NODA FILE REPORT 7

NODA Project 4053: Identifying sites/opportunities for forest-based ecotourism, Northern Ontario.

Report 3

GIS MAPPING OF POTENTIAL AREAS FOR ECOTOURISM IN NORTHERN ONTARIO

prepared by

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It should be noted that the views and conclusions contained in this report are those of the Authors and should not be construed as either policy or endorsement by Forestry Canada or the Ontario Ministry of Natural Resources.

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1.0. INTRODUCTION

The previous report (#2) outlined a methodology that proposed to utilize Geographical Information Systems (G.I.S.) to identify potential ecotourism areas within Northern Ontario. GIS technology was used to identify ecotourism sites by linking criteria [indicators for ecotourism suitability, see report #1] deemed important, with actual landscape characteristics of Northern Ontario. The overall purpose of this report is to present and discuss a set of maps of ecotourism potential within a selected area of Northern Ontario. It not the intention of the authors to reiterate the steps involved in the methodology as this has already been covered in report #2, but rather to explain and justify modifications that have been made to the methodology in order to produce the maps.

Much of this report is based on two preliminary studies that were undertaken within the time frame of the third phase of the overall project. First, a feasibility study was produced to measure the degree to which the attributes and value ranges, as outlined in report #2, conformed to the database provided by Forest Landscape Ecology Program (FLEP), a division within the Ontario Forest Research Institute (OFRI), located in Sault Ste. Marie, Northern Ontario. Second, a report was produced on the degree to which the methodology could be operationalized, applying it to a sample area within the overall study area. Maps were produced for each "thematic" layer of the GIS, along with the overlays of themes in order to identify potential types of ecotourism units.

Following these introductory statements, the second section of this report provides discussion on the revisions made to the methodology based on the feasibility study. Section three describes the test of the methodology within a selected sample section of the overall study area. Discussion centres on the procedure used to produce each thematic layer, the characteristics of each layer, and changes and recommendations with respect to the procedure needed to undertake the GIS for the entire study area. The fourth section describes the maps that were produced for the entire study area for each theme, the overlays of themes and the resultant maps displaying ecotourism type units. Some concluding

comments and discussion are provided in section five on the output presented in the previous section and on the next steps of the project, given that the GIS mapping has been completed.

2.0. REVISIONS TO THE METHODOLOGY

As the methodology was developed from a somewhat conceptual perspective and prior to obtaining the services of the Forest Landscape Ecology Program (FLEP), it was expected that the methodology may need to be revised to suit the FLEP database. For this purpose, a feasibility report was produced by the GIS analyst to highlight those areas of the methodology where potential changes would be required. This section of the report expands on the feasibility study, noting and explaining how each of the attributes were modified to correspond with the FLEP database. Each of the attributes is discussed below in the order they were presented in report two rather than their proposed hierarchical arrangement found in stage three of the methodology. Appendix 1 and 2 respectively show the attribute list, scores and value ranges as they first appeared in report #2 and how they were subsequently modified to correspond to the requirements needed for the FLEP database.

2.1. Presence or absence of community

Four categories were initially proposed, three for different types of community [villages (<250), small towns (250-5000) and urban (industrial-based) settlements (>5000)] and one representing the absence of permanent settlement in the area. There was no change to the number of categories selected for this attribute; the only change was in how each type was defined, and the size and range of population that was assigned to each class. Using the FLEP database, community size was classified in digital form into the following classes: unincorporated communities, towns and cities with population ranging from 1-1000, 1001-10,000 and >10,000, respectively. These definitions and population range were based on maps produced by the Land and Resource Information Branch of the Ministry of Natural Resources in 1992. Using these categories, communities were digitized from 1:250,000 NTS map sheets for the study area.

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2.2. Resource-related activity

In report #2 forestry and mining-related practices were grouped under a general attribute labeled resource-related activity. It was initially suggested that the score an area could receive would be determined by the presence or absence of certain resource types for a set percentage (e.g. > & < 20%) of each area. The feasibility study brought to the attention of the authors of this report the availability of satellite data, by decade, for clear-cut logging activity over the past forty years. In light of this, the scoring system was modified to accommodate the temporal dimension over which resource activities were present in the region. As such, regions that experienced cuts 30 to 40 years ago received a score of 4, whereas areas which experienced cutting in the past decade received a score of 1. A score of 5 was assigned to areas where there was no extractive activity present or cutting had taken place more than 40 years ago, if at all.

A second change to the procedure of mapping resource activity was to treat forestry and mining activities separately, creating a "thematic" layer for each activity. The reason behind this change was based on how these activities were recorded by the GIS. Areas of cutting were best displayed in the form of polygons, whereas mining activities in this form only showed up as points. As a result, trying to measure the extent of an area where both activities were ongoing (e.g. multi-use areas) was biased toward areas in which forestry practices were dominant. Also, under the initial scoring system, there was no accommodation made for areas in which only forestry practices were present.

2.3. Vegetation coverage

There were no changes to the scores and value range assigned to the vegetation coverage layer as the data used to produce this layer had previously been used by OFRI to map areas of old growth red and white pine under the Forest Fragmentation and Biodiversity Project. The feasibility report stated that there would be no technical difficulties in collapsing the 12

remotely sensed vegetation types to 5 for purposes of the study as it did not require any new information to be digitized, but rather only reclassifying existing data to conform to the categories that had been stated in report #2 (p. 24).

2.4. Access characteristics

In order to map this attribute, specific changes from what was presented in report #2 were needed. To begin with, the information displayed in report #2 (p. 24) focused more on the type of access as expressed in the form of a continuum which ranged from passive to arduous access, rather than the infrastructure (road network) present over the study region.

Three classes of roads were identified which could be digitized: hard surface roads (inclusive of all weather highways divided, two or more lanes, or two lanes or less), loose surface roads (inclusive of all weather surface and dry weather roads) and logging roads. The road network (first 2 classes) was digitized from NTS 1:250,000 topographic map sheets. The logging roads were derived from remotely sensed data.

In the initial report, a distance component was proposed to illustrate the requirements an area needed in order for it to be classed as having a certain access type. This idea was developed further for the purpose of delimiting those regions which had the potential to be most or least preferred by the ecotourist. For instance, areas outside of any buffers [2 km, 5 km and 10 km buffers around logging, loose surface roads and paved roads, respectively] were labeled as type I and viewed as most preferred, receiving a score of 5 whereas areas within the 10 km buffer around paved roads were labeled as a type IV access area, least preferred and assigned a score of 1.

2.5. Recreational activity

Although this attribute was mentioned in the previous report, the nature of the FLEP database and the reality that a variety of activities do not lend themselves to mapping using a GIS, resulted in this attribute being removed as a thematic layer within the GIS. In

addition, the ARDA land capability classification for Recreation has not been satisfactorily updated and is focused on intensive use of the landscape rather than the quality of the experience which is critical to activities such as ecotourism. The nature of recreational activity is often dependent on factors such as the duration of stay by visitors and the types of visitors that are attracted by activities. This type of information lends itself more readily to a questionnaire approach by which the characteristics of travelers, their desires and motivations can be obtained.

2.6. Wildlife

This attribute underwent significant change with respect to the value range shown in report #2 (p.27) and that used to identify ecotourism units over the study area. The emphasis in report #2 was on the wildlife setting, as noted by the presence of several areas within the scores that were assigned. Nature reserves, national and provincial parks received the highest score of 5, while deer yards and wintering sites were scored next highest with a 3. Aspects of this attribute were modified to emphasize wildlife potential of areas. The change toward wildlife potential was in response to the need to avoid identifying specific areas from which wildlife could be observed (e.g. feeding, mating, breeding and wintering sites), because of the possibility of subsequent disruption and disturbance. This is a problem which often occurs in ecotourism destinations, especially within the tropics, but it is not appropriate behaviour for ecotourists nor the image that the ecotourism industry, in general, would wish to promote. For these reasons, the wildlife layer within the GIS focused on the potential for certain types of wildlife within areas. The ARDA capability maps for both waterfowl and ungulates were used, with those areas classed from 1 to 3 receiving the best score (5), whilst areas of class 6 and 7 capability received the lowest score (1).

In the initial report, protected areas such as nature reserves and provincial parks were incorporated within the wildlife layer. A basic weakness of this arrangement was the

fact that many types of provincial parks have little wildlife associated with them, as many in the Study Area are classified as 'recreational' and 'waterway' parks. Only those parks classified as 'nature reserves', 'wilderness' and possibly 'natural environment' could be expected to have wildlife present to some extent. As a result, a separate "thematic" layer within the GIS was developed for protected areas, provincial parks and reserves. They are distinctive enough from the wildlife layer to justify creating a new layer, and this new layer provides inclusion of one element of the spectrum of recreational activity and potential in the form of designated recreational areas.

2.7. Landscape characteristics

The presence of water, rock outcrops and relative relief comprised the three landscape elements discussed in report #2 (p.27-28). The data for landscape were derived from remotely sensed satellite imagery (water and rock outcrops) and used in developing a Digital Elevation Model (DEM) (relative relief) for the study area. The value ranges remained the same as proposed in report #2, but changes were needed to calculate the percentage of each landscape characteristic that was found within ecotourism units and which corresponded with set value ranges outlined in the previous report. One problem that presented itself was that the calculation used to determine the percentage of water, within units, required knowledge of the boundaries of each ecotourism unit before they could be determined based on the attribute of the regions themselves. The feasibility report outlined a solution to this problem by dividing the study area into smaller grids of approximately 1 km by 1 km, calculating the percentage of water within the grids and applying these to potential ecotourism units within the grid. A similar procedure was contemplated to measure the presence of rock outcrops, but because this attribute only represented 1.5% of the study area, it was dropped from the analysis.

2.8. Procedure employed

One recommendation from the feasibility report was to arrange the "thematic" layers of the GIS in a hierarchical order in terms of their perceived importance for ecotourism. It was anticipated that restructuring the procedure in this way would help to simplify the functions performed by the GIS, in terms of the time needed to produce the layers, as any areas perceived to be unsuitable for ecotourism could be eliminated from the overall study area. Time consuming GIS functions such as producing overlays and buffering within layers could be undertaken in less time than was initially believed, given that not all of the study area would be involved in every step of the GIS for all of the "thematic" layers.

3.0 TEST OF METHODOLOGY WITHIN SAMPLE AREA

The methodology was tested using a sample area within the overall study area for the purposes of determining if ecotourism areas could be identified from the value ranges that were given to the above mentioned attributes; in other words, could the methodology be operationalized? A second reason for conducting a trial run was to determine if there were any limitations in either the methodology or in the GIS, and the implications of such in applying the method to the overall study area. Particular attention was paid to the "appropriateness" of the techniques employed and the "relevance" of scores that attributes received. The production of maps for each of the layers used in the GIS, along with the overlays to identify actual ecotourism type units, were considered as beneficial in suggesting the nature of procedural changes necessary before analysis was directed to the overall study area.

A relatively large sample region was selected to test the methodology, representing approximately 20 percent of the overall study area (Figure 1). The Test Area lies in the north central part of the overall area, sharing the northern boundary of the Study Area, and extending some 100 kilometers to the south, and measuring about 125 kilometers from west to east. The Test Area was selected as an initial examination of the area as it revealed that it had a reasonable representation of the full range of physical and human attributes possessed by the Study Area, with the exception of an absence of active mines. This allowed the methodology to be tested fully, and as noted earlier, enabled some minor problems to be identified and treated before the complete area was examined.

3.1. Analysis of maps

Maps were produced to show the presence of community, the extent to which the area had undergone harvesting in the last four decades, the nature of the vegetation coverage, and the road network and landscape characteristics, in terms of both the presence of water and

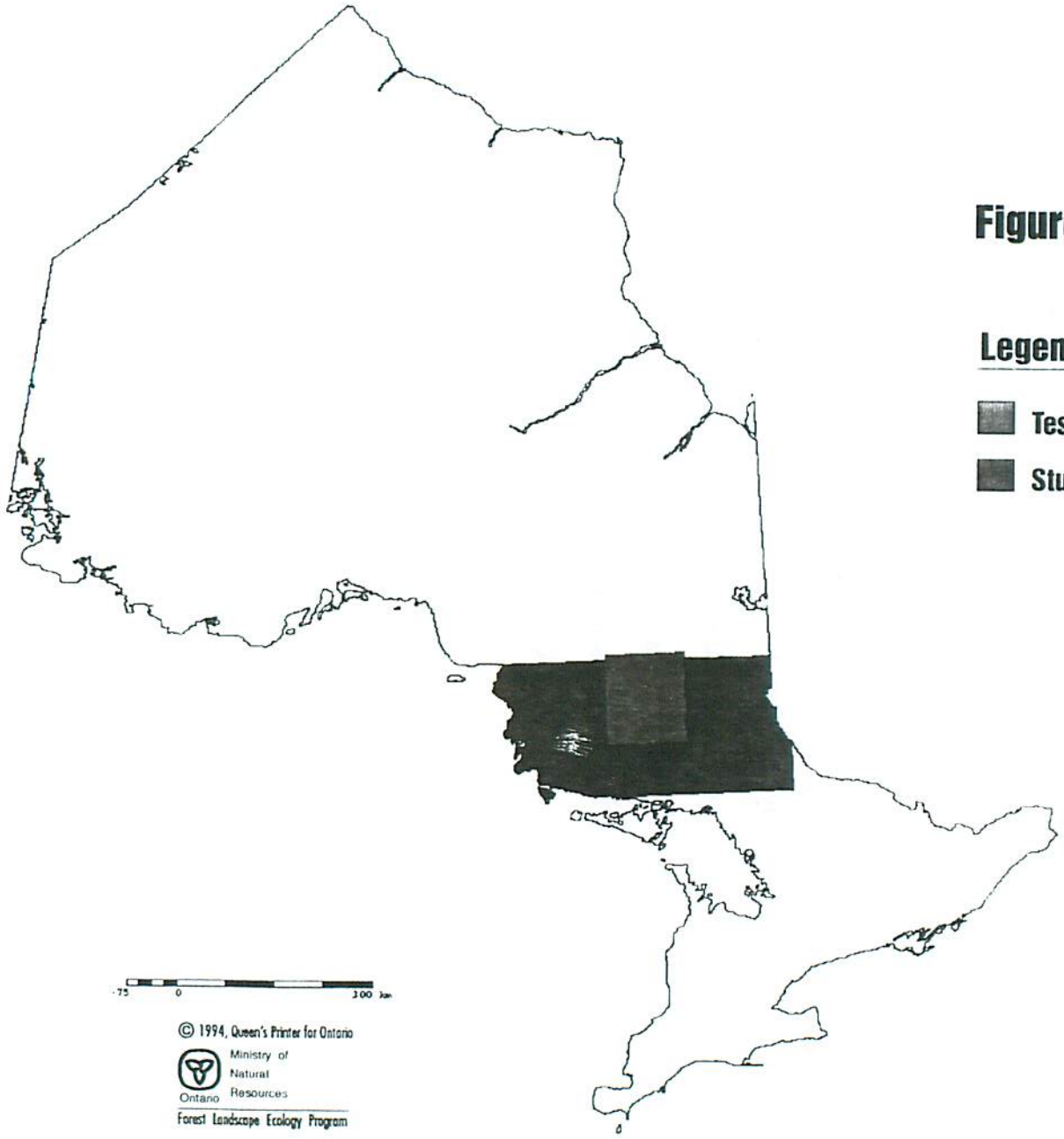

Figure 1. Project Region

absolute relief. No map was produced for mining-related activities as no mines were present within the test region. The wildlife layer was not produced because there was incomplete ARDA coverage for this region. As a result, the cumulative scores that an area within the test region could possibly receive were somewhat lower than those initially outlined in the second report, given the absence of two of the seven attributes of naturalness used to identify ecotourism units.

