

**PRINCESS POINT:  
THE LANDSCAPE OF PLACE**

**by**

**Frank Alfred Dieterman**

**A thesis submitted in conformity with the requirements  
for the degree of Doctor of Philosophy  
Graduate Department of Anthropology  
University of Toronto**

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# **Princess Point: The Landscape of Place**

**Frank Alfred Dieterman, Ph.D.  
2001**

**Department of Anthropology  
University of Toronto**

## **Abstract**

The *Landscape of Place* is an interpretation of Princess Point settlement as an expression of the surrounding landscape. Princess Point is a proto-Iroquoian group, who may or may not be direct ancestors of Ontario Iroquois, that occupied southwestern Ontario *circa* A.D. 500 to 1050. This dissertation defines and models the Princess Point settlement system with emphasis on the relative contributions of activities associated with a period of sedentarisation, social re-organisation, and subsistence change in the form of maize cultivation activities.

The research objective of this dissertation uses a substantive evaluation of the Princess Point settlement system through spatial and temporal modelling of the interrelationships between archaeological sites and the environment. The research objective also uses an inferential explanation of the Princess Point settlement system through spatial and temporal modelling of the interrelationships between space and place. The data sources include a cross section of 45 sites from Princess Point, Middle Woodland, and Glen Meyer cultures southwestern Ontario, and 10 random locations in the lower Grand River valley, analysed through geographic, topographic, water, and soil landscapes.

Landscape modelling illustrates the relationships between a community and its surroundings. These relationships are presented through the format of a viewshed in this dissertation, suggesting the recreation of a community's perception of their immediate landscape. The landscape approach presents site location preferences as cultural decisions based on both economic needs and socially determined needs. The landscape model, as applied to the Princess Point culture, is used to explain the effectiveness of applying a landscape methodology to prehistoric data sets in southern Ontario.

Princess Point site distribution follows a newly evolving pattern, whereby a bounded orientation is repeated at all scales. Discrete clusters consist of naturally bounded communities and oriented towards water resources. Sites with rich, yet restricted, resource zones are in association with immediate access to productive soils, placing a greater emphasis on cultivated resources. The *Landscape of Place* highlights the fulcrum of the shift from people living in the landscape to people living on the landscape.

## Acknowledgements

This dissertation is the culmination of a journey into the world of southern Ontario's prehistory, the theory of landscape, and the intricacies of Geographic Information Systems. The final product could not have been accomplished without the generosity of a number of individuals and institutions.

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# CHAPTER 1

## LANDSCAPE AS ARCHAEOLOGY

### Research Synopsis

The *Landscape of Place* is an interpretation of Princess Point settlement as an expression of the surrounding landscape. Princess Point is a proto-Iroquoian group, who may or may not be direct ancestors of Ontario Iroquois, that occupied southwestern Ontario *circa* A.D. 500 to 1050. The Princess Point settlement system is modelled through the employment of landscape analyses via a Geographical Information System to reconstruct, in part, an understanding of site location decision-making processes. A study of settlement systems can be used to analyse relationships to geographic features and relationships to social structure through an examination of the relationship between the people and the landscape of the settlement system. It is my belief that the landscape reflects the patterned behaviour of social groups. The archaeological record preserves enough of these patterns to enable an analysis of this behaviour (Savage 1990:339).

This research is framed by modelling late Middle Woodland (AD 200 to 700) and Early Ontario Iroquoian Glen Meyer (AD 1000 to 1200) site locations in southwestern Ontario to permit a comparative analysis of cultural variability in site selection criteria, landscape associations, and cultural activities. My research provides evidence that landscape played a socially cognisant role in the Princess Point settlement system in the determination of site location, and

maps out an adaptive landscape strategy for the inclusion of a new cultigen into an established cultural system.

The A.D. 500 to 1050 period of proto-Iroquoian development has been subject to some attention over the past 30 years (for example, see dissertations by Chen 1997, Finlayson 1977, Ounjian 1998, Stothers 1977, Williamson 1985, Smith 1987, Timmins 1992). However, a landscape approach has yet to be broached for this, or any, period of pre-contact settlement in southern Ontario. This research provides an examination of the relationship between environment, site location, and landscape through modelling of variables pertaining to geography, topography, water, and soil data sets.

### **Princess Point Archaeology**

Although Fox has stated that developments during the period A.D. 600 to 900 formed the basis for the emergence of a settled village agricultural-based lifeway by A.D. 1000 (Fox 1990:171), to date, no settlement analyses have been conducted for Princess Point nor for any society (i.e., Rivière au Vase, Sandbanks) dating to this temporal period in southern Ontario. The underlying rationale for Fox's statement lies in his (and others) explicit assumption of an *in situ* development for proto-Iroquoian settlement systems and implicit assumption regarding maize cultivation practices over the same time period. This research examines the latter assumption through an explicit assessment of the Princess Point settlement system and brings forth new data on proto-Iroquoian and Iroquoian settlement. A series of recent publications by Crawford, Smith and colleagues (Crawford *et al.* 1997, Crawford *et al.* 1998a, Crawford *et al.* 1998b, Smith 1997, Smith and Crawford 1997, Walker *et al.* 1997) emphasise Princess Point and its

importance in determining the shift to horticulture in eastern North America. An examination of the settlement system associated with this shift sheds light on the role of horticulture within Princess Point social organisation.

As noted by Smith and Crawford (1995:55), since Stother's 1977 monograph and prior to their own fieldwork, there has been very little concentrated work on Princess Point sites nor analyses of settlement data. Given that the most recent general summaries of archaeological fieldwork for this region are found in *The Archaeology of Southern Ontario to A.D. 1650* (see Fox in Ellis and Ferris 1990) and selections from the proceedings of the 1994 Ontario Archaeological Society symposium on Iroquoian origins (Bekerman and Warrick 1995) a re-evaluation is required in order to update the current state of the archaeological record ca A.D. 500 to 1050 in southern Ontario.

### **Secondary Agricultural Origins**

Southern Ontario was a secondary centre of agricultural origins for locally harvested crops, including maize, bean, cucurbit, sunflower, and tobacco, none of which are native to Ontario (see Crawford *et al.* 1998a:125). The emergence of food production in southwestern Ontario associated with the Princess Point culture was first reported by Stothers (1977) who recovered a single maize kernel from the Grand Banks site, four kernels from the Princess Point type site, and 44 kernels from the Porteous site, at that time believed to be a Princess Point site. Subsequently, it was hypothesised that Princess Point introduced maize to the region through an incipient form of maize cultivation, initialising a subsistence shift from wild resource pro-

curement to agricultural practices stemming from a migration from the south of corn horticulturalists shortly before A.D. 800 (see Stothers and Yarnell 1977).

This scenario remained the dominant interpretation of secondary agricultural origins in southern Ontario, prompting a model of tenth-century A.D. Iroquoian migration with Stother's hypothesis as one of the basic tenets (Snow 1995). Analyses of flotation samples from the Grand Banks site provided a swift counter-argument (see Crawford and Smith 1996). Five AMS dates on *Zea mays* from Grand Banks ranged in calibrated dates from A.D. 540 to 1030 (see Table 1 in Crawford *et al.* 1997). The period of secondary agricultural origins in southern Ontario has now been pushed back to at least the sixth-century A.D. Moreover, a recalibration of radiocarbon dates cast further doubt on the tenth-century migration hypothesis (see Smith 1997, also Shen 1997:7-10, Smith and Crawford 1997:11-12).

As a consequence, the traditional Middle to Late Woodland split at A.D. 1000, based on sedentary village life and the inception of maize horticulture is likewise challenged. The confirmed presence of maize in southern Ontario at this time places the onus directly upon Princess Point as the instigator of this practice. The process by which this introduction occurred is unknown at this time. The standard arguments, migration, diffusion, or assimilation, may each be valid. The role of maize in the Princess Point subsistence ecology is unknown, but was likely in the form of limited cultivation on river flats that slowly gained in intensity so that, by A.D. 1000, "Princess Point society was dependent upon food production as a subsistence regime" (Smith and Crawford 1997:27). Examinations of site patterning and settlement systems in contexts similar to Princess Point and reaching similar conclusions includes, among others, research

from north-central Europe (1979, Bogucki 1988), northern Japan (Crawford and Yoshizaki 1987, D'Andrea *et al.* 1995) and the American southwest (Spielmann 1991, van West 1994).

### **Geographical Information Systems and Archaeology**

The use of Geographic Information Systems (GIS) in archaeology is an extension of spatial analyses research. More than 30 years ago, Flannery investigated the potential of computer-assisted spatial analyses (Flannery 1968). Examples of the realisation of this potential document not only explicit computer applications and conclusions but also the history of spatial analyses (Clarke 1977, Flannery 1976a, Hodder and Orton 1976). The addition of GIS as a method of visualising spatial data has resulted in many contributions to the field of archaeology (for a selection of contributions, see edited volumes by Aldenderfer and Maschner 1996, Allen *et al.* 1990, Castleford 1992, Lock and Stancic 1995, Maschner 1996a).

Faced with spatially disparate data, an archaeologist can use GIS analysis to seek relationships, to produce composite variables and maps, and to model information output in a variety of manners (see Lock and Harris 1992 for a detailed synthesis of spatial analysis and GIS). Kvamme and Kohler (1988) best summarise the origins of the archaeological application of GIS, while Richards (1998) and Kvamme (1999) document GIS contributions to archaeology over the past decade.

Practitioners of archaeological settlement models frequently make use of GIS. A North America emphasis on large-scale data and the development of potential models through GIS applications in heritage management showcases GIS as an organisational device. The explanatory framework of European GIS studies place more emphasis on seeking relationships be-

tween sites, the human perception of the landscape, and forging and developing explicit links with archaeological theory (see Richards 1998:336-7). Llobera (1996:614) states that understanding the landscape is essential to understanding a society, and that the use of GIS overcomes the difficulty of exploring this theory by producing multiscalar map layers derived from the relation between a locale, or place, and its surroundings, or associated space.

The concern that the use of GIS inevitably leads to environmental determinism traces the problem to “geographic approaches from which GIS were built, treating space in an abstract geographical sense (as in Cartesian space)...[where] there is no observer, no perspective, and no history” (van Leusen 1996). But the term landscape connotes both a physical status and a culturally perceived status, leading to the understanding that the perception of space is closely tied to behaviour and can be demonstrated through GIS (Zubrow 1982:82). As proof, recent analytical forays into archaeological landscapes via GIS have successfully jettisoned this deterministic label. One such stance against environmental determinism (as portrayed by potential and locational GIS models, see Chapter 2) suggests the use of a methodology that combines interpretative and empirical research, achieved through a focus on the practices associated with settlement location (Llobera 1996:612). In addition, a GIS landscape analysis of Bronze Age settlement in southern Spain uses both socio-historical data and biophysical data leading to an interpretation of an archaeological site as “not simply a set of physical and material culture, but reflected sets of values as to how space should be perceived and experienced” (Verhagen *et al.* 1995:192). A similar opinion is found in the comment that “to make good use of GIS... archaeological sites must be used as data in and of themselves, not just as repositories for undiscovered artifacts” (Snow 1997).

The majority of current GIS archaeological models use the analysis not as an end-product, but as a necessary step in the validation of a variety of non-deterministic models. The GIS component of my research is executed in this manner. Moreover, although GIS has proven to be a successful and popular analytical tool in the analysis of archaeological landscapes, Bender *et al* (1997) aptly demonstrate that the theory and methodology of landscape modelling is not driven by technology, effectively providing archaeological landscape interpretation, without GIS technology, for a Bronze Age village in eastern Cornwall, England.

### **Landscape Archaeology**

A landscape approach to archaeology investigates the dynamic perspective of human-environment relationships. Moreover, a landscape approach “must address the study of landscapes with systematically collected data, careful evaluations of alternative explanations, and amassed evidence” over and above descriptive and speculative landscape investigations (Feinman 1999:685). The practices and meaningful activities of successive generations can be said to leave their mark on the landscape in the form of recognisable and significant patterns. In a manner similar to the strategies employed to seek patterns in, for example, stone tool manufacture or ceramic decorations, the strategy of landscape archaeology is to observe variation in patterns and non-conformities to assist in an explanation of the archaeological record through cultural, spatial, temporal, and cognitive similarities and differences.

### *Defining Landscape*

The majority of archaeological landscape research initiatives result in a unique user-motivated definition of landscape. Although I have adopted an extant definition of landscape for this research, many of the terms I use are unique to this research. While not uncommon in Europe and Great Britain, landscape archaeology has seen little application as an interpretative methodology in North America. Therefore, in that this terminology may be foreign to many, I provide brief definitions of principle landscape and modelling terms (Table 1.1).

Definitions of landscape are varied. From an ecological stance, landscape involves an examination of the relationships between settlement, stratigraphy, and landscape structure and change (Butzer 1982). Similarly, landscape is defined as a focus on various scales of spatio-temporal environmental heterogeneity (Stafford 1995:70). In contrast, those employing a phenomenological approach define landscape as a series of named locales, a set of relational places linked by paths, movements and narratives (Tilley 1994:34), with no reference to environmental linkages. Other researchers define landscape as contingent on the observer's personal view, spatial scale and adopted time span (Ingold 1993), to exist only when thought, seen, or experienced (Shanks 1992:141), or simply as a unit of human occupation, where the landscape is a broad holistic concept including humans and their anthropogenic ecosystem (Fisher and Thurston 1999:630).

The literature is rich in accounts documenting the perception of the natural environment from a wide diversity of cultures. An ethnographic viewpoint often traces culture specific definitions of landscape to a strong association between people and territory, and especially territory expressed as a landscape. For many aboriginal groups, the landscape is a collection of the

**Table 1.1: Table of definitions.**

<i>Landscape</i>	The spatial manifestation of the relations between humans and their environment ( <i>Crumley and Marquardt 1987</i> )
<i>Natural landscape</i>	Landscape as a measurable subject, comprised of physical elements in the natural world.
<i>Experienced landscape</i>	Landscape as a measurable object, perceived by the social system within which it is experienced.
<i>Space</i>	A conceptually limitless region exclusive of the social interactions of a community and for which there is no culturally derived landscape.
<i>Place</i>	A culturally experienced locale comprised of immediate surroundings or a habitually frequented area.
<i>Affordance</i>	An environmental situation that potentially offers, provides, or furnishes something to an individual, either positively or negatively ( <i>Gibson 1986</i> )
<i>Viewshed</i>	A zone of influence, or region of direct control, around a site as defined by the boundary of day-to-day cultural activities, synonymous with place.
<i>View form</i>	The variation in viewshed land area through comparative analysis of the amount of adjoining areas within the viewshed, identified as a contiguous value measured in ha.
<i>Isochron</i>	A measure of time, and calculated as distance, to complete an activity or travel a prescribed distance. Isochrons are bounded by the viewshed.
<i>Residence isochron</i>	A measure of time for activities and affordances with low mobility tasks associated with subsistence, settlement, and social organisation.
<i>Habitat isochron</i>	A measure of time for activities and affordances associated with high mobility tasks associated with subsistence, settlement, and social organisation.
<i>Geographic landscape</i>	The partitioning of land within clusters, viewsheds, and isochrons.
<i>Topographic landscape</i>	The partitioning of absolute (ASL) and ordinal group elevation data.
<i>Water landscape</i>	The partitioning of water resources and ordered watercourses.
<i>Soil landscape</i>	The partitioning of soil groups and soils suitable for plant cultivation.

permanent traces of ancestral actions (Weiner 1991:92). Hunter-gatherers revolve about a focus, which is sometimes a physical representation, but always involves a spiritual and social relationship (Wilson 1988). Moreover, hunter-gatherers indicate a greater concern with objects and features of the landscape, such as paths, tracks, sacred sites, water holes, haunts, etc. This represents a “construction...put on the landscape rather than the landscape undergoing a reconstruction” (Wilson 1988:50).

The non-Western ideologies that these cultural perceptions present provide an avenue of investigation in terms of deducing indigenous values. A variety of works address the geophysical surroundings of native groups and the connotations and inferences associated with the surroundings, incorporating the concepts of space, place, landscape and territory. These studies document the cultural classification and perception of the regional landscape. A cogent example is Nelson's (1983:36) work with the Koyukon people in central Alaska, where he notes the existence of a complex and sophisticated cultural template for geographic location and mental mapping. Also fitting are Fock's (1991) study of the Cañar Indian conceptualisation of landscape, examining the significance of both political and symbolic comprehension in relation to settlement location, and Basso's (1984) account of the moral significance the Western Apache attach to the landscape, forging bonds between individuals and features of the landscape and viewing the landscape as a keeper of tradition, thereby influencing patterns of social behaviour. Ethnographic studies also provide more general treatments of the cultural concepts of space and its association with settlement location (see Graham 1994, Holl and Levy 1993, Ingersoll and Bronitsky 1987, Longacre 1994).

What, then, is a landscape? A landscape is a spatial arena encompassing human-human and human-nature associations, both physical (outside human control) and sociohistorical (interactions between people coexisting in physical landscape). Moreover, landscapes must end somewhere in space, therefore the concept of landscape must include the concept of a boundary (Orser 1996:138-139). A simple, yet elegant definition of landscape is the “spatial manifestation of the relations between humans and their environment” (Crumley and Marquardt 1990:73). This definition neatly summarises the physical, social, and spatial interactions. In order to compare and contrast the relations between humans and their environment, a margin or border must be delimited as a key component of any cultural landscape.

I believe that landscape assessment requires a cross-cultural analysis in order to better analyse the relations between humans and the environment. In that vision functions as the predominant human sensory response and that the notion of landscape is typically visual, the human-environment relationships of past cultures are best analysed through visual means. Arguably, one may also speak of the aural landscape, the olfactory landscape, and the tactile landscape. A multi-sensual nature of perception implies that vision is never independent of the other senses (Rodaway 1994), but the practicality of re-constituting these other landscapes is beyond the scope of this research.

### *Heterarchical Analyses*

Heterarchy is defined as a “structural condition in which elements have the potential of becoming unranked (relative to other elements) or ranked in a number of ways, depending on systemic requirements” (Crumley and Marquardt 1990:74, see also Crumley 1994a:12). The

concept of heterarchy allows the analysis of different questions and problem sets at multiple levels or combinations of levels. In contrast, hierarchically structured analyses tend to nest levels of analysis in ways that may bias, contort, or simply erroneously configure dynamic parameters. Heterarchical analysis does not presuppose the impossibility of documenting a nested landscape hierarchy (see Bender *et al* 1997) but merely corrects for, or minimises, analytical bias.

A heterarchical analysis makes use of a multiscalar methodology to show variation in relationships over space and time (Verhagen 1995:258). Once a pattern or homogeneity is recognised at one scale, the analysis moves to either a larger or smaller scale at which point the patterns require new interpretation ( see Crumley 1994b, Crumley and Marquardt 1990, Fairclough 1999, Jochim 1994, Marquardt 1992, Nassaney and Sassaman 1995). If a multiscalar approach is viewed as a language, the analysis can be said to shift between sentences (large scale), words (medium scale), and letters (small scale). The interpretation of landscape shifts from cultural site clusters to unique site viewsheds to individual resource group locales (see Chapter 2 for a detailed examination of these concepts). The landscape model addresses the language of the data, not in a Hodder-like post-processual manner, but in a quantifiable heterarchical analysis.

### *The Human-Environment Relationship*

Landscape is both emic and etic, a product of human perception and a subject that can be read by an observer. As a product, the landscape is a construct of the social system within which it is experienced, a manifestation, a personal view, a thought. As a subject, the landscape is a measurable aspect of the physical world, the human-environment relationship, the spatial

and temporal scales. Although it is unlikely that any pre-contact culture can impart their emic perceptions to an archaeologist, the archaeologist can attempt to reconstruct, in part, a human perception of a cultural landscape by means of a subject-product dichotomy. Landscape as a subject follows a substantive approach while landscape as a product is an inferential approach.

The subject-product dichotomy is more commonly discussed under the rubric of the nature-culture debate. As Western thinkers, we tend to order things hierarchically. Thus, nature-culture is not constructed in a manner analogous to dualism philosophies but rather as a primary-secondary empiricism in which the primacy of the empirical world is represented by substantial things and cultural interpretations are essentially insubstantial. This results in an archaeological paradigm that dictates that an economic base is more important than a cultural infrastructure (Butzer 1982, Nicholas 1988, Winterhalder and Smith 1981), thereby legitimising the primacy of “ecosystem dynamics over cultural perceptions of landscape” (Thomas 1996:235). Settlement macro-patterns are typically assigned to ecological factors while micro-patterns are the result of sociocultural contexts (Willey 1968). Implicit in these statements are hierarchical structures typically assigned to nature-culture explanations. The few who believe that the opposite holds true, that landscapes are culture before they are nature (Schama 1995:61), remain within the hierarchical structure.

In practice, the nature-culture dichotomy has resulted in a wide disparity in archaeological landscape modelling with a strong emphasis in research and literature on landscape as a subject over landscape as a product and stressing ecological and environmental factors. To eliminate the inherent hierarchy, the culture-nature dichotomy can be replaced by the synergy of person-environment (Ingold 1992:44). Within the latter, one addresses the interrelationships

and not the exclusivity between subject and product (or culture-nature) (Widgren 1999:97). By adopting Crumley and Marquardt's definition of landscape, and through heterarchical analyses, we can understand landscape as both a subject and a product (or as nature and as culture). Few landscape analyses use this definition of landscape because they fail to recognise the duality of the landscape. It should be stressed that the human:environment relationship involves the co-evolution of sociohistorical and natural processes, and that their temporal and spatial intersection (see McGlade 1995) results in two related yet unique sets of landscapes, the natural landscape and the experienced landscape.

### *Natural and Experienced Landscapes*

The term, 'natural landscape', applies to the modelling of the natural system, using the notion of the landscape as a substantive measurable subject. As one component of the human-environment relationship, the natural landscape is comprised of subjects in the natural world which are typically physical in composition. This research uses physical parameters relating to hydrology, soil, phsyiography, and topography as they are measured as a subject of physical geography. The natural landscape consist of what is observed and measured on the ground (labelled as A in Figure 1.1).

