Northeast Archaeological Potential Model Interpretation for Archaeological Consultants

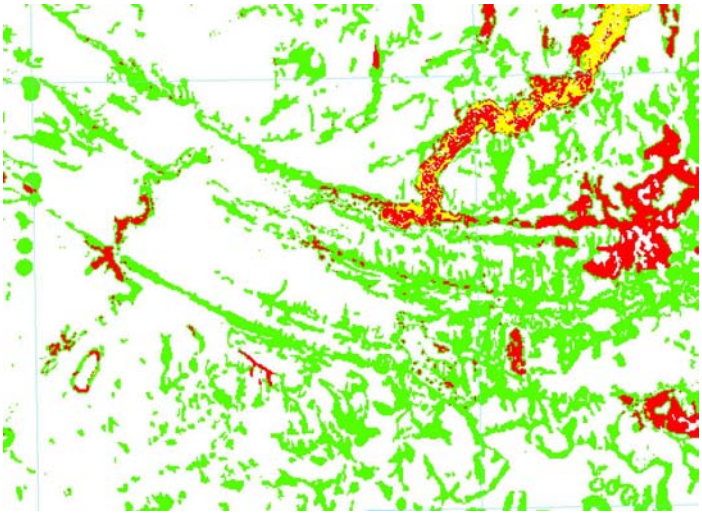

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Table of Contents

List of Figures

Model Interpretation – Consultants Version

The Millennia Research archaeological predictive model was completed for much of the NE oilpatch for the Oil & Gas Commission. Details regarding the Archaeological Overview of which the model, including analytical methods and model development, are available from yearly reports online at millennia-research.com (Benson, et al. 2003, Dady, et al. 2001, Eldridge, et al. 2002). Other directions on fulfilling archaeological requirements can be found on the "Archaeological Definitions and Guidelines" and "Flowchart" produced by the OGC. This guide is limited to interpreting the map itself.

This guide is to be followed once the model has been installed and the maps are displaying correctly on your computer. Metadata, README instillation files, and text files detailing suggested display options are supplied separately in electronic format.

Definition of "Four-colour" and "Full-Range" Potential Maps and Hillshade Layer

As consulting archaeologists, you will have access to the four-colour and full-range potential maps to help assess if fieldwork or additional evaluation should take place. It is necessary to know the differences between these map layers. You will probably find you will use the four-colour map as the basic guide, but will sometimes want to obtain additional information from the full range potential maps (Figure 1).

Full Range Potential Map - Definition

The full-range maps provide the full range of numeric scores for each ecosection model. Depending on the ecosection, the scores can range from –3 through 15, to -1 through 8. The higher numbers reflect higher site potential, and correspond to higher known site densities, and increasing risk of impacting archaeological sites for developers.

Four Colour Potential Map – Definition

The four-colour maps have had the full range model potential numeric scores divided into a standard "Low, Medium, High, Very High" categories. These categories have increasingly high site densities. Nearly half the known sites occur in Moderate potential, but High and Very High have large numbers of sites in a much smaller area.

Different Display Modes with Full Range Potential Maps

Figure 1 shows the model score with clearly separate colours for each score value. Sometimes it is more useful or interpretations are easier if this map is displayed using colours that consistently increase in hue with an increase in potential rating. This view allows a rapid assessment of "cool vs hot" zones in the map, which can be compared to development locations or alternate routing options. This view also often highlights errors in the digital elevation model, which will be described below.

