25	
SXT							64	72	
RIR			75			100			

[1] Soil series names and abbreviations as described in Alberta Soil Names Generation 2 User's Handbook (Alberta Soil Series Working Group 1992).

Table A-9. Similarity matrix for soil series[1] in the County of Forty Mile.

	MAB	CFD	CHN	TVS	ROL	HMS	HDY	CHZ	FMT
MAB	100	93	95	90	90	85	70	86	95
CFD		100	98	77	77	72	60	88	88
CHN			100	86	86	81	67	90	95
TIY	79	79	89						
BVL	68	74	77						

[1] Soil series names and abbreviations as described in Alberta Soil Names Generation 2 User's Handbook (Alberta Soil Series Working Group 1992).

Table A-10. Similarity matrix for soil series[1] in the County of Forty Mile.

	KGO	HUK	GEM	HDY	PUN	DHS	SPS	RIR	TAB
MAB			67	70	56	48	85	77	68
CFD			69	60	62	50	88	83	74
CHN	64		67	67	64	48	90	83	81
RAM	86				86				
PUN	100				100			77	
ROL		65	95	85					
HDY		90		100		76			

[1] Soil series names and abbreviations as described in Alberta Soil Names Generation 2 User's Handbook (Alberta Soil Series Working Group 1992).

Table A-11. Similarity matrix for soil series[1] in the County of Forty Mile.

	VST	ATP	CVD	GLS	WTN	LLD	INS	MAB
VST	100	84	85				30	41
ATP		100	69				30	34
CVD			100				21	48
GLS				100	28	25		
WTN					100	37		
LLD						100		

[1] Soil series names and abbreviations as described in Alberta Soil Names Generation 2 User's Handbook (Alberta Soil Series Working Group 1992).

6.0 ACCURACY

The purpose of calculating the accuracy of a soil inventory product is to make a quantitative estimate of the proportion of discreet soil entities predicted as occurring in the landscape by the soil map and legend. For this project, the accuracy was calculated in two ways: a) percent correct; and b) percent similarity. Both methods of calculating accuracy were used to evaluate the map as a whole, individual map units and even individual polygons.

Percent correct is a binary system which says yes, the soil was predicted or no, the soil was not predicted. For the percent correct evaluation, the observed soils were compared to the predicted soils (in the legend) on an exact match basis. There was no allowance for 'close' in the percent correct evaluation. Soils which were similar to but not the same as the series listed were classed as incorrect even though the difference may not have been great enough to affect any interpretation which may be made (for example O.B vs. E.B).

The percent similarity evaluation of the data used a slightly modified version of the statistic 'percent correct'. This evaluation considered the 'closeness' between the observed and the predicted soils. Instead of using the number of exact matches, the similarity value of each observed soil (Tables A-8 to A-11) was used in the formula. The sum of the similarity values was divided by the total number of observations to get an average for each transect. This average was then used as the similarity value for each transect.

A percent correct or percent similarity evaluation of a soil map can only be made at the level of precision used to make the map. For example, if the soils in the landscape are only described to the subgroup level, the percent correct for soil series cannot be calculated. As well, two assumptions were made before the data could be analyzed. It was assumed that the ground truth sample population was representative of the soil population as a whole and was independent of the data used to make the soil inventory product. The second assumption was that the sample population used to calculate the percent correct and percent similarity values was large enough to make a statistically valid estimate and that the sampling method used was statistically valid.

The procedure used in calculating the accuracy of a transect was:

1. Each site observation (soil series) was classified as either correct (predicted by the soil map) or incorrect (not predicted by the soil map). In order for a soil to be considered correct, an 'exact match' was needed between the observed and

predicted soils. Only the map unit description for the polygon in which the sample point occurred was used when deciding if the observed soil series was predicted by the soil map and legend.

This classification was done on both a proportional and a non-proportional basis for the percent correct evaluation. On a proportional basis, an observation was in agreement with the map legend up to the predicted percentage of that soil in the map unit. The number of predicted soils was determined by the upper limit of the range given in the legend (eg. 10-30%). For example, if in 17 observations the map legend predicted six (30%) wet soils and eight wet soils are found, then only six of the eight soils were classed as correct. The remaining two soils were classed as incorrect. If only four wet soils had been found, then all four soils would have been considered correct. On a non-proportional basis, an observation was classed as correct if it was mentioned in the map legend. Using the previous example, all eight wet soils would have been correct on a non-proportional basis.

2. The number of 'correct' sample points were totaled and the percentage correct was calculated using the formula:

$$\% \text{ correct} = \frac{\text{number of 'exact match' observations}}{\text{total number of observations}} \times 100$$

(Marsman and de Gruijter 1986).

3. Each observation site was assigned a similarity value based on the similarity matrices described earlier (Tables A-8 to A-11). All observations classed as correct in step 1 on a proportional basis were assigned a similarity value of 100. For each of the observed soil series not predicted by the map unit description, comparisons were made with other soils predicted as occurring in greater proportions than were actually found. All comparisons were made such that the highest possible similarity value was obtained for each soil. This evaluation of the field data was done for soil series on a proportional basis only.

4. The similarity value of each transect was calculated using the formula:

$$\% \text{ similarity} = \frac{\text{sum of the similarity values}}{\text{total number of observations}} \times 100$$

5. The percent correct and percent similarity values were then totaled and averaged for each mapping method. This step produced the following averages for both extrapolatory and SIL3 1:50 000 mapping methods:

   a) % correct, proportional
   b) % correct, non-proportional
   c) % similar, proportional

6. F-Tests at the 95% confidence level for each of the following comparisons were done using Microsoft Excel Version 4.0:

   a) extrapolatory method, % correct, proportional vs. non-proportional
   b) SIL3 1:50 000, % correct, proportional vs. non-proportional
   c) % correct, proportional, extrapolatory vs. SIL3 1:50 000
   d) % correct, non-proportional, extrapolatory vs. SIL3 1:50 000
   e) % similar, soil series, extrapolatory vs. SIL3 1:50 000

7. t-Tests for significant difference of the means at the 95% confidence level were done for each of the comparisons outlined in step 6, using Microsoft Excel Version 4.0. Two different tests were run depending upon the results of step 6. If there was a significant difference in the variances, a t-Test for two samples assuming unequal variances was used. If there was no significant difference between the two variances, a t-Test for two samples assuming equal variances was used.

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APPENDIX B: MAP UNIT NAMES AND COMPOSITION

The map unit names of each sampling location are listed for each mapping district and mapping method. As well, the soil series composition of each sampling location is provided.

Table B-1. Transect locations and map units evaluated for the Extrapolatory mapping method.

Transect Number	Sampling Location	Map Unit	Mapping District
1	NE1-6-10	MACF2/3	Etzikom
2	NE2-6-10	MACF1/3	Etzikom
3	NW15-6-10	MACF1/2i	Legend
4	SE19-6-10	MACF1/2i	Legend
9	NE9-8-12	CFD1/3	Conquerville
10	SW25-6-9	MACF8/3	Etzikom
11	SE33-6-7	MAB9/4	Etzikom
17	NE15-8-11	MAB6/4	Conquerville
18	SE33-10-8	MACF4/3c	Conquerville
19	SE27-5-7	BUT4/2a	Pakowki
25	SE1-9-12	CFD1/2i	Burdett
26	NW9-9-12	CHN6/2-3	Burdett
28	SE34-6-10	MACF1/3	Legend
29	NW25-8-9	MACF1/3	Conquervile
30	NW24-5-7	VSAT1/4-5	Pakowki
31	NW10-5-7	BUT4/2a	Pakowki
32	SW13-4-6	MYS1/2-3a	Pakowki
33	SW29-6-10	MACF1/3i	Legend
35	NE13-11-12	RAM1/2-3	Burdett
36	SE12-11-12	BVCF4/3	Burdett

Table B-2. Transect locations and map units evaluated for the SIL3 1:50 000 mapping method.

Transect Number	Sampling Location	Map Unit	Mapping District
5	SW10-6-11	MACF1/3i	Legend
6	SW31-5-12	MACF8/4h	Etzikom
7	SW10-6-14	MAB8/4	Etzikom
8	SW17-6-14	MAB2/4	Etzikom
12	SW25-11-10	MACF7/3	Burdett
13	NE4-10-9	MACF4/3	Conquerville
14	NW14-5-8	GLS1/2n	Pakowki
15	SW32-5-6	MYS3/2a	Pakowki
16	SW34-5-6	HUGE1/3	Pakowki
20	NW14-11-10	MACF4/3	Burdett
21	SW34-8-10	MACF2/3	Conquerville
22	SE3-9-8	MACF7/3	Etzikom
23	NE6-9-8	MACF3/3	Conquerville
24	NW28-6-11	MACF1/2	Legend
27	NW24-7-12	MACF1/3	Conquerville
34	SE9-4-7	GLS1/2n	Pakowki
37	SE12-10-12	MACF1/3	Burdett
38	SW27-10-12	MACF4/3	Burdett
39	SW10-7-14	CHCF1/2	Legend
40	NE5-7-13	RAPU1/2-3	Legend

Table B-3. Observed and predicted soil series composition of each sampling location within Extrapolatory mapped areas.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
1	MACF2/3	CFD (7) 41% MAB (7) 41% CHN (2) 12% TVS (1) 6%	MAB 20-50% CFD 20-50% GGW 15-30% erk** saline solonetzic
2	MACF1/3	MAB (9) 53% CFD (3) 18% CHN (2) 12% TVS (3) 18%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
3	MACF1/2i	CHN (4) 24% 1 saCHN MAB (4) 24% glTIY (3) 18% HMS (2) 12% glSPS (1) 6% ROL (1) 6% TVS (1) 6% CFD (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
4	MACF1/2i	ROL (7) 41% MAB (5) 29% HDY (3) 18% DHS (1) 6% CFD (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
9	CFD1/3	CFD (6) 35% MAB (5) 29% CHN (3) 18% TVS (2) 12% glCHZ (1) 6%	CFD 50-70% MAB 15-25% CHN 15-25% GGW erk solonetzic
10	MACF8/3	MAB (9) 53% 1 caMAB HMS (2) 12% CHZ (2) 12% CHN (1) 6% ROL (1) 6% B.SO (1) 6% DHS (1) 6%	MAB 20-50% CFD 20-50% erk 20-40% GGW 15-30% CHN solonetzic

continued...