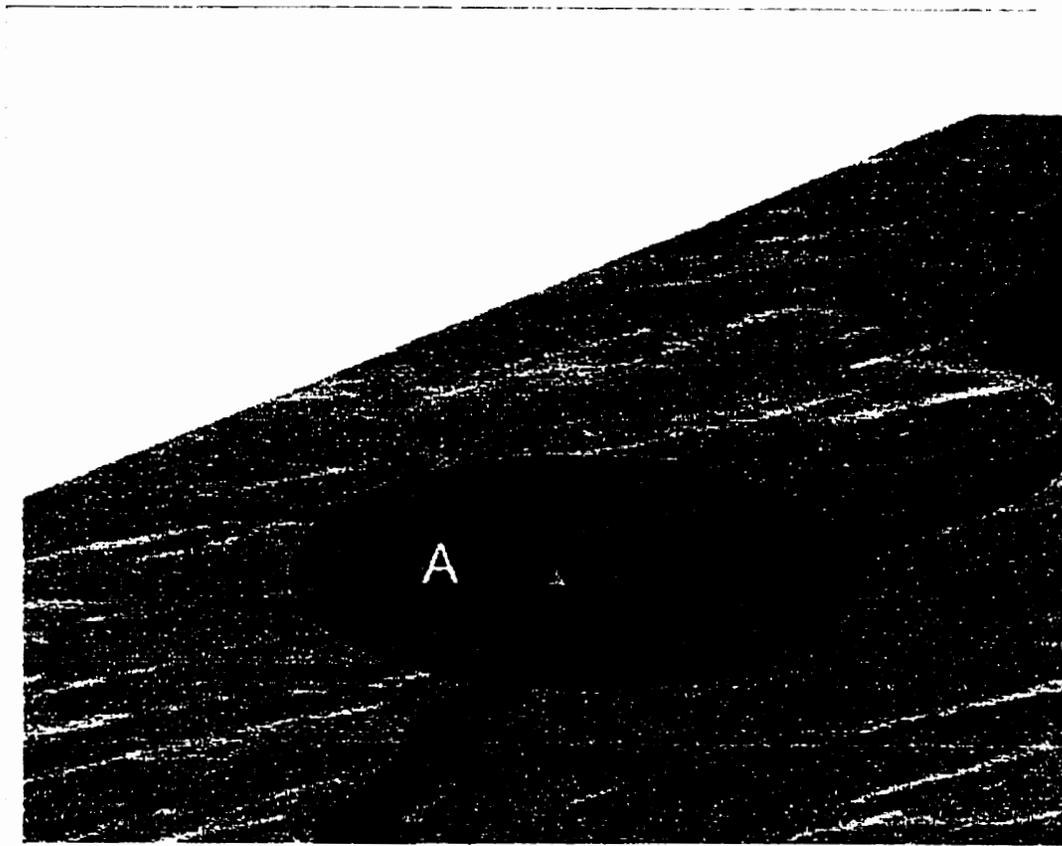
The term, 'experienced landscape', applies to the modelling of the social system, using the notion that landscape is a construct of a social system within which it is experienced via the human:environment relationship. As a social construct, an experienced landscape encompasses social interactions that involve socially prescribed activities, patterns of mobility, site-location decisions, and social boundaries. The experienced landscape consist of the same physical fea-

tures as the natural landscape but is treated as a product of human perception rather than scientific observation, or inferential over substantive. As a construct of human perception, the experienced landscape can take on unique meaning not only within a culture group, but also to individuals within that group. For this reason, the experienced landscape is depicted as a layer floating above that of the natural landscape to signify both the similarity in terms of physical geography and the variation inferred in an individual's perception of that landscape (labelled as *B* in Figure 1.2). In practice, an experienced landscape may account for a majority of a culture's worldview, rendering the physical world of the natural landscape secondary to the cultural world of the experienced landscape.

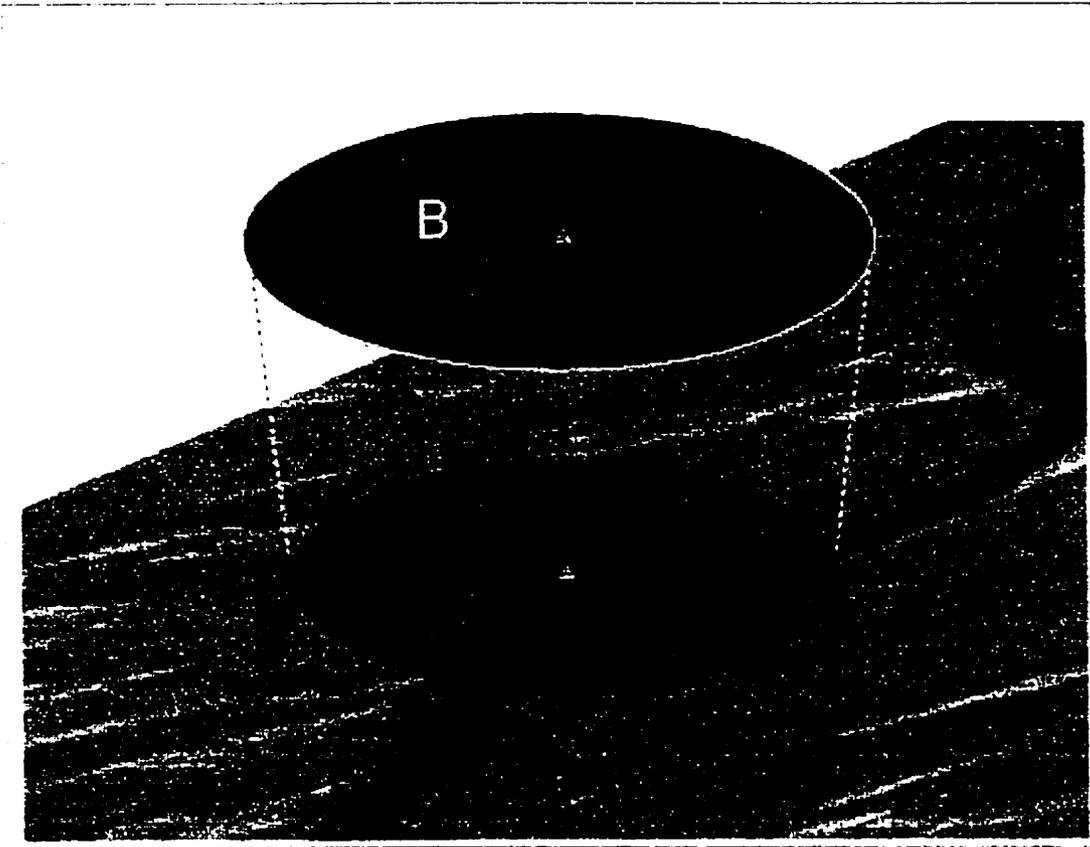
### *The Utility of Space and Place*

The significance of space and place in cultural context is encapsulated by a simple definition I devised: that place represents an experienced position in space. Implicit in this definition is the notion that space is an entity larger than that of place. Space is a conceptually limitless region outside of the social interactions of a community for which there is no culturally derived landscape. Place is a culturally experienced locale comprised of immediate surroundings or a habitually frequented area.

A variety of truisms exist with respect to space or place: all physical space is also inevitably symbolic space (Shore 1996:267); an understanding of place is essential for survival and that the idea of space is subordinate to the idea of the location of significant places (Tuan 1977:92); human activity involves the ordering and use of space (Lock and Harris 1992:82);



**Figure 1.1: Natural (A) landscape of a hypothetical site.**



**Figure 1.2: Experienced (B) landscape of a hypothetical site.**

and an understanding of space is an understanding that is shared with other members of the community (Darvill 1999:108). A community's understanding of space is "not really about distance of physical geography so much as the compartmentalisation of space according to socially defined categories" (Darvill 1999:108, see also Llobera 1996).

What, then, constitutes a socially defined category? How is space compartmentalised? What is a significant place? Since I believe the human-environment relationships of past cultures are best analysed through visual means, answers to these queries are found in the sociology of visual perception. An ecological approach uses the concepts of affordance and place to explain variation in landscape perception (see Gibson 1986). An affordance is a situation that potentially offers, provides, or furnishes something to an individual, either positively or negatively. The exploitation of ecologic niches by culture groups parallels Gibson's notion of affordances (see Barth 1969). The environment is composed of innumerable affordances that only become meaningful when experienced in relation to an individual. A set of positive affordances is described as a setting of suitable environmental affordances, documenting how one lives rather than where. Affordances, which are real and physical, are only understood in relation to the individual and in relation to the social system of a culture. Places are defined as properties of the environment as perceived by individuals. Although a place is physically located in the environment, it is equally a fact of the environment and a fact of behaviour. Places may be nested (a place within a place); places are named; and places do not necessarily have sharp boundaries (Gibson 1986:34, 127-129). In summary, an affordance is a situation while a place is a location.

A waterfall is an example of an affordance. It can be viewed positively, as a source of resources, or negatively, as a potentially life-threatening hazard. If no one is aware of the waterfall,

then it must fall under the notion of space. As an unrealised affordance, the waterfall is not culturally visualised and therefore is not meaningful in a culture's landscape. If the waterfall is habitually frequented, the waterfall's location then becomes a place within a cultural landscape. It takes on meaning. As fact of the natural landscape, the waterfall is unchanged. As a fact of cultural behaviour, the significance of the waterfall is immeasurable. It may represent a host of positive and negative affordances for a community and, in doing so, is embedded within the community's experienced landscape.

The concept of affordances is synonymous with the natural environment; a situation or element of the natural world which takes on meaning when perceived (either as useful or not) by the human-environment relationship. I stress that not all affordances in the natural landscape are exploited by people. If an affordance is not used within the human-environment relationship, the relationship is reduced (in terms of cultural utility) to an autonomous environmental parameter.

The concept of place is a correlate of the experienced landscape. A place is socially constructed solely at the discretion of an individual or society. The truism that an understanding of place is essential for survival rings true in that the affordances necessary to sustain a society are found in the relationship between places and the members of the society. The result is an experienced landscape to be remembered, revisited, and retained in the collective memory of a society as a providing place. The compartmentalisation into place and space is less concerned with the inherent parameters of the affordance than with the notion of a place as a culturally experienced affordance.

By embracing the observation that landscapes are the result of environmental perception, that landscape has to be contextualised (Bender 1993:2), and that such contexts are not passive

(Thrift 1996:43), I am able to derive the culturally dynamic term, *the landscape of place*. The explanation of the relationship between a place and those who occupied it is critical to understanding the rationale behind the selection of a given place. This contextual relationship is directly linked to the cultural perception of the environment as an experienced landscape, embodied in those who live at a specific place within a defined or bounded space.

### *The Significance of Viewsheds*

Viewshed analyses offer the means to get inside the heads of past societies (Richards 1998:337). A viewshed in GIS analysis comprises the area that can be seen from a specified vantage point or set of points. For example, a 360° viewshed from a hilltop location would include nearly all the surrounding landscape; a viewshed from the base of a cliff will typically result in a half circle or fan viewshed radiating outwards from the cliff face; and a viewshed within a deep valley consists of the valley floor and a portion of the slope of the valley walls. GIS viewshed analyses include a variety of options: line-of-site analysis (the land visible from a given location), cumulative viewsheds (the sum of lands visible from a series of locations), inter-visibility (whether two or more locations are visible to each other), fuzzy viewsheds (involving the use of distance-decay or cost-surface factors), and weighted viewsheds (the use of weighted variables) (see Maschner 1996a for a selection of archaeological viewshed analyses).

It is my opinion that a viewshed holds greater analytical significance beyond the visual vantage from a given site. I concur with the opinions that “perception based solely upon what can, and cannot, be seen is a gross and inadequate simplification” (Gillings and Goodrick 1996) and that a discrepancy exists between a GIS-generated objective viewshed and a socially

constructed subjective viewshed (Baldwin *et al.* 1998). A viewshed generated by a GIS should not be presented as an end product, but rather, as an intermediary analytical device to further data analysis, interpretation, and quantification (e.g., see Gaffney *et al.* 1996, Llobera 1996, Maschner 1996b).

The function of a viewshed within this research is to provide a measurable device with which to analyse natural and experienced landscapes through the human-environment relationship. Contrary to the GIS definition of viewshed, I define viewshed as a place, a zone of influence or region of direct control of any given site as bounded by day-to-day cultural activities as set out by both cultural and site-specific sets of affordances (area C in Figure 1.3). Analogous to my definition of viewshed is the definition of site exploitation territories, as developed by Jarman *et al.* (1982:32): “that area which was accessible to habitual exploitation by the occupants of the site”.

The viewshed can be analysed as both the subject of a natural landscape and the product of human perception within an experienced landscape. Although archaeologists have expressed reluctance to identify patterning where one can extrapolate individuals and groups within the landscape (see Bolen 1991), defined as such, a viewshed reveals “patterns in the archaeological record [that] if studied as a landscape...tell us about the ways people viewed and used their world” (Savage 1990:330). The range of affordances found within the viewshed determines its significance. I acknowledge that there will be significant utilised affordances that lie outside of the viewshed (e.g., quarry sites, animal migration corridors, sugar bushes, etc.), but it is beyond the scope of this landscape model to model their inclusion.

In order for the viewshed to be analytically significant, the remainder of the landscape must also be taken into account. To this end, the viewshed represents a modification of catchment analyses by acknowledging the importance of place as it relates to space (represented by the non-view component). The combination of areas  $C$  and  $c$  (the areas lying outside of the viewshed, or non-views, Figure 1.3) corresponds to a site's catchment (see Chapter 2).

The viewshed concept and its contribution to the landscape model must be viewed through three tenets. First, a site's viewshed represents an area of cultural significance for the occupants of a site through day-to-day interactions, in terms of the positive affordances offered by land and water, and the places associated with these attributes. Second, the visualisation of environmental resources as affordances, through the calculation of site viewsheds, is central to the success of the landscape model. Third, the day-to-day interaction associated with each site's viewshed is culturally divided into activity group catchments, explained in the following section, as suggested by ethnographic and ethnohistoric sources.

Moreover, the viewshed itself manifests an inherent parameter in the form of a view form. Each viewshed generates a unique signature or patterned view form displaying variation in the internal organisation of the viewshed and measured in ha by means of a GIS function. The analysis of variation in viewshed land area compares the amount of adjoining areas within the viewshed, identified as a contiguous value measured in ha (see Chapter 2).

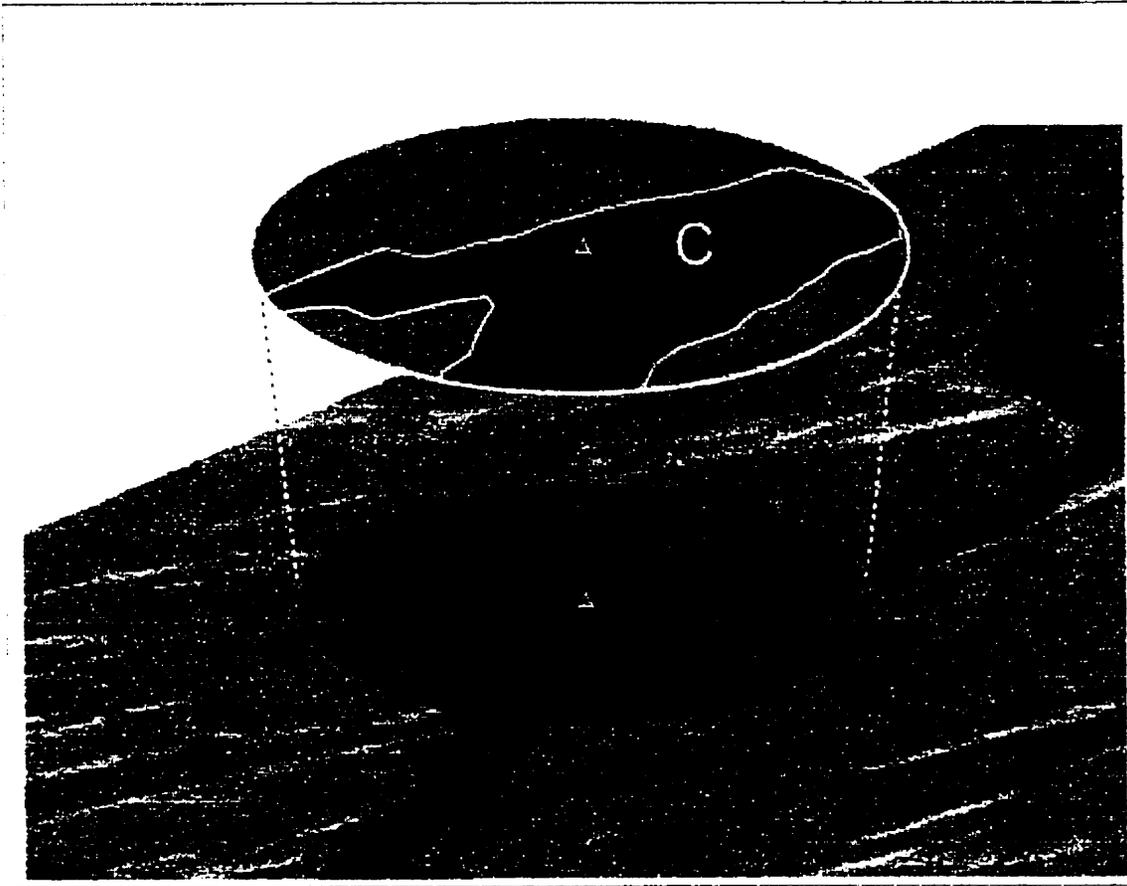
A parallel to the concepts of experienced landscape and viewshed are found in a modern psychological study on cognition (see Johnson *et al* 1992). This study details task environments and functional environments. I would equate the experienced landscape with a task environment, defined as "a subset of the physical environment that is relevant to a class of agents

who share common goals and sensitivity to available information” and the viewshed to the functional environment, defined as “a subset of the task environment that is specific to an individual agent and its goals...constituted of the information that is used...” (Johnson *et al.* 1992:307-308). The task and functional environments, as operationalised or cognised environments, mirror and support my theoretical construction of an experienced landscape. The experienced landscape, and its affordance potential, are the realised, cognised environment, or space, and viewsheds, in association with affordance utilisation, are the task environment, or place.

### *Time-Distance Isochrons*

Given that particular roles and relationships in society are patterned, commonplace and recurring activities are identified by the presence and absence of activity-related affordances. The change from forager to horticulturalist would generate cultural (and potentially visible) differences in landscape knowledge and activity loci (see Claassen and Joyce 1997:71). Dividing the viewshed into group-specific activity locales isolates the relationships between groups and practices. Different individuals, or groups of individuals, can occupy the same physical environment yet engage in entirely different activities and behaviours based on differences in goals and sensitivity to information (Johnsen 1992:307). This is a rephrasing of Gibson’s theory of affordances. Only those affordances that provide some cultural benefit become meaningful and therefore form part of the experienced landscape.

My basis for the determination of group-related activities and locales lies in the ethnographic and ethnohistorical identification of subsistence practices, gender groups, and the roles and relationships as determined by mobility, labour, and social organisation.



**Figure 1.3: Viewshed (C) of a hypothetical site.**

This identification of group patterning is graphically depicted and analysed through time-distance factors. The time-distance factor is defined as “the complex of forces which combine to determine exploitation thresholds” (Jarman *et al.* 1982:31). The concept of time-distance analysis is rooted in site catchment analysis of energy investment and economic return. The principle of site catchment is that, the further an area is from a given point, the more economic return is impeded by increasing energy investments. At some point, the energy investment outweighs the economic return. A catchment is frequently calculated based on walking time, typically expressed as circular boundaries of 5 or 10 km (see Flannery 1976b, Jarman *et al.* 1982, Jarman *et al.* 1972, Roper 1979, Vita-Finzi and Higgs 1970). Recent GIS studies using the site catchment time-distance factors offer better approximations of true isochrons rather than assuming unrealistic circular boundaries (see Gaffney *et al.* 1996, Hunt 1992, van Leusen 1996).

Bleed *et al.*'s (1989) analysis of an early Jomon community displays catchments, or exploitation territories, using one- and two-hour effort zones (following Jarman *et al.* 1972) resulting in time-distance isochrons as opposed to circular site catchments. The resulting boundaries depicted by the effort lines are remarkably similar to a GIS-generated viewshed; physical effort calculated by travel time over a topographic base versus visual distance calculated over a topographic base. The path of least resistance for either analysis dictates that steep slopes and steep valleys are virtually impenetrable while coastlines and open water present few encumbrances (depending on the nature of the body of water).

In terms of appropriate time-distance isochrons to be used, a variety of literature exists on ideal time-distance factors in addition to Bleed *et al.* One effort analysis concludes that a

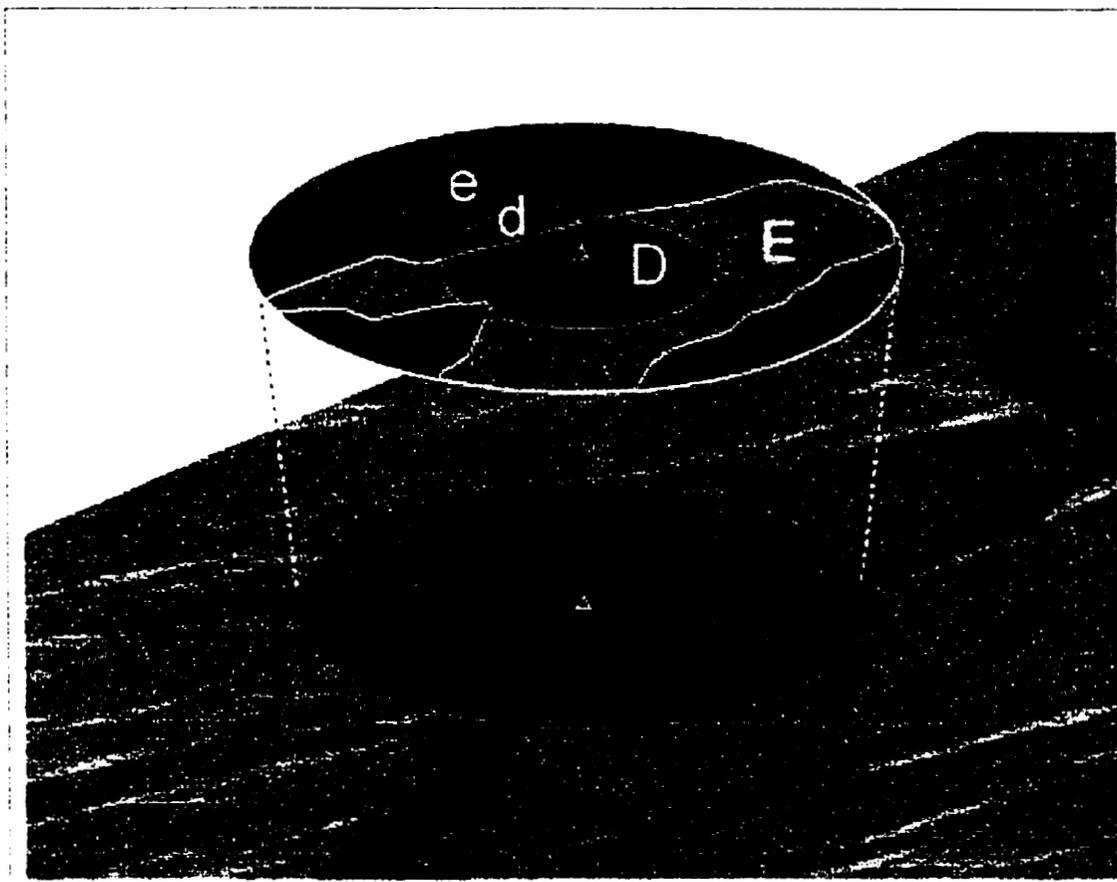
foraging area with a 3 km radius achieves the best results based on return rates (Kelly 1998:15) while a second promotes the area within 1 km of a site for arable economies (Jarman *et al.* 1982:32). A third analysis calculated that energy gain:expenditure ratios indicated that “a two kilometre distance appears to have been the upper limit for Iroquoian travel time with a load of corn, firewood, or building supplies” (Fecteau *et al.* 1994:6). This echoes a Middle Ontario Iroquoian study that indicates that a village’s primary catchment was a non-circular maximum of 2 km (Jamieson 1986:34). An analysis of the Great Plains Hidatsa documents that, ethnographically, women conducted their work within a range of 1.5 km from the settlement while men were more likely to work beyond these boundaries, a pattern replicated at distant buffalo hunting camps (Spector 1983:89).

All of the above time-distance models and observations concur that the majority of activities, based on a variety of economic returns, occur within a limited distance from a base camp or village. In that an isochron is a measure of time, and represented as distance, to travel a prescribed distance, I have identified two distinctive isochrons relating to the relative and absolute mobility of groups of individuals and their respective activities based on the above relationships: the residence group and the habitat group. The exploitation territories for arable economies identified by Jarman *et al.* (1982) best fit the isochron analysis in the landscape settlement model.(see Chapter 2).