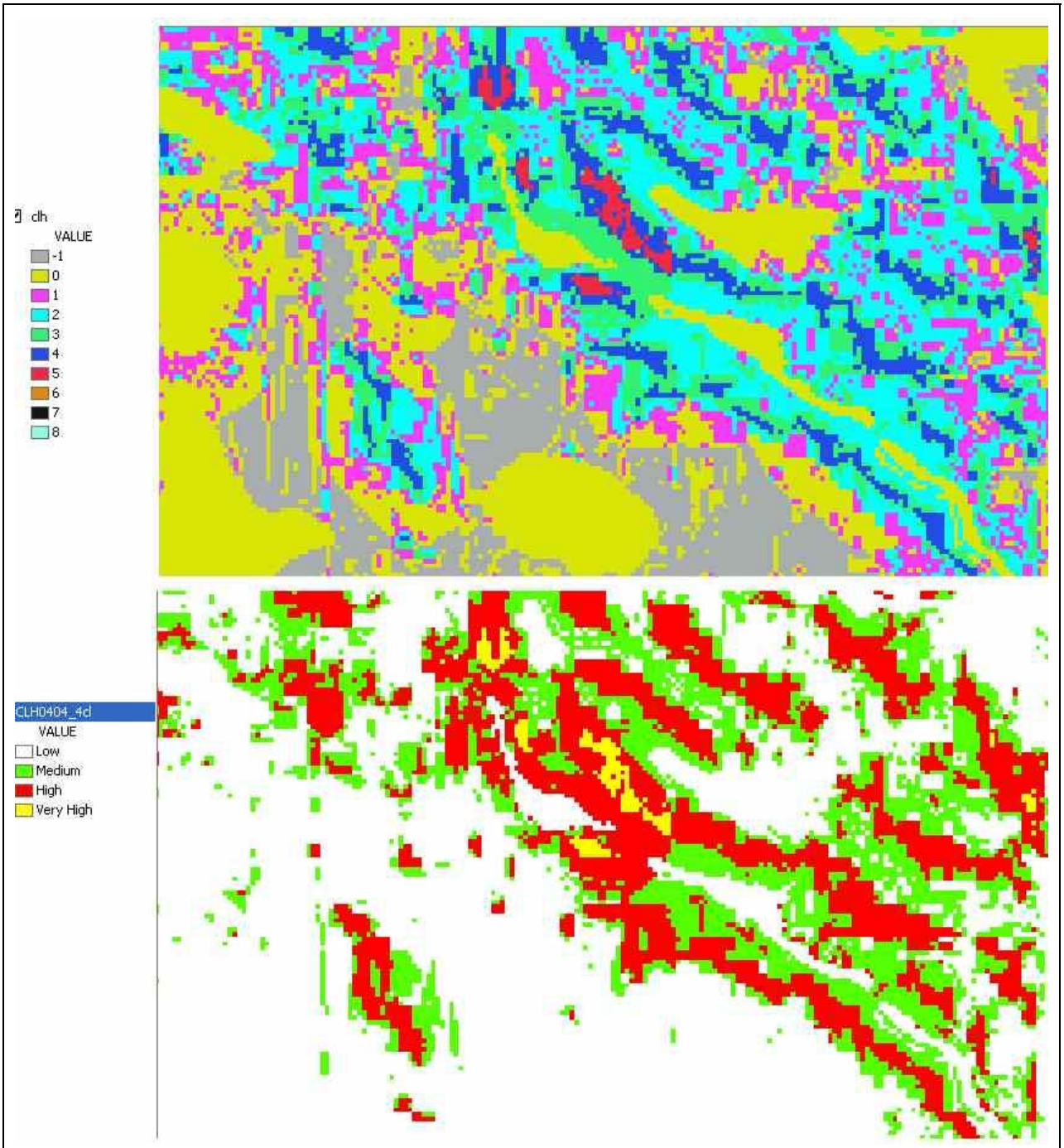

Figure 1. Contrast between Four-colour and Full Range Model Scores.
The Full Range scores show intermediate levels of potential within each of the four class model classes.