Table B-3. Continued.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
11	MAB9/4	ROL (9) 53% MAB (4) 18% GGW (3) 18% HDY (1) 6%	MAB 30-60% solonetzic 15-25% GGW 15-30% CFD erk
17	MAB6/4	MAB (6) 35% CHN (4) 24% FMT (3) 18% 1 coFMT CHZ (2) 12% ROL (1) 6% CFD (1) 6%	MAB 40-60% coarse soils 20-40% (FMT, ANO, stMAB) erk 15-30% CFD
18	MACF4/3c	CHN (5) 29% MAB (5) 29% 2 crMAB HMS (2) 12% CFD (2) 12% TVS (2) 12%	MAB 20-50% CFD 20-50% erk 20-40% GGW CHN solonetzic saline coarse soils
19	BUT4/2a	MYS (10) 59% 7 B.SZ 3 B.SS BUT (6) 35% 3 szBUT SXT (1) 6%	BUT 20-50% ORN 20-50% coarse phases 20-40% GGW saline
25	CFD1/2i	CFD (13) 76% 1 caCFD 1 coCFD CHN (4) 24%	CFD 50-70% MAB 15-25% CHN 15-25% GGW erk solonetzic
26	CHN6/2-3	CHN (13) 76% 1 zrCHN EXP (4) 24%	CHN 30-60% coarse soils 20-40% (BVL, RIR, TAB) CFD 15-25% MAB erk gravelly phases

continued...

Table B-3. Continued.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
28	MACF1/3	CFD (7) 41% 1 erCFD 1 coCFD MAB (3) 18% FMT (2) 12% CHN (2) 12% BVL (1) 6% erTAB (1) 6% glPTA (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
29	MACF1/3	BVL (5) 29% RIR (3) 18% 1 glRIR 1 saRIR CVD (3) 18% CFD (3) 18% 1 zrCFD MAB (2) 12% erANO (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
30	VSAT1/4-5	VST (8) 47% 3 glVST ATP (6) 35% glCVD (1) 6% glMAB (1) 6% INS (1) 6%	VST 40-60% ATP 30-50% CVD
31	BUT4/2a	MYS (9) 53% 5 B.SZ 2 B.SO 2 B.SS BUT (7) 41% 6 szBUT saORN (1) 6%	BUT 20-50% ORN 20-50% coarse phases 20-40% GGW saline
32	MYS1/2-3a	MYS (10) 59% 6 B.SZ 4 B.SS szBUT (6) 35% fiORN (1) 6%	MYS 30-50% (B.SS, B.SO) coarse soils 20-40% BUT 15-30% ORN 15-30%
33	MACF1/3i	MAB (10) 59% 2 coMAB CFD (3) 18% RAM (2)12% ANO (1) 6% PUN (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic

continued...

Table B-3. Concluded.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
35	RAM1/2-3	coBUT (12) 71% RAM (3) 18% RIR (1) 6% zrPUN (1) 6%	RAM 40-70% CHN + BVL 15-40% MAB PUN TAB
36	BVCF4/3	ANO (7) 41% 1 zrANO PLS (5) 29% CVD (3) 18% RIR (2) 12%	BVL 20-40% CFD 20-40% erk 20-30% RIR ANO TAB CHN

* Soils not having a specific percentage can occupy up to 15% of the map unit.

** Eroded, rego, and calcareous variants of the other soils predicted as occurring in the map unit.

Table B-4. Observed and predicted soil series composition of each sampling location within SIL3 1:50 000 mapped areas.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
5	MACF1/3i	MAB (7) 41% CFD (7) 14% CHN (1) 6% CHZ (1) 6% GGW (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk** solonetzic
6	MACF8/4h	CHN (5) 29% HMS (4) 24% MAB (3)18% TVS (3) 18% CFD (1) 6% GGW (1) 6%	MAB 20-50% CFD 20-50% erk 20-40% GGW 15-25% CHN saline solonetzic
7	MAB8/4	CFD (4) 24% CHN (4) 24% MAB (4) 24% TVS (2) 12% HMS (1) 6% FMT (1) 6% GGW (1) 6%	MAB 30-60% erk 20-40% GGW 15-30% CFD
8	MAB2/4	MAB (6) 35% CFD (4) 24% TVS (3) 18% CHN (3) 18% 1 saCHN HMS (1) 6%	MAB 50-70% GGW 15-30% CFD erk
12	MACF7/3	MAB (7) 41% TVS (3) 18% 1saTVS ROL (2) 12% HMS (1) 6% HDY (1) 6% FMT (1) 6% MYS (1) 6% CHN (1) 6%	MAB 20-50% CFD 20-40% solonetzic 15-30% (GEM, MYS, ROL) GGW saline erk
13	MACF4/3	MAB (10) 59% 2 caMAB CFD (4) 24% HMS (3) 18%	MAB 20-50% CFD 20-50% erk 20-40% GGW solonetzic saline

continued...

Table B-4. Continued.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
14	GLS1/2n	saGLS (17) 100%	GLS 50-70% glLLD 15-25% Solonetzic Gleysols 15-25% WTN
15	MYS3/2a	MYS (14) 82% 11 B.SS 2 CAB.SS 1 B.SO SZ.B (1) 6% RIR (1) 6% BVL (1) 6%	MYS 20-50% (B.SS, B.SO) saline soils 15-30% coarse soils 20-40% BUT 15-30% ORN 15-30%
16	HUGE1/3	HDY (7) 41% 3 caHDY HUK (5) 29% 1 caHUK ROL (4) 24% GEM (1) 6%	HUK+DHS 30-50% GEM+HDY 30-50% ROL+CHZ 15-30% MAB+CFD 15-30% saline gleyed
20	MACF4/3	TVS (4) 24% CFD (4) 24% CHZ (4) 24% 2 caCHZ 1 xtCHZ EXP (3) 18% CHN (1) 6% HMS (1) 6%	MAB 20-50% CFD 20-50% erk 20-40% GGW solonetzic saline
21	MACF2/3	CFD (6) 35% 1saCFD 1 zrCFD MAB (5) 29% CHN (2) 12% HMS (2) 12% GGW (2) 12%	MAB 20-50% CFD 20-50% GGW 15-30% erk saline solonetzic
22	MACF7/3	MAB (10) 59% CFD (3) 18% GEM (2) 12% CHZ (1) 6% TVS (1) 6%	MAB 20-50% CFD 20-40% solonetzic 15-30% (GEM, MYS, ROL) GGW saline erk

continued...

Table B-4. Continued.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
23	MACF3/3	MAB (7) 41% BLP (2) 12% CFD (2) 12% 1 saCFD zrCHN (1) 6% saCHN (1) 6% coGEM (1) 6% caBVL (1) 6% FMT (1) 6% GGW (1) 6%	MAB 20-50% CFD 20-50% saline soils 15-30% erk solonetzic GGW
24	MACF1/2	CFD (12) 71% MAB (4) 24% 1 saMAB CHN (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk
27	MACF1/3	CHN (5) 29% 1 glCHN CFD (5) 29% MAB (3) 18% TVS (3) 18% RAM (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
34	GLS1/2n	saWTN (17) 100%	GLS 50-70% glLLD 15-25% Solonetzic Gleysols 15-25% WTN
37	MACF1/3	CHN (11) 65% 4 saCHN 2 zrsaCHN FMT (1) 6% CFD (1) 6% zrTAB (1) 6% glTAB (1) 6%] caEXP (1) 6% saCHZ (1) 6%	MAB 20-60% CFD 20-60% CHN GGW erk solonetzic
38	MACF4/3	CHN (8) 47% 1 zrCHN TAB (5) 29% 3 zrTAB HMS (3) 18% 1 saHMS sazrCFD (1) 6%	MAB 20-50% CFD 20-50% erk 20-40% GGW solonetzic saline

continued...

Table B-4. Concluded.

Transect Number	Map Unit	Observed Soil Series	Predicted Soil Series*
39	CHCF1/2	TAB (10) 59% CHN (6) 35% fiBVL (1) 6%	CHN 40-60% CFD 30-50% MAB erk GGW solonetzic
40	RAPU1/2-3	RAM (12) 71% fiPUN (3) 18% coCHN (2) 12%	RAM 20-50%% PUN 20-50 KGO 15-20% stMAB CFD solonetzic

* Soils not having a specific percentage can occupy up to 15 percent of the map unit.

** Eroded, rego, and calcareous variants of the other soils predicted as occurring in the map unit.

APPENDIX C: FIELD DATA

This appendix contains the field data collected and used in the analysis and calculation of "percent correct" and "percent similar" results for each mapping method and each mapping district.