Although hunter-gatherer groups were the focus of Binford’s (1980, 1982) concept of residential and logistical mobility, the concept relates to the landscape model’s use of isochrons. Binford’s residential mobility is defined “as the movement of an entire group, both producers and dependents, from one point to another on the landscape [and] logistical mobility [is defined

as] the movement to and from a residential location by an individual or task-oriented group for purposes of obtaining matter, energy, or information...consisting of either daily forays or expeditions of several days or weeks" (Hitchcock 1982). Although residential mobility is not applicable to this research strategy, the concept of a viewshed is loosely analogous to that of logistical mobility. Both confer the notion of an area used for resource exploitation. I interpret a viewshed as a method of visually depicting Binford's logistical mobility. My identification and interpretation of mobility group patterning, as isochrons within the viewshed, represents a division of the area identified with logistical mobility. Therefore, residence and habitat mobility groups are not equated with Binford's residential and logistical mobility. However, residence and habitat mobility groups, when combined, depict an approximation of logistical mobility, or similarly, an exploitation territory.

In this research, the effort lines for the residence and habitat mobility groups have been restricted to the parameters of the viewshed, hence the non-concentric depiction of the two isochrons in relation to the site (labelled as *D* and *E* on Figure 1.4). The isochrons are restricted because they represent unique subsistence or activity groups operating within the confines of the concept of place (the viewshed) and relying on affordances within the experienced landscape. Isochron *D* reflects the immediate landscape surrounding a given site while isochron *E* accounts for landscape and affordances situated at a greater distance from the site proper. Likewise, *d* and *e* are representative of space; areas outside of the viewshed (Figure 1.4). Isochron analysis (although somewhat modified in this research) is not a component of the landscape studies observed to date in the literature.



**Figure 1.4:** Residence isochron ( $D$ ) and catchment ( $D+d$ ), habitat isochron ( $E$ ) and catchment ( $E+e$ ) of a hypothetical site.

### *The Temporal Landscape*

A landscape is contingent upon the personal view, the spatial scale, and the time span adopted by the observer (Ingold 1993). To assess patterning requires framing archaeological landscapes in time. Accordingly, landscapes must be fixed upon the temporal scale to avoid undermining any comparative analysis, for “any attempt to understand past societies has to take into account the...use of the landscape occurring before and after the society under investigation” (Benes and Zvelebil 1999:74). Nearly 30 years earlier, a similar sentiment was made: “tracing communities through time will shed important light not only on the development of these communities, but also on the social and political processes that are associated with it” (Trigger 1970:42).

Recent landscape models also advocate a multi-temporal analytical strategy (Crumley and Marquardt 1990, Orians and Heerwagen 1992, Rossignol and Wandsnider 1992). Many studies applying spatial and temporal analysis at a regional scale discuss and verify a comparative approach to quantify the interaction, change, and variation of settlement systems (Barton *et al.* 1999, Gilman and Thornes 1985, Kvamme 1985, Wandsnider 1996). Likewise, this research uses spatial and temporal analyses to model the Princess Point, Middle Woodland, and Glen Meyer cultural groups.

### **Summary**

This chapter details the theoretical underpinnings of the research program. In order to determine how a society or culture structures its surroundings, we must accept that a unique signature is retained in the archaeological record and analysable by means of a landscape modelling application. Central to this analysis is the concept of landscape, defined as a human-

environment relationship, and its attendant theoretical components, moving from defining landscape, to natural and experienced landscapes, to space and place within the landscape as visualised through GIS.

In Chapter 2, the landscape model follows a discussion of the merits and shortcomings of potential and locational models. The landscape model represents the research design for studying the Princess Point landscape in comparison with the Middle Woodland and Glen Meyer landscapes.

Chapter 3 comprises a discussion of the past, extant, and proposed settlement system for Princess Point groups based on the cumulative data spanning the past three decades. A comparison of this data with previous theories of Middle Woodland and Glen Meyer settlement systems follows, highlighting any continuity between Princess Point and the other two culture groups. Chapter 4 contains a detailed description of the sites utilised in this research, presented by culture group and by site cluster.

In Chapter 5, the landscape model data highlights the variation and patterning evident within and between culture groups (and a lower Grand River valley control group). The comparative landscape data comprise four scales of enquiry: cluster, site, viewshed, and isochron. The interpretation of the landscape model data provided in Chapter 6 emphasises the unique situation of the Princess Point groups in reference to landscape, maize cultivation activities, social organization, and the manifestation and evolution of societal boundaries.

## CHAPTER 2

### THE LANDSCAPE MODEL

The apt comment “when dealing with archaeological data, prediction and explanation are not identical” (Trigger 1989:377) carries significant weight in the following discussion on the practice and design of settlement system models. A brief comparison of settlement patterns and settlement systems leads to a larger discussion on substantive and inferential approaches to settlement models. The three settlement system models discussed herein, potential or predictive, locational, and landscape, span a continuum from evaluation to explanation (see also Altschul 1988).

Locational modelling addresses cultural choice in settlement location through an explanatory methodology. This type of settlement model has been used for three decades in Ontario (Campbell and Campbell 1992, Heidenreich 1971, Hurley *et al.* 1972, Jamieson 1986, Konrad 1973, Roberts 1980). Potential modelling emerged as an outgrowth of probability modelling (Banning pers. comm.) by using the mean of geographic variables to plot and evaluate cross-cultural site potential. More recent in application, the inception of potential models in Ontario began in the 1980s (Bellhouse *et al.* 1996, Burgar 1990, Dalla Bona 1994b, Dieterman 1992, Janusas 1988, Peters 1986, Young *et al.* 1995). Landscape modelling, not represented by any Ontario examples to date, involves more than assessing a site’s location in relation to the physical environment. The research design associated with a landscape model includes an as-

assessment of the relationships between a site, its surroundings, and the people who inhabited the site, using landscape as a mediator. With the evaluation to explanation continuum in mind, this discussion will address potential modelling, then locational modelling, followed by landscape modelling.

The construction of a landscape settlement model addresses the settlement system of the Princess Point culture. The model uses human-environmental relationships in order to isolate patterning in the natural and experienced landscapes. The application of standardised spatial and temporal analyses is set out in two objectives: an evaluation of the relationships between site location and environment, and an explanation of the relationships between place and space.

A brief discussion of the use of GIS in a landscape model follows. I explain the utility of GIS-generated maps and provide an explanation of the GIS map generation process. Data sources, scale, and the GIS data sets are also addressed.

### **Substantive and Inferential Approaches**

There are two underlying approaches of that are applicable to settlement studies; substantive and inferential. A substantive approach uses evaluative models anchored by data relating to form, space, time. An inferential approach uses explanatory models that encompass society and ideology. Typically, settlement pattern studies have focused on artifact types in combination with site types, emphasising substantive content over inferential context. Many have attempted to close this gap, most notably Binford's middle-range theory (1983), focusing on material culture as accepted evidence of behaviour. More recently, some have taken the content out of

settlement studies and relied mainly upon culture and context (Barrett and Kinnes 1988, Hodder 1990), spawning what Trigger denotes as cultural determinists (1995:450).

I believe that settlement data can be used to trace cultural development using a combination of substantive content (in the methods of Crumley, Flannery, Kvamme for example) and inferential context (in the methods of Duke, Llobera, McGlade for example). The opinion that any explanation of the archaeological record is incomplete if human behaviour, beliefs, and traditions are ignored (Trigger 1995:450) dictates a need for a combination of both approaches. This belief is best supported, not by recent post-processual advocates, but by past comments from archaeologists such as Trigger, that “tracing communities through time will shed important light not only on the development of these communities, but also on the [associated] social and political processes” (1970:42), and similar sentiments from Fletcher (1977:48) and Flannery (1976a:178). While the concept is not new, application is scant.

An early categorisation of archaeological site patterning encompassed five categories: individual houses; the spatial arrangement of houses within a site; the relationship of house types to other features; the over-all community plan; and the spatial relationships of sites to one another over a large area (Vogt 1956:174). Two decades later, Flannery defined settlement pattern as an empirically derived pattern of sites in the regional landscape noting, that settlement patterns are usually studied by site counts, size, distance between sites, and other measurable attributes (1976c:162). More often than not, current usage of the term settlement pattern refers to intra-site spatial patterning detailing the location of post moulds, features, house orientations, palisades, etc. The dominant modern usage of settlement pattern modern is the study of the spatial arrangement of the archaeological record at an intra-site level.

A settlement system is defined as the set of rules that generated the settlement pattern in the first place (Flannery 1976a:162). Flannery adds that some of these rules can be deduced by simulation or through modelling. The current use of the term, settlement system, is consistent with Flannery's rules or underlying structure responsible for the patterning visible in the archaeological record. For the most part, however, modern analyses of settlement systems remain focussed on subsistence and trade and less on human behaviour (Trigger 1989:327).

The initiation of the study of settlement patterns in North America is often traced to G.R. Willey's (1953) monograph on the Virí Valley, followed closely by his edited text on New World settlement patterns (Willey 1956). Other seminal works include Chang's *Settlement Archaeology* (1968) and Flannery's *The Early Mesoamerican Village* (Flannery 1976a). Willey believed there was no settlement pattern approach but simply an awareness of settlement data that extended archaeological interest to take in a larger and legitimate part of the record (1956:1). This belief was soundly refuted when settlement pattern studies in the 1960s and 1970s took on an approach, fueled by the presupposition that settlement is largely influenced by ecological factors (Trigger 1968:61). Since then, a majority of North American archaeologists have regularly modeled settlement location using substantive methods such as central place theory, site catchment areas, nearest neighbour analyses, and Thiessen polygons, to name but a few techniques (for example Binford 1980, Hodder and Orton 1976, Jochim 1981, Struever 1968).

Vogt, a contemporary of Willey, expressed the opinion that cultural beliefs and values might affect settlement patterns in a manner appearing to override considerations of ecological and economic adjustment (Vogt 1956:181). Recent settlement research reflects a similar view on the significance of cultural explanations as grounds for choosing a settlement locale. Examples

of inferential research embracing human behaviour as the motivating force behind settlement location choice are found in North America from the east (Custer 1984, Custer 1986), southeast (Nassaney 1991) and the midwest (Duke 1991), and in Europe from France (Crumley and Marquardt 1987), Finland (Kirkinen 1996), Spain (Gilman and Thornes 1985), as well as numerous research projects on Neolithic settlement systems in Great Britain (Barrett 1994, Barrett and Kinnes 1988, McGlade 1995, Spikens 1996).

Flannery acknowledged the inferential approach to settlement systems to a limited extent by noting that the challenge of settlement systems lay in the interplay, or interrelationships, between social distance, subsistence needs, and the geometry of location (Flannery 1976b:117). He deduced that, while factors of site catchment contributed to locating villages on the landscape, that social factors, not influenced by catchment analysis, influenced village spacing (Flannery 1976d:178). Note that the emphasis therein still stressed an substantive contribution. A similar principle can be found in middle-range theory (see Binford 1980) and as well as in explanatory and operational accounts combining substantive and inferential approaches to modelling settlement systems (see Drennan 1976, Salmon 1982:152).

An inferential settlement system approach includes the belief that the importance of factors “other than solely environmental [are responsible] for shaping human patterning across the landscape” (Allen 1990:199). Examples of this approach in Eastern North American archaeology include two pertinent Woodland period commentaries. First, the Middle to Late Woodland transition has too often been defined on the basis of material culture rather than on social structure inferred through patterns of subsistence, settlement and community (Fox 1990:172). Second, more specifically, factors leading to the evolution of relatively small and

autonomous multi-lineage communities after A.D. 1000 originated with the consolidation of smaller and more numerous bands during the Middle Woodland in tandem with changes in food production and social organisation (Niemczycki 1984:34). Examples of settlement system models for northeastern North America that incorporate a social approach include the doctoral theses of Williamson (1985), Smith (1987), Warrick (1990), Hasenstab (1990), and Timmins (1992) wherein each author details unique aspects of Iroquoian social organisation.

### **Potential Modelling**

A potential model is often referred to as a predictive model but, as Pihl (1986:38) correctly notes, a potential model attempts to predict only areas of high archaeological potential (i.e., the potential for the recovery of archaeological sites based on the location of known sites in an area in combination with natural features) and not actual site locations. The model's key function is the calculation of potential locations based on a set of criteria deduced from modelling the location of known sites. The majority of new sites recovered in a region are hypothesised to lie within an area of high potential. Other variables used in potential modelling follow similar logical paths (see Dalla Bona 1994a for an excellent overview of potential modelling). The majority of potential models attempt to provide site potential parameters for the entire span of pre-contact habitation. The result is a division of study areas into zones of archaeological potential at a variety of project-defined scales. The practitioners of potential modelling in Ontario are typically affiliated with government agencies (municipal or provincial), corporations, or other cultural resource managers (Table 2.1).

Potential modelling practitioners use physiographic parameters exclusively, although this is not an inherent limitation of the models' design. Parameters include variables associated with water, soil, topography, site size, and function. Most potential models, applying one or a pair of variables as parameter determinants, are univariate or bivariate. Multivariate potential models frequently jettison the more cumbersome variables after preliminary analyses and concentrate on the one or two most successfully modeled parameter(s) (see Young *et al* 1995, Bellhouse *et al* 1996).

Standardised variables are used by most practitioners of potential models, of which the foremost is the association of sites with types of watercourses, expressed as the distance to water (see Bellhouse *et al.* 1996). The implication of the distance to water variable is that a high percentage of known sites is situated within a prescribed distance from a water source. This ubiquitous variable is validated through calculations of distance to water from a series of known sites. A preset distance from a watercourse resource represents an industry standard for potential modelling, calculated to recover 80% of sites as defined by the area of potential (see Pihl 1986 for calculations).

A recent publication concluded that distance to water displays an exponentially decreasing pattern when associated with water type and soil drainage variables while all other variables tested were not significant. Moreover, other "locational, environmental and cultural data were found to be too variable" (Bellhouse *et al.* 1996:83). Other researchers concluded that the type of watercourse rather than distance to water was the single most significant variable (Young *et al.* 1995). Both studies attempted to model the entire southern Ontario region. In contradic-

**Table 2.1: Selected site potential models (Ontario).**

<i>Year</i>	<i>Author</i>	<i>Affiliation</i>	<i>Region</i>	<i>Objective</i>
1986	Peters Pihl	Ontario Hydro Mayer Pihl, Poulton & Associates	Southwestern Ontario	all cultures
1988	Janusas & MacDonald	Regional Municipality of Waterloo	Waterloo region	all cultures
1990	Burgar	Metropolitan Toronto and Region Conservation Authority	Greater Toronto Area	all cultures
1992	Dieterman	Ontario Hydro	Toronto to Sudbury corridors	all cultures
1994	Della Bona	Lakehead University, Ministry of Natural Resources	Thunder Bay district	all cultures
1995	Young <i>et al</i>	Ministry of Transportation	Southern Ontario	all cultures
1996	Bellhouse <i>et al</i>	Ontario Hydro	Southern Ontario	all cultures

tion, a third study focused on Waterloo region stated that water type is not a significant variable, noting instead a relationship between well and imperfectly drained soil and site location (Janusas 1988:130, MacDonald 1988:115).

Apparently, no single potential model variable is without its detractors. It is an honest admission that, for all cultural periods, the difficulty in making generalisations about settlement locations beyond that of fairly simplistic statements is due to the diverse geographic variability of southern Ontario (Young *et al.* 1995:35). Moreover, predictive models “do not address the cultural behaviors that generated the locational patterns identified” (Hasenstab 1996:224). The recovery of Princess Point, and other sites, within what would have been deemed low potential glacial ravines at Cootes Paradise (see Smith *et al.* 1996) represents a salient example of the limited accuracy or appropriateness of potential models, demonstrating the need to analyse and explain settlement systems through a more robust methodology.

### **Locational Modelling**

Locational models were developed prior to potential models and, in effect, made potential modelling possible. Locational models represent an explanatory methodology as opposed to the more limited evaluative methodology of potential models. There are three major differences between the two methodologies. Foremost, locational model data sets consist of actual sites; any subsequent interpretations are in reference to these sites and not the possibility (or probability) of additional sites. Second, multiple variables are uniformly used to analyse the data sets. Third, the practitioners of locational models attempt to formulate an explanation for the archaeological record of a given group, at a given time, within a bounded region using comparative data analy-

ses and hypothesis testing as methodologies for model validation and confirmation. The objectives of a locational model are typically temporally or culturally restricted, or both. Researchers typically are of academic affiliation (see Table 2.2).

The majority of locational models draw on many of the same variables as potential models. The early 1970s initiatives of Heidenreich (1971), Hurley, Lee and Storck (1972), and Konrad (1973) demonstrate the consistency of the underlying principals of locational modeling: a comparison of the characteristics of site location with the surrounding area through comparative analyses of a series of archaeological sites and their association with physiographic variables. Three decades ago, Heidenreich's research on Huronia concluded that a series of variables influenced the selection of Huron village sites. A combination of water, soil, defensiveness, and surrounding vegetation acted as culturally favourable conditions for site location in that 87% of Contact Period sites (120 of 138 sites) were located on well drained soil ranging in texture from sands to sandy loams, which in turn comprised 66% of Huronia soil (Heidenreich 1971:109). More recently, a successful locational model for the Potomac River basin in West Virginia varied little in methodology from that of Heidenreich (see Neumann 1992). By their design, locational models are able incorporate more rigorous hypothesis testing over that of potential models, including the use of model validation prior to field testing and theoretical development based on locational decisions. The only method of validation for a potential model is to conduct an archaeological survey, either confirming or refuting the potential of an area from which the accuracy of the model is assessed by the rate of site recovery.

**Table 2.2: Selected locational models (Eastern North America).**

<i>Year</i>	<i>Author</i>	<i>Affiliation</i>	<i>Region</i>	<i>Objective</i>
1971	Heidenreich	York University	Simcoe County	Huronian
1972	Hurley <i>et al</i>	University of Toronto	Wisconsin	all cultures
1973	Konrad	York University	Greater Toronto area	all cultures
1980	Roberts	York University	Burlington ON area	aceramic sites
1985	Schermer & Tiffany	University of Iowa	Iowa	Woodland
1986	Jamieson	Trent University	Southern Ontario	Late Woodland
1987	Horne	University of Waterloo	Waterloo	Late Woodland
1990	Savage	-	Eastern Woodlands	Late Archaic
1990	Allen	University of Pittsburgh	New York State	Late Woodland
1990	Hasenstab	University of Massachusetts	New York state	Late Woodland
1992	Campbell & Campbell	York/McGill University	Southern Ontario	Late Woodland
1992	Neumann	-	West Virginia	Middle/Late Woodland
1995	Stevens	Parsons Engineering Science	NY, PA, NJ	Late Archaic

Locational models are tested *a priori* through the modelling of random locations, or non-sites, in the study area, as a control and test of locational model hypotheses. A study that modelled 108 sites and 100 random or non-sites determined site location preferences via a comparative analysis of the relationships between site location and environmental diversity (Schermer and Tiffany 1985). Using a similar methodology, the selection of 50 random locations acted as control data for modelling 91 Archaic sites in southern Ontario (Roberts 1980). The above studies show that site location models generally satisfy culture-specific interpretations of association, but not of explanation.

Not all locational models have to satisfactory results. Campbell and Campbell (1992), erroneously billing their model as predictive or potential, set out to model soil texture, relief, drainage, and frost-free days against the known set of horticultural villages in southern Ontario. Since they do not claim or attempt to predict the location of new sites, by definition their research falls under the rubric of a locational model. They conclude that no single variable is responsible for site locations, and ultimately rely upon soil conditions and climate as the primary determinants based on the limitations of horticultural activities. However, the model uses an inappropriate scale to validate their results. The 100 km<sup>2</sup> cell resolution fails to accommodate any semblance of local variation, neither for relief and drainage, as noted by the authors, nor for the soil data upon which their conclusion rests. Soil variation is documented at a scale of 1:63,360, far too coarse a scale. In order to attempt this type of locational study, an examination of the soil at a much more detailed scale is required, as is a set of random locations to act as control data.

A locational model's examination of the interrelationships between environment and cultural groups is generally limited to testing for positive or negative associations. Site location

models, therefore, fall short of qualifying as true studies of settlement systems for they neither address the significance of settlement in association with cultural explanation, nor uncover the rules behind the choice of settlement location.

### **Landscape Modelling**

Landscape modelling takes into account more than just a site's location in relation to physiographic surroundings. Modern landscape archaeology details the evaluation of archaeological evidence in the context of the surrounding landscape in order to reconstruct "the evolving relationships that existed between former cultural and physical landscapes" (Lock and Harris 1996:215). A diversity of landscape models share similar themes: spatial relationships, locational analysis, central-place theory, perception studies, cultural geography, human-environment relationships and human ecology (Lock and Harris 1996:216). Landscape modelling practitioners address a community's perception of the immediate (experienced) landscape through three avenues: an examination of the physical environment guided by explicit social scientific questions; a recognition of the culturally shaped human-environment interactions, which are historical, dynamic, and accretionary; and the realisation of the dynamic interaction between human environments and human behaviour (Feinman 1999:685). The resulting interpretations are attempts to explain of the relationships between communities and their surroundings.

Landscape models are typically focused on a single or a related collection of features, restricted both temporally and geographically in scope, and to date are implemented almost exclusively by academics (Table 2.3). The lack of North American landscape models (or landscape theory) appears to be due to a reluctance to link landscape and archaeology as the basis of

an explanation, instead most researchers prefer to use operational or substantive explanations on the route to site evaluation. Tellingly, predictive and locational models are the only two types of models identified in a seminal work on archaeological settlement modelling in the United States (Judge and Sebastian 1988). Surprisingly, given the abundance of landscape analyses in the United Kingdom and Europe, there is a similar lack of settlement systems research integrating landscape features with environmental and topographical data (see Spikens 1996:87).

The current practice of landscape modelling often involves determining the viewshed of a given locale or series of locales. Typically, these locales are associated with an outstanding human-modified or natural feature on the landscape (e.g., stone circles, long barrows) in an attempt to address the very question that is avoided by potential and locational models, that is, an explanation of the rules or relationships underlying the choice of site location. Two practitioners, approaching landscape modelling from a modern planning perspective and an archaeological perspective, have reached similar conclusions: a landscape can be reconstructed through an examination of the associations between physiography and cognition (Baldwin *et al.* 1998, van Leusen 1999).

### **Grounding a Landscape Settlement Model**

A landscape settlement model addresses the fundamental question of why a group chose a particular locale. While potential and locational settlement models engage in valid substantive aspects associated with the evaluation of site location in relation to physical surroundings, they

**Table 2.3: Selected landscape models (Europe).**

<i>Year</i>	<i>Author</i>	<i>Affiliation</i>	<i>Region</i>	<i>Objective</i>
1995	Wheatley	University of Southampton	south England	Neolithic long barrows
1995	McGlade	University College London	general	theory (human-landscape)
1996	Llobera	University of Oxford	south England	Late Bronze Age ditches
1996	Lock & Harris	West Virginia University	south England	Iron Age hillfort
1997	Bender <i>et al</i>	University College (London)	south England	Bronze Age village & cairns
1997	Verhagen <i>et al</i>	-	south Spain	Bronze age settlement
1998	Baldwin <i>et al</i>	University of Leicester	general	theory (environmental cognition)
1998	Lake <i>et al</i>	University of Reading	west Scotland	Mesolithic
1999	van Leusen	Groningen Institute of Archaeology	general	summary (viewshed)

do not address the human perception of landscape. The advantage of a landscape settlement model lies in the ability to infer the cultural behaviours that generated the locational patterns (Hasenstab 1996:224) within the context of beliefs and practices (Trigger 1989:292, Trigger 1995:450, see also Plog 1990).

A landscape settlement model necessitates a framework to place a given culture within the context of surrounding cultures. The methodology for determining change over time involves the comparison of data irregularities and anomalies from different archaeological sequences (see Trigger 1989:409). Data irregularities are associated with both temporal and spatial aspects of archaeological sequences. Given that Princess Point chronologically straddles the Middle and early Late Woodland periods, spanning A.D. 500 to 1200, the relationships between Middle Woodland, Princess Point, and Early Ontario Iroquoian (Glen Meyer) provide the temporal sequence required for evaluation and explanation of the Princess Point settlement system. Unfortunately, the data for Rivière au Vase and Sandbanks groups are not sufficient at this time to provide a definitive spatial context analyses of Princess Point.