Figure 2 shows the communities which are present in the sample area. As this region is located in a remote part of Northern Ontario, away from large industrial-based centres, only 5 unincorporated communities [population of 1000 persons or less] were found: Sultan, Biscotasing, Westree, Gogama and Shining Tree.

The extent to which the sample area has been cut over in the last four decades is reflected in Figure 3. From this map, it would appear that most logging occurred in the past two decades. The size of areas cutover 30 to 40 years ago are considerably less, not necessarily because there was less activity during that period, but more likely as the result of the difficulty for remotely sensed imagery to differentiate areas of new growth from four decades ago from more established cover. Although the map shows considerable logging has been present, the fact that much of the region has not experienced logging can be taken as a positive aspect from the perspective of the potential for ecotourism. This map, however, does not show those areas that may have been approved for timber harvesting in the future, and this could have a major impact on the potential for ecotourism to be considered as a long-term venture within this type of setting.

The mix of vegetation coverage for the sample area is presented in Figure 4. Examination of the vegetation coverage reveals that a high proportion of the area is covered by a mixed forest of type I and II [for explanation of what each type comprises, see Appendix 1] and dense coniferous forest; forest types which were perceived to be preferred by ecotourists over areas dominated by sparse coniferous forest and poorly vegetated areas. An overlay of the vegetation layer with that of cutovers previously discussed, reveals that

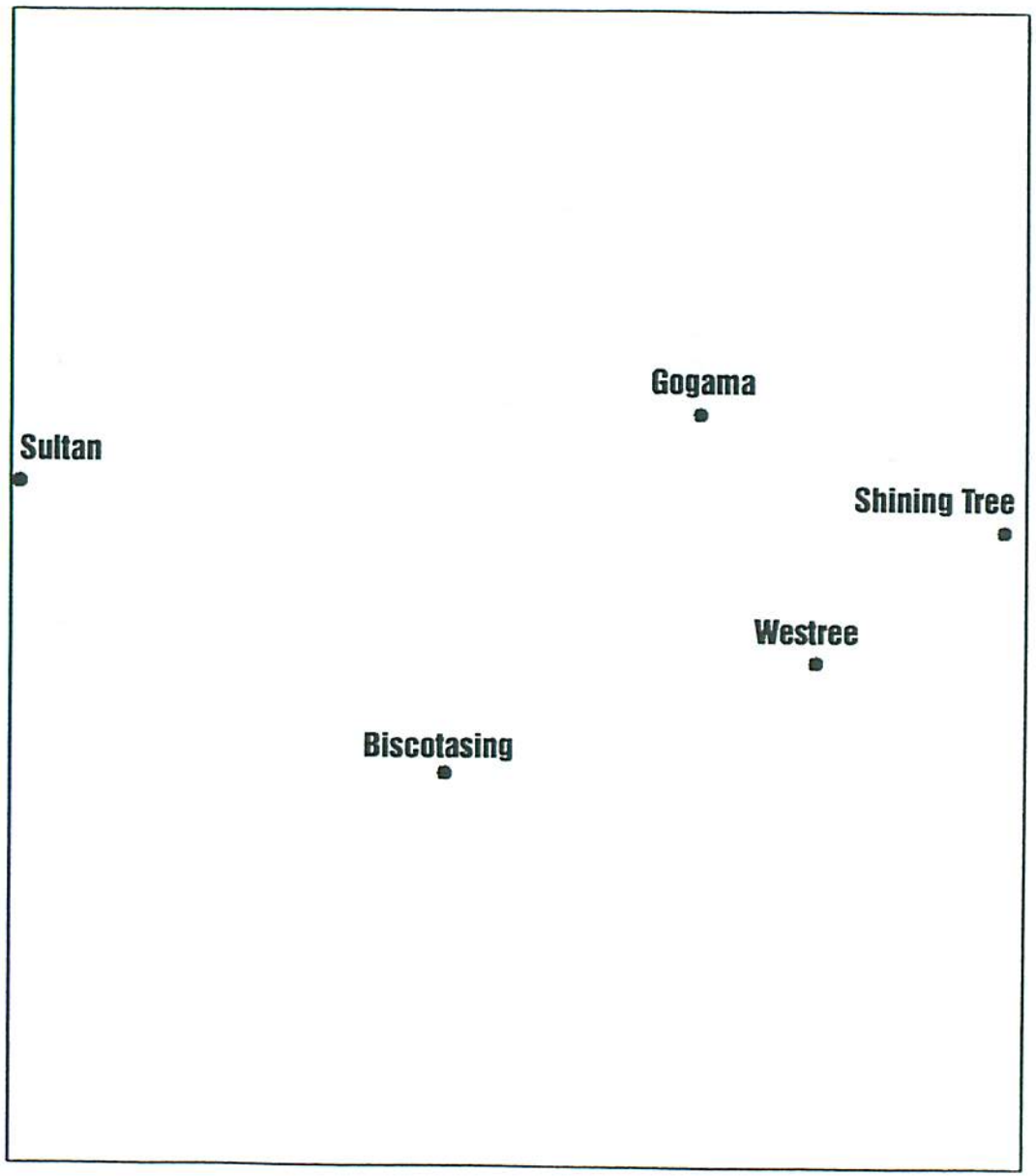

Figure 2. Presence of Community

Legend

- Unincorporated Community

-10 0 40 km

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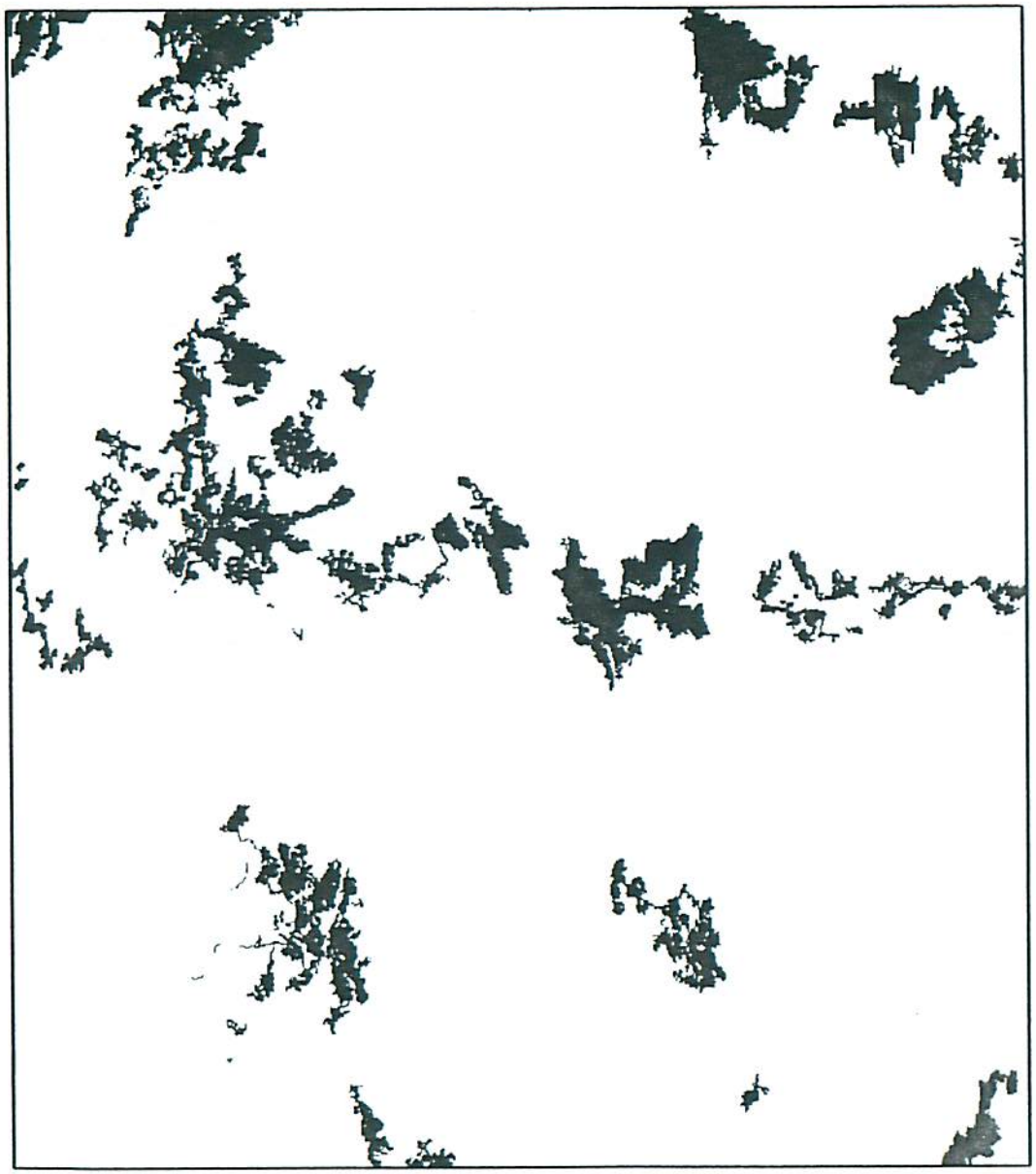

Figure 3. Resource Related Activity - Cutovers

Legend

- 0 - 10 Years
- 10 - 20 Years
- 20 - 30 Years
- 30 - 40 Years

-10 0 40 km

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Figure 4. Vegetation

Legend

- Mixed Forest Type I
- Mixed Forest Type II
- Dense Coniferous Forest
- Sparse Coniferous Forest
- Poorly Vegetated Areas
- Water
- Other

-10 0 40 km

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for the most part, areas of mixed forest are not juxtaposed with areas that have been cut over. This is important given the probability that ecotourists would be most likely to prefer the varied landscape provided by mixed forest types to areas which have been clearcut and where there is little evidence of new growth. The aesthetic appeal of viewing a mixed forest type landscape may be dramatically altered if less attractive areas, such as clearcuts are also visible or are present nearby. Most of the poorly vegetated areas correspond to regions that have recently been cutover, and from viewing the road network for this area of Northern Ontario [to be discussed later in this section] are seen to be found mostly alongside the various types of access routes.

Figure 5 provides a detailed breakdown of the types of roads present, and as such therefore, the type of land access which is possible throughout this part of Northern Ontario. Only one paved road is present, which runs north/south across the sample area. There are few loose surface roads, one running east/west, and the majority connect with a myriad of logging roads throughout the entire region shown on the map. Given the dominance of logging roads in this particular setting, it is evident that the issue of access along the logging roads, and the possible resulting conflicts that may result with resource-based activities, will play a vital role, especially if ecotourism areas are identified in isolated areas which are only accessible from the logging roads. The issue of the right of access, therefore, will be a crucial consideration in identifying types of ecotourism units, because if areas cannot be reached by land-based access, the potential of these regions for ecotourism activities will be restricted to the eco-specialist who can or 'is prepared to' access such settings by traveling on foot or by water.

Landscape characteristics, in terms of water present and absolute relief, are shown as Figures 6 and 7, respectively. There is a considerable amount of water present, either in the form of lakes or rivers. This is important, as it is anticipated that many ecotourism type activities within Northern Ontario will be tied to existing water-based recreation activities currently offered by tourism operators and outfitters. Figure 7 shows the change of