Legend for abbreviations used throughout the tables in Appendix C:

Soil textures

fi = fine
mf = moderately fine
me = medium
mc = moderately coarse
vc = very coarse

Drainage Classes

P = poor
I = imperfect
MW = moderately well
W =well
R = rapid
VR = very rapid

Parent Materials

TILL = morainal (till)
GLFL =glaciofluvial
GLLC = glaciolacustrine
RESI = residual
FLEO = fluvioeolian
EOLI = eolian
ORGA = organic
FLLC = fluviolacustrine
FLUV = fluvial
LACU = lacustrine

Soil Phases

b = buried profile (paleolithic)
ca = calcareous variant or phase
co = coarse variant
cr = carbonated variant
er = eroded variant or phase
fi = fine textured variant
gl = gleyed variant or phase
sa = saline variant or phase
slp = slope wash veneer overlying the described parent materials
st = stony phase
sz = solonetzic variant
ta = thin A horizon
xc = fine textured subsoil (clay)
xt = till subsoil
ze = eluviated variant
zr = rego variant (weakly developed)

Soil Series

Soil series names and abbreviations as described in Alberta Soil Names Generation 2 User's Handbook (Alberta Soil Series Working Group 1992).

Table C-1. Field data used in the analysis of Extrapolatory mapping.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
NE1- 6-10	1-1	me	LACU	mf	TILL	w	O.B	CFD	slp
	1-2	me	LACU	mf	TILL	w	O.B	CFD	slp
MACF2/3	1-3	mf	TILL			w	O.B	MAB	
	1-4	me	LACU	mf	TILL	w	O.B	CFD	
Etzikom	1-5	mf	TILL			w	O.B	MAB	
	1-6	mf	TILL			mw	O.B	CHN	
	1-7	me-mf	LACU			w-mw	O.B	CHN	
	1-8	me	LACU	me	TILL	w	O.B	CFD	
	1-9	mf	TILL			w	O.B	MAB	
	1-10	mf	TILL			w	O.B	MAB	
	1-11	mf	TILL			w	CA.B	TVS	
	1-12	me	LACU	mf	TILL	w	O.B	CFD	
	1-13	mf	TILL			w	O.B	MAB	
	1-14	mf	LACU	mf	TILL	w	O.B	CFD	slp
	1-15	me	LACU	mf	TILL	w	O.B	CFD	slp
	1-16	mf	TILL			w	O.B	MAB	
	1-17	mf	TILL			w	O.B	MAB	
NE2- 6-10	2-1	mf	TILL			w	O.B	MAB	
	2-2	mf	TILL			w	CA.B	TVS	
MACF1/3	2-3	mf	TILL			w	O.B	MAB	
	2-4	mf	TILL			w	O.B	MAB	
Etzikom	2-5	mf	TILL			w	O.B	CHN	
	2-6	me-mf	LACU			w	O.B	CHN	
	2-7	me	LACU	mf	TILL	w	O.B	CFD	
	2-8	mf	TILL			w	O.B	MAB	
	2-9	mf	TILL			w	O.B	MAB	
	2-10	mf	TILL			w	CA.B	TVS	
	2-11	me	LACU	mf	TILL	w	O.B	CFD	slp
	2-12	mf	TILL			w	CA.B	TVS	
	2-13	mf	TILL			w	O.B	MAB	
	2-14	mf	TILL			w	O.B	MAB	
	2-15	mf	TILL			w	O.B	MAB	
	2-16	mf	TILL			w	O.B	MAB	
	2-17	me	LACU	mf	TILL	w	O.B	CFD	
NW15- 6-10	3-1	me-mf	LACU			mw	O.B	CHN	b
	3-2	me	LACU			i	GLE.B	TIY	b,gl
MACF1/2i	3-3	me	LACU			i	GLE.B	TIY	b, gl
	3-4	me	LACU	fi	LACU	i	GL.B	SPS	b, gl, er
Legend	3-5	me	LACU			i	GLE.B	TIY	b, gl
	3-6	mf	TILL			w	SZ.B	ROL	
	3-7	me	LACU			w	O.B	CHN	
	3-8	me	TILL			w	O.B	MAB	
	3-9	mf	TILL			w	O.B	MAB	
	3-10	mf	LACU			mw	O.B	CHN	sa
	3-11	mf	TILL			w	R.B	HMS	
	3-12	mf	TILL			w	CA.B	TVS	
	3-13	mf	TILL			w	O.B	MAB	
	3-14	mf	LACU			w	O.B	CHN	slp
	3-15	me	LACU	mf	TILL	w	O.B	CFD	slp
	3-16	mf	TILL			w	R.B	HMS	
	3-17	mf	TILL			w	O.B	MAB	

... continued...

Table C-1. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
SE19- 6-10	4-1	mf	TILL			w	O.B	MAB	
	4-2	mf	TILL			w	SZ.B	ROL	
MACF1/2i	4-3	me	TILL			w	B.SO	HDY	
	4-4	mf	TILL			w	SZ.B	ROL	ta
Legend	4-5	mf	TILL			w	SZ.B	ROL	
	4-6	mf	TILL			w	SZ.B	ROL	
	4-7	mf	TILL			w	O.B	MAB	
	4-8	mf	TILL			w	B.SO	HDY	
	4-9	mf	LACU	mf	TILL	w	B.SS	DHS	slp
	4-10	mf	TILL			w	SZ.B	ROL	
	4-11	mf	TILL			w	O.B	MAB	
	4-12	me	TILL			w	SZ.B	ROL	
	4-13	mf	TILL			w	SZ.B	ROL	
	4-14	mf	TILL			w	B.SO	HDY	
	4-15	mf	TILL			w	O.B	MAB	
	4-16	mf	TILL			w	O.B	MAB	
	4-17	mf	LACU			mw	O.B	CHN	
NE9- 8-12	9-1	me	LACU			mw-i	O.B	CHN	
	9-2	me	LACU			mw	O.B	CHN	
CFD1/3	9-3	me	LACU	mf	TILL	mw	O.B	CFD	
	9-4	mf	LACU	mf	TILL	w	O.B	CFD	
Conquerville	9-5	mf	TILL			w	CA.B	TVS	
	9-6	mf	TILL			mw	O.B	MAB	
	9-7	me	LACU	mf	TILL	mw	O.B	CFD	
	9-8	mf	LACU			i	GLSZ.B	CHZ	gl
	9-9	mf	LACU	mf	TILL	mw	O.B	CFD	
	9-10	me	LACU			mw-i	O.B	CHN	
	9-11	mf	TILL			w	O.B	MAB	
	9-12	mf	TILL			w	CA.B	TVS	
	9-13	mf	TILL			w	O.B	MAB	
	9-14	mf	LACU	mf	TILL	w	O.B	CFD	
	9-15	mf	TILL			w	O.B	MAB	
	9-16	me	LACU	mf	TILL	w	O.B	CFD	
	9-17	mf	TILL			w	O.B	MAB	
SW25- 6- 9	10-1	mf	TILL			w	R.B	HMS	
	10-2	mf	TILL			w	O.B	MAB	
MACF8/3	10-3	mf	TILL			w	O.B	MAB	
	10-4	mf	LACU	mf	TILL	w	SZ.B	CHZ	slp
Etzikom	10-5	mf	LACU			mw	O.B	CHN	slp
	10-6	mf	TILL			w	SZ.B	ROL	
	10-7	mf	TILL			w	CA.B	MAB	ca
	10-8	mf	TILL			w	O.B	MAB	
	10-9	mf	LACU			mw	B.SO		
	10-10	mf	TILL			w	O.B	MAB	
	10-11	mf	TILL			w	O.B	MAB	
	10-12	mf	LACU	mf	TILL	w	SZ.B	CHZ	slp
	10-13	mf	TILL			w	R.B	HMS	
	10-14	mf	LACU	mf	TILL	w	B.SS	DHS	slp
	10-15	mf	TILL			w	O.B	MAB	
	10-16	mf	TILL			w	O.B	MAB	ta
	10-17	mf	TILL			w	O.B	MAB	ta

... continued...

Table C-1. Continued.

Sampling	Site	PM 1		PM 2		Drainage	Soil	Soil	Soil
Location	No.	Texture	Type	Texture	Type		Subgroup	Series	Phase
SE33- 6- 7	11-1	me-mf	TILL			mw	O.B	MAB	
	11-2	me-mf	TILL			w	SZ.B	ROL	er
MAB9/4	11-3	mf	TILL			w	SZ.B	ROL	er
	11-4	me-mf	TILL			w	SZ.B	ROL	er
Etzikom	11-5	mf	LACU			p	O.LG		
	11-6	mf	TILL			w	B.SO	HDY	er
	11-7	me	TILL			w	SZ.B	ROL	
	11-8	mf	TILL			w	O.B	MAB	
	11-9	mf	TILL			w	SZ.B	ROL	st
	11-10	mf	LACU	mf	TILL	i-p	GL.B	MHN	ze
	11-11	mf	TILL			w	O.B	MAB	er
	11-12	mf	TILL			w	SZ.B	ROL	
	11-13	mf	TILL			w	SZ.B	ROL	er
	11-14	mf	TILL			w	O.B	MAB	
	11-15	me-mf	TILL			mw	SZ.B	ROL	
	11-16	mf	LACU			p	SZ.HG		
	11-17	mf	TILL			w	SZ.B	ROL	
NE15- 8-11	17-1	me-mf	TILL			w	O.B	MAB	
	17-2	mf	TILL			w	SZ.B	ROL	
MAB6/4	17-3	mf	TILL			w	O.B	MAB	
	17-4	me	LACU			w-mw	O.B	CHN	
Conquerville	17-5	me	LACU	me	TILL	w	O.B	CFD	
	17-6	me	TILL			w	O.B	MAB	er
	17-7	me	TILL			w	O.B	FMT	
	17-8	me	TILL			w	O.B	FMT	
	17-9	me	LACU			w	O.B	CHN	slp
	17-10	me	TILL			w	O.B	MAB	er
	17-11	me	LACU			w	SZ.B	CHZ	
	17-12	me	LACU			w	SZ.B	CHZ	
	17-13	me-mc	TILL			w	O.B	FMT	co
	17-14	me	TILL			w	O.B	MAB	
	17-15	me	LACU			w	O.B	CHN	slp
	17-16	me	LACU			w	O.B	CHN	slp
	17-17	mf	TILL			w	O.B	MAB	
SE33-10- 8	18-1	mf	TILL			w	R.B	HMS	
	18-2	me	LACU			mw	O.B	CHN	b
MACF4/3c	18-3	me-mf	LACU			mw	O.B	CHN	b
	18-4	me	LACU	mf	TILL	w	O.B	CFD	slp
Conquerville	18-5	mf	TILL			w	O.B	MAB	cr
	18-6	mf	TILL			w	O.B	MAB	
	18-7	me-mf	LACU			mw	O.B	CHN	slp
	18-8	mf	TILL			w	R.B	HMS	
	18-9	mf	TILL			w	O.B	MAB	
	18-10	mf	TILL			w	R.B	HMS	
	18-11	me	LACU	fi	LACU	w	O.B	CHN	fi
	18-12	mf	TILL			w	CA.B	TVS	
	18-13	me	LACU	mf	TILL	w	O.B	CFD	slp
	18-14	mf	TILL			w	O.B	MAB	
	18-15	mf	TILL			w	CA.B	TVS	
	18-16	me	LACU			w	O.B	CHN	slp
	18-17	mf	TILL			w	O.B	MAB	cr