The period spanning A.D. 500 to 1200 encompasses a time of unprecedented change. This span is given the appellation the sedentarisation of pre-contact Iroquoians (Chapdelaine 1993). Accompanying the appearance of sedentary communities are equally significant changes in subsistence practices and products related to maize cultivation. Changing habitation and subsistence practices complement alterations in mobility patterns and social organisation. The latter represent significant societal and ideational transformations, yet there is an under-representation of archaeological analyses for this temporal period in southern Ontario.

Embedded within the archaeological record, with varying degrees of visibility, is evidence pertaining to sedentism, subsistence practices, mobility patterns and social organisation. These patterns or cultural traits can be used archaeologically to distinguish one group from another. Patterned traits may be unique or shared by a number of groups within a region. Shared traits, while not culturally unique, provide support for a broader interpretation of settlement systems. The following discussions on sedentism, subsistence, mobility, and social groups highlight their respective contributions to the development of a landscape settlement model for Princess Point.

#### *On Sedentism and Subsistence*

The trends toward sedentism and a reliance on maize cultivation are interrelated developments, yet their causal relationship is not clear. Increased sedentism may occur without cultigens while some groups may use domesticates while settling down (Arnold 1993:79, see also, Rocek and Bar-Yosef 1998). Although it is commonly accepted that the emergence of food production requires a modification in the structure of society (see Bender 1975), sedentism does not necessarily equate with year-round settlement, regardless of the subsistence base (Chapdelaine 1993:176). This raises the possibility of semi-sedentary societies, in relation to a period of horticultural and settlement transition, that are “hard to pin down because [they present] a degree of change in the intensity and permanency” (Chapdelaine 1993:176) of occupation. The transformation (in terms of sedentarisation) probably occurred slowly over the period A.D. 800 to 1200, paralleling the advent of the longhouse. The longhouse itself represents a design or evolution into “a tool for sedentariness” (Chapdelaine 1993:184). Likewise, Niemczycki ar-

gues for an intermediate phase of semi-sedentariness for the New York State Owasco between A.D. 1000 and 1300 (Niemczycki 1984). Chapdelaine and Niemczycki both argue for a slower pace of change than that suggested by either Stothers (1977) or Noble (1975), who each posited a shift to sedentism by A.D. 1000.

The presence of villages in the early Late Woodland represents a stage, and not the end, of a transition from hunter-gather to horticulturalist economies (Williamson 1985:350). This gradual transition, occurring in the social and political realms as well as the economic one, represents a continuation of the Middle Woodland trend towards an emphasis on a centrally based subsistence strategy with the goal of accumulating a winter food supply (Williamson 1983:28). Within the Ontario archaeological community, a consensus is forming that sedentary communities emerged slowly between the Middle and Late Woodland periods (see Ferris and Spence 1995, Smith 1997a).

One researcher queries whether the adoption of an architectural environment (i.e., villages and houses) indicates a transformation from a sociocultural infrastructure founded on a focus to one founded on a border (Wilson 1988:58). The architectural or built environment represents a “construction placed on the landscape rather than the landscape undergoing a reconstruction” (Wilson 1988:50); i.e., sedentary people impose villages, houses, and gardens on the landscape. The house appropriates the mediation and synthesis of the natural symbols of both the body and the landscape (1988:58), mirroring Chapdelaine’s comment regarding long-houses. The significant difference between mobile and sedentary communities is that the former read or find objects and features on the landscape while the latter represent such features through their built environment by the establishment of boundaries (Wilson 1988:139). The

phenomenon of sedentism, based on a sociocultural need for an architectural environment, manifests in the erection of a border. The border takes on many forms: a village, a longhouse, a palisade, or a bounded landscape such as a clearing surrounding a village.

An analysis of subsistence practices provides a similar border or boundary manifestation. The world-wide process of plant domestication is broadly interpreted: as Darwinian evolution whereby culture has no role in the eventual domestication process (Hart 1999, Rindos 1984), as economic (Flannery 1976a) and environmental determination such as favourable climatic change (Stark 1986), as social determination such as demographic pressure models (Bender 1985, Cohen 1975), as exchange or external influence whereby the indigenous culture was influenced or coerced (Dincauze and Hasenstab 1989), or as rising out of cultural and ideological complexity (Hodder 1990). For the last, the inclusion of agriculture in a subsistence system does not predicate the successful physical reorientation of society in terms of planting, collecting and storage strategies but rather upon the ability of cultures to include agriculture within their social constructs of the world, of their society, of the local landscape, and as a food source (Hodder 1990:182, see also Mulk and Bayliss-Smith 1999:370). Envisioned through a culturally symbolic separation of the wild from the domestic, the construction of a border creates a *domus-agrios* dichotomy delimited by exclusion, control, and domination (Hodder 1990:45). This dichotomy is similar to the culture-nature, human-environment debate and place-space interrelationships discussed previously.

To further explain the sedentism and subsistence relationship, I draw some parallels between eastern the North American Woodland period and the European and Near Eastern Neolithic. The origins of Old World agriculture reside in the combination of long natural proc-

esses and somewhat less lengthy social events including the organisation of economic activities resulting in settled villages. The *domus-agrios* dichotomy inherent in settled Old World villages promotes the creation of community distinctions or boundaries encapsulated by the terms house, hearth and pot. Houses, through hearth activities, and the decoration of pots, by way of an embedded cultural code, emphasise boundaries (Hodder 1990:294-295).

For eastern North America, Hart (1999) hypothesises a long natural process for the natural diffusion of maize (see Hart 1999). A variety of archaeological locales provide evidence of a reorientation from hunter-gatherer-fishers to horticultural-based permanence, organising economic activities leading to settlements in the form of villages. The principle of a wild:domestic separation mirrors the Iroquoian ideological and practical separation of the forest from the clearing surrounding a village (Fenton 1998). Ethnohistorical evidence suggests that Iroquoian groups practiced a lifelong reinforcement of the separation of village (or clearing) and forest (see Perrelli 1994:1). The appearance and significance of the longhouse likewise emphasises boundaries. The complex Iroquoian cosmology associated with a longhouse maintained and reinforced the wild:domestic or forest:village dichotomy:

“the longhouse was more than a residence, it was a focal point of Iroquoian/Iroquois existence, it was the socio-political centre, the ritual centre, the economic centre, and the centre of the cultural and cosmological world. It was architecturally speaking an incredible building, durable, large, overwhelming, awe-inspiring, economically self-sustaining, and a permanent structure in an ever-changing and unreliable world” (Kapches 1995:94).

This testimony more than satisfies the adoption of an architectural environment as an indicator of a sedentary community founded on a border imagery. The longhouse acts as a self-contained societal border for social, economic and political relations. Although some may argue that the longhouse represents a focus as opposed to a border, the exclusionary (or exclusive) nature of longhouse membership, activities, and gender-related management better satisfies a limited, controlled, and closed (architectural) environment.

Palisades likewise behave as boundaries. The erection of village palisades fuels a continuing archaeological debate regarding their function. One rationale is rooted in the sociocultural architectural environment concept (Wilson 1988), a domestication metaphor that confronts and controls the agrios (Hodder 1990:294). Interpreted foremost as defensive (see Stothers 1977, Timmins 1997), the increase in palisade post rows over time generally presupposes interpretations of increased warfare. When confronted with posts of small diameter in fragmentary, single rows, interpretations revert to windbreaks, snow fences or attempts at defence from wild animals (Pihl 1999, Robertson 1994:3, Pearce 1984:384, in Trigger 1990:123).

Challenging the defensive interpretation of palisades is the belief that palisades represent a “surrounding wall demarcat[ing] a community boundary, and divid[ing] the world into two parts: those on the inside and those on the outside” (Ramsden 1990:170). Ramsden interprets palisades as symbolic statements of community membership. As membership becomes increasingly structured the palisade follows suit, becoming more formalised and expressive. Moreover, a palisade constrains a community’s mobility of residence, forming a social boundary (Ramsden 1990:170-173).

An equally valid hypothesis is that village boundaries were both artificial and natural, with anthropogenic growth in the immediate clearings as both a substitute and a supplement to palisades (Robertson 1994:7). I add to this that anthropogenic growth was a natural precursor to palisades, providing both subsistence gains and perhaps the seeds of a boundary manifestation that was at once both natural and artificial in design.

The archaeological plant remains from Grand Banks include a wide variety of fleshy fruits that indicate anthropogenesis (American nightshade, bramble, ground cherry, strawberry), and are otherwise almost exclusively associated with Glen Meyer and later, predominately horticultural groups. Furthermore, “these plants are likely attracted to the human impacted landscape [at Grand Banks] largely due to the increasing impact of gardening...” (Crawford *et al.* 1998:133). These and other plants served as a natural boundary for Princess Point communities. A palisade mirrors and stimulates natural succession and anthropogenic growth. It also fulfills the role of a societal border in the form of an architectural environment by excluding, controlling and dominating the natural border through the imposition of a human-modified cultural boundary. Moreover, a palisade as a societal border is expressed year-round, lacking the inherent seasonality of natural borders.

The final parallel between the Old World Neolithic and eastern North American Woodland is the use of ceramic decoration as complex cultural codes. On-going research demonstrates that the existence of a complex cultural code via ceramic decoration was well in place in by the appearance of Princess Point and that this code changed with Glen Meyer (D. Smith pers. comm.). The encoding of meaning in pottery provided a cultural boundary that participants acted on and whereby ceramic decoration implemented adherence to a group’s cultural

philosophy. The spatial placement and form of the decoration itself was rigidly bounded by rules and techniques. The change in decoration of ceramic vessels signifies an acknowledgement of cultural changes in space and place as defined by social boundaries (see Ramsden 1990:177).

### *On Mobility and Social Organisation*

Hunter-gatherer mobility, most often associated settlement-subsistence systems, centered on annual seasonal-round economic activities (for recent studies, see Rocek and Bar-Yosef 1998). Less frequent is the use of mobility as an analytical tool for horticultural settlement-subsistence systems despite the commonly held opinion that “at various seasons of the year, groups of farmers left the village and set up temporary camps in good foraging localities” (Flannery 1976:111). The study of mobility generally rests upon the utility of economic activities (e.g., Harris and Hillman 1989, Hawkes and O’Connell 1992, Keegan 1987, Kelly 1992, 1998) although the recognition of social distance is equally critical to village location (see Flannery 1976, see also various contributions in Scarry 1993). The economic focus has limited the social and cultural contributions to the studies of mobility and social organisation:

“How can we discuss the specific social or cultural contexts of, say, the practices of prehistoric gatherer-hunters at the inception of agriculture, if we fail to similarly theorize and contextualize the [social group] relations which may have informed the ways in which such practices were executed?” (Boyd 1997:28).

Pottery, as a factor favouring sedentism, acts as a constraint on mobility (most recently researched by Haaland 1999:376). This line of research offers mobility studies a release from

the economic constraints of past research. The combination of pottery and mobility is less likely an option than the combination of pottery and sedentism. However, once a societal structure, such as gender, is attributed to pottery, the relationship between mobility and pottery becomes less functional. If pottery constrains mobility, then the inference is that when gender and mobility are combined, the ultimate effect is one of decreased mobility, reflected in a settlement system with greater permanence of the residential base. Pottery and other hearth-centred activities reflect practices of an individual or group and display a distinctive mobility pattern that incorporates tasks that, in all likelihood, were performed closer to, rather than farther from, the hearth. A shift to a more sedentary settlement could result in a reduction in gatherer mobility of up to half the previous subsistence mobility (Jackson 1991:318).

Groups tend to divide labour so that a group responsible for stationary resources and activities are based near the residential base and a second group responsible for mobile resources possess more flexible habitation options (Watson and Kennedy 1991:259). Ethnohistorical sources indicate the separation of Iroquoians into two groups that functioned largely to divide subsistence-associated labour activities. Adult females, elders and children comprised a group associated with cultivation and gathering and adult males performed tasks such as game hunting and village protection (Perrelli 1994:18-21). This segmentation of society into two groups combines both gender classes and age cohorts.

The combination of mobility and gender in the form of a social group implies that gendered work is not necessarily sex-segregated work, and that women presumably ranged through a group's entire territory (Nelson 1983:111, 89). Ethnohistorical evidence demonstrates that women were present at camps and documents family groups hunting and fishing, and women

assuming responsibility for preparing and maintaining the so-called male hunting camps (see Perrelli 1994, Spector 1983). Archaeologically correlation of the last, through research based on ceramic data, supports the presence of a substantial number of women and children at resource camps on the Caradoc Sand Plain (Williamson 1990:343). Moreover, males performed the arduous task of land clearing, either for new fields and therefore in sight of or in close proximity to clearings, or for new village locations, typically at a greater distance from the residential base (Trigger pers. comm.). Hence, two exclusively bounded landscapes, admittedly fluid in size yet maintaining a distinctiveness as to function, represent the Iroquoian sociocultural infrastructure.

A functional and spatial association between mobility and social grouping stems from subsistence and settlement practices. A mobile hunting economy requires a greater territory than that of the territorial limits associated with a cultivation-based economy (Jarman *et al.* 1982:31). When both economies co-exist within a culture group, sedentism, defined as an extreme strategy of reduced mobility, represents a continuum rather than an absolute, similar to the domestication continuum for subsistence. Likewise, social organisation is a fluid resource adaptable to the current needs of a society. Moreover, the notion of landscape as a boundary links the four concepts to one another.

### **The Princess Point Landscape Model**

The landscape settlement model is an investigation of Princess Point, Middle Woodland and Early Ontario Iroquoian data sets to seek patterning in the human-environment relationship in southern Ontario *circa* A.D. 500 to 1200. The landscape settlement system model methodology addresses both substantive and inferential approaches. Unique cultural activities revealed by

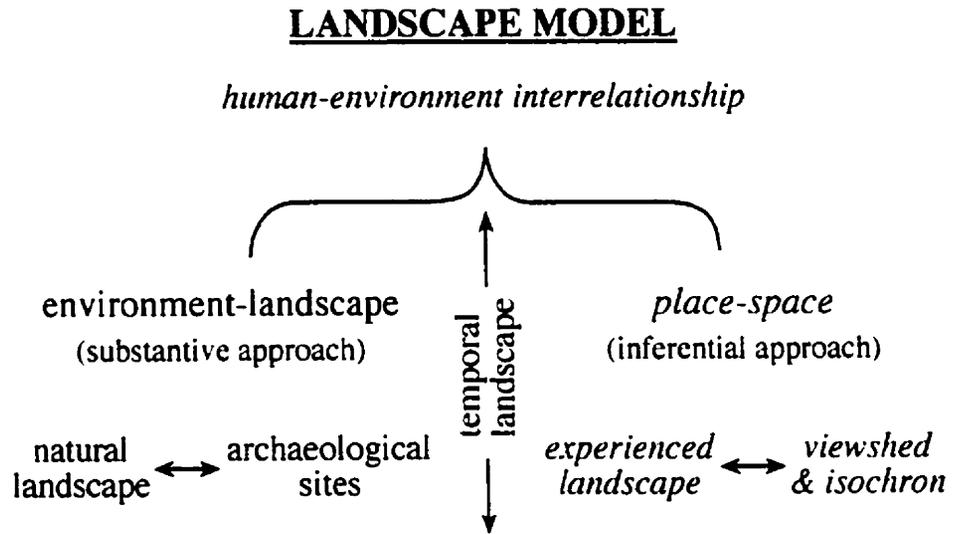
archaeological landscape patterning provides explanation of the ways a culture viewed and used its world (see also Savage 1990).

The landscape settlement model uses a dual approach:

- A. A substantive evaluation of the Princess Point settlement system through spatial and temporal modelling of the interrelationships between culture (archaeological data) and environment (natural landscape); and**
- B. An inferential explanation of the Princess Point settlement system through spatial and temporal modelling of the interrelationships between space (experienced landscape) and place (viewsheds and isochrons).**

The patterning resulting from the substantive analysis mirrors that of environmentally based evaluative data sets produced in locational models. The patterns resulting from the inferential approach represent space and place as determined through an analysis of the relationships between the experienced landscape, viewsheds, and isochrons. The advantage of a dual approach is the opportunity for interpreting the data sets separately, and in explaining the irregularities, anomalies and interrelationships between data sets through space and time (Figure 2.1).

The Princess Point culture group, as well as Middle Woodland, Glen Meyer groups and a lower Grand River valley control group comprised of randomly generated locations (or non-sites) are analysed through four unique landscape data sets consisting of geographic, topographic, water, and soil data (see Chapter 5). The result is an explanation of how archaeological cultures structure their relationship to their surroundings through landscapes.



**Figure 2.1: Landscape model illustrated through methodological interrelationships.**

### *Parameters of the Landscape Model*

Each landscape data set is modelled twice, as per the parameters of the landscape settlement model: to analyse the culture-environment interrelationships and the space-place interrelationships. I present the results and interpretations pertaining to these data sets in Chapters 5 and 6, respectively.

The landscape settlement model consists of four components: clusters, viewsheds, view forms, and isochrons. An explanation of the meaning and use of each of the four components follows.

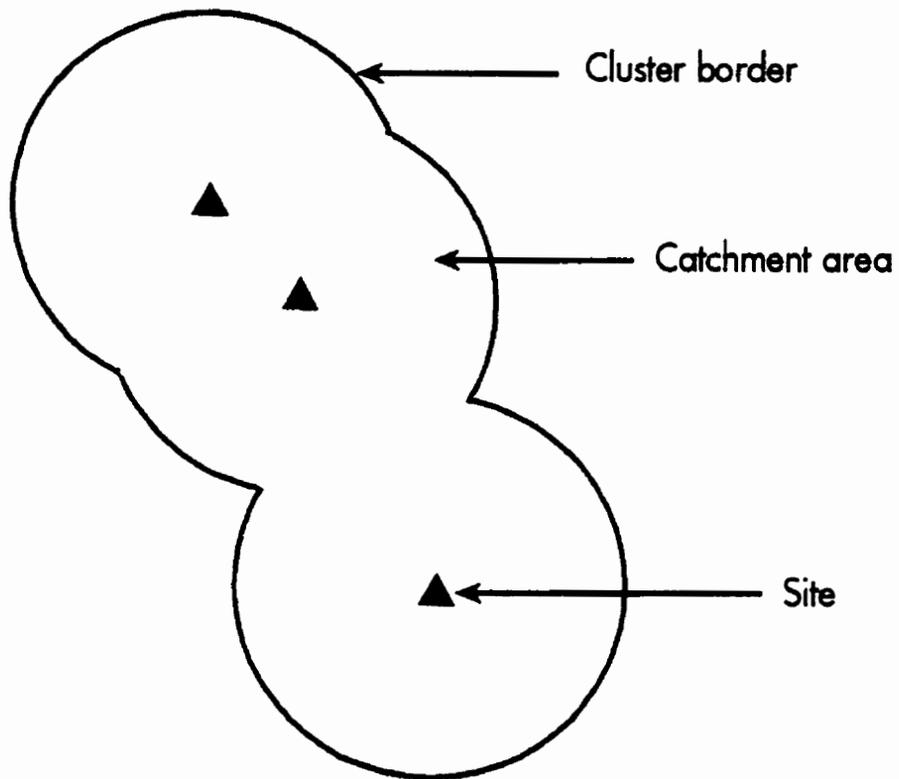
#### Clusters

Cultural site clusters provide the introductory data sets for the landscape model. A cluster consists of the cumulative catchments of sites bounded geographically (Figure 2.2). In formulating clusters, I make no distinction between contemporary sites and the sequential occupation of sites within a cluster. To date, Princess Point research has not determined the nature of the chronology of the sites within each cluster. While some sites are dated, a comprehensive series of dates associated with sites has yet to emerge. Dates are assigned to only six Princess Point sites used in this research. Likewise, there are dates for only three Middle Woodland and two Glen Meyer sites. Until dates for all sites within each cluster are available, the chronological position of any given cluster is unknown and any analysis must remain at the level of geographical association.

The determination of the cluster boundaries follows past research on settlement systems that used site catchment analysis. Traditional site catchment analysis, introduced to archaeology

by Vita-Finzi and Higgs (1970), investigated economic resources available in a catchment area or territory associated with a settlement with catchment defined as a “zone of resources, both wild and domestic, that occur within reasonable walking distance of a given village” (Flannery 1976:91). The first step in site catchment analysis is to derive a territory (catchment) belonging to a given focus (site) by applying some geographical rule. In its simplest form this would be a distance rule, resulting in a circular catchment with a typical radius of five or ten kilometres. The radius is chosen by experimenting with actual travel times or using ethnographic data (van Leusen 1999:218-219). Catchment studies typically use a 1 or a combination of 1, 2.5, or 5 km radii (e.g., see Flannery 1976b:108). Resources located beyond 5 km, while undoubtedly exploited for a variety of reasons, represent diminishing returns (1976b:116). Generally, the second step is to analyse the properties of the catchment area, usually to observe economic productivity (e.g., agricultural yield, foraging costs) in relation to energy investment.

Past research on some of the clusters used in the landscape settlement model resulted in similar conclusions. For example, the use of a 10 km catchment for the Calvert cluster to assess resources was found to be excessive in that the vast majority of resources for the period up to A.D. 1200 were probably obtained from an ovate catchment area no more than four to five kilometres in length (Timmins 1997:305). People did range further but their subsistence needs were well met within this parameter. Bogs and ponds located 3 and 4 km from the site did not offer additional resources that were not obtainable closer to the site. Catchment analysis indicated that the areas immediately surrounding the Calvert site were the most heavily exploited.



**Figure 2.2: Schematic diagram of the Cayuga cluster.**

Catchments of 2 and 10 km were used to research the Caradoc cluster. A 10 km catchment for Caradoc sites encompassed most of the regional variations in soil and vegetation, thereby greatly reducing the analytical value of each site's catchment. It was demonstrated that horticultural land requirements within a 2 km catchment were sufficient to provide nearly three quarters of the subsistence diet (Williamson 1985:317-318). More than half of a 1 km catchment for all village sites contained the best horticultural soil in the region. Three of the villages indicated significant use of swamps within 1 km, and analysis of the main flora and fauna recovered from three camp sites indicated procurement within a 1 km catchment (Williamson 1985:326-330).

I have set cluster boundaries used in the landscape settlement model at 5 km catchments using landscape boundary radii of 2.5 km around each site based on a combination of the above research results, preliminary investigations of the landscape model cluster locales, and the opinion that a landscape must be bounded. This equates to a 2,000 ha land area per site as the basis for landscape settlement modelling.

### Viewsheds

The landscape modelling of each site produces a unique experienced landscape and associated viewshed. The methodological sequence to produce a viewshed follows a GIS operational path. The generation of viewsheds used the following parameters: viewer map layer (on which any non-void cell will represent a viewpoint location), 2,500 m maximum viewing distance (viewshed boundary), 2 m viewing height above the ground surface (i.e., an approximation of adult height), surface elevation map (a DEM), site location map, and a 360° field of view. The

resulting GIS map layer displays unique values for the viewpoint itself, for cells visible, and for cells not visible from the viewpoint (Figure 2.3). The view form or pattern of the viewshed itself represents an additional analytical feature of the viewshed.

Setting the viewshed limit at 2.5 km radius allows comparisons to the site catchment data. Moreover, in defining a viewshed as a zone of influence, there is impracticality to an unlimited viewshed (in fact, there is valid opposition, see van Leusen 1999). The average person's tangible visual perception from a fixed location falls within the range of 2.5 km. Viewsheds are created for each site resulting in a total of 18 Princess Point, 12 Middle Woodland and 15 Glen Meyer viewsheds, in addition to the three sites dating *circa* AD 1000 and the control group. Each site's viewshed is presented in Appendix A.