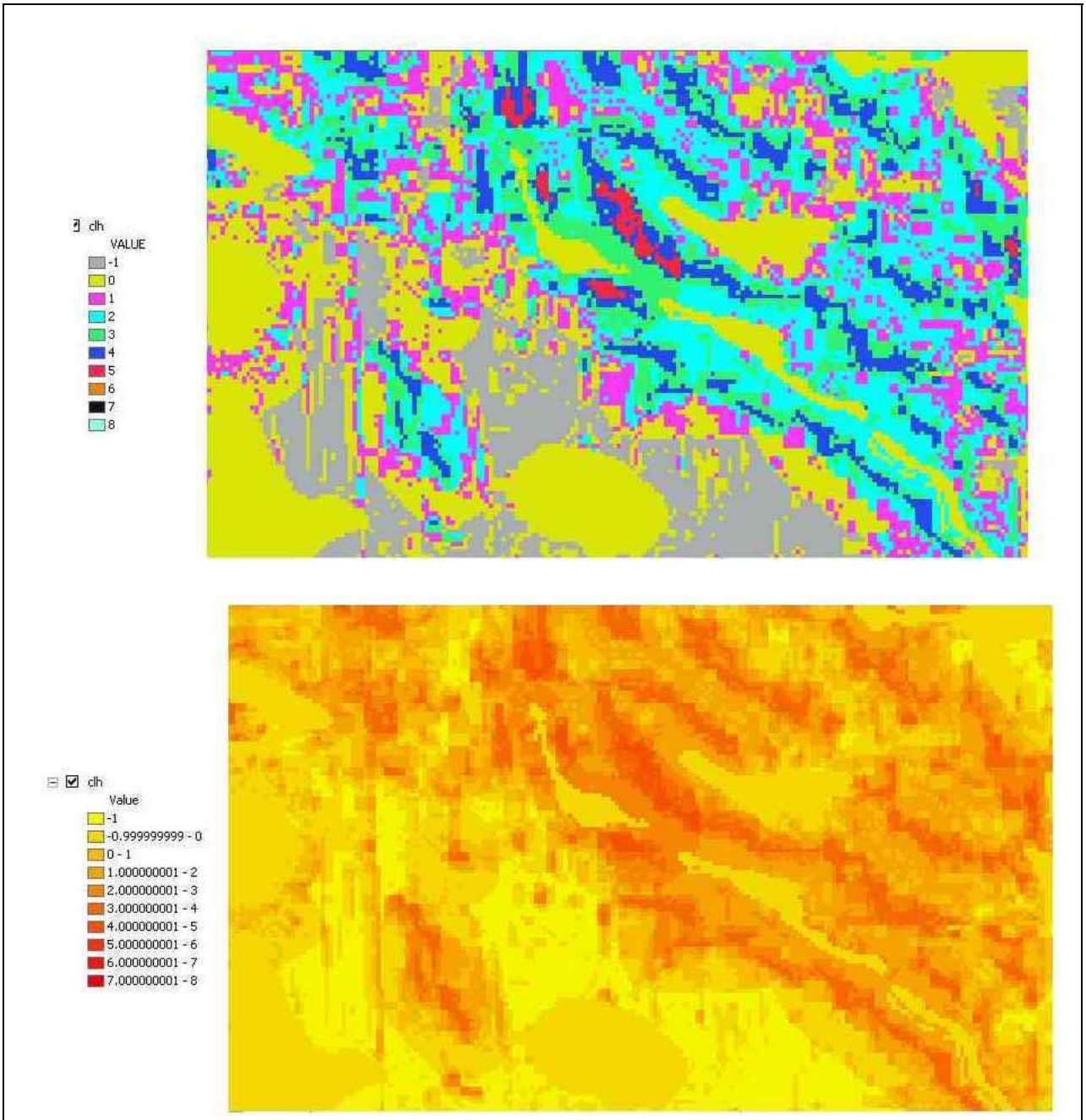

Figure 2. Contrast between Model Scores displayed as unique colours and graded colours. The model (raw) score can be displayed as unique colours to assist in identifying specific potential scores (top). However, it is more easily interpreted as a colour range, with lowest potential in one colour grading to highest potential in another (bottom, in this case yellow low to red high). This can enhance patterns that may be invisible using unique colours and less evident in the four-colour model. Most GIS software allows you to control the display in this way.

Hillshade Layer

A hillshade layer is provided as part of the model package. The hillshade represents the digital model of the land surface, shaded as if the sun was in the northwest at a 30 degree angle from the horizon. The hillshade layer highlights landforms and archaeologists have found it particularly useful in helping assess potential and interpreting the model (Arcas Consulting Archeologists Ltd. and Eagle Valley Research Ltd. 2004).

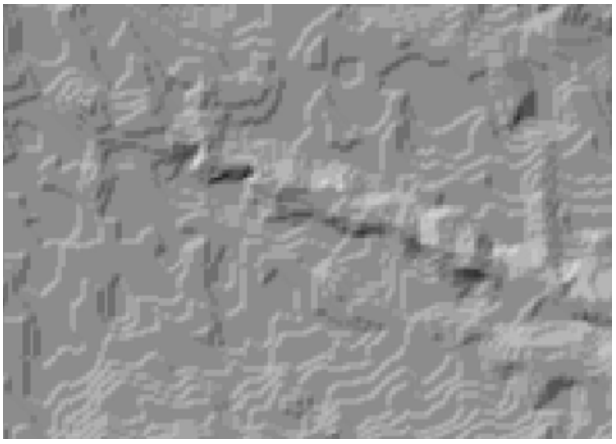

Figure 3. Hillshade at 1:20,000 scale.

A ridge feature is visible, but is unclear when the hillshade is viewed at 1:20,000 scale. Gradual slopes tend to look like small terraces with 1 m steps.

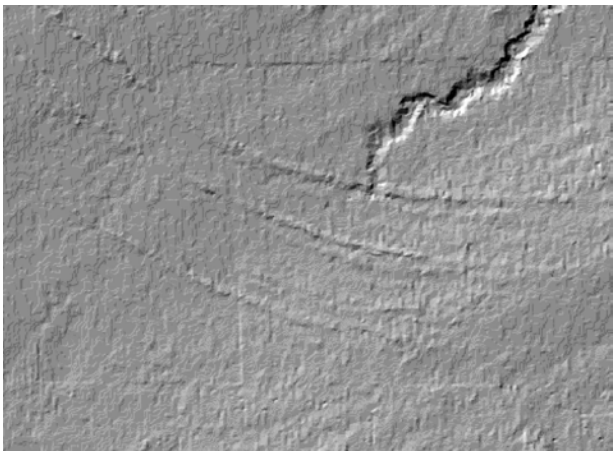

Figure 4. Hillshade at 1:100,000 scale.

Same area as above, zoomed out to 1:100,000 scale. The ridge feature is shown to be one of a series of parallel crescentic features, perhaps a series of glacial lakeshores at different stillstands. A modern creek begins at one of the ridges and proceeds to the northeast out of the frame. In general, the features and landforms appear smoother and are easier to see at this scale compared to 1:20,000 scale.

Due to the nature of TRIM data, the hillshade is best viewed at scales of about 1:100,000 (Figure 3, Figure 4), although larger scales can provide useful detail once overall patterns have been identified.

Examples Where the Model may Under Represent Archaeological Potential.

High potential microtopographic features cannot be modelled for using TRIM data, and may be modelled as Low potential. Microtopographic features are discussed briefly below and in more detail in the NE Overview annual reports.