... continued...

Table C-1. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
SE27- 5- 7	19-1	mf	FLUV			mw	B.SZ	MYS	sa
	19-2	mf	FLUV			mw	SZ.B	BUT	sa, sz
BUT4/2a	19-3	mf	FLUV	mf	FLUV	mw	B.SZ	MYS	sa
	19-4	mf	FLUV	mf	FLUV	mw	B.SZ	MYS	sa
Pakowki	19-5	mf	FLUV			mw	B.SS	MYS	
	19-6	mf	FLUV			mw	B.SZ	MYS	sa
	19-7	me	FLUV			mw	O.B	BUT	
	19-8	me	FLUV			mw	O.B	BUT	
	19-9	mf	FLUV			mw	SZ.B	BUT	sz
	19-10	mf	FLUV			w	B.SZ	MYS	sa
	19-11	fi-mf	FLUV			mw	B.SZ	MYS	
	19-12	mf	FLUV			mw-i	B.SS	MYS	
	19-13	mf	FLUV	mc	FLUV	mw-i	B.SS	MYS	
	19-14	mc	FLUV			mw	O.B	BUT	
	19-15	mf	FLUV	fi	FLUV	mw	SZ.B	BUT	sz
	19-16	mf	FLUV			mw	B.SZ	MYS	
	19-17	mc	FLUV	mf	FLUV	mw	O.R	SXT	
SE1- 9-12	25-1	me	LACU			mw	O.B	CHN	
	25-2	me	LACU	mf	TILL	mw	O.B	CFD	
CFD1/2i	25-3	mc-mf	LACU			mw	O.B	CHN	
	25-4	me	LACU	mf	TILL	mw	O.B	CFD	
Burdett	25-5	me	LACU	mf	TILL	mw	O.B	CFD	
	25-6	me	LACU	mf	TILL	mw	O.B	CFD	
	25-7	me	LACU	mf	TILL	mw	O.B	CFD	
	25-8	me	LACU	mf	TILL	mw	O.B	CFD	
	25-9	me	LACU	mf	TILL	mw	CA.B	CFD	ca
	25-10	me	LACU			mw	O.B	CHN	
	25-11	me	LACU	mf	TILL	mw	O.B	CFD	ta
	25-12	me	LACU			mw	O.B	CHN	b
	25-13	me	LACU	mf	TILL	mw	O.B	CFD	
	25-14	me	LACU	mf	TILL	mw	O.B	CFD	
	25-15	mc	LACU	me	TILL	mw	O.B	CFD	co
	25-16	me	LACU	me	TILL	mw	O.B	CFD	
	25-17	me-mf	LACU	mf	TILL	mw	O.B	CFD	
NW9- 9-12	26-1	me	LACU			w	CA.B	EXP	ta, er
	26-2	me	LACU			w	O.B	CHN	
CHN6/2-3	26-3	me	LACU			w	CA.B	EXP	
	26-4	me	LACU			w	O.B	CHN	b
Burdett	26-5	me	LACU			mw	O.B	CHN	b
	26-6	me	LACU			mw	O.B	CHN	
	26-7	mf-me	LACU			mw	O.B	CHN	
	26-8	me	LACU			w	R.B	CHN	zr, ca
	26-9	me	LACU			mw	O.B	CHN	b
	26-10	mf-me	LACU			w	CA.B	EXP	
	26-11	mf-me	LACU			w	O.B	CHN	
	26-12	me	LACU			mw	O.B	CHN	
	26-13	mf	LACU			mw	O.B	CHN	
	26-14	me	LACU			mw	O.B	CHN	
	26-15	me-mf	LACU			mw	O.B	CHN	
	26-16	mf-me	LACU			mw	CA.B	EXP	
	26-17	me	LACU			mw	O.B	CHN	

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Table C-1. Continued.

Sampling	Site	PM 1		PM 2		Drainage	Soil	Soil	Soil
Location	No.	Texture	Type	Texture	Type		Subgroup	Series	Phase
SE34- 6-10	28-1	mc	TILL			w	O.B	FMT	co
	28-2	me	LACU			w	O.B	CHN	
MACF1/3	28-3	me	TILL			w	O.B	FMT	
	28-4	mc-vc	FLUV			w	O.B	BVL	
Legend	28-5	me	LACU			w	O.B	CHN	
	28-6	me	LACU	me	TILL	w	O.B	CFD	
	28-7	me	TILL			w	O.B	MAB	
	28-8	me	LACU	me	TILL	w	O.B	CFD	ta, er
	28-9	me	LACU	mc-vc	FLUV	w	O.B	TAB	ta, er
	28-10	mf	TILL			mw	O.B	MAB	ta
	28-11	me	LACU	me	TILL	mw	O.B	CFD	
	28-12	me-mc	TILL			mw	O.B	MAB	co
	28-13	me	LACU			i	GLB.SS	PTA	co, gl
	28-14	me	LACU	me	TILL	mw	O.B	CFD	b
	28-15	mc	LACU	me	TILL	mw	O.B	CFD	co
	28-16	me	LACU	me	TILL	mw	O.B	CFD	
	28-17	me	LACU	me-mf	TILL	mw	O.B	CFD	
NW25- 8- 9	29-1	mc	FLUV			mw	O.B	BVL	
	29-2	mc	FLEO	me	LACU	mw	O.B	RIR	b
MACF1/3	29-3	mc	FLUV	me	LACU	i	GL.B	RIR	b, gl
	29-4	mc-vc	FLUV	me	LACU	w	O.B	RIR	co, sa
Conquerville	29-5	mc	FLUV	vc	FLUV	w	O.B	CVD	
	29-6	mc-vc	FLUV			w	O.B	CVD	
	29-7	mc	FLLC	vc	FLUV	w	O.B	CVD	
	29-8	vc-mc	FLUV	mf	TILL	w	O.B	ANO	er
	29-9	mc	FLUV			w	O.B	BVL	
	29-10	mc	FLUV			mw	O.B	BVL	b
	29-11	mc	FLUV			mw	O.B	BVL	
	29-12	mc-vc	FLUV			mw	O.B	BVL	
	29-13	me	FLLC	me	TILL	w	R.B	CFD	zr
	29-14	me-mf	TILL			mw	O.B	MAB	
	29-15	me	LACU	mf	TILL	mw	O.B	CFD	b
	29-16	me	FLUV	me	TILL	mw	O.B	CFD	
	29-17	mf	TILL			mw	O.B	MAB	
NW24- 5- 7	30-1	vc	EOLI	mf	TILL	i	GL.B	CVD	er, gl
	30-2	vc	EOLI			vr	O.R	ATP	
VSAT1/4-5	30-3	vc	EOLI			w	O.R	ATP	
	30-4	vc	EOLI			w	O.R	ATP	
Pakowki	30-5	vc	EOLI	mf	TILL	i	GLR.B	VST	er, gl
	30-6	vc	EOLI	mf	TILL	i	GLR.B	VST	er, gl
	30-7	mf	TILL			i	GL.B	MAB	er, gl
	30-8	vc	EOLI	mf	TILL	i	GLR.B	VST	er, gl
	30-9	vc	EOLI			i	R.B	VST	er
	30-10	vc	EOLI			w	O.R	ATP	
	30-11	vc	EOLI			r	O.R	ATP	
	30-12	vc	EOLI			mw	R.B	VST	
	30-13	vc	EOLI			p	O.HG	INS	st
	30-14	vc	EOLI			i	R.B	VST	
	30-15	vc	EOLI			i	R.B	VST	
	30-16	vc	EOLI	mf	TILL	i	R.B	VST	er
	30-17	vc	EOLI			w	O.R	ATP	b