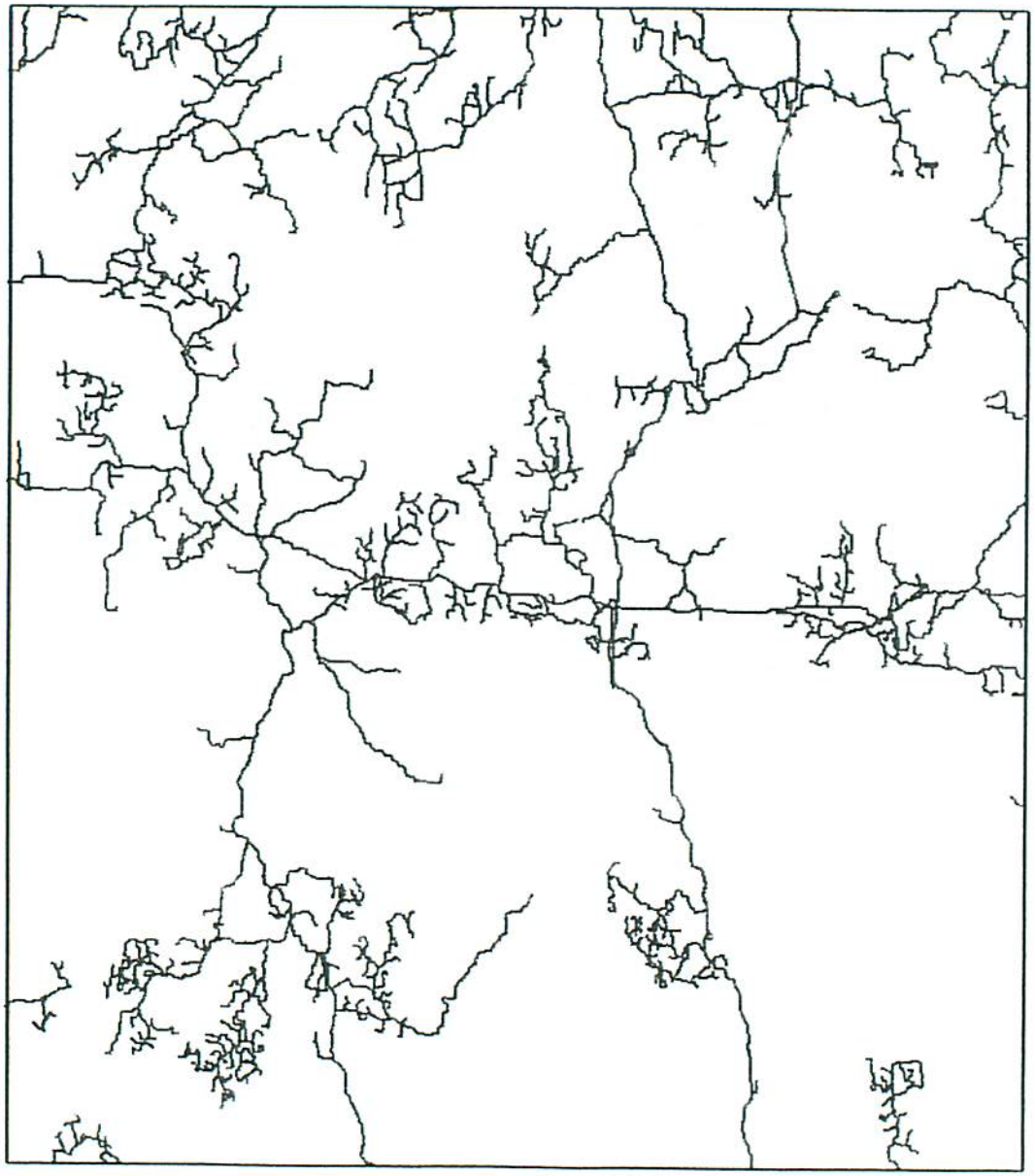

Figure 5. Access Characteristics

Legend

- Paved Roads
- Loose Surface Roads
- Logging Roads

-10 0 40 km

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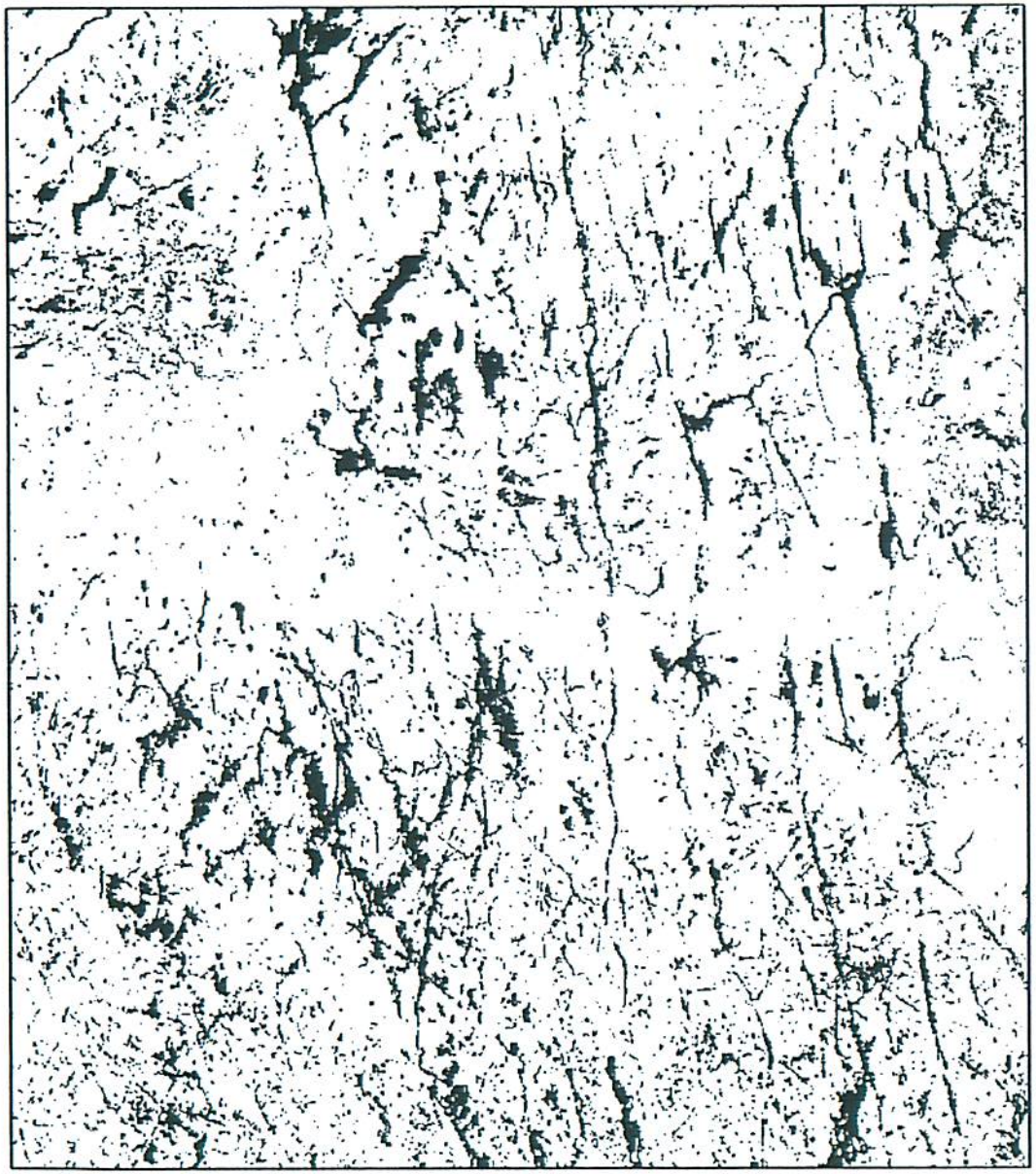

Figure 6. Landscape - Water

Legend

Water

-10 0 40 km

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Figure 7. Landscape - Relief

Legend (m)

- 300 - 350
- 351 - 400
- 401 - 450
- 451 - 500
- 501 - 550
- 551 - 600

-10 0 40 km

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absolute relief throughout the sample area in 50 metre intervals, with a total change in relief of approximately 267 metres throughout the area. The pattern is one in which the elevation increases from north to south over the test area, with the majority of the landscape falling within the 350 to 450 metre range. The fact that there is considerable change in absolute relief is important as the change in relief over an area has bearing on the extent to which it can be favourable to ecotourists. Areas which are relatively homogenous in relief may be considered to be less attractive than those in which the change in relief is more noticeable, as the latter provides possible viewpoints atop of escarpment-like features to overlook the landscape and view wildlife at a distance to avoid disturbance.

In order to eliminate certain areas becoming a part of ecotourism units, buffers of varying size [as determined by the value ranges in report #2] were placed around selected elements within the landscape. Figures 8 and 9 show the buffered regions around communities and the various access routes, respectively. As the communities within the sample area are small, a buffer of only 5 km was used to ensure that these communities would not become part of any ecotourism unit identified for this area. The buffers were placed around the various access routes to prevent the roads and the areas close to them becoming a part of an ecotourism unit as the presence of noise from roads conflicts with the image of wilderness most preferred and expected by the ecotourist population.

The overlay procedure used to identify ecotourism type units was applied to the following GIS layers: vegetation coverage, presence of community and cutovers. The resultant map of cumulative scores over the sample area are displayed in Figure 10. The majority of the sample region received a cumulative score of between 13 to 15 points.

Three maps were produced to illustrate the results of the overlay analysis when the 5 layers of the GIS were combined. Figure 11 shows those areas [500 square kilometers or greater] that initially qualified as Type I ecotourism units, where the best mix of attributes for ecotourism were found and [given the modifications from that used in the overall study area] a cumulative score of between 20-25 points was recorded. Five Type I

Figure 8. Community Buffers

Legend

Unincorporated Community (5 km Buffer)

-10 0 40 km

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Figure 9. Access Buffers

Legend

- Paved Roads (10 km Buffer)
- Loose Surface Roads (5 km Buffer)
- Logging Roads (2 km Buffer)

-10 0 40 km

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Figure 10. Overlay Layers
- Vegetation
- Community
- Cutovers

Legend (Scores)

- 13 - 15
- 10 - 12
- 6 - 9
- 3 - 5

-10 0 40 km

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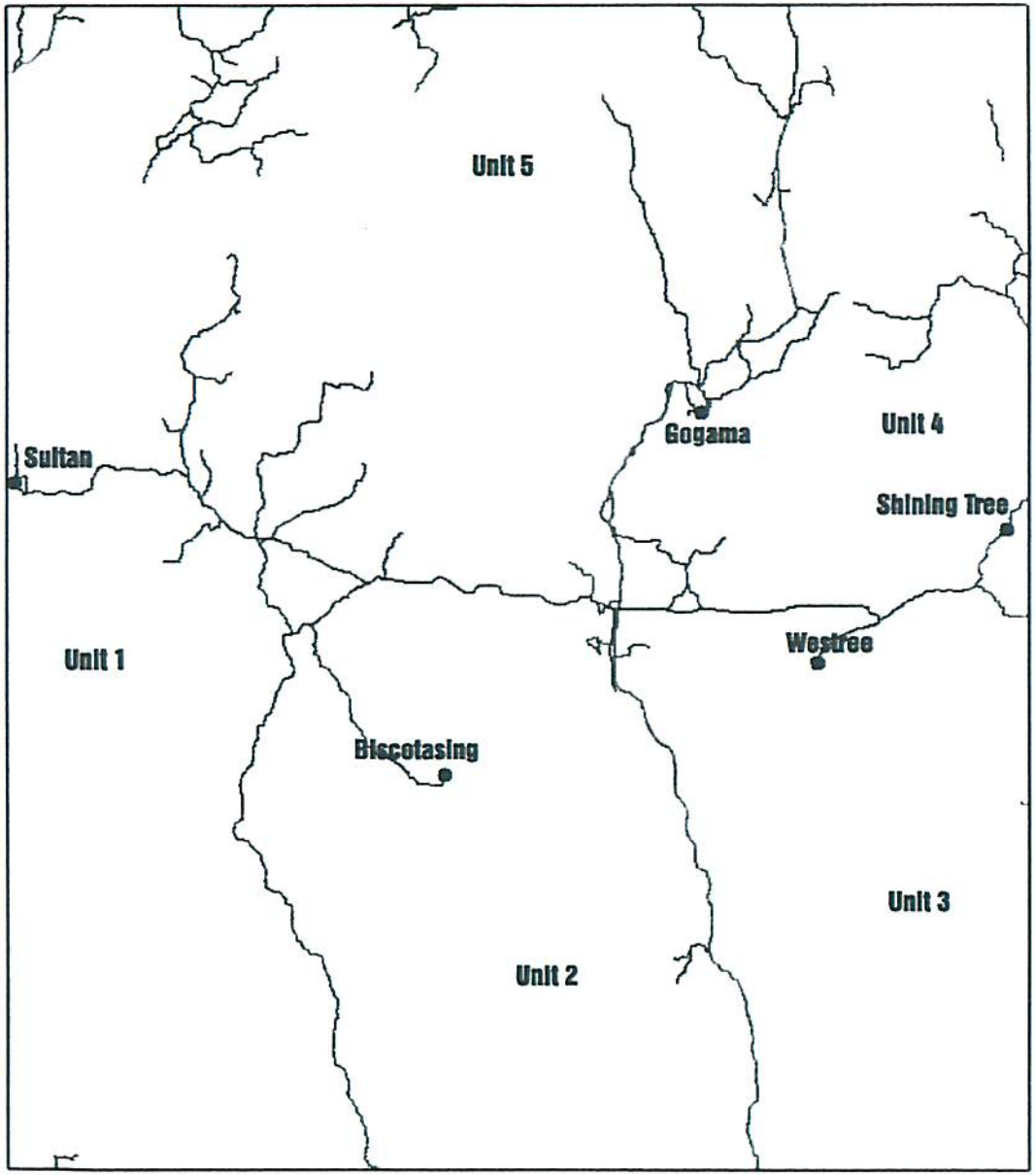

Figure 11. Type I Units

Legend (km^2)

Type I Unit

Unit 1 - 1341
Unit 2 - 942
Unit 3 - 1140
Unit 4 - 477
Unit 5 - 976

-10 0 40 km

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areas were identified within the sample area. Two Type II ecotourism units, in which a cumulative score of between 15-19 was recorded, are shown in Figure 12. Figure 13 displays all three types of ecotourism units [regardless of size] within the sample area.

3.2. Changes in methodology as a result of test area analysis

The results for ecotourism units demonstrated a weakness in the scores that were assigned to attributes and also the problem of defining units when not all of the attributes are used. From the output for the ecotourism units produced within the sample area, it was evident that some areas must be given a score of zero. In particular, areas within the buffered distance around communities and 10 kilometers away from major roads should not have qualified as part of an ecotourism unit. Using a score of zero for areas within 100 metres of a road, regardless of class, and within 10 kilometers of a city, or 5 kilometers of a town, would prevent areas such as the middle of a city or road from becoming part of a potential ecotourism unit. The substitution of zero scores to certain attributes ensured that problems of this nature did not influence the identification of different ecotourism units within the overall study area.

The boundaries of the ecotourism units were extremely complex, as is revealed in Figures 11,12, and 13, respectively. In order for the shape of the ecotourism polygons to be somewhat simplified for the overall study area, a grid system was proposed whereby the square received a score of 5 if 50 percent or greater of the area scored a 5 in the initial overlay. This system was employed within the overall study area to ensure that ecotourism units had a more clearly defined boundary, allowing for easier identification and analysis.