### View Forms

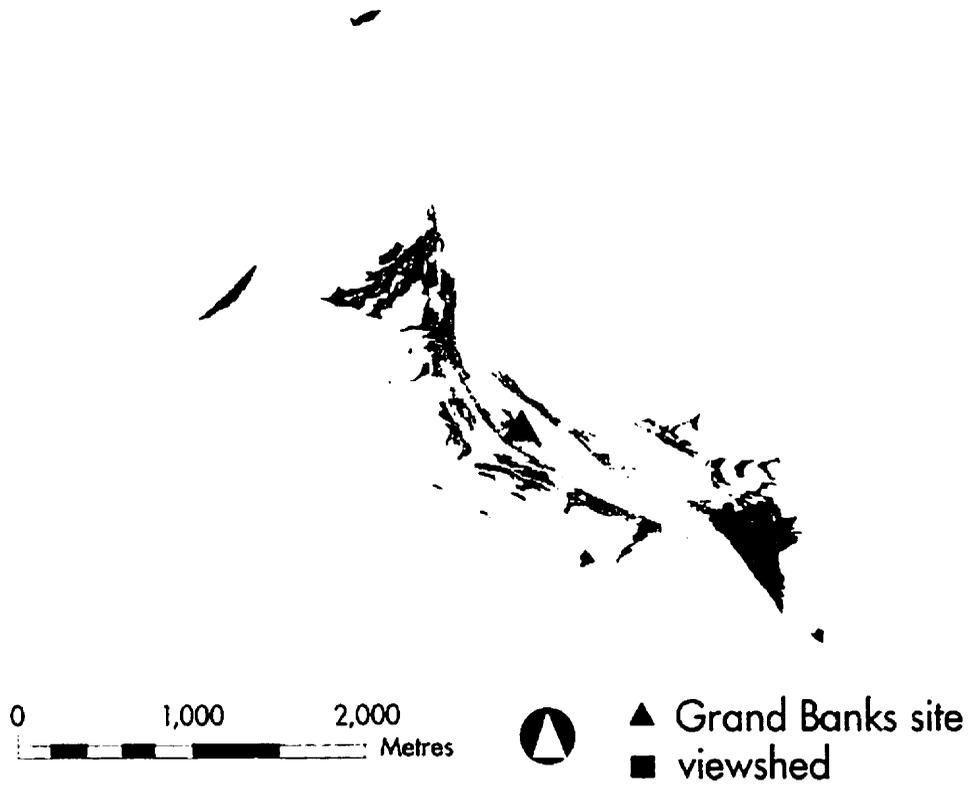
A viewshed manifests an independent parameter in the form of a view form. A view form displays variation in land area through comparative analysis of the amount of adjoining areas within the viewshed, thus enabling comparisons between sites and across culture groups. Each site's viewshed is subject to a GIS analysis whereby contiguous cells within the viewshed are assigned the same value, and unique values are assigned to non-contiguous cells. The user sets the parameter for what constitutes contiguous cells. The landscape model parameter is 200 m, the maximum area between viewshed cells herein identified as contiguous. Non-contiguous cells, i.e., those with greater than 200 m of empty or void cells between them, and their subsequent contiguous neighbours, are assigned a new value.

A spacing of 200 m allows for minor topographic variation, such as swales, that would not constitute a natural landscape boundary, but permits the establishment of a boundary for larger topographic features, such as rivers, escarpment, and drumlins, etc. This method identifies the contiguous nature of each viewshed resulting in a ha unit of measure. The resulting value for contiguous cells is then calculated as a percentage of the viewshed itself, resulting in a standardised measurement across sites and culture groups.

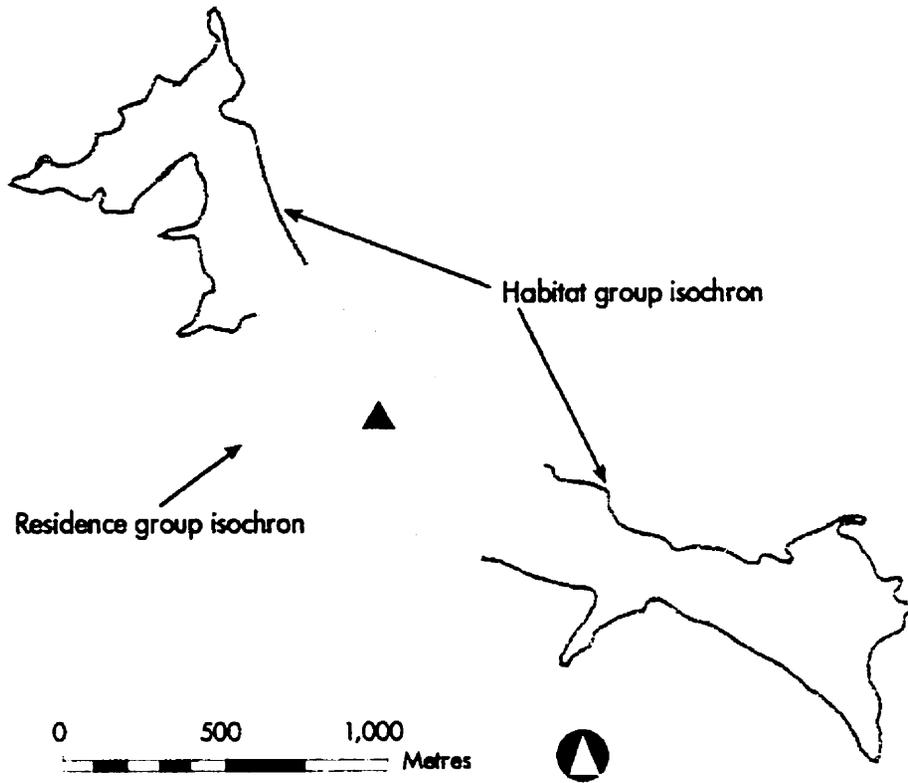
### Isochrons

An isochron is a measure of time, and graphically represented as distance, to travel a prescribed distance. Although similar to exploitation territories, isochrons are unique in that they are bounded by the viewshed. The territories under scrutiny in the landscape settlement model are the relative mobility of each of the residence group and habitat group. Each isochron indicates the distance travelled in a given time and thus is related to distance-decay or cost-surface analysis methodologies, which calculate the cumulative costs of travelling over a surface. These methodologies typically operate with catchment-style parameters set by time limits.

The time parameters for each of the two mobility groups are calculated from the ethnographic and archaeological data discussed previously (see section on mobility and social groups). The residence group's isochron is modelled on ten minute transects from a site and the habitat group is modelled on ten minute to one hour transects, exclusive of the residence isochron. Although the transects for each site do vary with terrain (as determined by GIS cost-surface analysis, see Dieterman 1999), they average a distance measurement of 1 km and 5 km, using Jarman *et al's* (1982:32) exploitation territory thresholds developed for arable economies,



**Figure 2.3: Grand Banks site and viewshed.**



**Figure 2.4: Grand Banks residence and habitat isochrons.**

for the residence and habitat groups, respectively. Additionally, I use individual site viewsheds to represent the landscape associated with each mobility group, effectively restricting the isochrons to the same boundaries as set by the viewshed. The result is a set of uniquely bounded isochrons per site for the residential and habitat groups (Figure 2.4).

### *The Substantive Approach*

The substantive approach involves examining the geographic characteristics of the local environment and contrasting the natural landscape with the archaeological data for each site and cluster of sites. The methodology for depicting the natural landscape is similar to that found in locational models: attributes consisting of physiographic characteristics. The difference lies in the assessment of the attributes. Rather than predict or prescribe the environment-site relationship (i.e., distance to water, degree of slope, etc.), I measure natural landscape attributes as independent variables that form a background or baseline data set. For example, attributes relating to water are assigned to primary or secondary watercourses, lacustrine, or wetland. Instead of assuming a culturally defined relationship in a geographic region, such as that between site and distance to water, the goal of the substantive approach is to present an environmental account of the landscape.

The substantive approach's contribution to the landscape settlement model highlights variation in physiographic data sets through the identification and evaluation of patterns. Individual sites are spatially modelled through intra-cluster and inter-cluster relationships, and temporally between cultures. In addition, site clusters are analysed through the four landscape data sets.

### *The Inferential Approach*

The inferential approach is used to analyse the relationships between the natural and experienced landscapes and viewsheds and isochrons for each site, between sites and clusters, and between cultural groups. Given that the experienced landscape, consisting of potential affordances in the human-environment relationship, represents an acknowledgement of the presence of affordances (as opposed to the natural landscape, which details environmental attributes), the inferential approach allows for an analysis based on social and ideological principles. This may appear to be merely a semantic distinction but in practice, the difference between a natural landscape's second order stream and an experienced landscape's potential water source, fishing source, clay source, or plant foods and raw materials is significant. A measure of the relationship between place and space consists of the variation between the affordances situated within the viewshed of each site and those outside of the viewshed. As noted in Chapter 1, this does not negate the potential of additional affordances outside the viewshed; however, the landscape mode does not address these affordances. In addition, the form of site viewsheds is compared from all sites and from the control group site viewsheds.

Residence and habitat group isochrons represent territories or activity areas assigned to mobility groups. The amalgamation of data relating to inferred and documented village and field oriented labour and social activities incorporating age and gender cohorts (typically, but not restricted to women, children, and elders). The habitat group isochron corresponds to an amalgamation of inferred and documented territory-oriented labour and social activities incorporating specific male age cohorts and nuclear family groups. The number and type of affordances encountered within each isochron are analysed through an inferential approach, including the rela-

tionships between isochrons and viewsheds for both mobility groups per site and inter-site, by culture and between cultures.

## GIS Mapping

This research makes use of a raster-based GIS application, MFworks 2.6, installed on an Apple iMac. A raster GIS is defined as a database of attributes linked to grid cells on a digital map:

“Maps are a representation of the distribution of attributes over a specific geographic area. ... An attribute map can be thought of as a layer within a stack of related maps, or simply, a map layer. A raster-based GIS imposes a grid structure over a surface. A raster map is a matrix of values, describing attributes, that are stored in cells that represent equal sized parcels of the real world” (*Thinkspace Inc. 1999:UG-DAT-2*).

### *Sources*

The GIS-based maps used in the landscape settlement model are digitized from the site data and published maps. The original maps used to develop the landscape settlement model consist of a variety of sources including archaeological sites, site record forms, soil, agricultural and topographic maps, and new data ascribed to GIS map layers.

The National Topographic Series (NTS) maps (1:50,000 or 1:25,000) combine both Universal Transverse Mercator (UTM) and latitude and longitude grid systems. While the metric 1:10,000 Ontario Base Map series are produced with UTM coordinates, the 1:25,000 Soil Survey Reports are set out in latitudes and longitudes. In the GIS, all attributes in cells were

recoded using UTM reference. Registration of the variously scaled map sheets was achieved through the establishment of a common geometry based on UTM coordinates. This geometry was used to overlay data from latitude and longitude maps by translating a series of cells per map, as required.

The sources used for the above include the Department of Energy and Mines NTS 1:25,000 maps for Muncey, Nelles, Melbourne, Strathroy West, Caradoc, Caledonia, Lamoka, Lambeth, Pond Mills, and Brantford-St. George, and 1:50,000 maps for Dunnville, Brantford, and Hamilton-Wentworth. Soil survey reports, at either 1:63,360, 1:50,000 or, most commonly, 1:25,000 scale, used include the counties of Brant (Acton 1992), Middlesex (Hagerty and Kingston 1992), Wentworth (Ontario Agricultural College and Department of Soil Science 1967), Waterloo (Ontario Agricultural College and Department of Soil Science 1971), Haldimand-Norfolk (Presant and Acton 1984), and Elgin (Schut 1982).

### *Scaling*

All data are digitized into map layers from map sheets scans. Each scan, once imported into the GIS program, required the calculation of cell resolution, a measure of scale that assigns each cell in the raster map layer a user defined value. For example, if a map scale representing 1 km, or 1000 m, occupies 575 cells on a map layer, the cell resolution or map layer scale is 1.74 m per cell ( $1000/575=1.739$ ). A common scale of measurement was established for the digitized map layers in the GIS. All maps are respaced (a GIS operation) so that a single raster cell in any given map layer represents a uniform measurement across map layers. For this purpose, the scale of 1:10,000 was chosen as the best scale to store data, in terms of computer file size,

ease of data coordination, and ground-truth representation. At this scale, the cell resolution on each map is 10 m per cell. Given that a map's cells are easily re-scaled to any selection depending on the desired result and size of the map layer, the selection of 1:10,000 does not restrict data manipulation to any degree; it simply operates as a common unit for data input, inventory and recovery.

### *GIS Mapping Procedure*

The production of a Digital Elevation Model (DEM) map from the digitised contour map is a four-step process (Figure 2.5). A DEM is a digital representation of cartographic information in raster form, composed of a "sampled matrix of elevations for regularly spaced locations within the area represented by the map. Each cell in the DEM map layer contains a value that indicates the average elevation of the parcel of land represented by the cell" (Thinkspace Inc. 1999: UG-DEM-1). The DEM is created through GIS interpolation resulting in a continuous data map whereby empty (void) cells are replaced with values using an algorithm that calculates or interpolates data from neighbouring values.

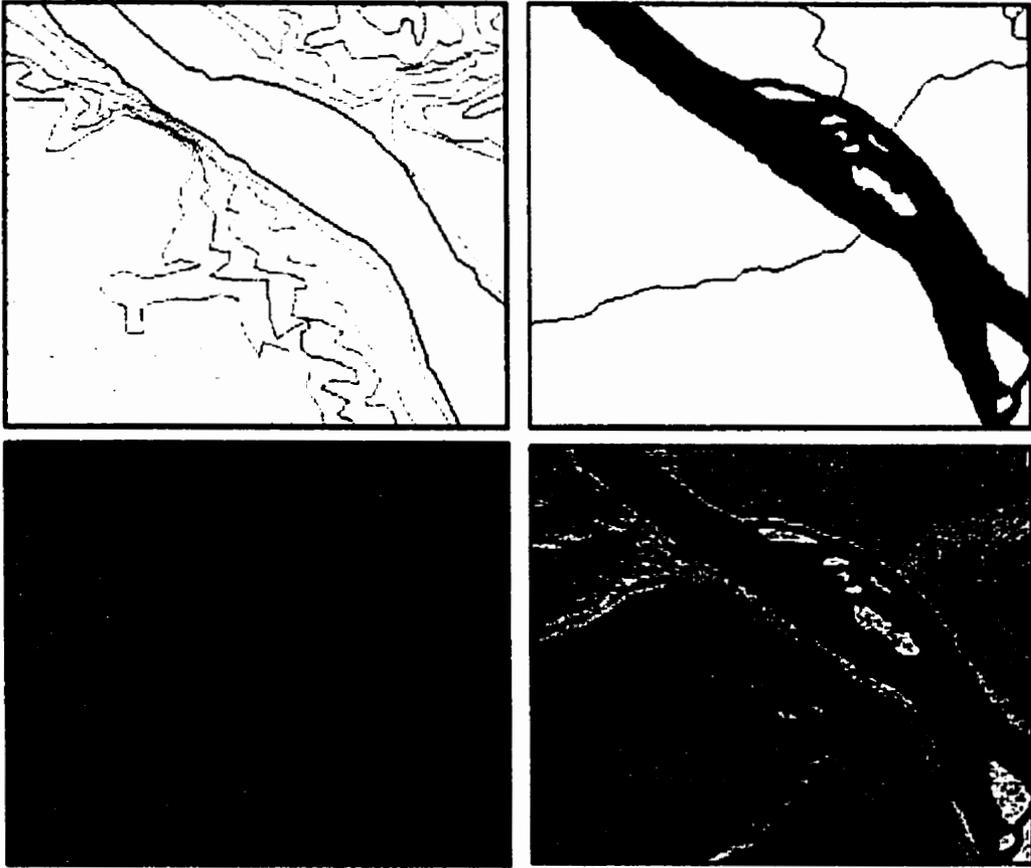
A digital terrain map (or pseudo-shaded relief map) emphasises elevation data via spatial enhancement produced using a GIS filter operation in tandem with a user defined GIS mask map (a three-by-three cell map layer to indicate light direction). A watercourse map layer acts as a mask to prevent contour rastering from spreading into non-land regions, such as rivers, lakes, etc. The final map requires value grouping, manipulating value colours, and a water map overlay. The term digital terrain map (DTM) describes this map format. As a base map for display purposes, a DTM presents a valid topographic depiction of any given area within the digitized re-

search area in the form of continuous, enhanced relief to aid analysis and interpretation when used with less visually interpretative overlays such as viewshed, soil, or drainage overlays.

Digitizing data pertaining to the geographic, topographic, water, and soil landscapes and archaeological sites follows a simpler two-step approach. If required, in-filling void cells transforms relevant digitised data sets into continuous data sets. Notable exceptions are the water resource map layers and the archaeological site maps. These maps display a majority of void cells simply as a result of the nature of the data set: linear streams and rivers or cell-specific archaeological site locations. The archaeological sites were digitised using UTM coordinates as provided on the Ontario Ministry of Tourism, Culture and Recreation site database. The site locations were ground-truthed, where possible, for Princess Point sites. Middle Woodland and Glen Meyer site locations were cross-referenced with file reports and published material for accuracy.

### *GIS Data Sets*

A GIS generated all of the landscape data sets utilised in this dissertation. The map layers generated from GIS operations support user defined data legends. The data legends, while too numerous to detail, typically depict each landscape component as a value and colour (user-defined), percentage, land area, number of cells, and any text used to describe a particular landscape attribute. The maps produced as a result of the landscape settlement model number in the hundreds and do not lend themselves for inclusion within this format of my dissertation. The maps are available from the author upon request.



**Figure 2.5: Production of a GIS digital terrain model (clockwise from upper left: contour layer; water layer; DEM map; DTM map).**

## Summary

A key component of the landscape model is the notion that the landscape is bounded and the analyses are, in effect, defined by these boundaries. Although I do not follow Gibson's ecological approach to any great extent beyond the analogies of visual perception, he states that the visual world has no boundaries (1986:206). This would appear to run contrary to the statement that a landscape must be bounded. I believe that the distinction lies in the composition of the natural landscape versus the experienced landscape. The natural landscape is similar to Gibson's visual world; an unbounded concept called the natural environment, which, when it is experienced, has no visual boundaries and is therefore similar to space. Gibson's visual perception approach also involves "knowing the world" (see Gibson 1986:258), to which I would equate the experienced landscape. Knowing the world is defined as the establishment of a center, a center that I have encircled with physical and cognised boundaries. Knowing the world is the experienced landscape, comprised of places.

The landscape settlement model satisfies one opinion regarding the utility of archaeological models: an ability to extract, in a logical framework, the underlying assumptions about cultural processes implicit in an explanation of prehistory (Trigger 1970:3). The landscape settlement model's logical framework incorporates the construction of natural and experienced landscapes, the constructs of space and place, and the development of viewsheds and isochrons. Furthermore, "tracing communities through time will shed important light not only on the development of these communities, but also on the [associated] social and political processes" (Trigger 1970:42, see also Plog 1990). This is a basic principle of the landscape settlement model.

The landscape settlement model for Princess Point may benefit from additional analyses of fauna and flora, settlement patterns, and material culture, each contributing and refining the model's results. The model provides a new avenue to interpret, evaluate, and explain the human-environment relationship for the period A.D. 500 to 1200 in southern Ontario as a complement to more traditional methodologies.

## CHAPTER 3

### ARCHAEOLOGICAL BACKGROUND

This chapter summarises the spatial and temporal frameworks underlying the analysis of the Princess Point settlement system in relation to Middle Woodland and Early Ontario Iroquoian manifestations in southern Ontario. In the following, I present updates on the state of archaeological site interpretation and settlement-subsistence research on Princess Point, Middle Woodland, and Glen Meyer groups. I show that previous theories of Woodland settlement systems in southern Ontario no longer conform to current archaeological data. I address the potential for settlement system continuity from Middle Woodland to Princess Point, and from Princess Point to Glen Meyer. An assessment of the significance and analytical potential of three transitional Princess Point-Glen Meyer sites follows.

#### **Setting the Stage**

The Woodland chronology remains the classificatory basis for pre-contact culture groups in northeastern North America. In southern Ontario, Middle Woodland, 400 B.C. to A.D. 900, is split geographically into three culture groups, the Saugeen, Point Peninsula, and Coutuere cultures. The Grand River serves as an arbitrary boundary (see Spence *et al.* 1990:157) between two of the culture groups, the Saugeen and Point Peninsula. Early Ontario Iroquois (EOI), A.D. 900 to 1275, is traditionally divided along geographic lines into two cultural

groups, the eastern Pickering and the western Glen Meyer, the boundary also lying in the general vicinity of the Grand River (see Wright 1966). The majority of current Middle Woodland and EOI researchers conclude that the previous segmented approach to culture history is inadequate. Recent interpretations treat the Middle Woodland Saugeen, Point Peninsula, and Couture culture groups, as well as the later EOI Pickering and Glen Meyer divisions, as regional variations of more complex cultural continua in both space and time (Smith 1990:288, Williamson 1990:295) (Table 3.1).

There is considerable lack of agreement in the placement of the Princess Point culture within the context of the Woodland chronology for southern Ontario. Similar classification uncertainty surrounds Rivière au Vase in southwestern Ontario, Sandbanks in central and eastern Ontario, and sites in the Ausable drainage, eastern Lake Huron shoreline and Bruce Peninsula of west-central Ontario. The period relevant to these groups has been called both Initial Late Woodland (Smith 1997a, Smith and Crawford 1997) and Transitional Woodland (see Ferris and Spence 1995, Pihl *et al.* 1998, Spence and Pihl 1984), essentially to accommodate the uncertainty in classifying the temporally convergent Princess Point, Sandbanks, and Rivière au Vase traditions.

A salient argument by Smith (1997a) against the adoption of the term Transitional Woodland appeals to concerns about inserting a regional transitional woodland substage into the larger Eastern North American scheme. Smith cites problems with ethnicity (proto-Iroquoian Princess Point and assumed Algonkian Rivière au Vase), differences in settlement-subsistence systems and, most significantly, the fact that the term, Transitional Woodland, im-

PLICITLY evokes an *in situ* transition from Middle Woodland to Late Woodland, a still undemonstrated scenario (Smith 1997a:59-61).

The variation or, more accurately, lack of consensus in the chronological placement of Princess Point is revealing in light of an absence of baseline studies. Eighteen references spanning nearly three decades place Princess Point within the southern Ontario cultural chronology (Table 3.2). Five authors slot it into either the Middle Woodland or Late Woodland while eight others propose either a transitional period between the two Woodland Periods or adhere to a wavering reluctance to associate Princess Point with any period. More revealing are the temporal spans assigned to Princess Point. Estimates of its beginning range from an early estimate of A.D. 200 to more recent ones spanning A.D. 400 to 700. The terminal date is also in flux, ranging from A.D. 500 through to 1050.

At present, Princess Point is tentatively dated between A.D. 540 and 1050. The early date is based on AMS  $^{14}\text{C}$  assays on maize at Grand Banks, yielding a calibrated radiocarbon date of A.D. 260 (540) 660 [TO-5307 $^{\text{C}}$ ] (Crawford *et al.* 1997) while the terminal date stems from calibrated radiocarbon dates on Princess Point sites Selkirk No. 5, A.D. 890 (1020) 1220 [DIC-175], Grand Banks, A.D. 990 (1030) 1210 [TO-5875], Bull's Point, A.D. 980 (1040) 1220 [TO-6341 $^{\text{C}}$ ] (Smith 1997a:47) and Cayuga Bridge, A.D. 870 (1030) 1280 [TO-7445] (Crawford pers. comm. 1999).