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Table C-1. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
NW10- 5- 7	31-1	me	FLUV	fi	LACU	mw	O.B	BUT	er
	31-2	me	FLUV	mc	FLUV	mw	B.SO	MYS	
BUT4/2a	31-3	me	FLUV			mw	SZ.B	BUT	sz
	31-4	me	FLUV	mf	FLUV	mw	SZ.B	BUT	sz
Pakowki	31-5	me	FLUV	mc	FLUV	mw	SZ.B	BUT	sz
	31-6	me-mc	FLUV	mf	LACU	mw	SZ.B	BUT	sz
	31-7	mf	FLUV	fi	LACU	mw	O.R	ORN	sa, fi
	31-8	me-mc	FLUV	mf	LACU	mw	SZ.B	BUT	sa, sz
	31-9	me	FLUV	mf	LACU	mw	SZ.B	BUT	er, sz
	31-10	me	FLUV	fi	LACU	mw	B.SZ	MYS	
	31-11	me	FLUV	fi	LACU	mw	B.SZ	MYS	
	31-12	me	FLUV	mf	LACU	mw	B.SS	MYS	er
	31-13	me	FLUV			mw	B.SO	MYS	er
	31-14	me	FLUV	fi	LACU	mw	B.SS	MYS	er, xc
	31-15	me	FLUV	fi	LACU	mw	B.SZ	MYS	er
	31-16	me	FLUV	fi	LACU	mw	B.SZ	MYS	er
	31-17	me	FLUV	fi	LACU	mw	B.SZ	MYS	er
SW13- 4- 6	32-1	mf	FLUV			mw	SZ.B	BUT	sz
	32-2	mf	FLUV			mw	SZ.B	BUT	sz
MYS1/2-3a	32-3	mf	FLUV			mw	SZ.B	BUT	er, sa, sz
	32-4	mf	FLUV			mw	SZ.B	BUT	er, sz
Pakowki	32-5	fi-mf	FLUV			mw	B.SZ	MYS	er
	32-6	fi	FLUV			mw	O.R	ORN	fi
	32-7	fi-mf	FLUV			mw	B.SZ	MYS	
	32-8	fi	FLUV			mw	B.SS	MYS	fi
	32-9	fi-mf	FLUV			mw	B.SS	MYS	fi
	32-10	fi-mf	FLUV			mw	B.SS	MYS	fi
	32-11	mf	FLUV			mw	B.SZ	MYS	
	32-12	mf	FLUV			mw	B.SZ	MYS	
	32-13	mf-fi	FLUV			mw	B.SZ	MYS	
	32-14	mf	FLUV			mw	B.SS	MYS	er
	32-15	mf	FLUV			mw	B.SZ	MYS	
	32-16	me-mc	FLUV			mw	SZ.B	BUT	er, sz
	32-17	mf	FLUV			mw	SZ.B	BUT	sz
SW29- 6-10	33-1	mc	FLUV	me	TILL	w	O.B	ANO	
	33-2	me	TILL			w	O.B	MAB	co, er
MACF1/3i	33-3	mf	TILL			w	O.B	MAB	
	33-4	mf	TILL			mw	O.B	MAB	
Legend	33-5	me	TILL			mw	O.B	MAB	er, st, co
	33-6	mf	TILL	me-mc	TILL	w	O.B	MAB	er
	33-7	mf	TILL			w	O.B	MAB	er
	33-8	mf	LACU	mf	TILL	mw	O.B	CFD	
	33-9	mc	FLUV			w	O.B	PUN	
	33-10	mf	TILL			w	O.B	MAB	
	33-11	me	LACU	mf	TILL	w	O.B	CFD	
	33-12	me	LACU	mf	TILL	w	O.B	CFD	
	33-13	me	LACU	me	FLUV	mw	O.B	RAM	fi
	33-14	mf	TILL			w	O.B	MAB	
	33-15	me	TILL			mw	O.B	MAB	er
	33-16	mf	TILL			mw	O.B	MAB	er
	33-17	me	LACU	vc	FLUV	w	O.B	RAM	

... continued...

Table C-1. Concluded.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
NE13-11-12	35-1	mc-vc	FLUV			w	O.B	BUT	co
	35-2	mc	FLUV			w	O.B	BUT	co
RAM1/2-3	35-3	mc-vc	FLUV			w	O.B	BUT	co
	35-4	mc	FLUV			w	O.B	BUT	co
Burdett	35-5	mc	FLUV	me	FLUV	w	O.B	RIR	
	35-6	mc-vc	FLUV			w	O.B	BUT	co
	35-7	vc	FLUV			w	O.B	BUT	co
	35-8	vc	FLUV			w	O.B	BUT	co
	35-9	mc-vc	FLUV			w	O.B	BUT	co
	35-10	mc-vc	FLUV			w	O.B	BUT	co
	35-11	mc-vc	FLUV			w	O.B	BUT	co
	35-12	mc	FLUV			w	O.B	BUT	co
	35-13	mc-vc	FLUV			w	O.B	BUT	co
	35-14	me	FLUV	vg	FLUV	w	O.B	RAM	
	35-15	mc	FLUV	vg	FLUV	w	O.B	RAM	co
	35-16	vc	FLUV	vgvc	FLUV	w	O.B	RAM	co
	35-17	vgvc	FLUV			w	R.B	PUN	zr
SE12-11-12	36-1	mc	FLEO	mf	TILL	mw	O.B	ANO	
	36-2	mc	FLEO	mf	GLTL	mw	O.B	ANO	
BVCF4/3	36-3	mc	FLEO	mf	GLTL	mw	R.B	ANO	zr
	36-4	mc	FLEO	mf	GLTL	mw	O.B	ANO	
Burdett	36-5	mc	FLEO	mf	GLTL	mw	O.B	ANO	
	36-6	vc-mc	FLEO	mf	TILL	mw	O.B	ANO	
	36-7	vc	FLEO	vc	LACU	mw	O.B	CVD	
	36-8	vc	FLEO	mf	LACU	mw	O.B	CVD	fi
	36-9	vc	FLEO	mf	GLTL	mw	O.B	PLS	
	36-10	mc	FLEO	mf	GLTL	mw	O.B	ANO	
	36-11	vc	FLEO	mf	LACU	mw-i	O.B	PLS	
	36-12	vc	FLEO	mf	TILL	mw	O.B	PLS	
	36-13	vc	FLEO			mw	O.B	CVD	
	36-14	vc	FLEO	mf	LACU	mw	O.B	PLS	
	36-15	vc	FLEO	mf	LACU	mw	O.B	PLS	
	36-16	vc-mc	FLEO	mf	LACU	mw	O.B	RIR	
	36-17	mc	FLEO	mf	LACU	mw	O.B	RIR	

Table C-2. Field data used in the analysis of SIL3 1:50 000 mapping.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
SW10- 6-11	5-1	mf	LACU			mw-w	O.B	CHN	
	5-2	mf	TILL			w	O.B	MAB	
MACF1/3i	5-3	mf	TILL			w	O.B	MAB	
	5-4	mf	LACU	mf	TILL	w	O.B	CFD	slp
Legend	5-5	mf	LACU	mf	TILL	p	O.LG	SKF	
	5-6	mf	LACU	mf	TILL	w	O.B	CFD	slp
	5-7	mf	LACU	mf	TILL	w	O.B	CFD	slp
	5-8	mf	TILL			w	O.B	MAB	
	5-9	me	LACU	mf	TILL	w	O.B	CFD	slp
	5-10	mf	LACU	mf	TILL	w	O.B	CFD	
	5-11	mf	LACU	mf	TILL	mw	SZ.B	CHZ	
	5-12	mf	TILL			w	O.B	MAB	
	5-13	me	LACU	mf	TILL	w	O.B	CFD	slp
	5-14	mf	TILL			w	O.B	MAB	
	5-15	me	LACU	mf	TILL	w	O.B	CFD	
	5-16	mf	TILL			w	O.B	MAB	
	5-17	me-mf	TILL			w	O.B	MAB	
SW31- 5-12	6-1	mf	TILL			mw	R.B	HMS	
	6-2	me	LACU			mw	O.B	CHN	slp
MACF8/4h	6-3	me	LACU			mw	O.B	CHN	slp
	6-4	mf	TILL			mw	O.B	MAB	
Etzikom	6-5	mf	TILL			mw	CA.B	TVS	
	6-6	mf	TILL			mw	O.B	MAB	
	6-7	mf	LACU	mf	TILL	p	HU.LG		
	6-8	mf	TILL			mw	R.B	HMS	
	6-9	mf	TILL			mw	O.B	MAB	ta
	6-10	mf	TILL			mw	R.B	HMS	
	6-11	me	LACU			mw	O.B	CFD	slp
	6-12	me	LACU			mw	O.B	CHN	slp
	6-13	mf	TILL			mw	CA.B	TVS	ta
	6-14	mf	LACU			mw	O.B	CHN	slp
	6-15	mf	LACU			mw	O.B	CHN	slp
	6-16	mf	TILL			mw	CA.B	TVS	ta
	6-17	mf	TILL			mw	R.B	HMS	
SW10- 6-14	7-1	mf	LACU	mf	TILL	mw	O.B	CFD	slp
	7-2	me-mf	LACU			mw	O.B	CHN	slp, b
MAB8/4	7-3	me-mf	LACU			mw	O.B	CHN	slp, b
	7-4	me	LACU	mf	TILL	w	O.B	CFD	slp
Etzikom	7-5	mf	TILL			w	O.B	MAB	er
	7-6	mf	TILL			w	R.B	HMS	
	7-7	me	TILL			w	O.B	FMT	
	7-8	mf-fi	LACU			p	O.LG	SKF	
	7-9	mf	TILL			mw	CA.B	TVS	
	7-10	mf	LACU	mf	TILL	mw	O.B	CHN	slp
	7-11	mf	LACU			mw	O.B	CHN	b
	7-12	mf	TILL			mw	O.B	MAB	ta
	7-13	mf	TILL			mw	CA.B	TVS	
	7-14	mf	LACU	mf	TILL	mw	O.B	CFD	slp
	7-15	me-mf	LACU	mf	TILL	mw	O.B	CFD	slp
	7-16	mf	TILL			mw	O.B	MAB	
	7-17	mf	TILL			mw	O.B	MAB	