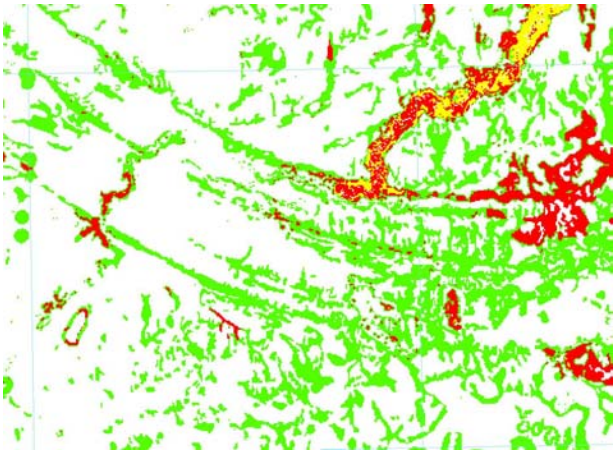

Figure 5. Crescentic features modelled as moderate potential .

Same area as Figure 4. The parallel crescentic ridge features are caught by the model, but they are shown mostly as moderate potential. The parts with the highest relief are high or very high potential. These are long features, about 20 km long each, and they may have served as travel corridors. Almost certainly sites are concentrated along their crests. Such features should be considered to have high, rather than moderate, potential, along their entirety. Note that sections of these features are included in the model where they are virtually invisible or very subtle in the hillshade.

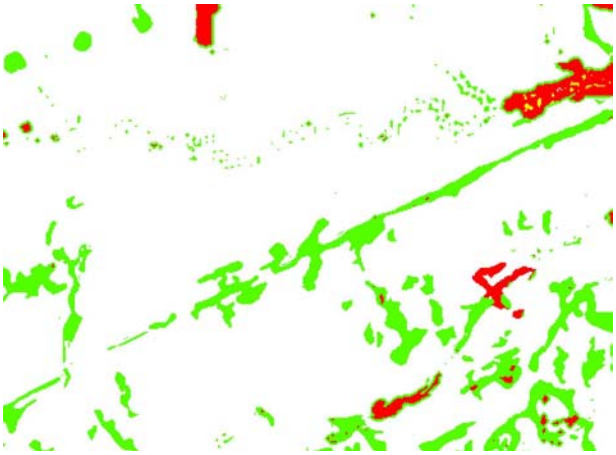

Figure 6. Linear feature modelled as moderate potential.

This figure shows a prominent linear feature running NE to SW. Such perfectly straight features should be examined with care, since they could be an artifact of DEM errors, or an anthropogenic feature. Scale is about 1:50,000.

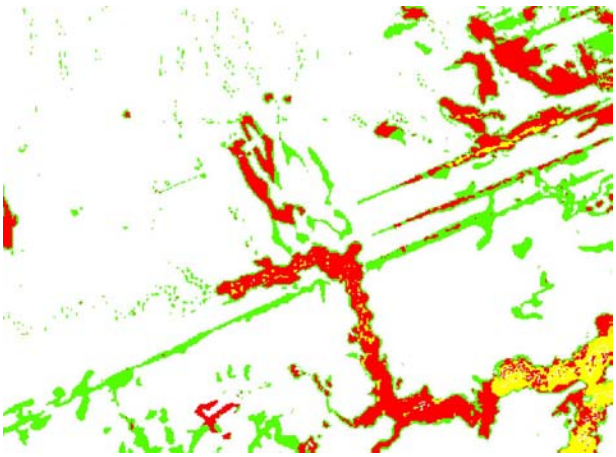

Figure 7. Linear feature displayed at a smaller scale.

Same area as above, zoomed out to 1:75,000 scale. The linear feature is actually one of a series of parallel linear ridges. The parts of this ridge shown as moderate potential should probably be considered high potential. The converse may also be true: straight features shown as moderate or high potential may be actually low potential if they are DEM errors (see below).

Instances Where the Model may Over Represent Potential

In general, the model is somewhat conservative and tends to over represent potential. Features with high archaeological potential will tend to be buffered. Comparison with lidar hillshading (see below) shows generally good correspondence for modelled features, but the size of the actual feature is often much smaller than the area modelled as high potential. Particularly on ridged topography, the ridge top will have high or very high mapped potential; the flanks of the ridge may also be modelled as moderate or high potential that is actually low. This can be taken into account where a linear development such as a pipeline parallels two clear ridges, but is well offset from both crests. It may be appropriate to determine that the archaeological potential and risk of impact is actually low for this particular situation. As with every instance, multiple sources of information should be used to make this determination.

Misclassification of landforms due to TRIM DEM (digital elevation model) inaccuracies are a major source of locations with overrepresented potential. These locations are often relatively easy to identify. Many occur along map sheet boundaries; others occur as a result of a 'waffle' pattern in the data.

The nature of the TRIM DEM is that the precision is often greater than the accuracy. This manifests in a 'waffle' pattern often visible in the hillshades. Square areas are precise relative to internal readings, but jump several metres in elevation where they join another square area – all within the acceptable TRIM accuracy targets (Figure 8, Figure 9).