The only consistent element in the Princess Point literature is the group's assumed association with a settlement subsistence system identified as a variant of Middle Woodland. This belief went uncontested until new research and the subsequent publication of data from

**Table 3.1: South-central Ontario cultural chronology.**

<i>Time Period</i>	<i>Context</i>	<i>Event Marker</i>	<i>Cultural Group</i>	<i>Geographic Distribution</i>
400 BC - AD 800	Middle Woodland	appearance of cord-marked pottery	Saugeen Point Peninsula	west of the Grand River north-east of the Grand River
AD 500 - 1050	Initial Late Woodland or Transitional Woodland	appearance of cord-wrapped stick im- pressed pot- tery, appear- ance of maize	Princess Point	from the Niagara River west to Long Point (Lake Erie), north to Brantford (on the Grand River), and west to the Credit River
AD 800 - 1250	Early Ontario Iroquoian	permanent settled vil- lages, horti- culture	Glen Meyer Pickering	west of Niagara Escarp- ment east of Niagara Escarp- ment

Table 3.2: Literature overview of Princess Point.

Year	Author	Affiliation	Span (A.D.)	Proposed settlement-subsistence system
1970	Stothers	post Middle Woodland/ transitional	900-1100	Sedentary, semi-sedentary patterns, situated on river flats, small sheltered inlets, streams near rivers - all on low ground, corn (and possibly bean) agriculture
1972	Noble & Kenyon	Middle Woodland	200-500	Subsistence reliance on riverine and forest economies
1973	Stothers	early Late Woodland	500-900	Spring/summer seasonal encampments on riverine mudflats, low-lying peninsulas, riverine junctions, lacustrine shorelines near river mouths focused on hunting, fishing, limited agriculture
1975	Noble	Middle Woodland	400-600	Small, coalescing riverine oriented settlements (non-villages), seasonal semi-permanent encampments
1977	Stothers	terminal Middle Woodland/ Late Woodland	600-900	Middle Woodland seasonal round pattern: spring/summer riverine/lacustrine macroband, winter upland microband, maize cultivation (intrusive)
1982	Fox	between Middle and Late Woodland	500?-700	Series of seasonal settlement pattern campsites along major river drainages, Lake Erie shoreline, very similar to Middle Woodland
1984	Fox	terminal Middle Woodland	510/530- 800	Mobile hunter, gatherer, fishers experimenting with corn and tobacco
1984	Spence & Pihl	"Transitional" Wood- land	500-800	Essentially Middle Woodland with the significant addition of maize cultivation
1990	Fox	Middle to Late Wood- land transition	700/750- 900	Too little data to interpret settlement, possible maize cultivation
1995	Ferris & Spence	"Transitional" Wood- land	500/600- 900	Continuation of Middle Woodland seasonal round pattern
1995	Burse	Middle to Late Wood- land transition	700/750- 900	Riverine/lacustrine orientation, small number of terraced sites, few upland sites (intrusive)
1995	Mayer	Middle Woodland	500-900	incipient horticulture, predates transition to villages

**Table 2.2: Literature overview of Princess Point (cont'd).**

<i>Year</i>	<i>Author</i>	<i>Affiliation</i>	<i>Span (A.D.)</i>	<i>Proposed settlement-subsistence system</i>
1995	Snow	Middle Woodland	650-900	Warm season riverine/lacustrine, winter camps in uplands, no large settlements, no maize cultivation
1995	Smith & Crawford	Late Woodland	700-1050	Group-centred community, long-term river bar bases, short-term, special-purpose, upland & terrace sites
1996	Crawford & Smith	early Late Woodland/ "Transitional" Woodland	500-1000	Clustered, large, compact, semi-sedentary sites, floodplain and upland locales, maize cultivation
1996	Snow	Late Woodland	600-?	Incipient maize horticulture (intrusive)
1997	Smith & Crawford	Initial Late Woodland/ "Transitional" Woodland	500-1050	Transition to stable centred settlement system, reorientation to a major landscape feature, maize cultivation
1997	Smith	Initial Late Woodland	500-1050	Likely based on hunting, gathering, fishing, maize gained importance through time, with a focus on lacustrine, riverine and wetland locations
1998	Pihl <i>et al</i>	Transitional Woodland	600-800	Holmdale site: house structures, single-row palisade, low terrace on oxbow of the Grand River (Brantford), maize & tobacco

Princess Point sites began to provide evidence for river bar (floodplain) settlement and maize cultivation (see Crawford and Smith 1995, Smith and Crawford 1996), casting doubt on previous assumptions.

With Middle Woodland sites dating up to A.D. 800, Princess Point starting ca A.D. 500 and ending post-A.D. 1000, and some early Late Woodland sites dating from A.D. 800, most Ontario researchers now concur that there is no clear start date for Late Woodland (see Ferris 1995:103). Middle Woodland ends and Late Woodland begins at different times in different regions as a result of archaeologist's definitions, methodologies, and supporting theoretical frameworks (Smith 1997a:58).

### **The Origins of the Southern Ontario Chronology**

The current cultural chronology for southern Ontario pays an important debt to Ritchie's cultural chronological model for northeastern North America, developed in 1944 and modified by Ritchie and MacNeish in 1949. Changes in ceramic styles demonstrated an *in situ* continuum from Point Peninsula to Iroquoian cultures in western New York State (see Ritchie 1969). The Middle Woodland Point Peninsula in the New York chronology dates from ca A.D. 100 to 1000. The Middle Woodland Kipp Island phase, ca A.D. 500 to 850 (Snow 1980), is contemporary with southern Ontario's Saugeen, Rivière au Vase, and Couture cultures.

The Owasco and the Iroquois are the two cultural stages or aspects of New York State's Late Woodland chronology. Representing the temporal equivalent of Glen Meyer in southern Ontario, three sequential phases define the Owasco dating from ca A.D. 1000 to 1300; Carpen-

ter Brook, Canandaigua, and Castle Creek, more commonly referred to as Early, Middle and Late Owasco (Niemczycki 1984:24).

At a glance, the New York State chronology indicates that the Late Woodland Iroquoian Owasco directly follows the Middle Woodland period ending ca A.D. 1000. Chronologically situated between Point Peninsula and Owasco is a poorly defined and under-investigated culture group, Hunter's Home, defined as a late Middle Woodland manifestation in western New York. Viewed as a "terminal development...of the Point Peninsula cultural continuum in central and eastern New York" (Ritchie 1969:253-254), Ritchie admits a difficulty in explicitly defining Hunter's Home beyond representing a vague stage of transition into inchoate Owasco culture. Admittedly few sites dating to ca A.D. 800 to 1000 are assigned to Hunter's Home (Black Rock, Turnball, White, Kipp Island 4, Willow Tree, and Portage) coupled with limited detailed excavation data (see Niemczycki 1984, Ritchie and Funk 1973, Ritchie 1969, White 1961).

This description mirrors Princess Point research in Ontario, prior to 1993, although Princess Point did have the advantage of a greater number of registered sites. Hunter's Home is justified as a culture group by distinctions observed between Middle Woodland Kipp Island and Owasco Carpenter Brook, or Early Owasco, including an increase in cord-decorated ceramics, complete with punctates and flattened instead of rounded lips, a general increase in undecorated pipes, a trend towards diversity in lithic tool types and numbers, especially the triangular Levanna point (foreshadowing the Owasco sequence) and elimination of burial ritualism in favour of more commonplace treatment (Ritchie 1969:254-258). Furthermore, maize cultivation was "already being practiced as an important aspect of the Hunter's Home economy"

(Ritchie and Funk 1973:356). For the record, Snow dismisses the phase as spurious, viewing Hunter's Home as a culture affiliated with Point Peninsula (Snow 1995:65).

This detailing of Hunter's Home is to point out the parallels to Princess Point material culture in southern Ontario. Beginning just across the Niagara River (there are Princess Point sites on Grand Island, see Bursey 1995), sites resembling Princess Point are recorded as far off as the southern shores of Lake Erie (Perrelli pers. comm.). While it is beyond the scope of this research to go beyond the suggestion of a link or association, the similarity of material culture, subsistence pattern, and temporal range does lend credence to the development and evaluation of a Princess Point-style settlement-subsistence system with widespread implications beyond that of southern Ontario, including the presence of maize cultivation on either side of the Niagara River dating ca A.D. 500 to 1000.

The Ontario chronology, owing much of its genesis to New York State cultural manifestations, suffers a similarly poorly defined, if not ignored, critical period of proto-Iroquoian development. This poorly defined proto-Iroquoian period perpetuates the current confusion surrounding Princess Point.

## **Reconstructing The Princess Point Settlement System**

### *Historical Overview*

Princess Point, as a culture construct, originates with the 1940s and 1950s fieldwork of Lee and MacNeish. Lee envisioned MacNeish's Ontario Owasco designation as transitional from Middle Woodland Point Peninsula to Late Woodland Glen Meyer as supported by several Owasco style sites in southern Ontario. These sites were recovered earlier by Wintenberg

and documented at that time as a non-Iroquoian ceramic tradition underlying Iroquoian components (e.g., the Middleport site).

The Princess Point cultural group was identified and documented on the basis of fieldwork conducted between 1968 and 1974 (see Stothers 1976). Stothers (1977:24 ) reclassified Lee's Ontario Owasco to signify explicitly that Princess Point was the Ontario Owasco transitional group. The Princess Point Complex, as Stothers (1976:137, see also 1977) initially defined it, incorporated three regional foci in south-central and south-western Ontario: a Point Pelee focus, a Grand River focus, and an Ausable focus (near Lake Huron), with sites assigned to Early, Middle and Late phases, dating between A.D. 600 to 900. Since then, the Point Pelee and Ausable foci have been excluded, the former identified as the Rivière au Vase culture while the unaffiliated Ausable focus is demonstrably not Princess Point (Fox 1982, 1984). In addition, the Early, Middle and Late phases have been dropped in favour of a continuous culture period. Recent studies do not support a tripartite division based on either ceramic attributes (Bekerman 1995) or radiocarbon dates (Smith and Crawford 1997). Since the rationale for the use of the term complex has been eliminated, I would encourage an abridgment of the cultural terminology. Currently, Princess Point represents a single cultural component dating from ca A.D. 500 to 1050, based on the identification of more than 80 archaeological sites situated in an area from Long Point to the west, the Credit River drainage to the northeast, and the Niagara River to the southeast (Fox 1982, 1984, 1990).

### *Previous Settlement System Hypothesis*

The Middle Woodland seasonal round proposition brought forward over two decades ago (Stothers 1977), suffers from a paucity of research on settlement-subsistence systems data and, as a consequence, constrains analyses of Princess Point sites. Subsequently, the Princess Point settlement system model of large-site macro-band riverine and lacustrine aggregation in the late spring and summer, and small-site micro-band upland dispersal in the fall and winter (summary by Smith *et al.* 1996) remains undemonstrated. The majority of sites are on river flats, low-lying peninsulas, and lakeshores near river mouths. These locales are considered to have been as seasonal spring-summer encampments associated with a diffuse hunting and fishing economy and limited maize cultivation (Stothers 1977:117). A similar scenario characterised Princess Point during the early 1980s; a series of seasonal campsites along major river drainages displaying a settlement pattern very similar to that of Middle Woodland (Fox 1982:19). The very nature of the Middle Woodland settlement system in a riverine region was assumed rather than tested at that time (see Finlayson 1977).

The seasonal camp interpretation stems from the observation that current floodplains on the Grand River have a large number of Princess Point sites situated on them. The chain of thought resulting in an assumed seasonal settlement pattern took the modern hydrological situation on the Grand River and extended it a thousand years into the past. The result of this assumption, taken for granted over the past quarter century, is to base an unknown settlement system (Princess Point) on an untested and assumed settlement system (Middle Woodland).

### *Recent Research on Princess Point Settlement Systems*

From 1993 to 2000, Crawford, Smith and colleagues examined Princess Point sites on the lower Grand River and at the western end of Lake Ontario as part of a multi-disciplinary research project on secondary agricultural origins in northeastern North America. Research included the partial excavation of Princess Point sites on lateral river bars and terraces at Grand Banks, Cayuga Bridge, Meyer, and Forster, and test excavations at Bell Terrace, Young 1, Bell Flats and Armstrong Flats. They discuss the implications of these sites' location on a stable Middle Holocene riverine system (see Walker *et al.* 1997). The result has implications with regard to settlement systems and horticulture origins for the Grand River sites (see Crawford *et al.* 1998a), and for the Princess Point cluster at Cootes Paradise at the western end of Lake Ontario at Bull's Point, Bull's Cove (Smith *et al.* 1996), Sassafras Point, and the Princess Point type site.

The research of Crawford and Smith (Crawford and Smith 1996, Crawford *et al.* 1997, Crawford *et al.* 1998a, Crawford *et al.* 1998b, Smith 1997a, Smith 1997b, Smith and Crawford 1995, Smith and Crawford 1997) provides a significant analysis of the Princess Point settlement system. Their work demonstrates the stability of lateral river bars in the Grand River for the period of Princess Point occupation. They recovered settlement pattern data from Grand Banks, Cayuga Bridge and other lateral bar sites and documented that maize had appeared in Ontario by the 6<sup>th</sup> century A.D. at Grand Banks. Furthermore, in addition to the Grand River valley research, the occupation of glacial ravines at Cootes Paradise demonstrated that the Princess Point settlement system is more complex than that of Middle Woodland cultures.

The tentative conclusions of this research with regard to settlement systems that the transition to more 'centred' communities may have occurred before Glen Meyer (Crawford and Smith 1996:7), and that a precursor to the Iroquoian pattern of base site and special-purpose sites may have been emerging (Smith *et al.* 1996). The admission that a "rigorous examination of the Princess Point settlement system is still in its infancy" (Smith and Crawford 1997:28) is an honest appraisal.

#### *Princess Point Settlement Data*

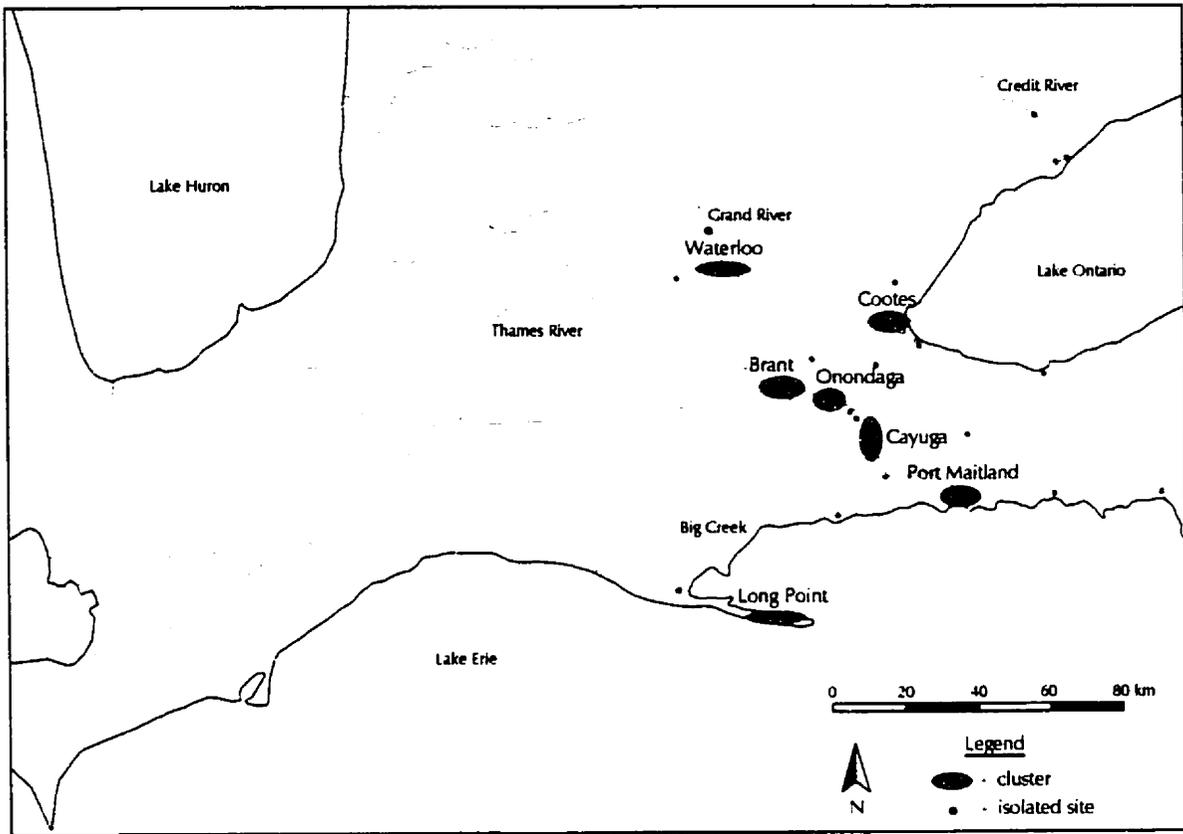
Princess Point sites readily fall into discrete clusters. I have identified ten Princess Point clusters to date, including the division of the Grand River cluster (see Crawford and Smith 1996:783-784, Smith and Crawford 1997:13) into four discrete clusters (see Figure 3.1, Table 3.3). There are notable single site outliers in the Niagara Peninsula, on the shorelines of Lake Erie and Lake Ontario, and shoreline erosion may have destroyed others. The majority of the clusters center on the Grand River, from the mouth at Lake Erie to Waterloo. The three clusters not situated on the Grand River are associated with other riverine resources; one with a unique lacustrine feature at Long Point on Lake Ontario, another in a unique rivero-lacustrine habitat on Spencer Creek and Cootes Paradise, and the third, a small riverine cluster, to the northeast on the Credit River.

Paleosols on Grand River river bars frequently yield Princess Point sites. The study of paleosols at Grand Banks (Crawford *et al.* 1998a, Walker *et al.* 1997) demonstrates that there were two stable periods representing regional equilibria. The first (PI) dates between 2,700 and 4,000 years ago., while the second (PII) dates from at least 1500 years ago to possibly the 19<sup>th</sup>

century, when forest clearing resulted in annual flood events and significant alluvial accumulation. The recovery of Princess Point cultural material in PII from depths of 50 cm to 75 cm below current surface levels occurred along the entire 700 m Grand Banks river bar. The Grand Banks settlement pattern, recovered through 80 m<sup>2</sup> of excavation, displays a complex cluster of posts and features. The multi-component nature of the area from which these excavations recovered the majority of post moulds and a lack of posts in two areas that appear to be uniquely Princess Point constrains interpretation.

At the Cayuga Bridge site, situated 2 km downstream from Grand Banks on a 1 km long river bar, excavations 30 years ago revealed a substantial amount of material culture from a 7 m trench excavation into the river bank (Stothers 1977). Recent excavations at Cayuga Bridge, 100 m north of the 1969 test trench (loci 2), uncovered Princess Point material in a 45 m<sup>2</sup> area at depths of 1.5 to 2 m below the current floodplain surface (Crawford and Dieterman 1999).. Furthermore, as with Grand Banks, artifact recovery from the exposed PII in the eroded river bank extended along the entire length of the river bar. Artifacts include cord-wrapped stick impressed ceramics accompanied by a wide range of lithic artifacts and a friable collection of faunal material. Preliminary analysis indicates that the last included deer, fish, and small mammals, making it similar to the faunal assemblage from Cayuga Bridge loci 1 (Burns 1972).

The settlement data at Grand Banks and Cayuga Bridge, consisting of overlapping structure walls, hearths, ash pits, and unidentifiable post mould patterns give rise to the hypothesis that both sites (and potentially other Princess Point river bar sites) represent long-term multiple occupations, either as continuous settlement shifts on the river bar or as repeated occupations of the river bar.



**Figure 3.3: Princess Point clusters and sites in southern Ontario.**

**Table 3.3: Princess Point clusters.**

<i>Cluster name</i>	<i>No. of sites</i>	<i>Watershed affiliation</i>	<i>Cluster (km<sup>2</sup>)</i>	<i>Landscape orientation</i>
Cayuga	5	Grand River	5 km	riverine
Cootes Paradise	10	Dundas Creek, Lake Ontario	6 km	wetland, lacustrine
Indiana	4	Grand River	6 km	riverine
Long Point	4	Lake Erie	14 km	lacustrine
Onondaga	10	Grand River	8 km	riverine
Oxbow	8	Grand River	10 km	riverine
Port Maitland	5	Grand River, Lake Erie	10 km	riverine, lacustrine
Waterloo	7	Grand River	12 km	riverine

The Meyer site is approximately 3.5 km upstream from Grand Banks, situated on a 6 m terrace overlooking large Grand River flats on both sides of the river. The terrace is opposite three Princess Point sites on a large, 5 km east bank river bar. Meyer is registered as a multicomponent Princess Point and Neutral site based on variation in ceramic decoration observed during a 1970 test excavation, approximately 30 m west of the terrace edge. An examination of rim sherds from the University of Toronto's 1998 and 1999 excavations indicates predominantly a Princess Point occupation. The ceramics, stamped exterior rims with cord-wrapped stick impressed interiors, marks a change from the ceramics decorated with cord-wrapped stick on exteriors and interiors recovered at Cayuga Bridge and Grand Banks (D. Smith pers. comm. 1998). Recovered ceramics also document a Middle Ontario Iroquoian (Uren) occupation at Meyer, dating to A.D. 1300 to 1350, and the recovery of at least two glass beads in 1998 support a later Neutral occupation of the site.

The settlement pattern at Meyer consists of a dense concentration of hundreds of post moulds associated with more than 75 features, including at least four oval hearth floors and an assortment of ash-filled, bell-shaped and basin-style pits. Although various lengths of structure walls are discernible, there are no house patterns visible.

At Meyer, the adjacent river flat has no known sites on it, nor has any paleosol been observed from test trenching on the flat between the Meyer terrace and the Grand River. Ground penetrating radar indicates that this river flat was subject to episodes of channeling over time, rendering it relatively unstable, and hence the lack paleosol development (Desloges pers. comm. 1999). Test excavations at Bell Flats and Armstrong Flats, both situated on a west bank river flat

200 m downstream from Meyer, resulted in the recovery of material culture, including cord-wrapped stick ceramics, from a 50 cm deep paleosol.

Settlement data from other Princess Point sites are limited. Bull's Point featured a 4 m rectangular structure in association with two shallow interior features (Smith *et al* 1996). The Sassafras Point and Princess Point sites revealed overlapping settlement data from more recent occupations, similar to Meyer and Grand Banks. At ORRA, settlement data included 39 posts, a hearth and four small pits, signifying a fairly large structure (upwards of 17 m by 10 m), yet this is far from conclusive (Wimmer and Mayer 1998). Excavations at Alder Creek, situated in a hilly inland location on a small tributary of the Grand River, and a small right-of-way excavation at Johnson's Flats, on the Grand River in Caledonia, did not yield any post moulds. The recovery of a hearth, calcined bone, ceramics and scraping tools, with an absence of fleshy fruit and nut remains lead Timmins (1992a: 16) to postulate that the site represents a cold-weather occupation. At Johnson's Flats, situated on the downstream end of a 2 km river bar, Princess Point material was found in a PII horizon without any evidence of settlement patterns, representing an area possibly too constricted for structures.

Princess Point settlement patterns consist of overlapping occupations to the extent that individual house patterns are difficult to discern. Two trends emerge from the recent research for the Grand River clusters; a focus on stable river bars whose presence is typically indicated by paleosol development, and a focus on terrace locales immediately above large, channeled flats.