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Table C-2. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
SW17- 6-14	8-1	me	LACU	mf	TILL	w	O.B	CFD	slp
	8-2	mf	TILL			w	CA.B	TVS	
MAB2/4	8-3	mf	TILL			w	R.B	HMS	er
	8-4	mf	TILL			w	CA.B	TVS	ta
Etzikom	8-5	mf	TILL			w	O.B	MAB	
	8-6	me	LACU	mf	TILL	w	O.B	CFD	slp
	8-7	mf	TILL			w	O.B	MAB	
	8-8	mf	TILL			w	O.B	MAB	
	8-9	mf	TILL			w	O.B	MAB	
	8-10	me	LACU	mf	TILL	w	O.B	CFD	slp
	8-11	me	LACU			mw	O.B	CHN	
	8-12	me	LACU			mw	O.B	CHN	sa
	8-13	mf	TILL			w	O.B	MAB	
	8-14	me	LACU			w	O.B	CHN	slp
	8-15	me	LACU	mf	TILL	w	O.B	CFD	slp
	8-16	mf	TILL			w	O.B	MAB	
	8-17	mf	TILL			w	CA.B	TVS	
SW25-11-10	12-1	me	TILL			mw	CA.B	TVS	sa
	12-2	mf	TILL			mw	R.B	HMS	sa
MACF7/3	12-3	mf	TILL			w	CAB.SO	HDY	ca, sa
	12-4	me	TILL			mw	O.B	MAB	er
Burdett	12-5	me	TILL			mw	O.B	MAB	er
	12-6	me	TILL			w	O.B	FMT	er
	12-7	me	FLEO	me	LACU	w	B.SO	MYS	er
	12-8	me-mf	LACU			mw	O.B	CHN	er
	12-9	me	TILL			mw	O.B	MAB	er
	12-10	me	TILL			w	CA.B	TVS	er
	12-11	me	TILL			w	O.B	MAB	er
	12-12	me	TILL			w	O.B	MAB	er
	12-13	me-mf	TILL			w	SZ.B	ROL	
	12-14	me	TILL			w	O.B	MAB	
	12-15	mf	TILL			w	SZ.B	ROL	
	12-16	mf	TILL			w	O.B	MAB	
	12-17	mf	TILL			w	CA.B	TVS	
NE4-10- 9	13-1	mf	TILL			w	O.B	MAB	
	13-2	me	LACU	mf	TILL	w	O.B	CFD	slp
MACF4/3	13-3	me	LACU	mf	TILL	w	O.B	CFD	slp
	13-4	mf	TILL			w	O.B	MAB	cr
Conquerville	13-5	mf	TILL			w	R.B	HMS	
	13-6	mf	TILL			w	O.B	MAB	
	13-7	mf	TILL			w	O.B	MAB	
	13-8	mf	TILL			w	O.B	MAB	
	13-9	mf	TILL			w	CA.B	MAB	ca
	13-10	mf	TILL			w	O.B	MAB	
	13-11	mf	TILL			w	R.B	HMS	
	13-12	mf	TILL			w	R.B	HMS	
	13-13	mf	TILL			w	O.B	MAB	
	13-14	me	LACU	mf	TILL	w	O.B	CFD	slp
	13-15	me	LACU	mf	TILL	w	O.B	CFD	slp
	13-16	mf	TILL			w	O.B	MAB	
	13-17	mf	TILL			w	O.B	MAB	

... continued...

Table C-2. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
NW14- 5- 8	14-1	fi	LACU			p	R.G	GLS	sa
	14-2	fi	LACU			p	R.G	GLS	sa
GLS1/2n	14-3	fi	LACU			p	R.G	GLS	sa
	14-4	fi	LACU			p	R.G	GLS	sa
Pakowki	14-5	fi	LACU			p	R.G	GLS	sa
	14-6	fi	LACU			p	R.G	GLS	sa
	14-7	fi	LACU			p	R.G	GLS	sa
	14-8	fi	LACU			p	R.G	GLS	sa
	14-9	fi	LACU			p	R.G	GLS	sa
	14-10	fi	LACU			p	R.G	GLS	sa
	14-11	fi	LACU			p	R.G	GLS	sa
	14-12	fi	LACU			p	R.G	GLS	sa
	14-13	fi	LACU			p	R.G	GLS	sa
	14-14	fi	LACU			p	R.G	GLS	sa
	14-15	fi	LACU			p	R.G	GLS	sa
	14-16	fi	LACU			p	R.G	GLS	sa
	14-17	fi	LACU			p	R.G	GLS	sa
SW32- 5- 6	15-1	mf	FLUV			w	B.SS	MYS	er
	15-2	mf	FLUV	mc	FLUV	w	B.SS	MYS	
MYS3/2a	15-3	mf	FLUV			w	B.SS	MYS	er
	15-4	mf	FLUV			w	B.SS	MYS	er
Pakowki	15-5	mf	FLUV			w	B.SO	MYS	er
	15-6	mf	FLUV			w	B.SS	MYS	er
	15-7	me	FLUV			w	B.SS	MYS	er
	15-8	mf	FLUV			w	B.SS	MYS	er
	15-9	mf	FLUV	mc	FLUV	w	CAB.SS	MYS	er, ca
	15-10	mf	FLUV			w	CAB.SS	MYS	er, ca
	15-11	me	FLUV			w	B.SS	MYS	er
	15-12	mc	FLEO	me	FLUV	w	SZ.B		er
	15-13	me-mf	FLUV			w	B.SS	MYS	er
	15-14	me	FLUV			w	B.SS	MYS	
	15-15	mc	FLEO	mf	LACU	w	B.SS	MYS	
	15-16	mc	FLEO	me	LACU	w	O.B	RIR	
	15-17	mc	FLEO			w	O.B	BVL	
SW34- 5- 6	16-1	mf	TILL			w	SZ.B	ROL	
	16-2	mf	TILL			w	CAB.SS	HUK	er, ca
HUGE1/3	16-3	mf	TILL			w	B.SO	HDY	
	16-4	mf	TILL			w	B.SO	HDY	
Pakowki	16-5	mf	TILL			w	CAB.SO	HDY	ca
	16-6	mf	TILL			w	SZ.B	ROL	
	16-7	mf	TILL			w	B.SS	HUK	er
	16-8	mf	TILL			w	CAB.SO	HDY	ca
	16-9	me	LACU	mf	TILL	w-mw	B.SO	GEM	slp, er
	16-10	mf	TILL			w	B.SO	HDY	
	16-11	mf	TILL			w	SZ.B	ROL	
	16-12	mf	TILL			w	B.SS	HUK	er
	16-13	mf	TILL			w	B.SO	HDY	
	16-14	mf	TILL			w	B.SS	HUK	slp
	16-15	mf	TILL			w	CAB.SO	HDY	er, ca
	16-16	mf	TILL			w	SZ.B	ROL	
	16-17	mf	TILL			w	B.SS	HUK	

... continued...

Table C-2. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
NW14-11-10	20-1	mf	LACU	me	TILL	w	CA.B	EXP	
	20-2	mf	TILL			w	CA.B	TVS	
MACF4/3	20-3	mf	TILL			w	CA.B	TVS	
	20-4	me	LACU			w	CA.B	EXP	b
Burdett	20-5	mf	TILL			w	CA.B	TVS	
	20-6	me	LACU	mf	TILL	w	O.B	CFD	
	20-7	me	LACU	mf	TILL	w	O.B	CFD	
	20-8	mf	LACU			mw-w	CA.B	EXP	
	20-9	mf	TILL			w	CA.B	TVS	
	20-10	me	LACU	mf	TILL	w	SZ.B	CHZ	xt
	20-11	me	LACU			w	SZ.B	CHZ	
	20-12	me	LACU			w	O.B	CHN	
	20-13	me	LACU	mf	TILL	w	O.B	CFD	
	20-14	mf	LACU			w	CASZ.B	CHZ	ca
	20-15	mf	LACU			w	CASZ.B	CHZ	ca
	20-16	mf	TILL			w	R.B	HMS	
	20-17	me-mf	LACU	mf	TILL	w	O.B	CFD	slp
SW34- 8-10	21-1	mf	TILL			w	O.B	MAB	
	21-2	me	LACU	mf	TILL	mw	O.B	CFD	b
MACF2/3	21-3	mf	LACU			mw	O.B	CHN	b
	21-4	me	LACU	mf	TILL	i-mw	O.B	CFD	b
Conquerville	21-5	me	TILL			mw	O.B	MAB	
	21-6	mf	LACU	mf	TILL	w	O.B	CFD	
	21-7	mf	LACU	mf	TILL	w	O.B	CFD	sa
	21-8	mf	TILL			mw	R.B	HMS	
	21-9	mf	TILL			mw	R.B	HMS	
	21-10	mf	LACU	mf	TILL	w	R.B	CFD	zr
	21-11	mf	TILL			w	O.B	MAB	
	21-12	mf	TILL			w	O.B	MAB	b
	21-13	me	LACU	mf	TILL	mw	O.B	CFD	b
	21-14	mf	LACU			w	O.B	CHN	b
	21-15	mf	TILL			w	O.B	MAB	
	21-16	me	LACU			p	O.LG	SKF	
	21-17	me	LACU			i	O.LG	SKF	
SE3- 9- 8	22-1	me	LACU	mf	TILL	mw	O.B	CFD	
	22-2	mf	TILL			w	O.B	MAB	
MACF7/3	22-3	mf	TILL			w	O.B	MAB	ta, er
	22-4	mf	LACU	mf	TILL	mw	O.B	CFD	
Etzikom	22-5	mf	LACU	mf	TILL	w	SZ.B	CHZ	
	22-6	me	LACU	mf	TILL	mw	B.SO	GEM	er
	22-7	mf	TILL			w	O.B	MAB	
	22-8	mf	TILL			mw	CA.B	TVS	
	22-9	mf	TILL			w	O.B	MAB	
	22-10	mf	TILL			mw	O.B	MAB	
	22-11	mf	TILL			mw	O.B	MAB	er
	22-12	mf	TILL			w	O.B	MAB	
	22-13	me	LACU	me	TILL	w	O.B	CFD	
	22-14	mf	TILL			w	O.B	MAB	
	22-15	mf	TILL			w	O.B	MAB	er
	22-16	me	LACU	mf	TILL	mw	B.SO	GEM	
	22-17	mf	TILL			mw	O.B	MAB	

... continued...