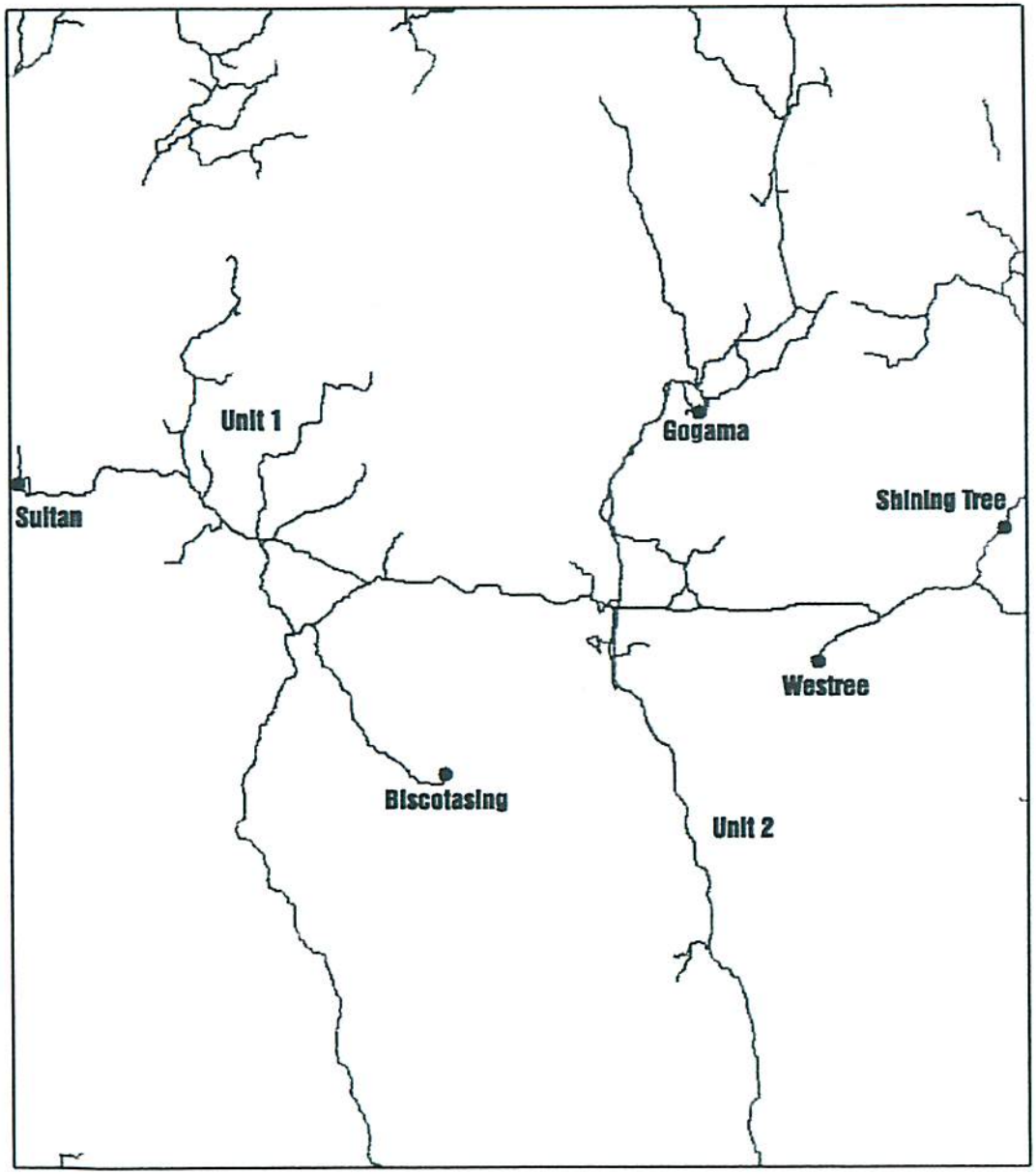

Figure 12. Type II Units

Legend (km²)

Type II Unit

Unit 1 - 1021
Unit 2 - 1828

-10 0 40 km

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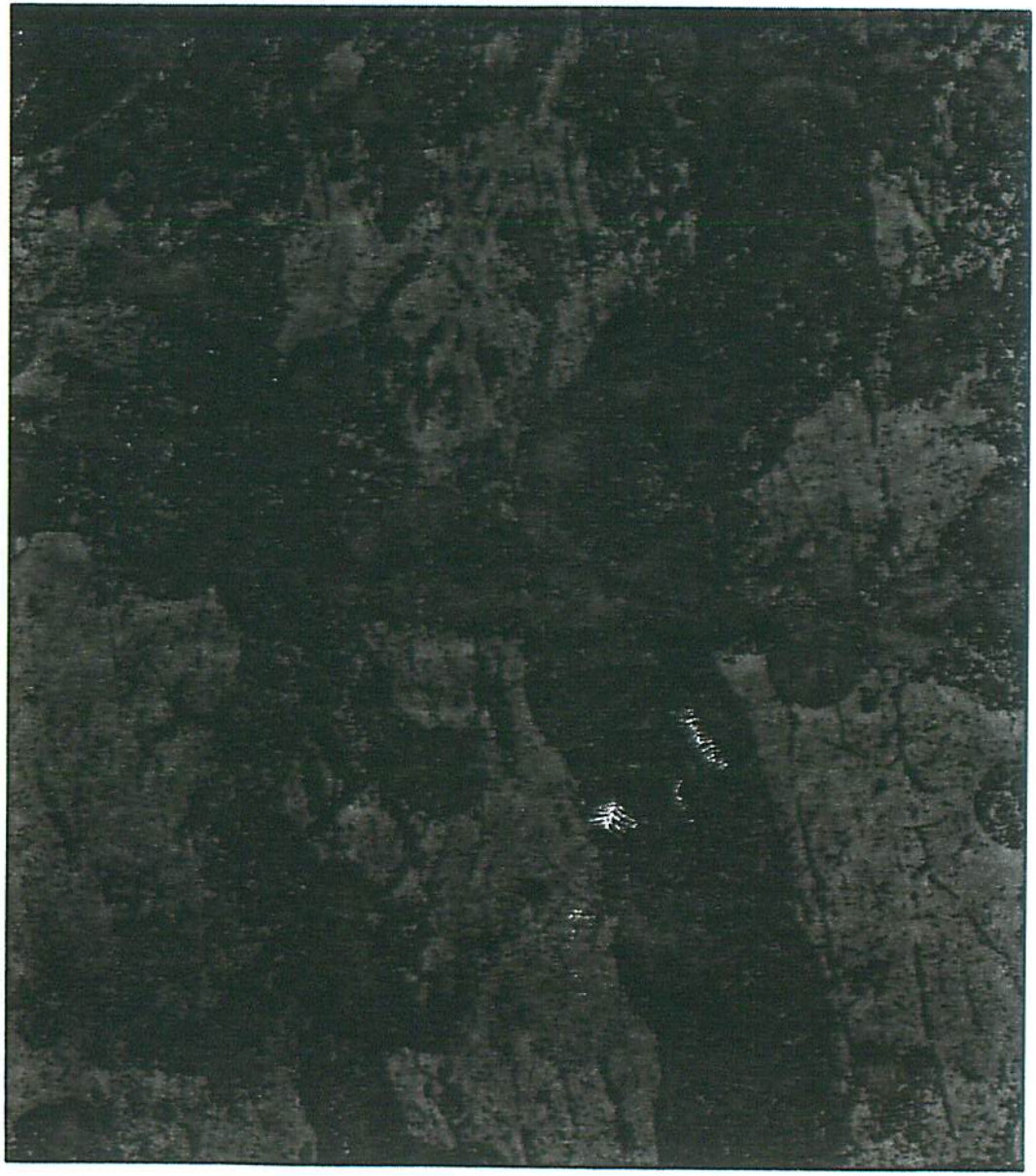

Figure 13. Ecotourism Scores

Legend (Scores)

- 21 - 25
- 16 - 20
- 10 - 15

-10 0 40 km

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4.0. ANALYSIS FOR OVERALL STUDY AREA

This section of the report discusses the results of the overall study area. Figure 14 shows the complete area under investigation, entitled Study Area. The Study Area comprises some 80,000 square kilometres in area, extending from Near Sault Ste. Marie in the south west to North Bay in the south east, and from the northern edge of Lake Superior Provincial Park in the north west to beyond Kirkland Lake in the north east. Its boundaries are the 48th parallel to the north, Lake Superior to the west, the Ontario/Quebec border to the east, and a line from slightly south of Sault Ste. Marie to North Bay in the south. It is approximately 400 kilometres in width from west to east, and 200 kilometres in depth from north to south.

Figure 15 displays what has been titled Vegetation. This figure is based on information collected and digitized for the Forest Landscape Ecology Program. The procedure used to prepare the data was the same as that used for the Test Area. The figure contains five types of vegetation cover based on the more detailed information held by the Ontario Forest Research Institute. As noted in the earlier report, it was considered essential to reduce the number of vegetation types to no more than five, with the mixed forest categories obtaining the highest scores. The vegetation type and scores are shown in Appendix 2, as mentioned earlier in the report.

The figure shows the considerable variety of vegetation types existing within the region, and particularly the fragmented nature of the cover. Only in the western part of the region are there extensive areas of homogeneous vegetation cover, in this case, the low scoring Sparse Coniferous Forest. The belt of Poorly Vegetated Areas on the southern edge of the area represent much of the bare rock and denuded landscape around Sudbury.

The vegetation types regarded as most suitable for ecotourism are found mostly in the central and northern parts of the Study Area. The Mixed Forest Type 2 is highly fragmented, with no significantly sized contiguous areas, the greatest concentrations being in the south east of the area. The Mixed Forest Type 1 does occur in more sizable

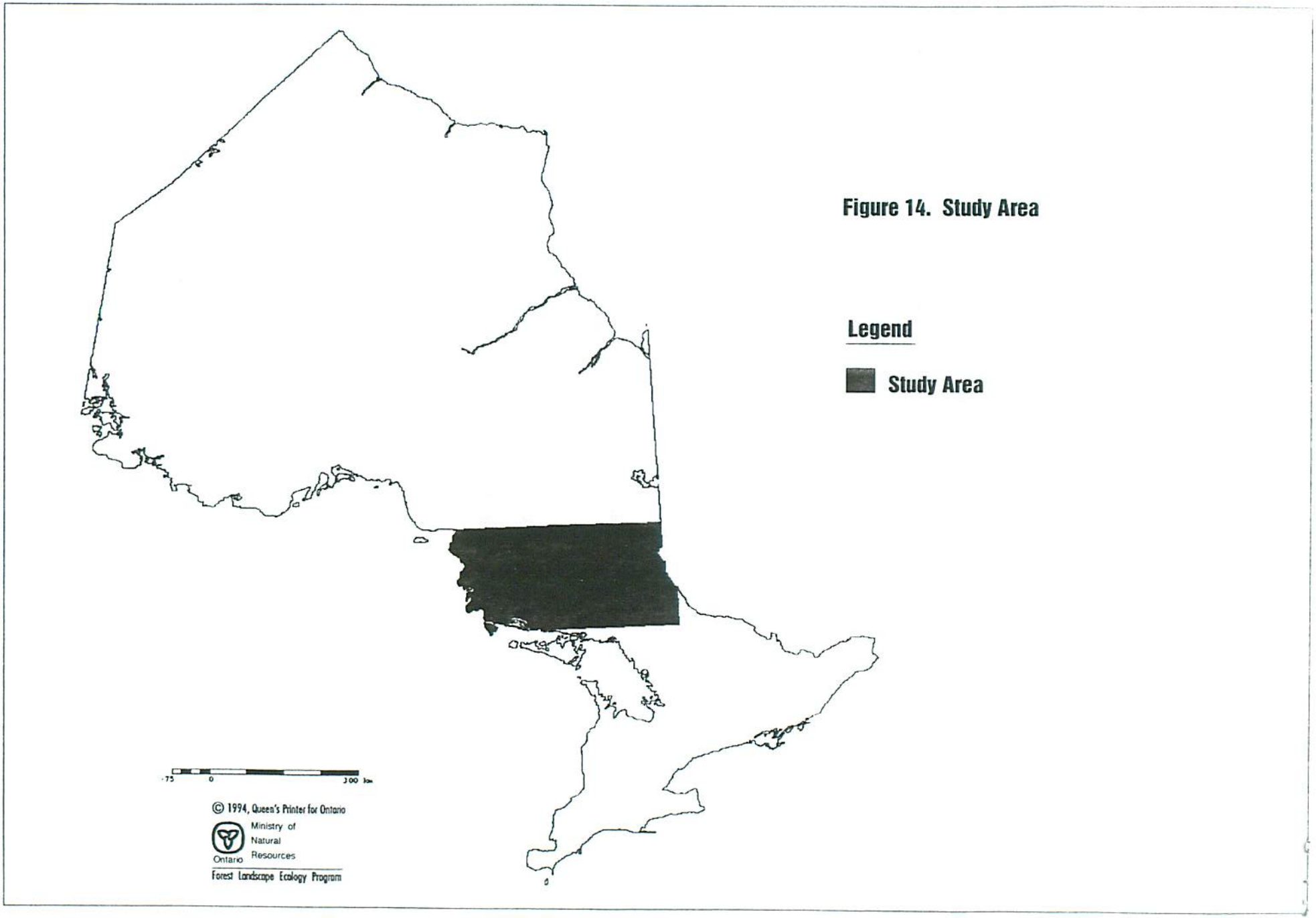

Figure 14. Study Area

Figure 15. Vegetation

Legend

- Mixed Forest Type I
- Mixed Forest Type II
- Dense Coniferous Forest
- Sparse Coniferous Forest
- Poorly Vegetated Areas
- Water
- Other

-25 0 100 km

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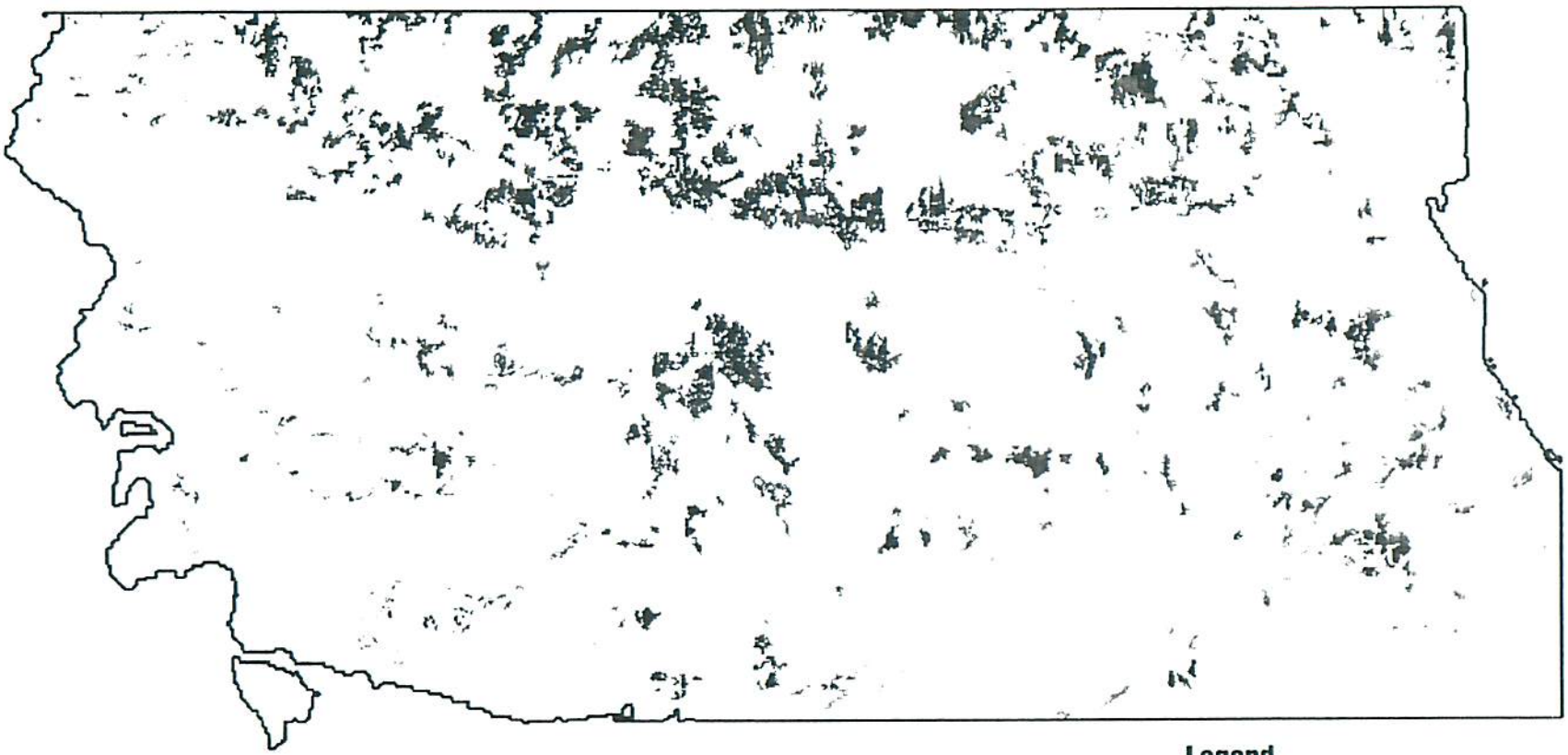
segments throughout the central and northern parts of the area, and indicates areas with high potential as attractive sites for ecotourism.