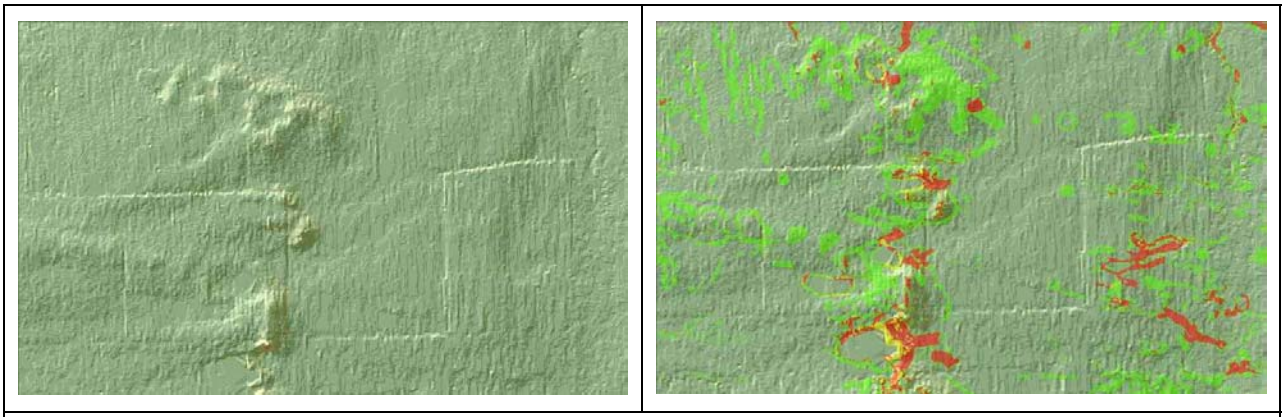

Figure 8. TRIM DEM 'Noise' features.

The left image shows a characteristic 'waffle' pattern in the hillshaded DEM, where 'tiles' of data are several metres offset in elevation to each other. In this case, it did not affect the potential model (right image, overlaying the potential model), because the change in elevation was below the threshold the model was instructed to identify.

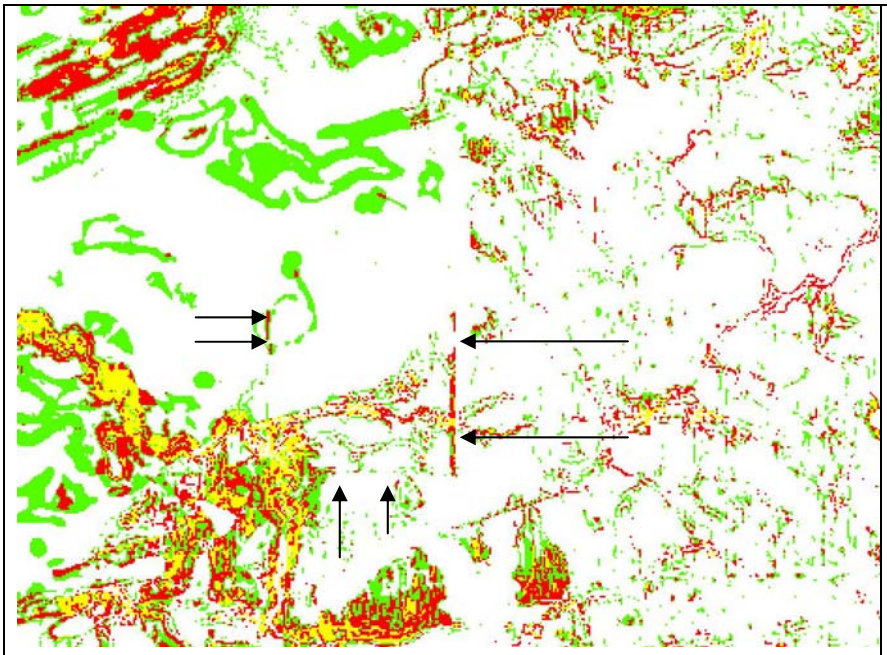

Figure 9. TRIM DEM 'Noise' features. The model over represents potential along some waffle boundaries in this figure (see arrows). For a development falling along such a feature, it would be appropriate to interpolate from other modelled features bracketing the error.

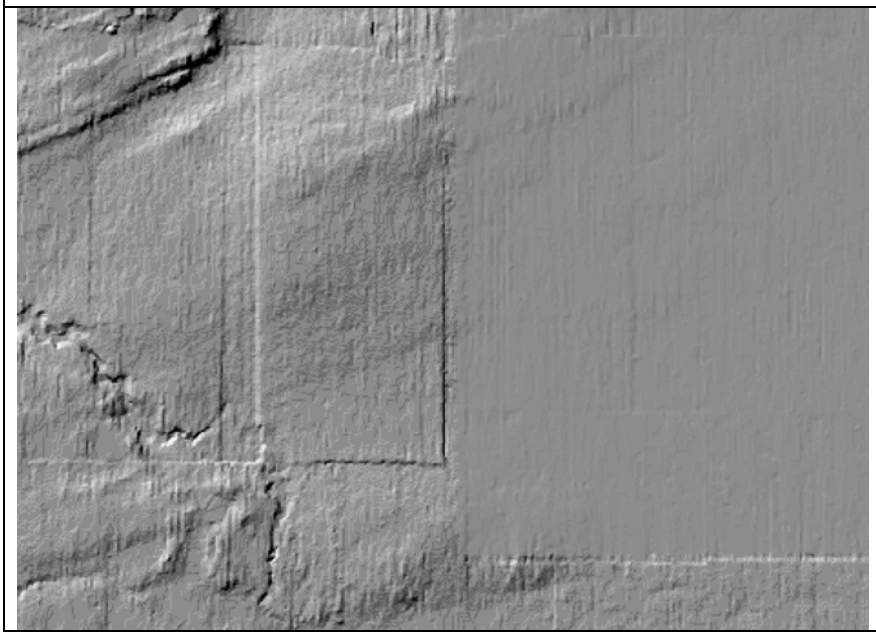

Figure 10. TRIM DEM 'Noise' features. The hillshade for the previous figure area makes the overrepresentation easy to confirm. Also note the variation in the level of detail in different parts of the DEM.