Table C-2. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
NE6- 9- 8	23-1	mf	TILL			w	O.B	MAB	
	23-2	mf	TILL			w	O.B	MAB	
MACF3/3	23-3	mf	TILL			mw	O.B	MAB	
	23-4	mf	TILL			mw	O.B	MAB	
Conquerville	23-5	mf	TILL			mw	O.B	MAB	er, ta
	23-6	mf	TILL			mw	O.B	MAB	
	23-7	me	LACU			mw	R.B	CHN	zr
	23-8	mf	LACU			mw	O.B	CHN	sa
	23-9	mf	LACU	mf	TILL	w	O.B	CFD	sa
	23-10	mc	EOLI	me	TILL	mw	B.SO	GEM	co
	23-11	mf	LACU	mf	TILL	p	O.G	IWT	sa
	23-12	mf	LACU			mw	B.SZ	BLP	
	23-13	mf	LACU	mf	TILL	mw	B.SZ	BLP	xt
	23-14	mf	LACU	mf	TILL	w	O.B	CFD	
	23-15	mf	TILL			mw	O.B	MAB	
	23-16	me	TILL			mw	O.B	FMT	fi
	23-17	mf	FLUV	mc-vc	FLUV	mw	CA.B	BVL	ca
NW28- 6-11	24-1	mf	TILL			mw	O.B	MAB	ta, er
	24-2	me	LACU			mw	O.B	CHN	b
MACF1/2	24-3	mf	TILL			mw	O.B	MAB	ta, er, sa
	24-4	mf	LACU	mf	TILL	mw	O.B	CFD	
Legend	24-5	mf	LACU	mf	TILL	mw	O.B	CFD	b
	24-6	me	LACU	me	TILL	w	O.B	CFD	b
	24-7	mf	LACU	me	TILL	w	O.B	CFD	b
	24-8	mf	LACU	mf	TILL	w	O.B	CFD	slp
	24-9	mf	LACU	mf	TILL	w	O.B	CFD	
	24-10	mf	TILL			w	O.B	MAB	
	24-11	mf	LACU	mf	TILL	w	O.B	CFD	b
	24-12	mf	LACU	me	TILL	w	O.B	CFD	b
	24-13	mf	LACU	mf	TILL	w	O.B	CFD	
	24-14	mf	LACU	mf	TILL	w	O.B	CFD	
	24-15	me	TILL			w	O.B	MAB	
	24-16	me	LACU	me	TILL	w	O.B	CFD	
	24-17	mf	LACU	me	TILL	w	O.B	CFD	
NW24- 7-12	27-1	me	LACU			mw	O.B	CHN	
	27-2	me	TILL			mw	O.B	MAB	st
MACF1/3	27-3	me	TILL			mw	CA.B	TVS	slp, st
	27-4	me	LACU	mf	TILL	mw	O.B	CFD	
Conquerville	27-5	me	LACU			mw	O.B	CHN	b
	27-6	me	LACU	mf	TILL	mw	O.B	CFD	
	27-7	mf	TILL			mw	CA.B	TVS	
	27-8	me	LACU	mf	TILL	mw	O.B	CFD	
	27-9	mf	LACU	mf	TILL	mw	O.B	CFD	
	27-10	me	LACU	mc	FLUV	w	O.B	RAM	
	27-11	me	TILL			w	CA.B	TVS	
	27-12	me	TILL			mw	O.B	MAB	
	27-13	mf	LACU			i	GLE.B	CHN	gl, ze
	27-14	me	LACU			mw	O.B	CHN	
	27-15	me	LACU			mw	O.B	CHN	
	27-16	me	LACU	mf	TILL	w	O.B	CFD	
	27-17	mf	TILL			w	O.B	MAB	

... continued...

Table C-2. Continued.

Sampling Location	Site No.	PM 1 Texture	PM 1 Type	PM 2 Texture	PM 2 Type	Drainage	Soil Subgroup	Soil Series	Soil Phase
SE9- 4- 7	34-1	fi	LACU			mw	O.R	WTN	sa
	34-2	fi	LACU			mw	O.R	WTN	sa
GLS1/2n	34-3	fi	LACU			mw	O.R	WTN	sa
	34-4	fi	LACU			mw	O.R	WTN	sa
Pakowki	34-5	fi	LACU			mw	O.R	WTN	sa
	34-6	fi	LACU			mw	O.R	WTN	sa
	34-7	fi	LACU			mw	O.R	WTN	sa
	34-8	fi	LACU			mw	O.R	WTN	sa
	34-9	fi	LACU			mw	O.R	WTN	sa
	34-10	fi	LACU			mw	O.R	WTN	sa
	34-11	fi	LACU			mw	O.R	WTN	sa
	34-12	fi	LACU			mw	O.R	WTN	sa
	34-13	fi	LACU			mw	O.R	WTN	sa
	34-14	fi	LACU			mw	O.R	WTN	sa
	34-15	fi	LACU			mw	O.R	WTN	sa
	34-16	fi	LACU			i-mw	O.R	WTN	sa
	34-17	fi	LACU			mw	O.R	WTN	sa
SE12-10-12	37-1	mf	LACU			mw	O.B	CHN	sa
	37-2	mf	LACU	mf	TILL	mw	R.B	CHN	zr, sa, xt
MACF1/3	37-3	mf	LACU			mw	O.B	CHN	sa
	37-4	mf	LACU	mc	FLUV	mw	R.B	TAB	zr
Burdett	37-5	me	LACU			mw	CA.B	EXP	b, ca
	37-6	mf	LACU	mf	TILL	mw	R.B	CHN	zr, sa
	37-7	me	TILL			mw	O.B	FMT	
	37-8	mf	LACU	mf	TILL	mw	O.B	CHN	
	37-9	mf	LACU	mf	TILL	mw	O.B	CHN	
	37-10	mf	LACU			mw	O.B	CHN	sa
	37-11	mf	LACU			mw	O.B	CHN	b
	37-12	mf	LACU			mw	SZ.B	CHZ	sa
	37-13	mf	LACU			mw	O.B	CHN	sa
	37-14	mf	LACU			mw	O.B	CHN	
	37-15	me	LACU	mf	TILL	mw	O.B	CFD	
	37-16	mf	LACU	mc	FLUV	i	GL.B	TAB	gl
	37-17	me	LACU			mw	O.B	CHN	b
SW27-10-12	38-1	me	LACU	mc	FLUV	mw	R.B	TAB	zr
	38-2	mc	LACU	vc	FLUV	mw	O.B	TAB	
MACF4/3	38-3	me	LACU	vc	FLUV	mw	O.B	TAB	
	38-4	me	LACU			mw	O.B	CHN	
Burdett	38-5	me	LACU	vc	FLUV	mw	R.B	TAB	zr
	38-6	me-mf	LACU			mw	O.B	CHN	
	38-7	me	LACU			mw	O.B	CHN	
	38-8	me	LACU	mc-vc	FLUV	mw	R.B	TAB	zr
	38-9	me	LACU			mw	O.B	CHN	
	38-10	me	LACU			mw	O.B	CHN	
	38-11	me	LACU	mc	FLUV	mw	O.B	CHN	
	38-12	me	LACU			w	R.B	CHN	zr
	38-13	me	LACU			w	O.B	CHN	
	38-14	me	LACU	me	TILL	w	R.B	CFD	zr, er, sa
	38-15	me	TILL			w	R.B	HMS	sa
	38-16	mf	TILL			w	R.B	HMS	
	38-17	me-mc	TILL			w	R.B	HMS	

... continued...

Table C-2. Concluded.