Figure 16 displays one aspect of Resource Related Activity, namely Cutovers. As noted in Report 2, the evidence of cutovers is not conducive to ecotourism, and thus the more recent the cutover, the less attractive the area is likely to be for ecotourists. The data used are identical to those used in the testing of the methodology on the Test Area. The few older cuts, those over 30 years old are found scattered in the south and south east of the area, and are relatively insignificant. The other three categories are found throughout the area, although there is a preponderance of the more recent cutovers in the northern half of the area.

There is some relationship visible between the pattern of cutovers in this figure and the distribution of roads shown on the access map (see Figure 22). Similarities with the logging road pattern is to be expected, but there are also clear links between the more recent cutovers and the location of some of the paved roads shown. The overall pattern of cutovers reveals considerable areas in the south and west of the area not affected, but a comparison with the previous figure showing vegetation cover reveals that many of these areas are covered by less desirable forms of vegetation. While many of the cutovers themselves are not of great size, especially in the north and central parts of the area they are often very close to one another and therefore comprise significant portions of the landscape of these segments of the Study Area.

Figure 17 illustrates the presence of water with in the Study Area. The overall north south pattern of drainage is evident from the orientation of many of the lakes and rivers shown. There is presence of water throughout the area, with significant concentrations in the central regions and towards the eastern edge north of North Bay. Only in the west and in the extreme north east is there a relative absence of water, and even here there are water bodies and streams, although many are too small to show at this scale. The linkage

Figure 16. Resource Related Activity - Cutovers



Legend

- 0 - 10 Years
- 10 - 20 Years
- 20 - 30 Years
- 30 - 40 Years

-25 0 100 km

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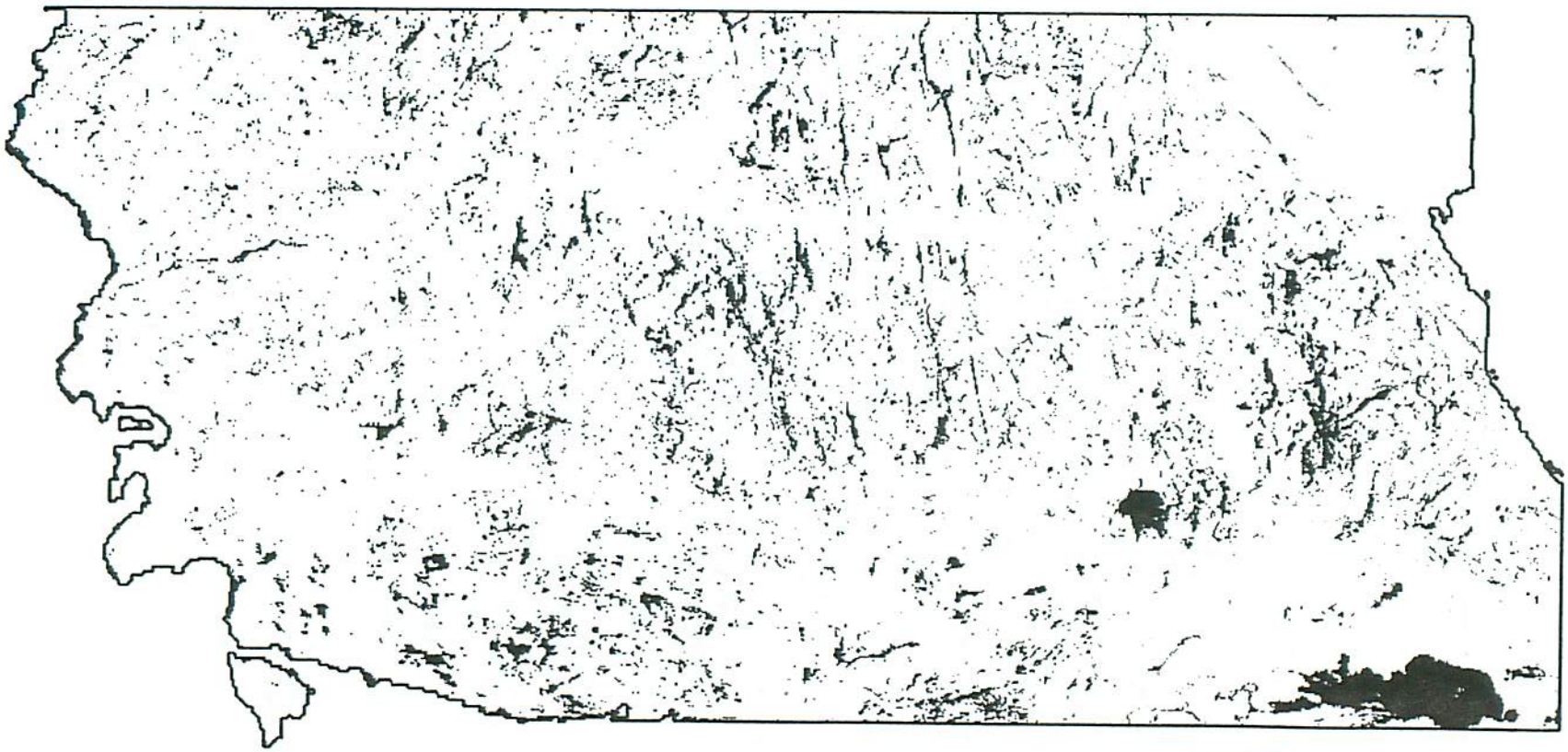
Figure 17. Landscape - Water



Legend

Water

-25 0 100 km

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between the water systems is of crucial importance to ecotourism which may be water based, for example, using canoeing as a means of access and transportation within the area.

The other component of Landscape is Relief, which is shown in Figure 18. Here absolute relief is shown. While from a visual perspective relative relief may have more significance, from a vegetation and hence wildlife perspective absolute relief plays a greater role. The figure shows a variation in absolute relief of almost five hundred metres. The general pattern displayed is one of two significant features, the east and south being relatively low, with elevations rising to the north and west, except in the immediate vicinity of the lake shore. The highest areas are in the west-central segment of the Study Area, and to a degree this is also the area of greatest relative relief also. Some of the major valleys of rivers flowing into Lake Superior show clearly even at this scale.

Figure 19 shows the information obtained from the ARDA land capability system with respect to ungulates and waterfowl. As noted earlier, these two classes were combined, with the highest category of either class being used for the purposes of the score. That is, if an area was shown as Class Three in the waterfowl map, but only Class 6 in the Ungulate Map, the polygon concerned would receive a score of 4 (ARDA Class 1-3). One segment of the Study Area, the extreme north west, was not covered by the ARDA mapping program. It has been assigned an arbitrary value of 3, representing ARDA Classes 4 and 5, which corresponds to the predominant score received by the rest of the areas. It has been left blank in the figure however, as no digitized date exist for the area. The score was assigned to allow the area to be considered in the same way as the bulk of the Study Area.

The figure shows clearly that the areas with lowest potential for wildlife lie to the south of the area, with a concentration in the central portion of the Study Area. There are very few areas which attain a high score, representing Classes 1 and 2, the largest of these being in the extreme north west of the area. The implication being that what diversity in capability for wildlife exists within the area is present at a very small scale only, if at all.

Figure 18. Landscape - Relief

Legend (m)

- < 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- > 600

-25 0 100 km

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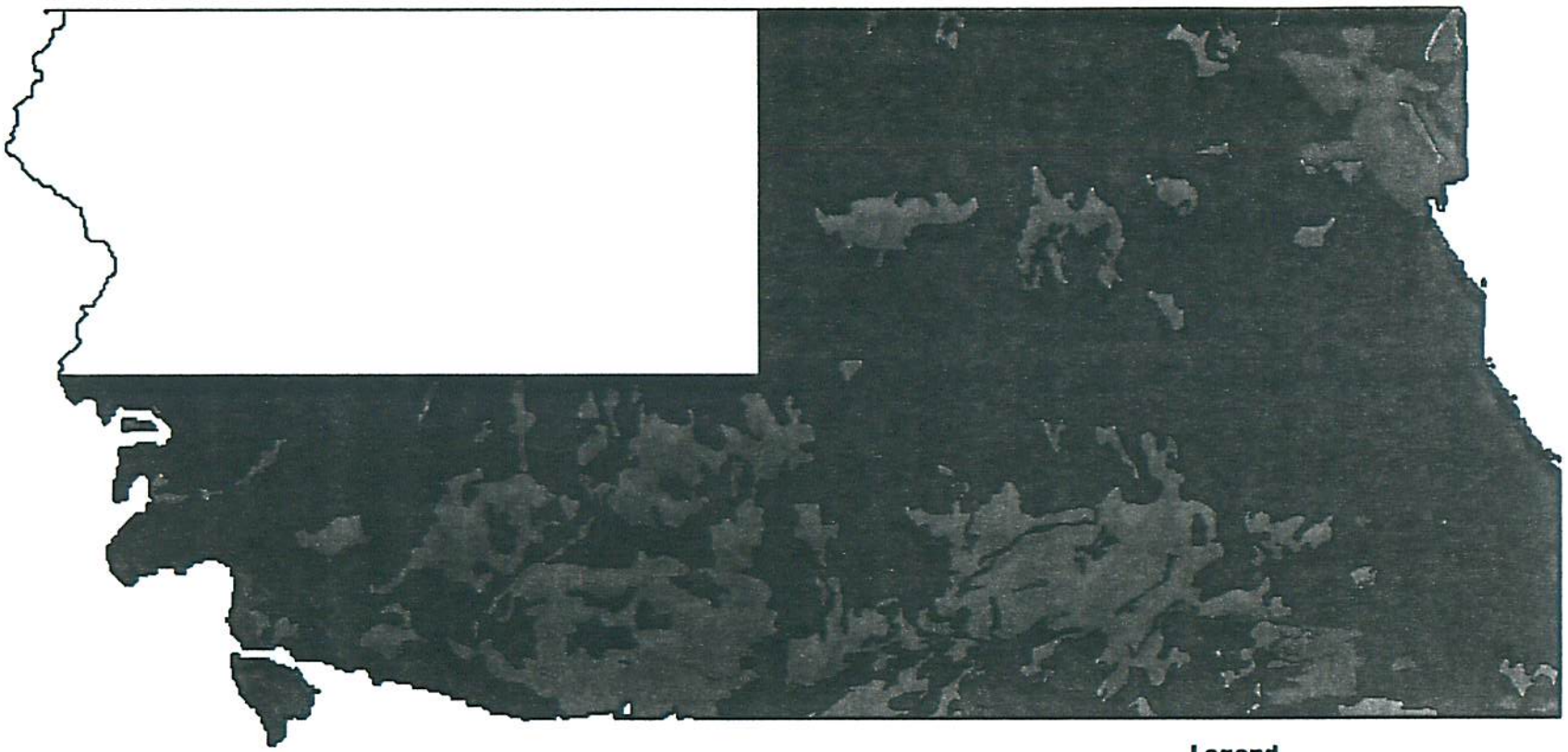
Figure 19. Wildlife



Legend

- ARDA Class 1- 3
- ARDA Class 4 - 5
- ARDA Class 6- 7
- ARDA Coverage Not Available

-25 0 100 km

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Figure 20 shows the location of provincial parks within the Study Area. The majority are classed as 'recreation' or 'natural environment' parks. One 'waterway' and 'wilderness' park is present in the Study Area. Given the size of many of the parks, it can be suggested that the majority of these protected areas are not really relevant to ecotourism, unless used as campsites. The Missisagi River 'waterway' park may be useful as an access route.

Figure 21 displays the first of the human elements to be considered. The scores are in inverse proportion to the size of the community, with the size of the buffers reflecting the range of the size of communities. The major urban centres, Sault Ste. Marie, Elliot Lake, Sudbury and North Bay are all located on the southern edge of the Study Area, perhaps fortunately in the generally lower scoring regions from the physical criteria. Many of the smaller towns are also located in the south, with the exception of those around Kirkland Lake in the extreme north east of the area. The belt of small unincorporated communities reflect to a large degree the access network running west to east across the northern part of the area. The vast part of the Study Area remains unaffected by communities and urban development.