### *The Current Hypothesis for Princess Point Settlement Systems*

The Princess Point settlement-subsistence system plays a crucial role, given its chronological placement, in the development of theoretical models of the origins of horticulture and the shift to a sedentary lifestyle in southern Ontario. Significant inroads have been made over recent years regarding secondary agricultural origins (Crawford *et al.* 1998a), lithic technology and sources (Ormerod 1994, Shen 1997), and ceramic techniques and styles (Bekerman 1995, Watts 1997), with the goal of demonstrating material culture continuity and developmental change within the 500-year Princess Point cultural sequence. Comparatively, Princess Point has been the subject of few analyses in regards to settlement and subsistence practices.

A synthesis of recent contributions to Middle Woodland and Glen Meyer settlement-subsistence data provides bracketing support for the Princess Point hypothesis. Smith and Crawford (1997:25) have rightly cautioned against basing Princess Point settlement models on Middle Woodland patterns, calling into question the extant Princess Point model. The Princess Point model stemming from this research represents a synthesis of available data.

Princess Point settlement comprises a centred or focused pattern of community clusters oriented towards major riverine and lacustrine environments. Subsistence needs revolve around a mixed subsistence economy consisting of traditional gathering and hunting of resources accompanied by limited cultigen cultivation. Settlement needs follow the needs of subsistence, requiring locales that satisfy both traditional activities and maize cultivation. Consequently, this orientation to the local landscape shifts from a Middle Woodland preference for riverine and upland areas to a preference for stable, alluvium-rich, river flats. This preference persists for the majority of the 500-year Princess Point cultural phase, leading to the Glen Meyer preference for

sandy upland locales to further intensify cultigen production. A possible scenario is that an initial attempt, *circa* A.D. 1000, to increase cultigen production may have met with failure or only limited success on the Grand River alluvium, prompting a settlement shift. The westward spread of Glen Meyer is substantiated by chronological data, the earliest sites being found on the Grand River ca A.D. 1000, followed by settlement of the Norfolk Sand Plain and then the Caradoc Sand Plain and Ausable regions (Timmins 1997:219).

### **Updating Extant Middle Woodland (Saugeen) and Late Woodland (Glen Meyer)**

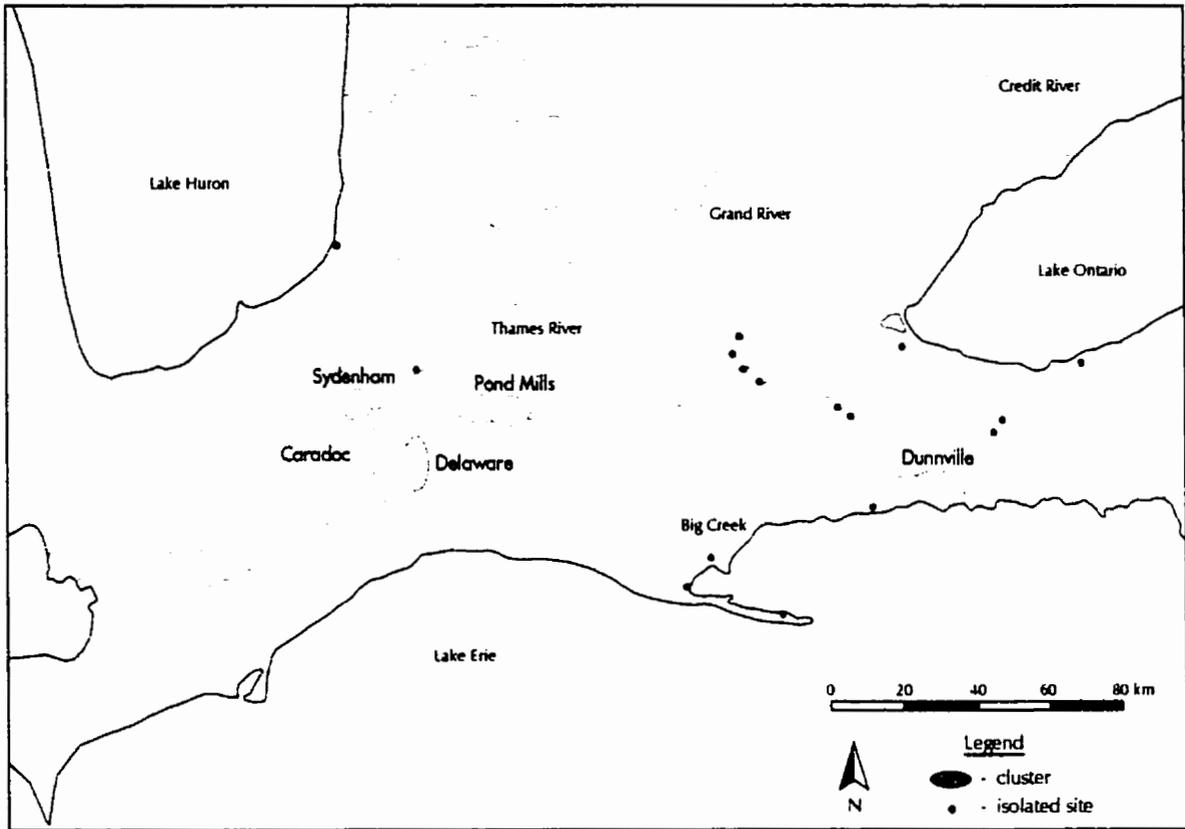
#### **Settlement System Models**

##### *Middle Woodland (Saugeen) Research*

Middle Woodland components in southern Ontario traditionally date from 300 B.C. to A.D. 700 (Spence *et al.* 1990:142). A recent extension of the range, from 400 B.C. to A.D. 800, is presented through a recalibration of all available radiocarbon dates from the region (Smith 1997a:53). The Middle Woodland period is split into three spatial divisions (based on ceramic attributes): Couture, in southwestern Ontario; Saugeen, in the remainder of southwestern Ontario; and Point Peninsula, in south central and eastern Ontario and New York state. The latter period is characterised by ceramics decorated by dentate stamping or pseudo-scalloped impressions, the nature of settlement and subsistence systems, and mortuary practices (Smith 1997a:55, Spence *et al.* 1990:142). Many researchers believe the establishment of a Middle Woodland cultural continuum, distinguished by local variability, is inevitable (Ferris and Spence 1995:98, Spence *et al.* 1990:148).

Recent research on Middle Woodland includes settlement-subsistence analyses of Saugeen assigned sites west of London (Pihl 1996, Timmins 1989, Wilson 1991, Wilson 1994). The cultural context for Saugeen stems from excavations at the Donaldson site, situated 13 km from Lake Huron on a terrace overlooking the Saugeen River rapids (Wright and Anderson 1963). An understanding of the settlement-subsistence system subsequently developed from then-current Point Peninsula archaeological data and Algonkian ethnographic accounts that a two-part seasonal cycle involved macro and microband fluctuation. Large groups collected spawning fish in the spring and summer, then dispersed to winter hunting territories (Wright 1963:49; Wilson 1991:11). Later investigations of the Saugeen settlement-subsistence system (Finlayson 1977:577) portray two distinct settlement types; a riverine-oriented spring-summer macroband and a lacustrine-oriented late-summer, early-fall microband, with probable winter microband settlement.

An update of the Middle Woodland Saugeen settlement-subsistence system to reflect the current state of archaeological research uses research on riverine-oriented late Middle Woodland sites in the middle Thames River watershed near London (Timmins 1989). Site analyses, material culture, and faunal material indicate that the regional distribution of Saugeen sites focuses on bogs and kettles, river valleys, and forested upland environments (Timmins 1989:15). This distinctively non-lacustrine settlement-subsistence system differs from the traditional two-phased Middle Woodland model, most notably in the lack of a spring-summer focus on large bodies of water. Timmins envisions macrobands along the middle Thames River in spring and summer, large inland base camps near ponds in fall and winter, and excursions



**Figure 3.3: Middle Woodland clusters and sites in southern Ontario.**

**Table 3.4: Middle Woodland (Saugeen) clusters.**

<i>Cluster name</i>	<i>No. of sites</i>	<i>Watershed affiliation</i>	<i>Cluster (km<sup>2</sup>)</i>	<i>Landscape orientation</i>
Caradoc	6	Thames River	10 km	upland, riverine
Dunn	11	Grand River	14 km	riverine, marsh
Sydenham	7	Sydenham River	6 km	riverine
Delaware	5	Thames River	13 km	upland, riverine
Pond Mills	13	Thames River	8 km	riverine, wetland

by smaller groups to hunting and gathering sites throughout the cold season. The fragmentation of Middle Woodland groups during winter may have been less pronounced than previously thought (Timmins 1989:15).

An alternative model postulates that the Middle Woodland settlement-subsistence round involved a great deal more residential stability (Wilson 1991:13). Large riverine occupations, such as Boresma, served as base camps on and off throughout the year, thereby providing a focal point for local group movements. This model portrays Middle Woodland as a series of localised complexes, each marginally different from their neighbours but more easily distinguishable from more distant contemporaries (Spence *et al.* 1990:143, Wilson 1991:10). The subsistence rounds of Middle Woodland groups located inland on the headwaters of major drainages differ substantially from groups with a lacustrine aspect (Pihl 1996:107, Wilson 1991:19). Consequently, Pihl (1996:106-107) postulates a more stable residency, utilising riverine-oriented base camps as semi-permanent settlements coupled with inland micro-camps for riverine Middle Woodland settlements. Rather than residential seasonal mobility, this results in a semi-sedentary, hunter-gatherer-fisher settlement-system.

#### *Late Woodland (Glen Meyer) Research*

Late Woodland Glen Meyer (or Early Ontario Iroquoian) sites are associated with cultures typically characterised by a village-horticultural pattern of settlement-subsistence. The Glen Meyer culture dates from ca A.D. 900 to 1300 (Williamson 1990:308). This period also owes much of its framework to the chronology for New York State. MacNeish's 1952 definition of Owasco incorporated four divisions, including an Ontario Owasco manifestation defined

by settled village life and maize horticulture. The same year, Lee divided Ontario Owasco into four foci: Point Pelee, Port Royal, Kreiger, and Glen Meyer. Lee then altered the framework so that Glen Meyer was made to develop out of the Ontario Owasco tradition. Wright provided the first systemic description of Glen Meyer in 1966 (Timmins 1997:16-17, Williamson 1990, Wright 1966).

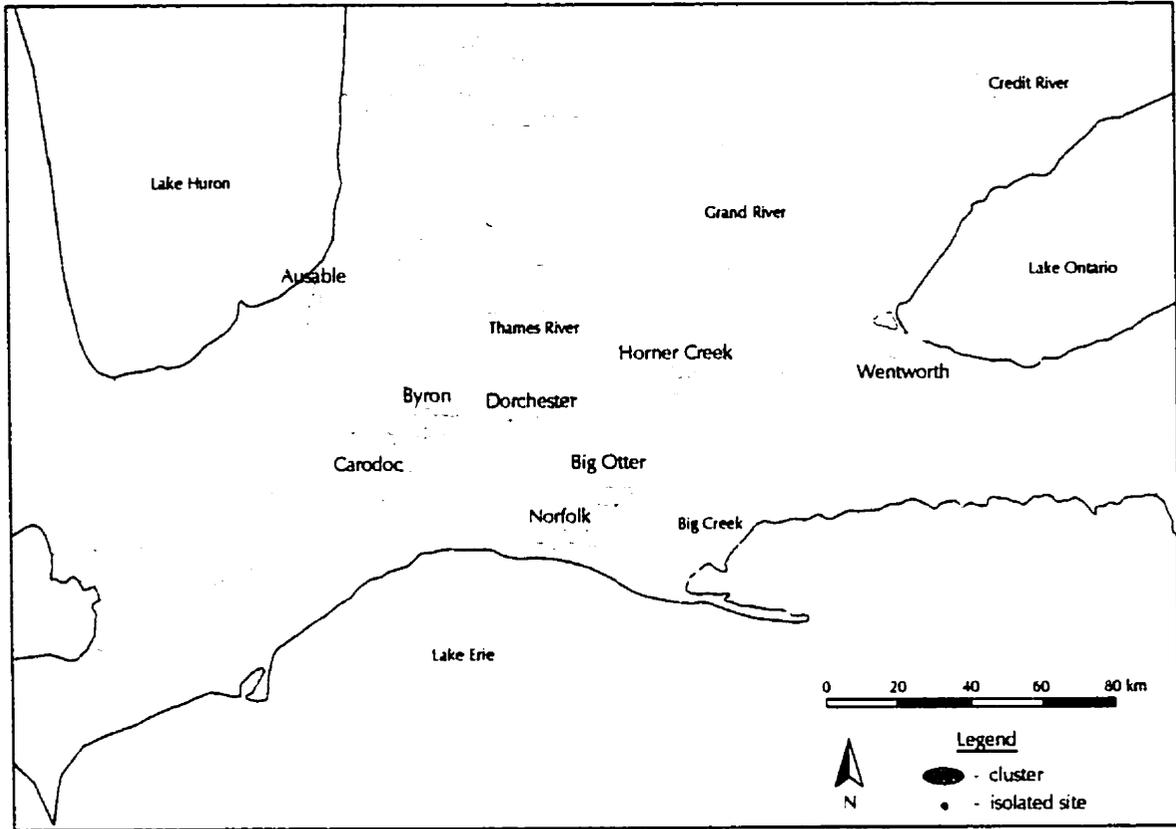
An early definition of Glen Meyer, based on nine sites, includes “the first evidence of agriculture as a major element in the subsistence pattern, large sedentary villages containing substantial house structures, villages located some distance away from navigable water on small tributaries and frequently palisaded” (Wright 1966:95). Subsequent Glen Meyer village excavations (Fox 1976, Noble 1975, Noble and Kenyon 1972) validated this description, leading to a consensus that Glen Meyer displays a diffuse agricultural economy. Current interpretations highlight the fact that Glen Meyer sites occur on elevated sandy soils with access to a wide variety of environmental zones (Timmins 1997:227, Warrick 1984:3, Williamson 1983). Glen Meyer sites also occur in clusters that are geographically discrete and regional, and inhabitants of each cluster were probably adapted to a slightly different environment (Williamson and Robertson 1994:34).

In Figure 3.2, I have followed Timmins’ Dorchester and Williamson’s Caradoc clusters, although encompassing the Mill Stream cluster, and grouped the remaining known sites into eight additional clusters.

Each region within the Glen Meyer settlement-subsistence system experienced unique cultural adaptations at different times, yet displayed considerable uniformity in settlement-subsistence patterns at a macro-regional scale. Yet few research initiatives use a regional per-

spective for reconstructing Glen Meyer settlement-subsistence systems, instead relying on Ritchie's Owasco pattern of camp, hamlet and village components (Williamson 1990:313). Ritchie classified camps as either recurrent seasonal spring-summer fishing stations or as temporary winter-fall hunting posts, hamlets as single houses with semi-permanent occupation, and villages as settlements with two or more houses (Ritchie and Funk 1973:359). Glen Meyer settlement-subsistence most likely involved villages or base settlements in addition to seasonally occupied multi-purpose hamlets occupied in the fall to exploit and process forest animals and in the spring to exploit spawning fish (Spence *et al.* 1990:312-320).

Recent research on the Glen Meyer Caradoc and Dorchester clusters employ a regional settlement system perspective (Timmins 1992b, 1997, Williamson 1985, 1990). Of the 25 Glen Meyer sites on the Caradoc Sand Plain, five are villages or base settlements and the remaining 20 seasonally occupied hamlets that served various hunting or extraction functions. Sixteen of the latter are on soil classified as unsuitable for horticulture, while all village sites are on sand loams close to swamps or marsh areas (Williamson 1990:317). The 1.5 ha Roeland village revealed eight overlapping houses, interpreted as a sequence of unplanned, long-term, palisaded occupations. Three seasonal camps, each measuring less than 0.5 ha, have indicators pointing to fall and spring occupations. Extractive camps are located within a 5 to 10 km radius of the village sites. Radiocarbon dates suggest that the sites on the sand plain were occupied for 150 years (Williamson 1985, 1990). A demonstrated dependence on naturally occurring local resources runs counter to Noble's earlier theory of a fully horticultural focus (Noble 1975, in Timmins 1997:26).



**Figure 3.3: Glen Meyer clusters and sites in southern Ontario.**

**Table 3.5: Glen Meyer clusters.**

<i>Cluster name</i>	<i>No. of sites</i>	<i>Watershed affiliation</i>	<i>Cluster (km<sup>2</sup>)</i>	<i>Landscape orientation</i>
Ausable	7	Ausable	16 km	riverine, lacustrine
Big Otter	13	Lake Erie drainage	12 km	upland, riverine
Byron	15	Thames River	16 km	upland, riverine
Caradoc	25	Thames River	20 km	sand plain, wetland
Dorchester	7	Thames River	10 km	sand plain, riverine
Wentworth	8	Lake Ontario drainage	12 km	on/off escarpment, creek
Horner	5	Horner Creek	10 km	sandplain, upland, riverine
Norfolk	6	Lake Erie drainage	20 km	sandplain, riverine

Extensive research of the Dorchester cluster identified six hamlet or extractive camps and a village. Five micro-environmental zones are documented within a 5 km radius of the Calvert village; a sandy upland plateau on which the site is situated, the water resources of the Thames River and adjacent Dorchester Swamp Creek, the Dorchester Swamp to the southeast, upland forests that ring the sandy plateau, and a series of glacial ponds located to the south (Timmins 1997:236). The Calvert site spans the period from A.D. 1150 to 1250 and has four overlapping occupations, from a single, seasonally occupied house to a palisaded three- to four-house, planned village. Faunal material indicates a focus on mammal hunting, with white-tailed deer predominant, bracketing a period of increased fishing. Floral remains indicate that maize was a staple food source, accompanied by cultivated squash, bean, sunflower, and numerous fleshy fruit (Ounjian 1998). The above suggests a year-round occupation for Calvert (Timmins 1997:236-237).

A lack of site excavation and a large extent of unsurveyed area, especially around Dorchester Swamp, combine to limit analysis of settlement systems in the Dorchester cluster. Timmins concludes his research by formulating a new model of village settlement. He proposes that each of the politically autonomous and economically self-sufficient Glen Meyer site clusters in southwestern Ontario represents two or three village communities living in a circumscribed area and sharing a diverse resource base (Timmins 1997:239).

The Glen Meyer settlement-subsistence system indicates a two-stage process. Villages are the equivalent of base settlements occupied year-round, around which the primarily subsistence activities would be horticulturally-based. Spring and fall extraction excursions away from these villages provided access to seasonally recurring resource procurement zones (Williamson

1990:339). There is little consensus whether villages were unplanned (as Williamson suggests for Roeland) or planned (as Timmins suggests for Calvert). The only agreement is that the early Glen Meyer settlement pattern is characterised by small overlapping houses (Fox 1976 1998, Timmins 1997, Warrick 1984, Williamson 1985). Research on settlement, paleoethnobotanical, and faunal data implies that these well-established, centrally-based, sedentary communities operating in a circumscribed area, using a diverse base of hunted, collected, and gradually increasing horticultural resources (Ounjian 1998, Timmins 1997, Williamson 1985).

### **Middle Woodland - Princess Point Continuity**

While no one advocates year-round occupation, some researchers imply that Middle Woodland settlements were sedentary (Ferris and Spence 1995:100). Middle Woodland clusters appear most frequently at upland headwaters of major drainage systems, while Princess Point displays primarily a riverine focus on the banks of a major river system. Given the appearance of maize during the sixth-century A.D. at Grand Banks, this movement may reflect the need for more suitable horticultural land, which the alluvium-rich river bars offered. This does not preclude the use of the river bars by Middle Woodland groups for harvesting, yet a move to the river bars of the Grand River suggests an increase in their importance for maize cultivation rather than wild resource harvesting. In support of this hypothesis, a use-wear analysis of Middle Woodland and Princess Point lithic samples indicates an increase in the proportion of tools dedicated to plant working at the expense of tools used for meat preparation (Shen 1997:273). Interestingly, this settlement shift is neither evident in models of Middle Woodland communi-

ties in southern Ontario, nor documented by an increase of late Middle Woodland sites on the Grand River.

The argument for continuity of settlement-subsistence systems from Middle Woodland to Princess Point is tenuous based on current evidence. Middle Woodland groups are associated with longer-term base camps, seasonally re-occupied, and logistically, if not geographically, centred to exploit a variety of resources. Princess Point groups occupied major riverine system floodplains to better address maize cultivation practices, potentially through a similar base camp orientation which became (semi-) sedentary habitations.

### **Princess Point – Glen Meyer Continuity**

The majority of early Glen Meyer sites share a complex settlement pattern with overlapping structures and high densities of post moulds (Fox 1976:178; Timmins 1997:19), which most researchers agree indicate long-term occupation. The Princess Point settlement patterns at Cayuga Bridge, Grand Banks and Meyer also show complex patterns of posts and features, and these dense habitation patterns similarly indicate long-term or repeated occupation.

Likewise, the sedentary nature of Glen Meyer settlement, as indicated by repeated structure rebuilding, appears to have its genesis in Princess Point settlement patterns, given the structural and feature evidence at Cayuga Bridge, Meyer, and other sites. In turn, this pattern has a more-than-passing resemblance to Middle Woodland base camp re-occupations.

Timmins, following Noble (1975) and Fox (1976), believes Glen Meyer represents a continuum from Princess Point, from an initial development in the Grand River drainage followed by a western spread across the Norfolk Sand Plain and ultimately into the Dorchester,

Caradoc, and Ausable regions (Timmins 1997:219). In apparent support of this theory, two terraced Glen Meyer village sites have recently been discovered on the lower Grand River, Forster (Burse *et al.* 1998) and Thompson (Mayer *et al.* 1995), as well as a smaller terraced site and a cemetery or ossuary (Woodley 1994). These sites are important anomalies in the Glen Meyer scheme. The anomalies include the presence of village sites some distance from known clusters (although Thompson and Forster are approximately 5 km apart and may represent a partial community cluster), the presence of Glen Meyer in an area of dense Princess Point occupation, whereas previously Glen Meyer and Princess Point distributions were considered distinct and exclusive, and the placement of sites (Thompson and Forster) on non-sandy soil (Smith 1995:5-6). Thompson and Forster provide convincing evidence of continuity from Princess Point to Glen Meyer. The sites may represent a Glen Meyer population that did not move onto the sand plains, for each site dates from the mid- to late Glen Meyer sequence. Thompson dates to A.D. 1200 to 1250 (Mayer 1995:13) and Forster to A.D. 1220 (Smith 1997:72). Moreover, based on the decoration of ceramic rim sherds, both sites contain a Princess Point component.

The Glen Meyer population appears to have resided in regional clusters. The composition of each cluster represents two to three small, multi-extended family villages. Additional research is needed to determine if the villages were occupied concurrently or sequentially, although Timmins (1997:227-228) favours the interpretation that contemporary communities occupied each cluster. Princess Point sites are also readily grouped into clusters, each typically with at least three large-scale occupations, and occasionally associated with outlying resource-oriented camps and extraction sites. As with Glen Meyer clusters, there is little evidence to determine whether occupation within Princess Point clusters was contemporary or sequential .