If higher potential occurs in straight lines following this 'waffle' pattern, then the higher levels of potential should be discounted, and a potential rating interpolated from the values on both sides of the line. Ensure that regularly spaced north-south ridges (which occasionally occur in the area) are not present. Such features will be evident in vegetation changes or shadows visible in orthophotos, whereas DEM noise will have no correlation with ground vegetation. With practice, you will be able to distinguish these without reference to the orthophotos.

The use of forest cover as a proxy for terrain results in moderate potential assessed for areas that actually have low potential. In some parts of the study area, operational use of the model found that many areas mapped moderate potential were covered by aspen (poplar) but a lack of differentiated terrain meant that they had low archaeological potential (Arcas Consulting Archeologists Ltd. and Eagle Valley Research Ltd. 2004). These could be reassessed as low potential if there is other information confirming the lack of topographical features.

Considering Model Variables when Interpreting Model

Archaeologists using this model (or any model, for that matter) often want to know why the model scores a piece of land as it does (AH Stryd, personal communication 2004). Knowing why an area scores moderate or higher potential can help determine the level of effort recommended for further study.

Ideally, consultants would have access to all the data that contributes to the model to determine how, exactly, a certain grid cell obtained its potential rating. Unfortunately, the model uses too many layers of information for this to be reasonable, and would require a very large amount of computer storage space. However, broad categories of attributes contribute to potential: landforms, water bodies, forest cover, and cultural features, and an informed guess can usually be made regarding the reasons for a potential rating.

Proximity to water.

Proximity to water bodies will be evident from the hillshade or in a comparison with topographic maps.

Landforms

Landforms are generally ridges, hilltops, terrace edges, or other slope breaks. Landforms can provide a range of additional values: for instance, a local hilltop situated on a terrace edge may be scored on several individual landform variables. The model comes with separate slope and hillshade layers (Figure 12, Figure 11). When displayed under the potential ratings, these two layers should allow visual identification of many landforms that contribute to potential. Some landforms may not be evident under certain lighting conditions (and if Figure 4 and Figure 5 are compared, the crescentic landforms are more continuously emphasised in the model and appear more interrupted in the hillshade). Comparison of the TRIM hillshading with an orthophoto (most are available through RAAD) is also very helpful for interpretation.

Microtopographic landforms cannot be derived from TRIM digital elevation points, which are about 80 m apart: the DEM interpolates these to 20 m cells. The minimum size landform recognized will be about 100 m or more across in both east-west and north-south dimensions, except in unusual circumstances. LIDAR, if available, should be used to identify microtopographic features (Figure 11).