Unlike the previous figure, the figures showing Access Characteristics (#22) and Access Buffers (#23) show a very considerable human intrusion into the Study Area. The map of Access Characteristics reveals that although paved roads are few in the area, three major north-south routes, including the Trans Canada Highway in the extreme west of the area, and discontinuous segments in the south east and north east around the urban settlements there, other roads abound. Loose surface roads are extremely dense in three regions, the north east around Kirkland Lake, the south east around Sudbury and North Bay, and the south west around Sault Ste Marie. Some of these represent converted logging roads, but many represent the spread of settlement. Logging roads follow the pattern of cutovers, as noted earlier, and are widespread and are clumped, reflecting the pattern of timber development and exploitation. The location of the logging roads was

Figure 20. Protected Areas

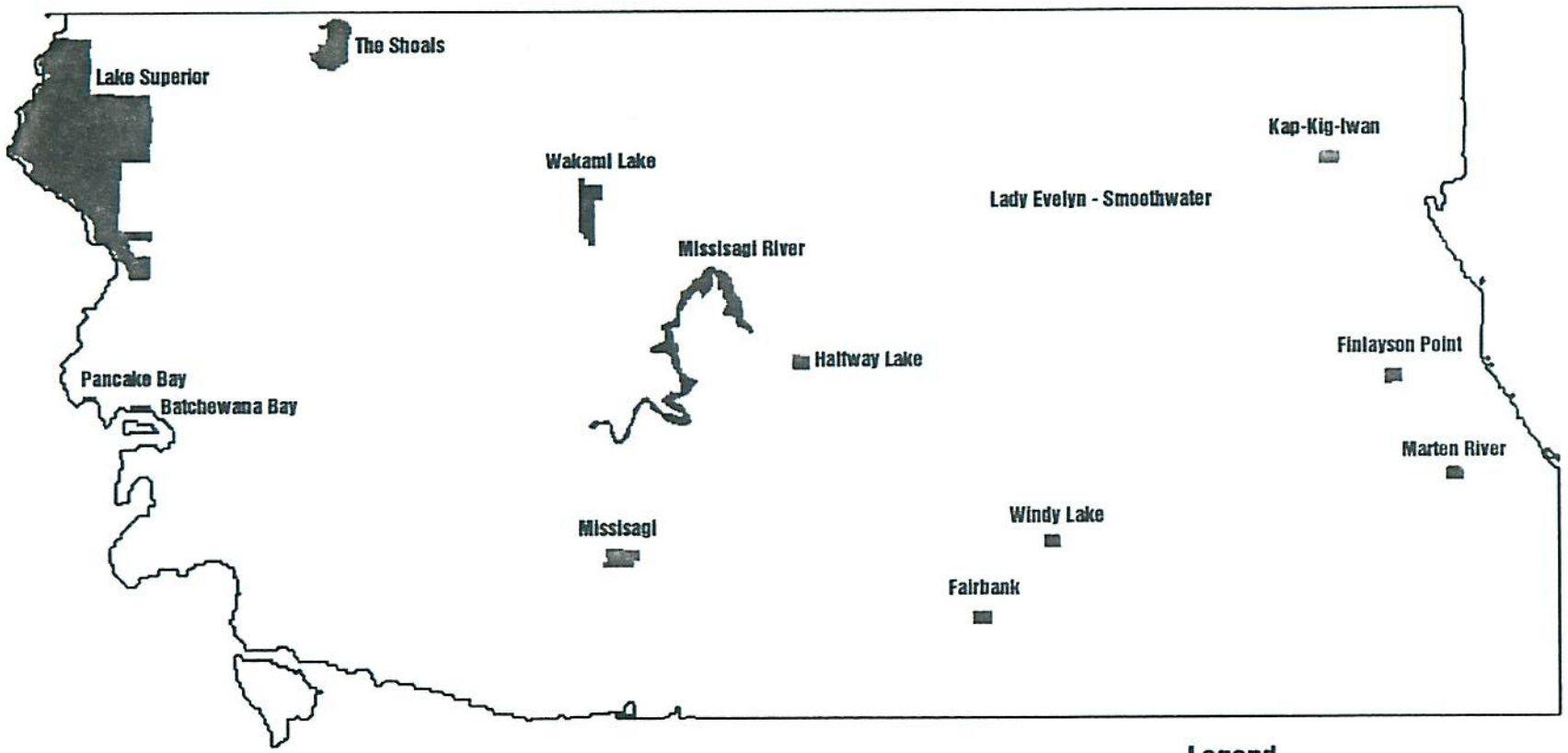

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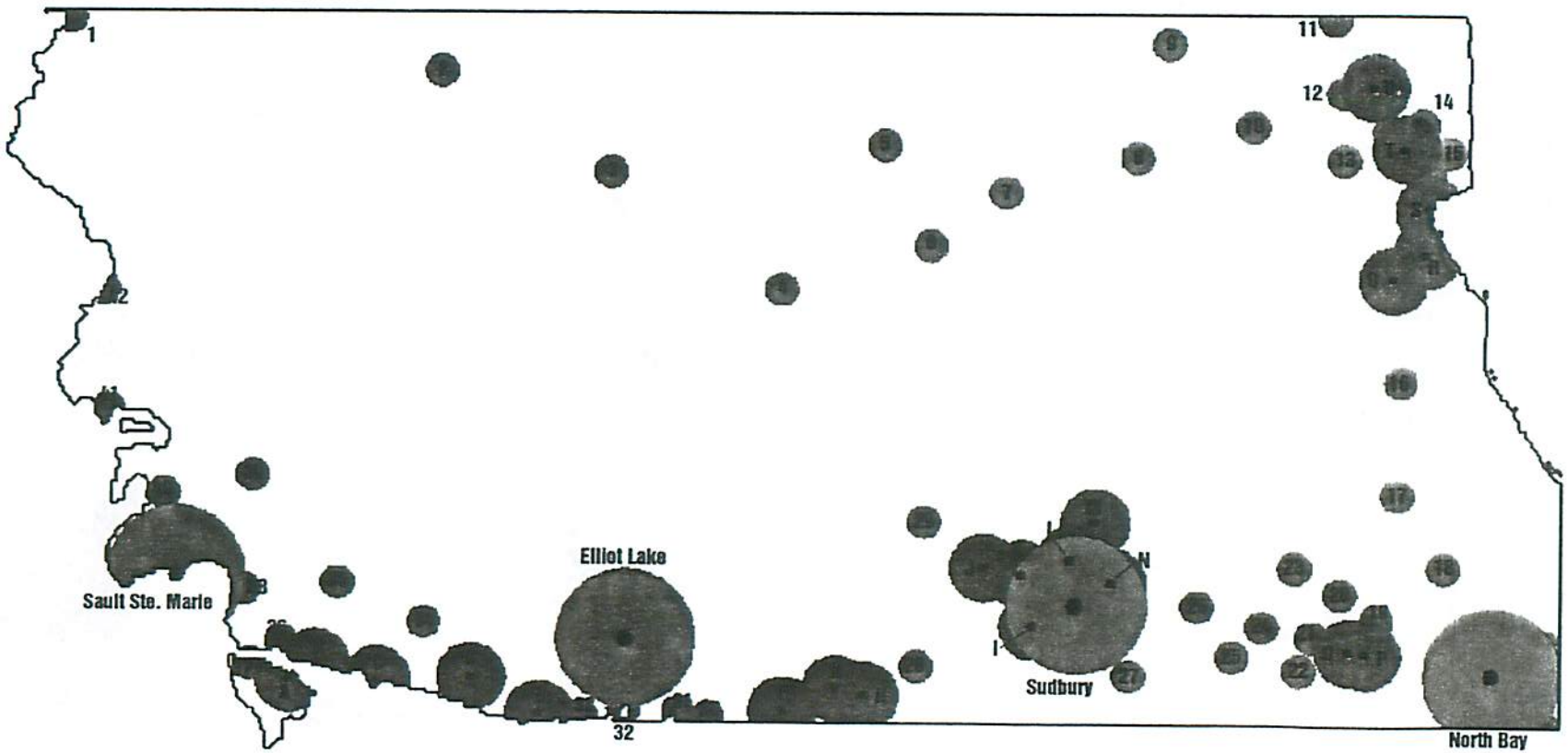
Figure 21. Community Buffers



-25 0 100 km

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Legend

- City (20 km Buffer)
- Town (10 km Buffer)
- Unincorporated Community (5 km Buffer)

Figure 21: Community Index

Cities:

- Sault Ste. Marie
- Elliot Lake
- Sudbury
- North Bay

Towns:

A. Hilton Beach
B. Bruce Mines
C. Thessalon
D. Iron Bridge
E. Blind River
F. Massey
G. Webbwood
H. Espanola
I. Lively
J. Dowling
K. Chelmsford
L. Val Caron
M. Capreol
N. Garson
O. Cache Bay
P. Sturgeon Falls
Q. Latchford
R. Cobalt
S. New Liskeard
T. Thornloe
U. Englehart

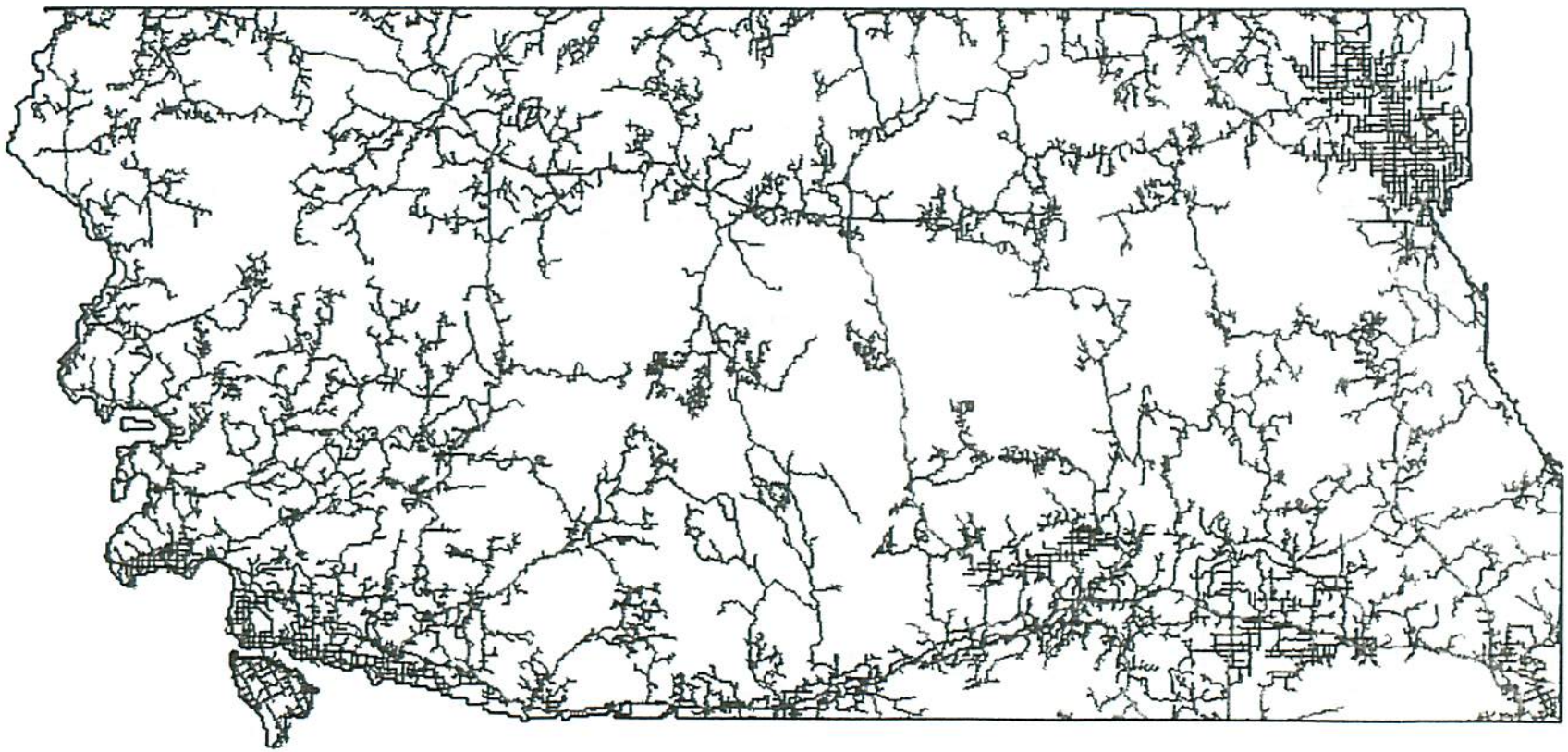
Unincorporated Communities:

1. Wawa
2. Chapleau
3. Sultan
4. Biscotasing
5. Gogama

Unincorporated Communities:

6. Westree
7. Shining Tree
8. Gowganda
9. Matachewan
10. Elk Lake
11. Tarzwell
12. Charlton
13. Kenabeek
14. Hilliardton
15. Belle Vallee
16. Temagami
17. Marten River
18. Tilden Lake
19. Crystal Falls
20. Field
21. Verner
22. Lavigne
23. River Valley
24. Warren
25. St. Charles
26. Markstay
27. Estaire
28. Nairn Centre
29. Cartier
30. Spanish
31. Cutler
32. Spragge
33. Algoma Mills
34. Wharncliffe
35. Poplar Dale
36. Desbarats
37. Richards Landing
38. EchoBay
39. Searchmont
40. Goulais River
41. Batchewana Bay
42. Montreal River

Figure 22. Access Characteristics



Legend

- Paved Roads
- Loose Surface Roads
- Logging Roads

-25 0 100 km

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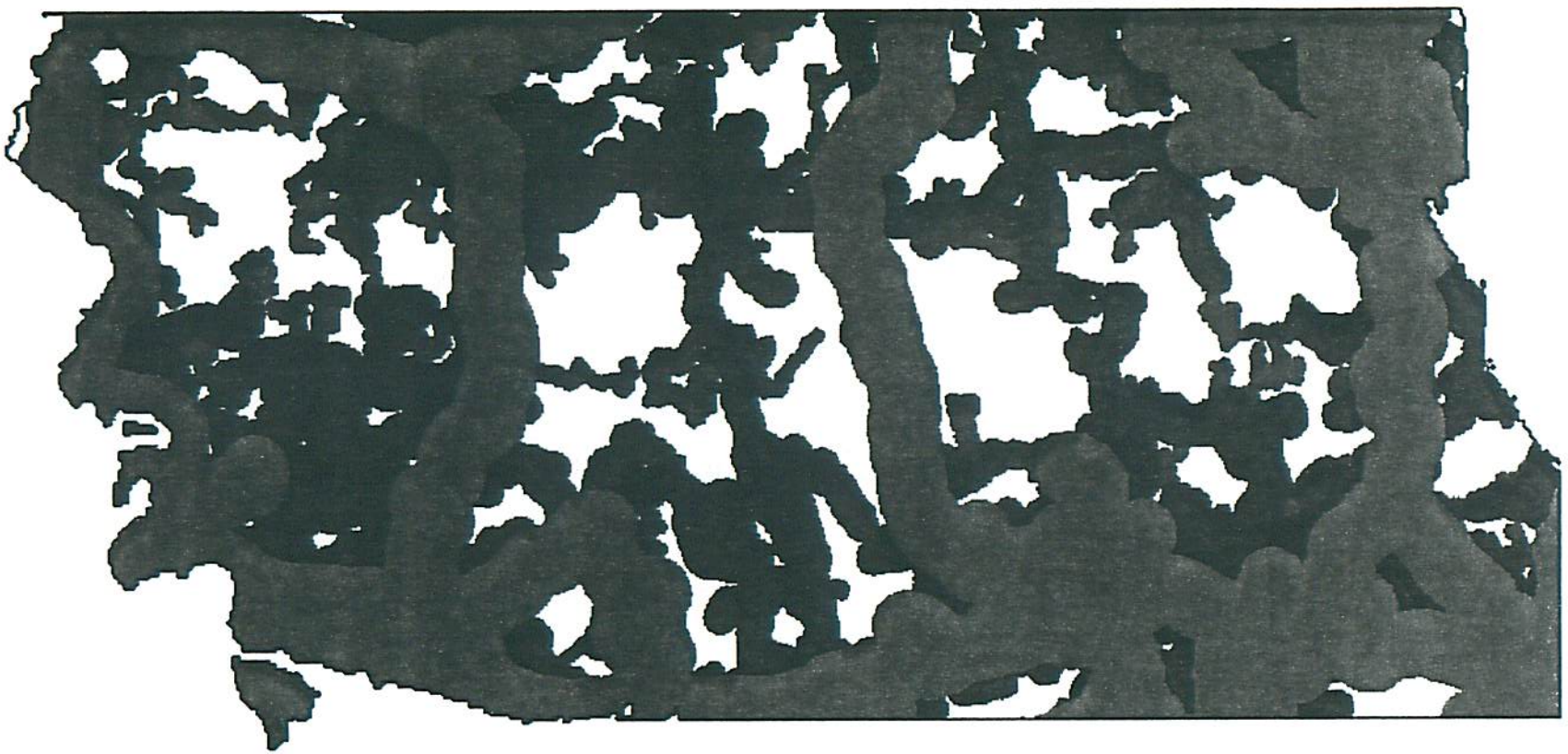
obtained from satellite imagery, while the paved and loose surface roads were digitized from 1:250,000 road maps.