Sampling	Site	PM 1		PM 2		Drainage	Soil	Soil	Soil
Location	No.	Texture	Type	Texture	Type		Subgroup	Series	Phase
SW10- 7-14	39-1	me	LACU	mc	FLLC	w	O.B	TAB	
	39-2	me	LACU	mc	FLLC	w	O.B	TAB	
CHCF1/2	39-3	me	LACU			w	O.B	CHN	
	39-4	me	LACU	mc	FLLC	w	O.B	TAB	
Legend	39-5	me	LACU	mc	FLLC	w	O.B	BVL	fi
	39-6	me	LACU	mc	FLLC	w	O.B	TAB	
	39-7	me	LACU			w	O.B	CHN	
	39-8	me	LACU	mc	FLLC	w	O.B	TAB	
	39-9	me	LACU			mw	O.B	CHN	
	39-10	me	LACU	mc	FLLC	w	O.B	TAB	
	39-11	me	LACU			w	O.B	CHN	
	39-12	me	LACU	mc	FLLC	w	O.B	TAB	
	39-13	me	LACU	mc	FLLC	w	O.B	TAB	
	39-14	me	LACU	mc	FLLC	w	O.B	TAB	
	39-15	me	LACU			w	O.B	CHN	
	39-16	me	LACU			w	O.B	CHN	
	39-17	me	LACU	mc	FLLC	w	O.B	TAB	
NE5- 7-13	40-1	mf	LACU	vg	FLUV	w	O.B	RAM	
	40-2	vgmf	FLUV			w	O.B	PUN	fi
RAPU1/2-3	40-3	vgme	FLUV			w	O.B	PUN	fi
	40-4	me	LACU	vg	FLUV	w	O.B	RAM	
Legend	40-5	me	LACU	vg	FLUV	mw	O.B	RAM	
	40-6	me-mf	LACU	vg	FLUV	mw	O.B	RAM	
	40-7	vgme	FLUV			w	O.B	PUN	fi
	40-8	me-mc	LACU	vg	FLUV	w	O.B	RAM	
	40-9	me	LACU	vg	FLUV	w	O.B	RAM	
	40-10	me	LACU	vg	FLUV	mw	O.B	RAM	
	40-11	me	LACU	vg	FLUV	w	O.B	RAM	
	40-12	me	LACU	vg	FLUV	w	O.B	RAM	
	40-13	me-mf	LACU	vg	FLUV	w	O.B	RAM	
	40-14	mf	LACU	vg	FLUV	w	O.B	RAM	
	40-15	me	LACU	vg	FLUV	w	O.B	RAM	
	40-16	me	LACU	mc	FLUV	w	O.B	CHN	co
	40-17	me	LACU	mc	FLUV	w	O.B	CHN	co

APPENDIX D: RESULTS

Appendix D contains the detailed results of the analyses conducted for the comparison of Extrapolatory and SIL3 1:50 000 mapping methods.

Table D-1. Results of the comparison of observed vs. predicted soil series for the Extrapolatory mapping method.

Transect Number	Exact Match (n/17)		Similarity (n/17)	Percent Correct		Percent Similar
	P	NP		P	NP	
1	15	15	16.96	88.2%	88.2%	99.8%
2	17	17	17.00	100.0%	100.0%	100.0%
3	15	16	16.40	88.2%	94.1%	96.5%
4	9	17	15.93	52.9%	100.0%	93.7%
9	17	17	17.00	100.0%	100.0%	100.0%
10	15	17	16.80	88.2%	100.0%	98.8%
11	12	17	16.50	70.6%	100.0%	97.1%
17	10	10	16.48	58.8%	58.8%	96.9%
18	15	17	16.91	88.2%	100.0%	99.5%
19	6	9	11.52	35.3%	52.9%	67.8%
25	17	17	17.00	100.0%	100.0%	100.0%
26	14	17	16.70	82.4%	100.0%	98.2%
28	13	13	16.36	76.5%	76.5%	96.2%
29	6	6	13.94	35.3%	35.3%	82.0%
30	11	11	15.33	64.7%	64.7%	90.2%
31	3	3	10.75	17.6%	17.6%	63.2%
32	10	11	15.38	58.8%	64.7%	90.5%
33	13	13	15.96	76.5%	76.5%	93.9%
35	3	3	15.88	17.6%	17.6%	93.4%
36	6	9	15.09	35.3%	52.9%	88.8%
Mean	11.35	12.75	15.69	66.8%	75.0%	92.3%
Variance	20.87	23.04	3.07	0.07	0.08	0.01

Table D-2. Results of the comparison of observed vs. predicted soil series for the SIL3 1:50 000 mapping method.

Transect Number	Exact Match (n/17)		Similarity (n/17)	Percent Correct		Percent Similar
	P	NP		P	NP	
5	17	17	17.00	100.0%	100.0%	100.0%
6	15	17	16.96	88.2%	100.0%	99.8%
7	11	12	16.68	64.7%	70.6%	98.1%
8	12	14	16.40	70.6%	82.4%	96.5%
12	15	15	16.93	88.2%	88.2%	99.6%
13	17	17	17.00	100.0%	100.0%	100.0%
14	12	17	15.50	70.6%	100.0%	91.2%
15	13	15	14.72	76.5%	88.2%	86.6%
16	13	13	16.60	76.5%	76.5%	97.6%
20	12	13	16.44	70.6%	76.5%	96.7%
21	15	15	16.96	88.2%	88.2%	99.8%
22	15	16	16.81	88.2%	94.1%	98.9%
23	14	14	16.67	82.4%	82.4%	98.1%
24	15	16	16.63	88.2%	94.1%	97.8%
27	15	16	16.72	88.2%	94.1%	98.4%
34	0	0	7.56	0.0%	0.0%	44.5%
37	6	8	14.48	35.3%	47.1%	85.2%
38	4	4	15.30	23.5%	23.5%	90.0%
39	6	6	14.49	35.3%	35.3%	85.2%
40	9	12	16.08	52.9%	70.6%	94.6%
Mean	11.8	12.85	15.80	69.4%	75.6%	92.9%
Variance	21.01	22.66	4.49	0.07	0.08	0.02

Table D-3. Results of the comparison of observed vs. predicted soil series for Extrapolatory mapped areas in each mapping district.

Mapping District	Transect Number	Exact Match (n/17)		Similarity (n/17)	Percent Correct		Percent Similar
		P	NP		P	NP	
Burdett	25	17	17	17.00	100.0%	100.0%	100.0%
	26	14	17	16.70	82.4%	100.0%	98.2%
	35	3	3	15.88	17.6%	17.6%	93.4%
	36	6	9	15.09	35.3%	52.9%	88.8%
	Mean	10.00	11.50	16.17	58.8%	67.6%	95.1%
Conquerville	9	17	17	17.00	100.0%	100.0%	100.0%
	17	10	10	16.48	58.8%	58.8%	96.9%
	18	15	17	16.91	88.2%	100.0%	99.5%
	29	6	6	13.94	35.3%	35.3%	82.0%
	Mean	12.00	12.50	16.08	70.6%	73.5%	94.6%
Etzikom	1	15	15	16.96	88.2%	88.2%	99.8%
	2	17	17	17.00	100.0%	100.0%	100.0%
	10	15	17	16.80	88.2%	100.0%	98.8%
	11	12	17	16.50	70.6%	100.0%	97.1%
	Mean	14.75	16.50	16.82	86.8%	97.1%	98.9%
Legend	3	15	16	16.40	88.2%	94.1%	96.5%
	4	9	17	15.93	52.9%	100.0%	93.7%
	28	13	13	16.36	76.5%	76.5%	96.2%
	33	13	13	15.96	76.5%	76.5%	93.9%
	Mean	12.50	14.75	16.16	73.5%	86.8%	95.1%
Pakowki	19	6	9	11.52	35.3%	52.9%	67.8%
	30	11	11	15.33	64.7%	64.7%	90.2%
	31	3	3	10.75	17.6%	17.6%	63.2%
	32	10	11	15.38	58.8%	64.7%	90.5%
	Mean	7.50	8.50	13.25	44.1%	50.0%	77.9%

Table D-4. Results of the comparison of observed vs. predicted soil series for SIL3 1:50 000 mapped areas in each mapping district.

Mapping District	Transect Number	Exact Match (n/17)		Similarity	Percent Correct		Percent
		P	NP	(n/17)	P	NP	Similar
Burdett	12	15	15	16.93	88.2%	88.2%	99.6%
	20	12	13	16.44	70.6%	76.5%	96.7%
	37	6	8	14.48	35.3%	47.1%	85.2%
	38	4	4	15.30	23.5%	23.5%	90.0%
	Mean	9.25	10.00	15.79	54.4%	58.8%	92.9%
Conquerville	13	17	17	17.00	100.0%	100.0%	100.0%
	21	15	15	16.96	88.2%	88.2%	99.8%
	23	14	14	16.67	82.4%	82.4%	98.1%
	27	15	16	16.72	88.2%	94.1%	98.4%
	Mean	15.25	15.50	16.84	89.7%	91.2%	99.0%
Etzikom	6	15	17	16.96	88.2%	100.0%	99.8%
	7	11	12	16.68	64.7%	70.6%	98.1%
	8	12	14	16.40	70.6%	82.4%	96.5%
	22	15	16	16.81	88.2%	94.1%	98.9%
	Mean	13.25	14.75	16.71	77.9%	86.8%	98.3%
Legend	5	17	17	17.00	100.0%	100.0%	100.0%
	24	15	16	16.63	88.2%	94.1%	97.8%
	39	6	6	14.49	35.3%	35.3%	85.2%
	40	9	12	16.08	52.9%	70.6%	94.6%
	Mean	11.75	12.75	16.05	69.1%	75.0%	94.4%
Pakowki	14	12	17	15.50	70.6%	100.0%	91.2%
	15	13	15	14.72	76.5%	88.2%	86.6%
	16	13	13	16.60	76.5%	76.5%	97.6%
	34	0	0	7.56	0.0%	0.0%	44.5%
	Mean	9.50	11.25	13.60	55.9%	66.2%	80.0%

Table D-5. Probability values (PV) for F-tests and t-tests to check for significant differences between results.

Comparison	F-test	t-test
Extrapolatory mapping, % correct, P vs. NP	0.416	0.436
SIL3 1:50 000 mapping, % correct, P vs. NP	0.351	0.482
% correct, P, Extrapolatory vs. SIL3 1:50 000	0.494	0.758
% correct, NP, Extrapolatory vs. SIL3 1:50 000	0.486	0.948
% similar, Extrapolatory vs. SIL3 1:50 000	0.208	0.869

P - proportional, NP - non-proportional
Ho (F-test): The variances are equal
Ho (t-test): The difference of the means is equal to 0
Decision rule: accept Ho if PV is less than or equal to 0.05