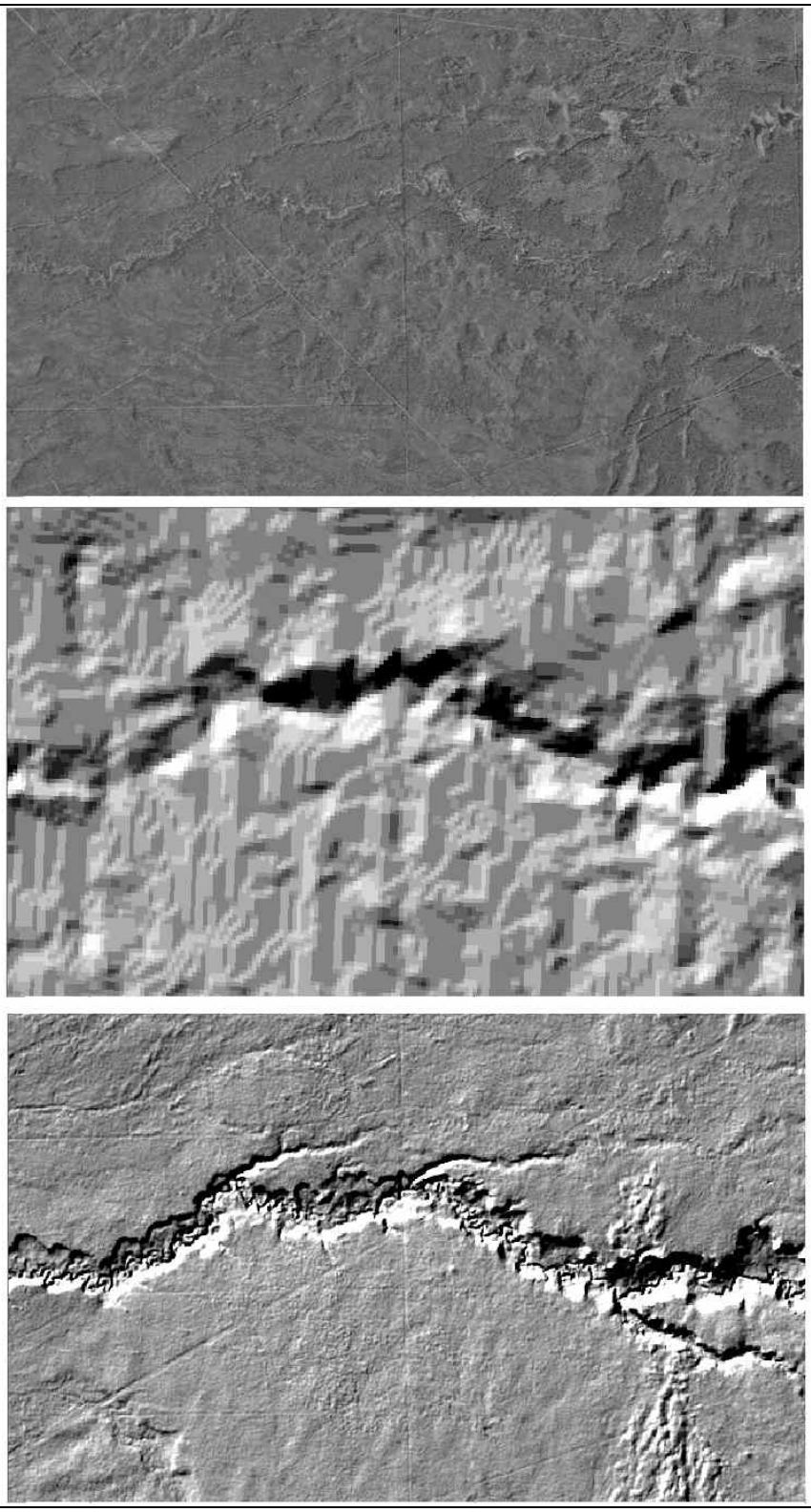

Figure 11. Orthophoto (top) compared to TRIM hillshaded DEM (middle) and to LIDAR bare-earth hillshaded DEM (bottom).
Actual LIDAR is nine to 36 times more detailed. This illustrates why microtopographical features can be modelled for in LIDAR but not in TRIM, and can be invisible or difficult to interpret from orthophotos. Scale about 1:10,000.

Forest Cover

Irregular polygons of moderate or higher potential are likely due to forest cover that correlates with site location, especially if no landforms or water features can be seen (Figure 12). Where forest cover co-occurs with landforms or proximity to water features, then the potential may be increased to high or very high.