When the buffers are applied to the Access network, the pattern shown in Figure 23 demonstrates that very little of the Study Area is outside any of the buffers. A discontinuous belt of several moderately sized areas emerges in the central part of the area, with smaller blocks scattered throughout the remainder of the area. The logging roads assume much less importance than the loose surface roads, since the logging roads, for the most part, branch off the loose surface roads, but do not travel very far from them and are consequently absorbed within the larger buffers of these roads.

The last element of the human impact on the landscape is mining (Figure 24), an activity generally unattractive to ecotourists, and hence buffered. Two major areas of mining activity, past and present, are shown on the map. The one in the north east is to the west of Kirkland Lake, and the one to the south is centred on Sudbury and runs west to Elliot Lake. A few other isolated mining operations are present, but this pattern of buffers is confined for the most part to less desirable land and vegetation cover, and does not present as severe a problem as may have been anticipated initially.

Figure 25 displays four Type I Ecotourism Units, representing the areas identified as having the most potential for ecotourism development on the basis of the criteria used. Not surprisingly, in light of the other figures already discussed, none of these units are in the south of the Study Area, nor in the west. One of them is in the central part of the area, one in the north central, and two in the eastern part of the area, south of Elk Lake. Not surprisingly, none of the areas are entirely homogenous, that is, there are small areas within the overall units which are not of an equal high value, as shown by the empty pixels in the figure. Also not surprisingly, the shapes are generally far from symmetrical, reflecting the natural elements such as water bodies and topographic features, and the absence of intrusive human impacts.

Figure 23. Access Buffers



Legend

- Paved Roads (10 km Buffer)
- Loose Surface Roads (5 km Buffer)
- Logging Roads (2 km Buffer)

-25 0 100 km

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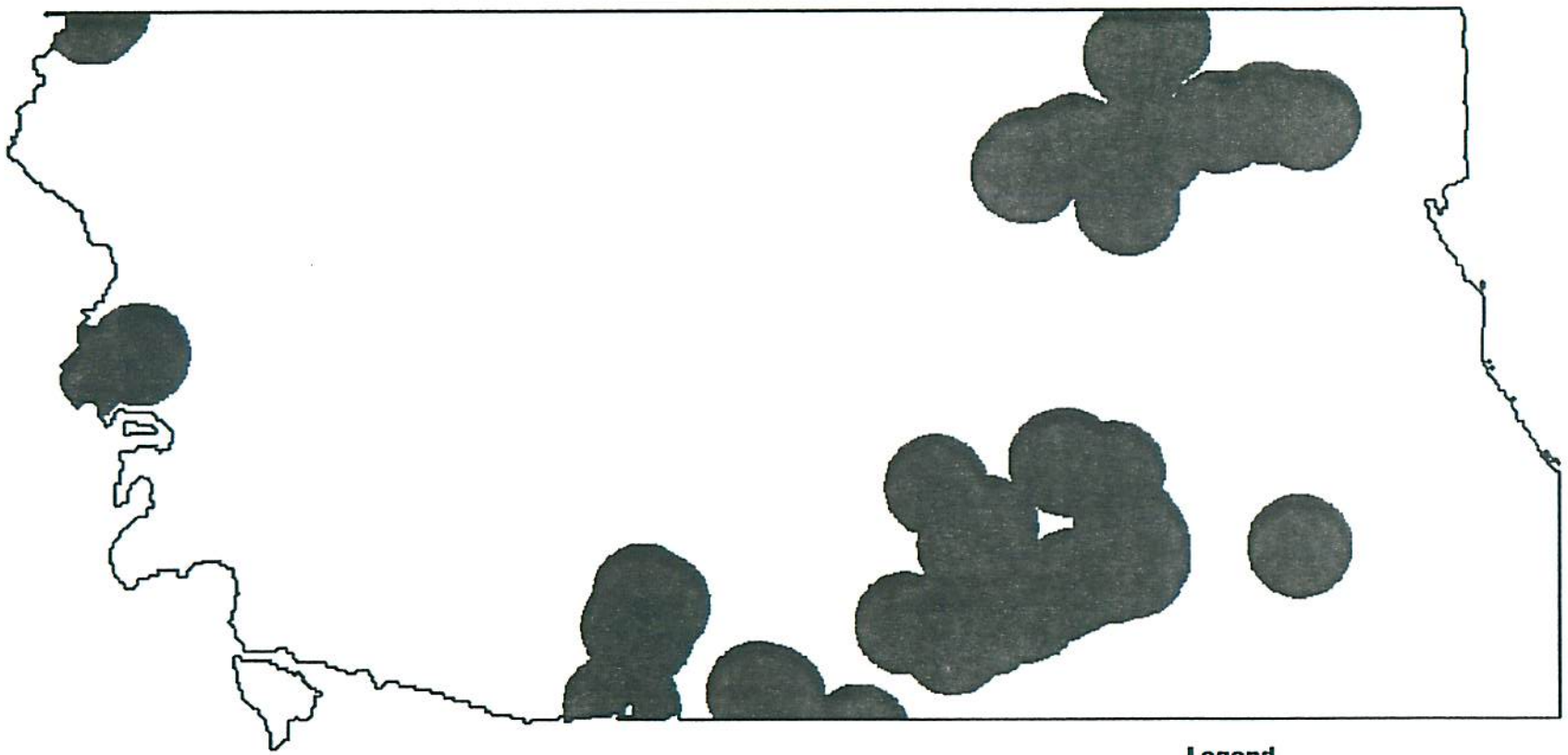
Figure 24. Resource Related Activity - Mines



Legend

Mines (15 km Buffer)

-25 0 100 km

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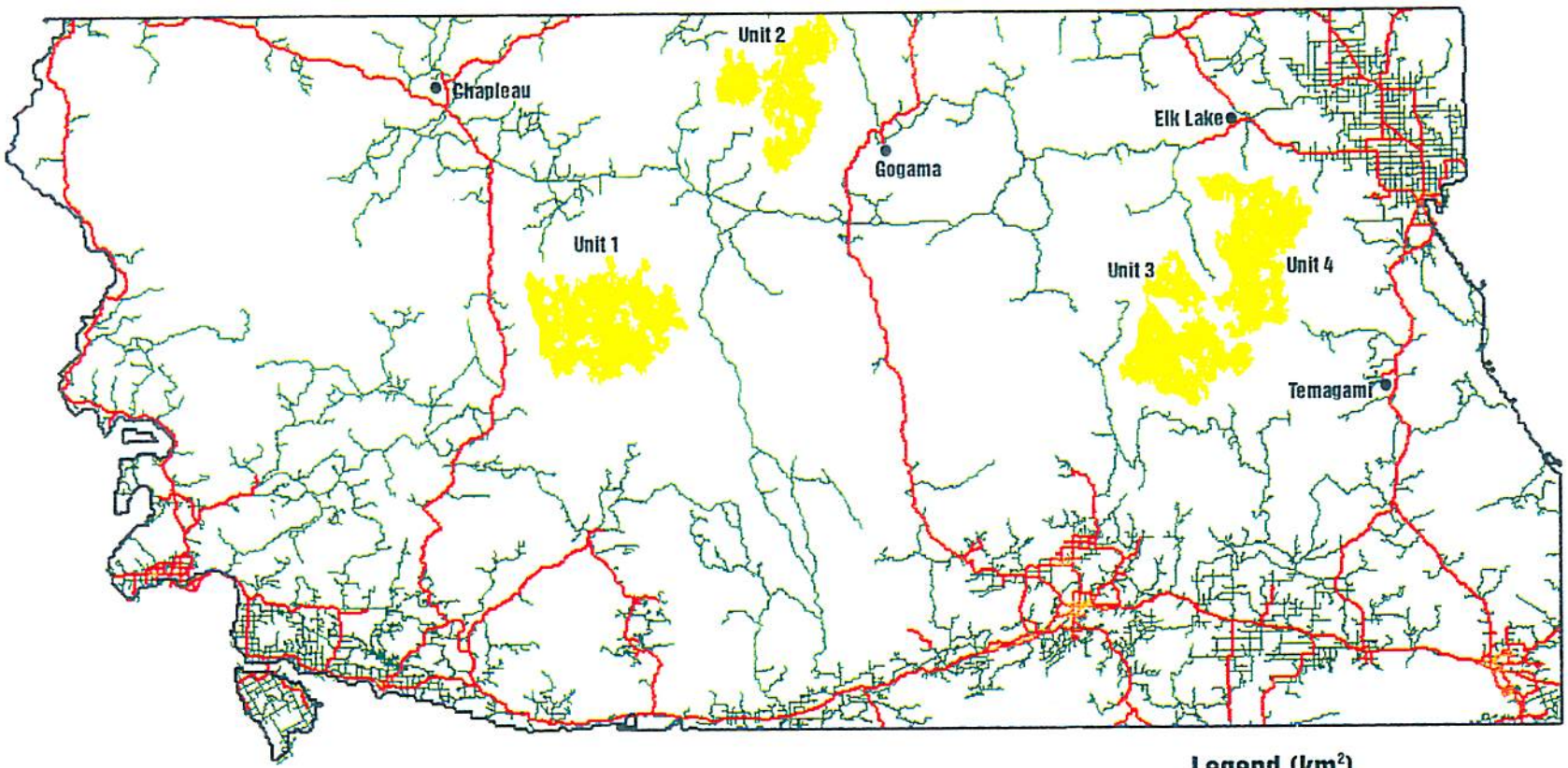
Figure 25. Ecotourism Type I Units



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The more relaxed criteria involved in delimiting Type II Ecotourism Units (Figure 26) is reflected in the map of these units. A considerable proportion of the Study Area falls under the Type II Ecotourism Unit, although again the southern part of the area receives little coverage. The majority of the units fall into the central belt again, although this time there are several units in the west of the area. The average size of units is considerably larger than the size of the Type I Ecotourism Units, although a number of the units have obviously been dissected by elements of the access network. Those units in the north west are more contiguous and uniform than was the case for the Type I Units.

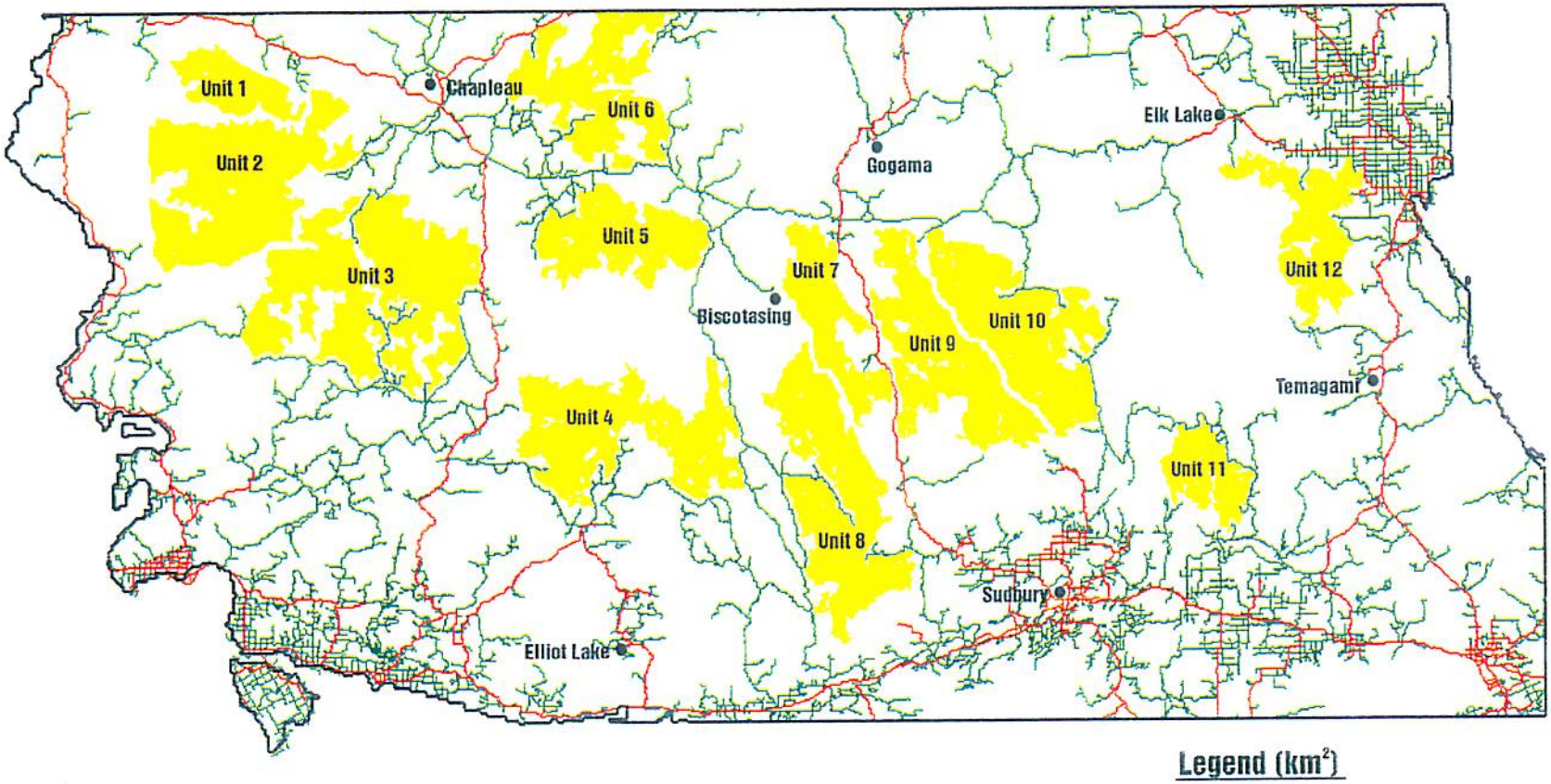
The final figure (# 27) represents a more accurate if somewhat more confusing presentation of the data. A greater proportion of the Study Area falls under Type II criteria than appears on the Type II Unit map because of the minimum size limits imposed for the identification of both Type I and Type II Ecotourism Units. This also occurred because roads which were present in these areas were given a score of zero and as a result broke these areas into several polygons of sizes less than required to form an ecotourism unit. As well, some of the smaller areas which reach Type I standard but are spatially separated from larger Type II Unit areas are then incorporated into Type II Units, as for example happens in the western part of the area.