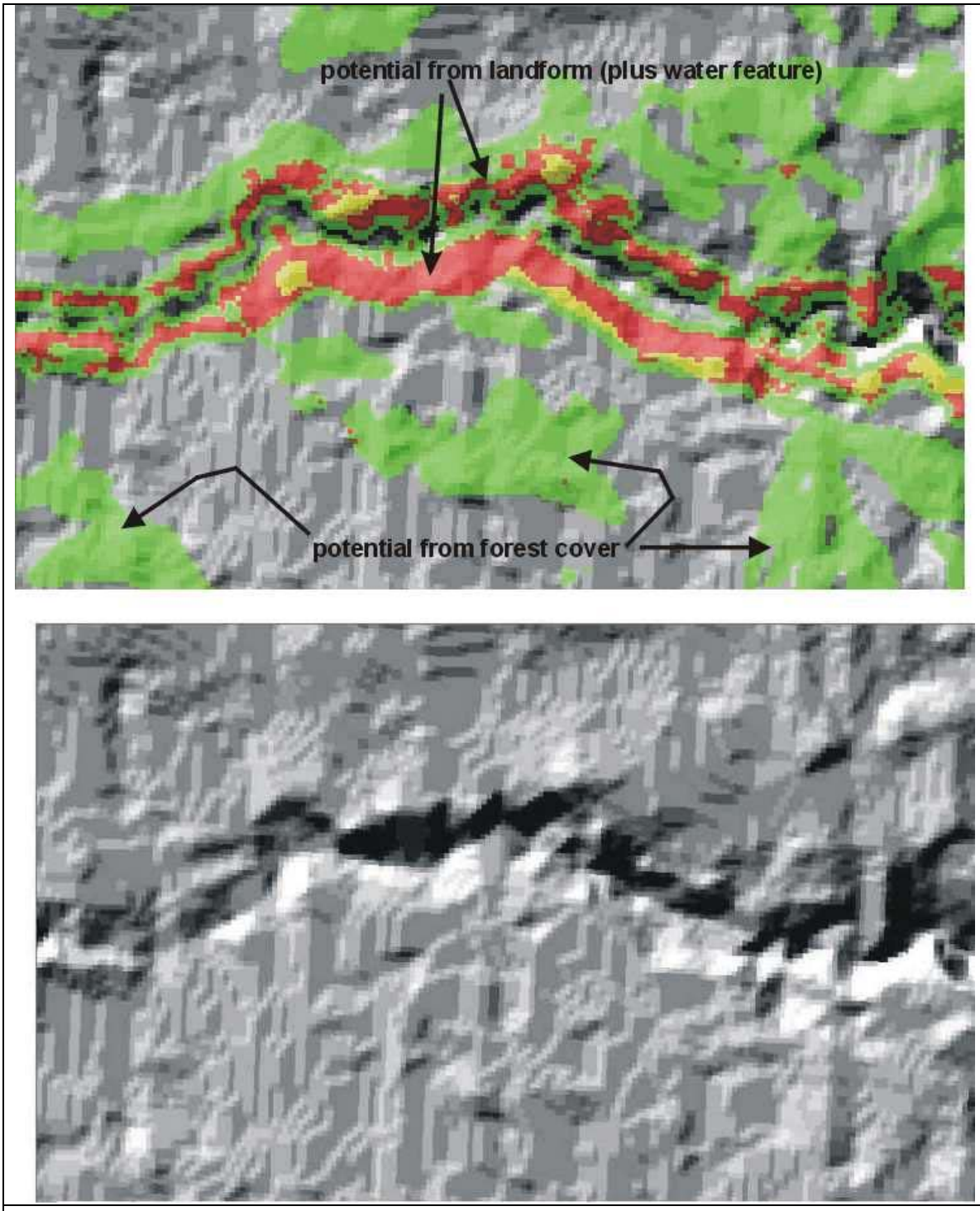

Figure 12. Landform and forest cover potential interpretation. Four colour map and hillshading shown.

Trails

Trails will often be evident from linear bands of higher potential (Figure 13).

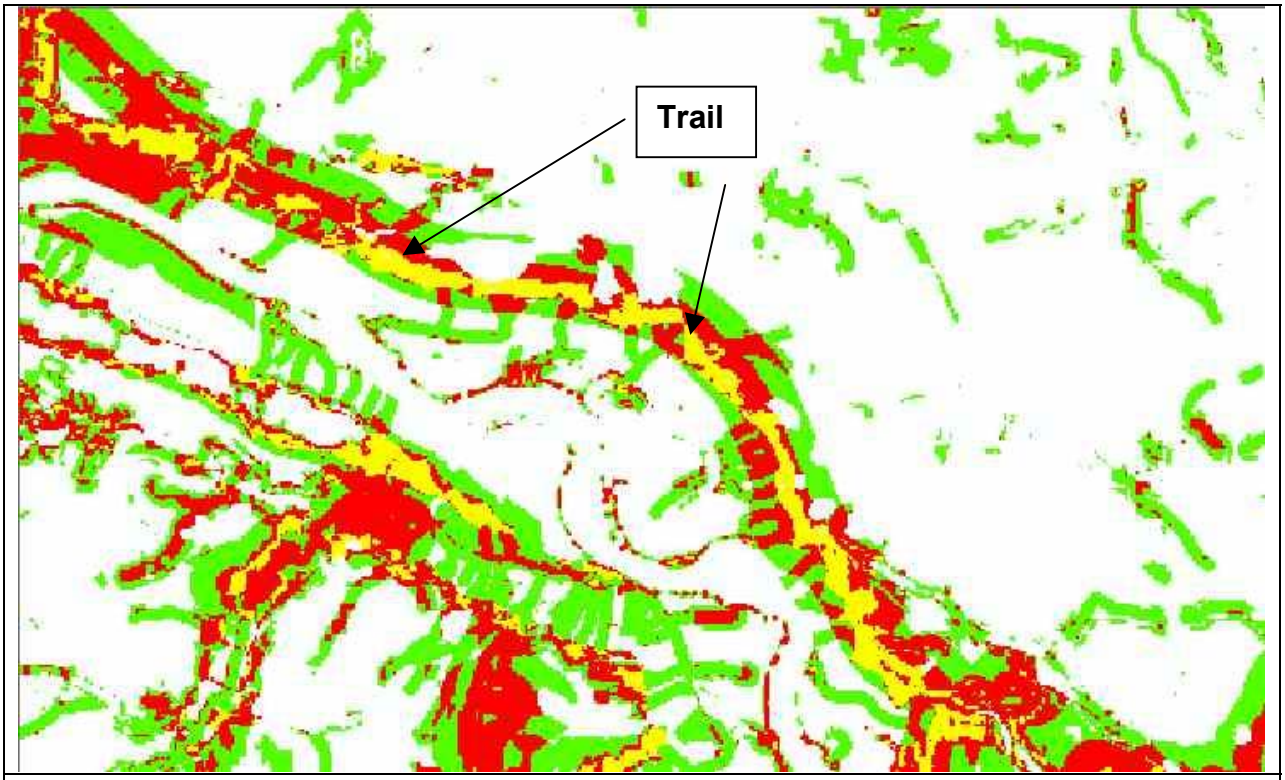

Figure 13. Trail.
Trail is evident following north terrace of meandering river. Potential values derived from landforms, forest cover, etc. are increased in two buffer widths. Scale about 1:50,000.

If you are conducting an AOA or pre-AIA review and know the locations of aboriginal trail features that aren't evident on the potential maps, you should increase the potential classes of moderate and higher to high or very high within a few hundred metres of such a trail. Trails are strong predictors of archaeological site locations.

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