The predominant impression gained from the overall figure displaying Ecotourism Scores is the absence of significant areas in the south and in the north east and south west parts of the Study Area, but the relative abundance of potentially high quality ecotourism sites in the central and northern parts of the area, particularly the central portion.

4.1. Procedure used to identify ecotourism units

The 'thematic' layers were not arranged in a hierarchy in order to rank the criteria, as initially proposed. Instead, scores were added on a pixel by pixel basis for each of the layers as it was determined that the final score an area received remained the same

Figure 26. Ecotourism Type II Units



Legend (km²)

Type II Units

Unit 1: 414	Unit 7: 646
Unit 2: 1679	Unit 8: 1461
Unit 3: 2050	Unit 9: 1227
Unit 4: 414	Unit 10: 1352
Unit 5: 857	Unit 11: 437
Unit 6: 1047	Unit 12: 752

-25 0 100 km

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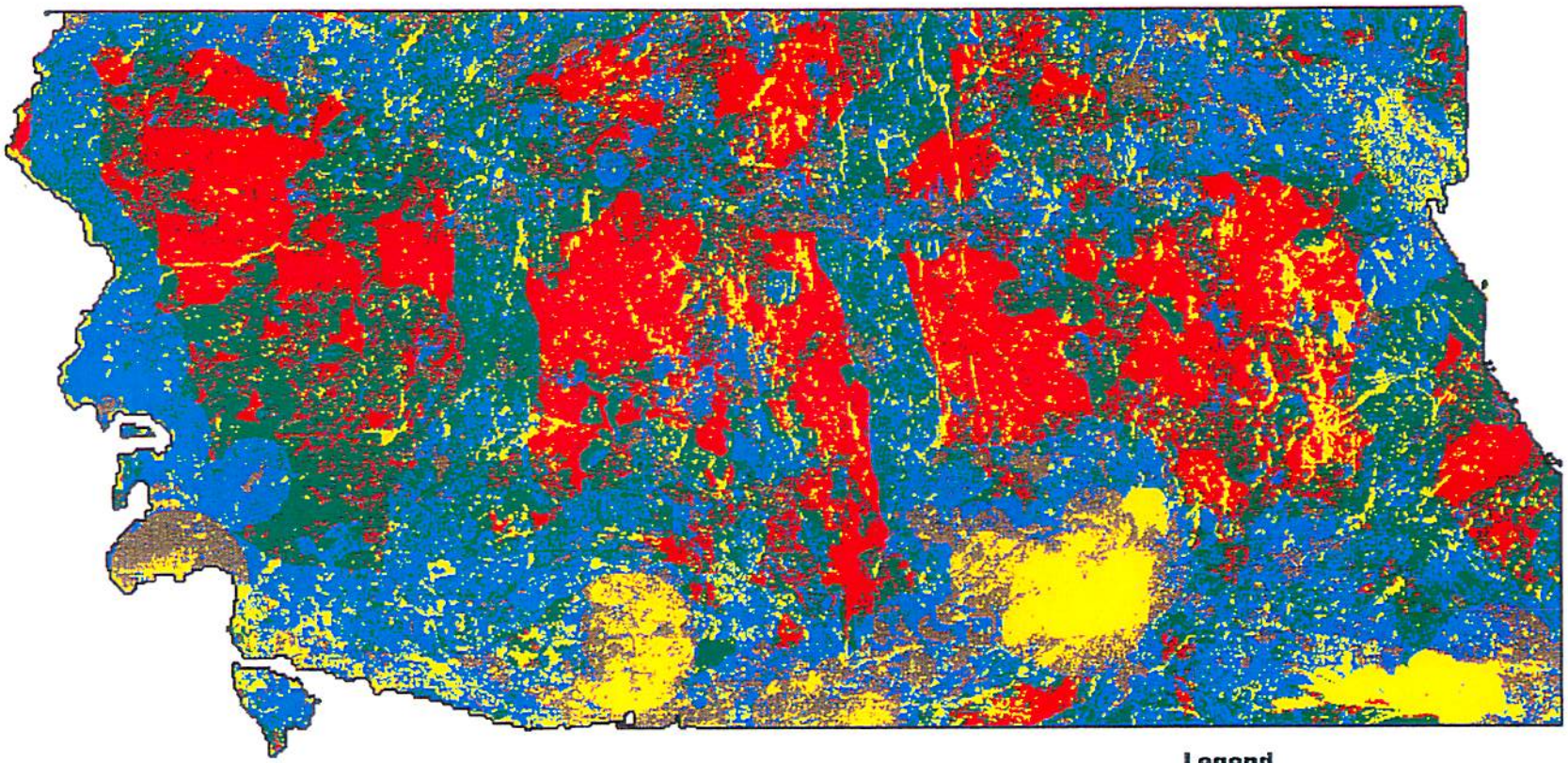
Figure 27. Ecotourism Scores



Legend

- 26 - 30
- 22 - 25
- 18 - 21
- 14 - 17
- 10 - 13

-25 0 100 km

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regardless what order they were placed in the hierarchy. Access and wildlife were found to be the most important criteria in shaping the ecotourism units.

The following procedure was used to identify Type I ecotourism units. First, after all scores were accumulated, areas which scored between 26 and 30 points were isolated and placed into a separate class. Second, areas which received a score less than 25 were eliminated. Third, a buffer with a width of 1 kilometer was placed around all roads and overlaid onto the Type I scores. The purpose in doing this was to eliminate any potential Type I scores for those areas within the buffered distance. Next, the area of all Type I polygons was calculated and any polygon smaller than 300 sqaures kilometers was eliminated. The final stage involved determining the score these remaining polygons received when the criteria of landscape was considered. A score of 5 was required if they were to be identfied as Type I ecotourism areas. Those polygons which failed to score a five were considered suitable as Type II ecotourism units. By using this procedure, 4 Type I ecotourism units were identified within the Study Area (see Figure 25). Type I ecotourism units received a cumulative score of between 31 and 35 points.

This procedure was modified to identify Type II ecotourism units. All areas (polygons) which received a score of between 23 and 30 points, for the primary 'thematic' layers combined, were placed into a separate class. Areas which scored within the Type I range (26-30) were removed from this class as they represented areas less than 300 square kilometers in size. These areas were removed from the analysis in order to ensure that the same areas were not used twice to identify ecotourism units. Type II ecotourism units were then identified by following the same procedure that was used from the third stage onwards to identify Type I units. Type II ecotourism units represented areas within the Study Area (see Figure 26) of 300 square kilometers or greater which scored between 27 and 30 points.

5.0. CONCLUSIONS

This report has presented and discussed the testing and application of the methodology developed for the study. The initial criteria and attributes discussed in Reports 1 and 2 were applied to a selected Test Area in order to assess their applicability. Modifications were made to certain elements as noted above, and the methodology was then applied to the complete study area. The resulting figures for the individual layers of the GIS and the composite figures showing Ecotourism Units and overall scores have been presented and discussed. The methodology is regarded as having been successful on the basis of the proven feasibility of the production of maps identifying areas with the potential for ecotourism development. An examination of the areas identified reveals no obvious inconsistencies or observations, and the Ecotourism Units identified represent the base on which field assessment of the potential of the study area for forest-based ecotourism can be made

The methodology employed in this stage of the overall project focused predominantly on the physical attributes of the region, with less attention being given to the social and cultural dimensions of ecotourism. Using the areas identified from the overall analysis, on-site examination of each unit will be undertaken. This will allow confirmation of the suitability of the area, identification of any unrevealed issues or problems, and possible finer delineation of boundaries. Discussions will also be held with representatives within those communities located in close proximity to actual units, and with existing tourism operators in the vicinity of units to determine the level of interest in offering ecotourism activities and toward catering to an ecotourist clientele. It should be emphasized that tourism operations already exist within the area, some involved in what may be regarded as forms of ecotourism. It is important to inventory such operations and other tourism developments to assess the current level of supply of appropriate opportunities, and to assess the current level of use of areas identified as Ecotourism Units of at least Type I standard.

The methodology, as is the case with all GIS methodologies, provides information on which decisions can be based. Ground truthing or validation of areas identified is essential. Such validation has to be accompanied by identification both of existing use of areas identified and local attitudes towards existing and potential future development, if such development is to be successful and appropriate to the needs of the local area.

Appendix 1

Presence of Community

Score	Community type	Population size
5	absence of permanent settlement	0
3	hamlets/villages	less than 250
2	small towns	250-5000
1	urban settlements (industrial based)	>5000

Resource-related activity

Score	Resource Type	% of "Area"
5	no presence of extractive activities	100 per cent
3	forestry practices (cutover area)	
	presence of mining activities	< 20 per cent
1	multi-use area	> 20 per cent

Vegetation coverage

Score	Vegetation Type	% of "Area"
5	Mixed forest (type 1)	>50 % coniferous >10 % white & red pine
4	Mixed forest (type 2)	> 50 % deciduous/coniferous < 10 % white or red pine
3	Dense coniferous forest	> 80 % jack pine, black spruce
2	Sparse coniferous forest	> 80 % deciduous
	burns and cutover i.e. all others except	> 10 years old
1	Poorly vegetated areas, clearcuts, burns	shrub cover < 10 years old

Access Characteristics

Score	Type	Distance	Mode of Access
5	Arduous/ remote	> 10 kms. from nearest access point	Hike, canoe or air drop into area
4	Hard/rugged	0-10 kms from nearest track or trail	Hike or use of ATV
3	Difficult/ vigorous	0-2 kms from logging road access	Hike from logging roads
2	Moderate/ casual	100m-1 km off minor roads	Park and walk
1	Easy/passive	100 meters off paved road/boat access	Automobile, tour bus, power boat

Recreational Activity

Score	Recreational Activity(examples)	Type of Ecotourist
5	camping, hiking canoeing viewing wildlife, photography (> 7 days)	Specialist
4	camping, hiking, canoeing viewing wildlife, photography (4-7 days)	Hard core naturalist
3	camping, hiking, canoeing viewing wildlife, photography (2-3 days/nights)	Soft core ecotourist
2	viewing culture, wildlife, photography (< 48 hours, i.e. up to 1 overnight)	Generalist
1	viewing culture, wildlife photography (few hours)	Day tripper

Wildlife

Score	Area where wildlife are viewed
5	Species viewed in a wilderness setting (no human induced barriers restricting movement of wildlife) Viewing wildlife within protected areas (nature reserves) Viewing wildlife within certain zones within nature reserves, and other protected areas (provincial and national parks)
3	Viewing wildlife at certain uncontrolled point access (deer yards, feeding stations, wintering sites)
1	Viewing wildlife close to areas of permanent settlement

Landscape (Absolute relief)

Score	Characteristic	Measure
5	High Relative Relief	Max. elevation - min. elevation
3	Medium relative relief	Change in elevation up to 10 meters
1	Little relative relief	Change less than 10 meters

Landscape (Water)

Score	Characteristic	% of Area
5	Presence of water	5-20 %
3	Presence of water	20-50 %
1	Presence of water	0-5% or > 50 %

Landscape (Rock Outcrops)

Score	Characteristic	% of Area
5	Rock Outcrops	1-10 %
3	Rock Outcrops	10-50%
1	Rock Outcrops	< 1 % or 50-100

Appendix 2

PRIMARY CHARACTERISTICS

Presence of Community

Score	Community Type	Population Size
5	absence of permanent settlement	0
3	unincorporated communities	1-1000
2	small towns	1001-10,000
1	urban settlements (industrial based)	>10,000

Resource-related Activity (forestry)

Score	Resource Type	% of "Area"
5	no presence of forestry activities	100 per cent
3	forestry practices I(cutover area)	<20 % cutover 30-40 yrs
2	forestry practices II	>20 % cutover 20-30 yrs
1	forestry practices III	>20 % cutover 10-20 yrs

Resource-related Activity (mining)

Score	Resource Type	% of "Area"
5	no presence of mining	100 per cent
3	mining practices I	abandoned mines present
1	mining practices II	operational mines present

Vegetation Coverage

Score	Vegetation Type	% of "Area"
5	mixed forest (type 1)	>50 % coniferous >10 % white & red pine
4	mixed forest (type 2)	> 50 % deciduous/coniferous, < 10 % white or red pine
3	dense coniferous forest	> 80 % jack pine, black spruce,
2	sparse coniferous forest burns and cutover i.e. all others except	> 80 % deciduous, > 10 years old
1	poorly vegetated areas, clearcuts, burns	shrub cover, < 10 years old

Access Characteristics

Score	Type	Value Range
5	access area I	areas outside of any buffers around all roads
3	access area II	areas within 2Km buffer around logging roads
2	access area III	areas within 5Km buffer around loose surface roads
1	access area IV	areas within 10 Km buffer around paved/major roads

Wildlife Setting

Score	Type	Value Range
5	wildlife setting I	ARDA class areas 1-2
3	wildlife setting II	ARDA class areas 3-5
1	wildlife setting III	ARDA class areas 6-7

SECONDARY CHARACTERISTICS

Landscape (Absolute relief)

Score	Characteristic	Measure
5	high relative relief	> 25 metres
3	medium relative relief	10-25 metres
1	little relative relief	less than 10 metres

Landscape (Water content)

Score	Characteristic	% of "Area"
5	presence of water	5-20 %
3	presence of water	20-50 %
1	presence of water	0-5% or > 50 %