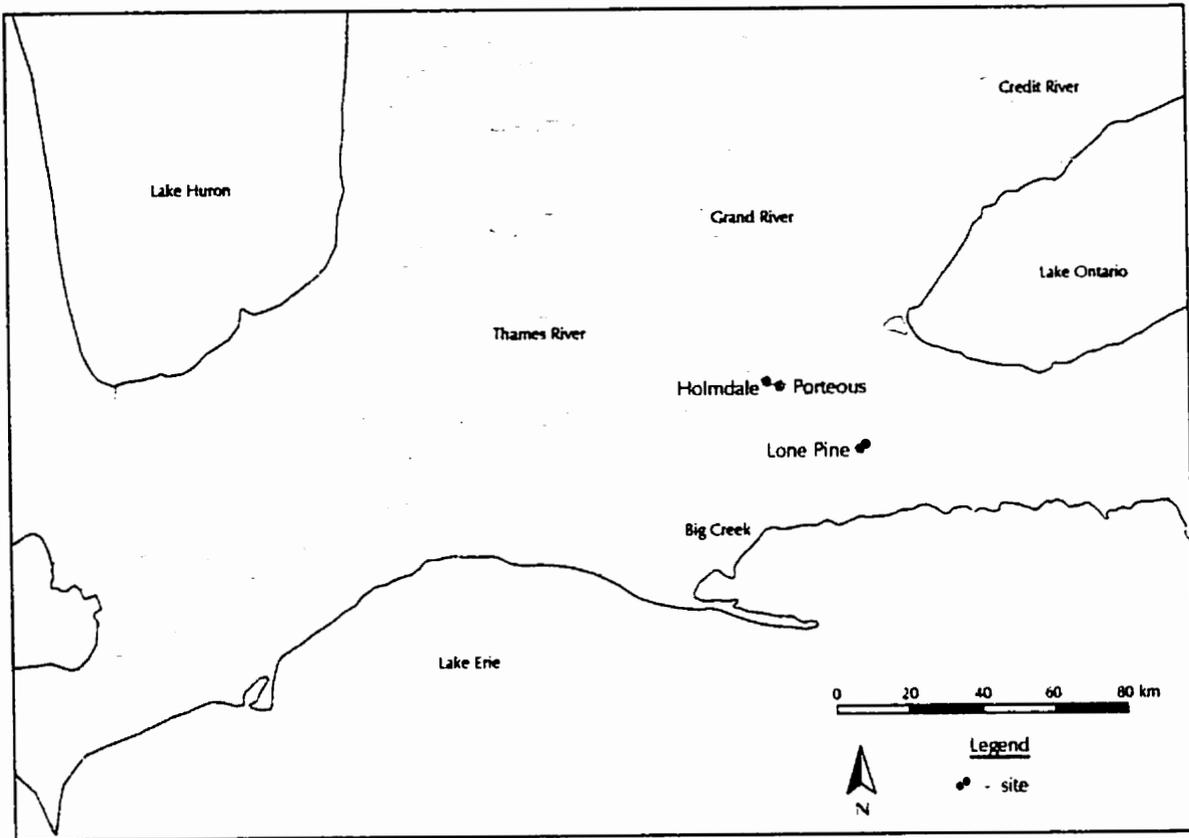
## **The Grey Sites**

The three 'grey' sites in the lower Grand River region are Holmdale, Porteous, and Lone Pine (Figure 3.4). Their ambiguous cultural classification stems from an inability to confidently assign either a Princess Point or Glen Meyer label to these sites, which display a combination of attributes from each culture group. The three sites may potentially demonstrate continuity between Princess Point and Glen Meyer. Each of the three sites stands out from surrounding Princess Point and Glen Meyer sites through its material culture and settlement pattern. Most importantly, each site would constitute an anomaly in either of the conventional Princess Point or Glen Meyer classes.

Radiocarbon dates for each of the sites span the late 10<sup>th</sup> century to the mid 11<sup>th</sup> century, a period commonly assigned to Glen Meyer, although sites assigned to Princess Point are also recorded during this time span. A seriation of Porteous and Lone Pine ceramics within a larger Princess Point collection concluded that the two sites fall at the extreme late end of the Princess Point spectrum (Bekerman 1995). Settlement at two of the sites displays house structures, but these are not similar to known examples of the early Ontario Iroquoian village (see Timmins 1997). For these reasons, the Holmdale, Porteous, and Lone Pine sites are temporarily assigned a culturally 'grey' status.

## **Summary**

This chapter touches upon a variety of topics, incorporating Woodland history, southern Ontario chronology, and Middle Woodland and Early Ontario Iroquoian research initiatives, to



**Figure 3.4: Grey sites in southern Ontario.**

emphasise the need to rework the hypothesised yet untested model of Princess Point settlement systems proposed two decades ago. The rationale behind this model, which posits seasonal aggregation and dispersal similar to that of the then-assumed Middle Woodland system, stems from lack of research initiatives on Princess Point sites and, until recently, a lack of critical assessment of the Middle Woodland model.

Revisions to models of Middle Woodland and Glen Meyer settlement-subsistence systems are presented in light of recently published and unpublished data, providing temporal and cultural brackets for the development of the Princess Point model. New Princess Point data outlined in this discussion confirm the stability of Princess Point occupation on paleosols on Grand River lateral bars, the permanence of settlement at Grand Banks, Cayuga Bridge, and Meyer, and the potential for similar results on other lateral bars on the Grand River.

The re-interpretation of the Middle Woodland settlement-subsistence system and the classification of sites into clusters oriented around the repeated occupation of base camps argues for a Middle Woodland to Princess Point cultural continuity. Likewise, the complexity of settlement data at Meyer, Cayuga Bridge and Grand Banks and the observed similarity of settlement data with Glen Meyer sites argues for a Princess Point to Glen Meyer continuity.

Additional research is needed to confirm the reworked Princess Point settlement system, including botanical and faunal analyses, and a set of radiocarbon dates for site clusters to sort out chronology that may aid in documenting a settlement shift from river bars to terraces. The archaeological background discussion lays out the groundwork from which order to develop a model of Princess Point settlement systems that is based on landscape analysis.

## CHAPTER 4

### ARCHAEOLOGICAL SITES DATA

This chapter outlines the archaeological sites used in the landscape settlement model. Archaeological data consist of three culture groups and nine site clusters: two for the Middle Woodland, four for Princess Point and three for Glen Meyer. Included is a control group cluster of randomly generated locations in the lower Grand River valley.

#### **Princess Point Clusters and Sites**

The Princess Point sites considered here are from four of the eight identified Princess Point clusters: Indiana, Oxbow, Cayuga and Cootes Paradise. The University of Toronto researched the Cayuga, Indiana and Cootes Paradise clusters between 1993 and 2000 and provides for the best available information on Princess Point sites. The Oxbow cluster, situated on the Grand River encompassing two of the 'grey' sites, Porteous and Holmdale, provides for ideal comparative material.

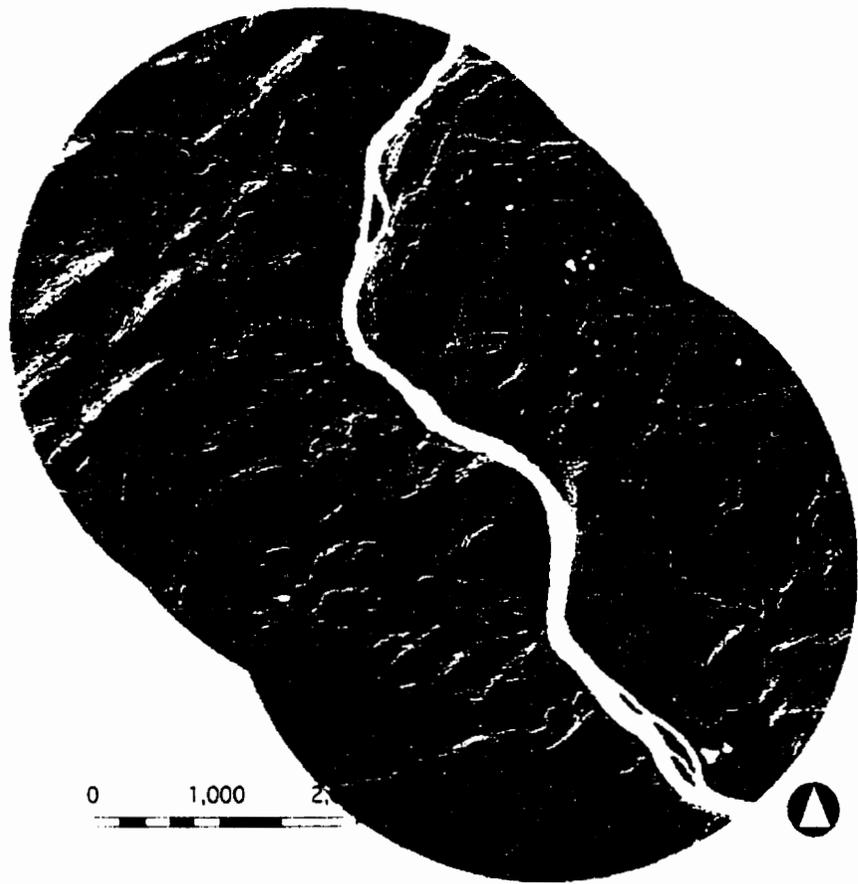
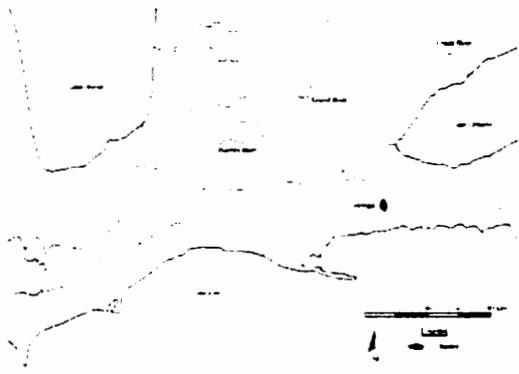
#### *Cayuga Cluster*

The Cayuga cluster incorporates five Princess Point locales in and immediately north of the town of Cayuga: Cayuga Bridge (loci 1 and 2) (AfGx-1), CNR Bridge (AfGx-5), Grand Banks (AfGx-3), and Young 1 (AfGx-6). A sixth site across the river from Grand Banks,

Horseshoe Pits (AfGx-155), may represent an additional Princess Point locale, but artifact recovery is limited to a surface collection of lithics and cord-impressed body sherds. Cayuga Bridge occupies the entire length of the river flat, incorporating loci 1 and 2, as well as the CNR Bridge and Smith sites. For this reason, only three sites comprise the Cayuga cluster: Cayuga Bridge, Grand Banks and Young 1 (see Figure 4.1; the triangle symbol indicates site location but, as noted above and in reference to other sites, the actual extent of a site frequently sites extend beyond the symbol).

The Cayuga Bridge site, located on a river flat that extends 1000 m north-south along the west bank of the Grand River, is in a paleosol 1 m below the present ground surface. Along the 2 m high riverbank cut, artifacts are found eroding out of the paleosol nearly the entire length of the river bar. A 45 m<sup>2</sup> excavation at loci 2 yielded 59 post moulds and 14 features, including two ash-filled hearths, numerous ash pits, refuse pits and a shallow, basin-shaped pit. The site is tentative interpreted as two areas of intensive occupation, delineated by post patterns and supported by measures of artifact densities, potentially suggesting two (not fully exposed) circular or oval structures.

The Grand Banks site, defined by a 1,000 m long scattering of artifacts on a 10 ha river flat, is approximately 2 km upstream from Cayuga Bridge. Test excavations between 1993 and 1995 resulted in 80 m<sup>2</sup> of excavation over three areas. While all three have a high concentration of artifacts, Area C alone displays complex, overlapping posts and features. Area B had seven posts and a large pit feature. The 45 m<sup>2</sup> Area C had 93 posts, four hearths, two stone-filled features, and numerous small pits and surface stains. Unfortunately, in Area C, in contrast with



**Figure 4.1: Selected Princess Point sites in the Cayuga cluster.**

**Table 4.1: Cayuga sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Cayuga Bridge (AfGx-1)	650 (890) 1170 855 (965) 1020 870 (1030) 1280	- (test excavation 1970, 1998)	On a 2 km. river flat, adjacent to Grand River
Grand Banks (AfGx-3)	240 (540) 660 240 (570,600) 830 650 (780) 980 880 (1000) 1150 990 (1030) 1210	- (test excavation 1972, 1993-95)	On a 1.5 km. river flat, adjacent to Grand River
Young 1 (AfGx-6)	no date	camp? (test excavation 1993)	On a clay knoll, 3 metre terrace, 400m gentle slope to Grand River

Areas A and B, mixing of Late Archaic and historic materials adversely affected Princess Point interpretations (Crawford *et al.* 1998, Smith and Crawford 1997). Despite a considerable amount of attention, the settlement pattern data from Grand Banks does not lend itself yet to the identification of discernable house structures.

Atop a small knoll on a gradually rising terrace, approximately 400 m from the west bank of the Grand River, is the Young 1 site. Heavily plough disturbance and heavy clays restricted site excavations to test pitting and a pair of 1 m test units in 1993. Artifacts were very fragmented and included a rim sherd with cord-wrapped stick decoration. Smith and Crawford (1997:20) indicate that the site, although lacking sufficient data, likely represents a short-term seasonal camp.

### *Indiana Cluster*

The Indiana cluster (situated immediately north of Indiana Road on both banks of the Grand River) incorporates six Princess Point sites: Bell Terrace (AfGx-125); Bell Flats (AfGx-151); Meyer (AfGx-26); Indiana (AfGx-2); Lester 2 (AfGx-47); and York 2 (AgGx-3). Test excavations at Armstrong Flats (AfGx-152) has revealed only plain, cord-malleated body sherds to date. The Bell Flats and Bell Terrace sites underwent limited test excavations and are likewise not used in the landscape analysis.

The Meyer site, on a 6 m high terrace overlooking a large Grand River flat, with three Princess Point sites on a river bar across the Grand River, is approximately 3.5 km upstream from Grand Banks. Recent AMS radiocarbon results from a corn cupule date the site to the eighth-century A.D. (1270 ±100BP, calibrated to A.D. 600 (720, 750, 770), 980 [TO 8150]),

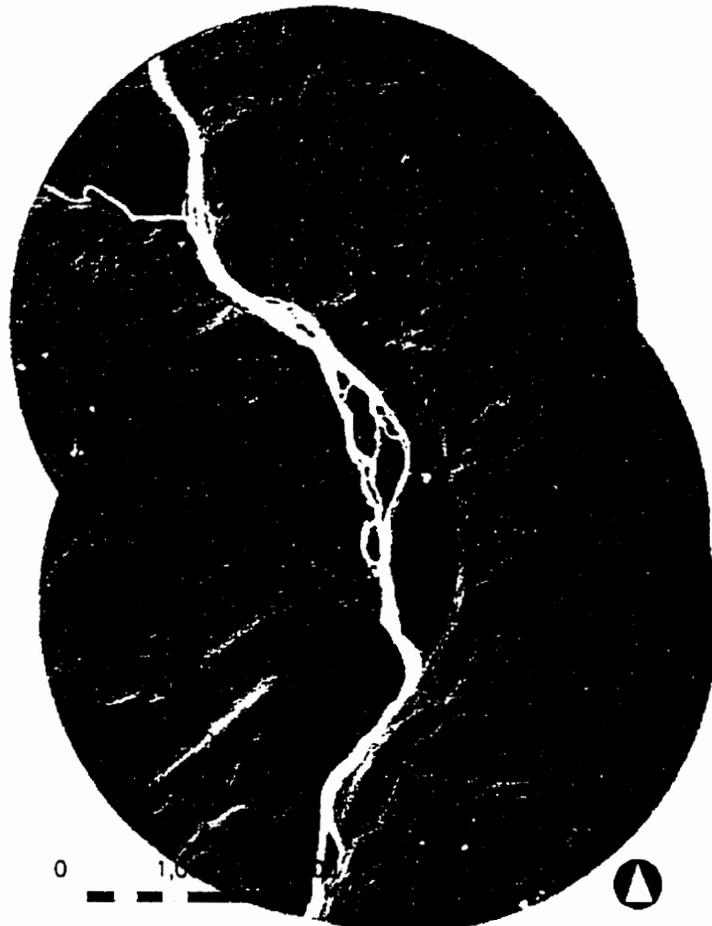
Crawford pers comm 2001). The Meyer site is adjacent to a terrace edge and centred on a pocket of fine sandy soil. Stothers registered the terrace site in 1970 as a multicomponent Princess Point and Neutral site. His excavation consisted of a small test unit approximately 30 m west of the terrace edge.

A comprehensive test pit survey of the terrace resulted in the excavation of 100 m<sup>2</sup> through 1998 and 1999 (Smith and Dieterman 1999a). The settlement pattern observed at Meyer consists of a dense concentration of hundreds of post moulds associated with more than 75 features, including at least four oval hearth floors, and an assortment of ash-filled, bell-shaped and basin-shaped pits. The settlement pattern is denser than that of Cayuga Bridge and Grand Banks yet lacks any discernable house structures. Although sectioning a number of posts recovered Princess Point rim sherds, without any definite house patterning, it is difficult to assign culture affinity to the settlement pattern data.

Across the Grand River from Meyer and situated on a 5 km long river bar are the other three sites in the Indiana cluster. Registered by Stothers in 1974, there is little detailed information available for the Indiana 1, Lester 2 and York 2 sites. Site record and field notes indicate that the sites are comparable to Grand Banks and Cayuga Bridge in that they represent large-scale settlements associated with paleosols.

### *Oxbow Cluster*

The Oxbow cluster represents six Princess Point sites: Glass (AgHb-5), Stratford Flats (AgHb-50), Oxbow Flats (AgHb-14), Bow Park (AgHb-34), Mohawk Chapel (AgHb-2), and



**Figure 4.2: Selected Princess Point sites in the Indiana cluster.**

**Table 4.2: Indiana sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Indiana 1 (AfGx-2)	no date	- (collected 1974)	At south end of a 5 km. river flat, adjacent to Grand River
Lester 2 (AfGx-47)	no date	- (collected 1974)	At mid-point of a 5 km. river flat, adjacent to Grand River
Meyer (AfGx-26)	660 (720, 750, 770) 980	- (test excavation 1974;1998-99)	On a 6 m terrace overlooking a 2 km. river flat. Site set back 750m from Grand River
York 2 (AgGx-3)	no date	camp (collected 1974)	At north end of a 5 km. river flat, adjacent to Grand River

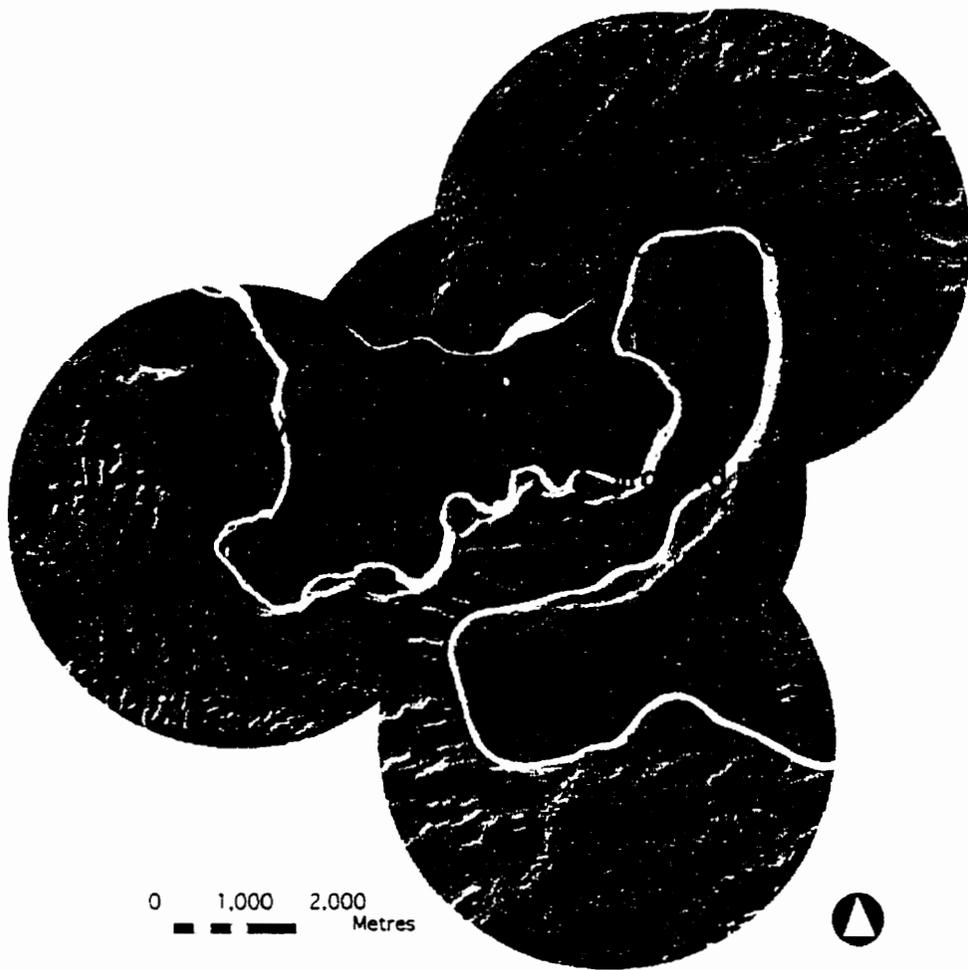
Tutela (AgHb-6). These sites, except the terraced Mohawk Chapel, are on river flats similar to the locales of the Cayuga and Indian clusters. Stratford Flats is on a paleosol and the remainder of the sites may be in like circumstances, although unproven to date by excavation.

The convex bank-side of a large point bar on the Grand River contains the Bow Park site. Surface collections on this river flat in 1981 determined that a portion of the site is present on a small ridge, while flood action has eroded the remainder of the site. The Oxbow Flats site, located on the same point bar, is affected by similar flood action. Artifacts from numerous surface collections include a range of lithics, faunal material, and Princess Point-associated ceramics. The Stratford Flats site, on a river flat immediately adjacent to the Grand River, was subject to a small rescue excavation, which recovered a partially eroded hearth associated with ceramics. The Tutela site, on the west bank of the Grand River on a small river flat, remains unexcavated.

The only site in the cluster not currently located on the Grand River is Mohawk Chapel, although an examination of the locale suggests that the river previously ran through a channel that surrounded the site. This assumption is confirmed by an 1850 insurance plan of Brantford that depicts the Grand River following the course of the now abandoned channel adjacent to the site. In 1974, excavation of a 16 m<sup>2</sup> area, on a flat near the edge of a small hill, did not recover any settlement data. On the north side of the river and also on a large river flat, is Glass, the southernmost site in the cluster. No settlement information exists for this site (Stothers 1975).

### *Cootes Paradise Cluster*

At the extreme western end of Lake Ontario, west of a north-south glacial bar restricting the Spencer Creek outlet, resulting in a large wetland environment, is Cootes Paradise and the



**Figure 4.3: Princess Point sites in the Oxbow cluster.**

**Table 4.3: Oxbow sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Bow Park (AgHb-34)	no date	- (surface collected 1981)	On river flat of Grand River, severely eroded
Glass (AgHb-5)	no date	- (test excavated 1974)	On river flat of Grand River
Mohawk Chapel (AgHb-2)	400 (550) 670	- (test excavated 1970-71)	On terrace approx. 100m from Grand River
Oxbow Flats I (AgHb-14)	no date	- (surface collected 1974, 1981)	On river flat of Grand River
Stratford Flats (AgHb-50)	640 (1010) 1300	camp (limited test excavation 1982)	On river flat of Grand River
Tutela (AgHb-6)	no date	- (test excavated? 1972)	On river flat of Grand River

Cootes Paradise cluster. A 1793 map of Cootes Paradise (see Gentilecore and Head 1983) depicts a substantially different land-to-water ratio than the current situation. A large area of the southern portion of the wetland consists of land or marsh rather than open water. Spencer Creek had a relatively distinctive stream course along the current north shore leading to the current outlet.

The Cootes Paradise cluster consists of nine known (registered and unregistered) Princess Point sites, grouped into north and south shore localities. On the north and east shores of the wetland, two sites are on terraces or peninsulas above the water, three sites are at the water's edge and two are on small islands. The three sites on the south shore are all on low ground. The five sites selected for landscape modeling, based on documented archaeological activities, are: Princess Point (AhGx-1), Sassafras Point 1 (AhGx-3), Lilac Gardens (AhGx-6), Arboretum (AhGx-8), and Bull's Point (AhGx-9) (see Figure 4.4).

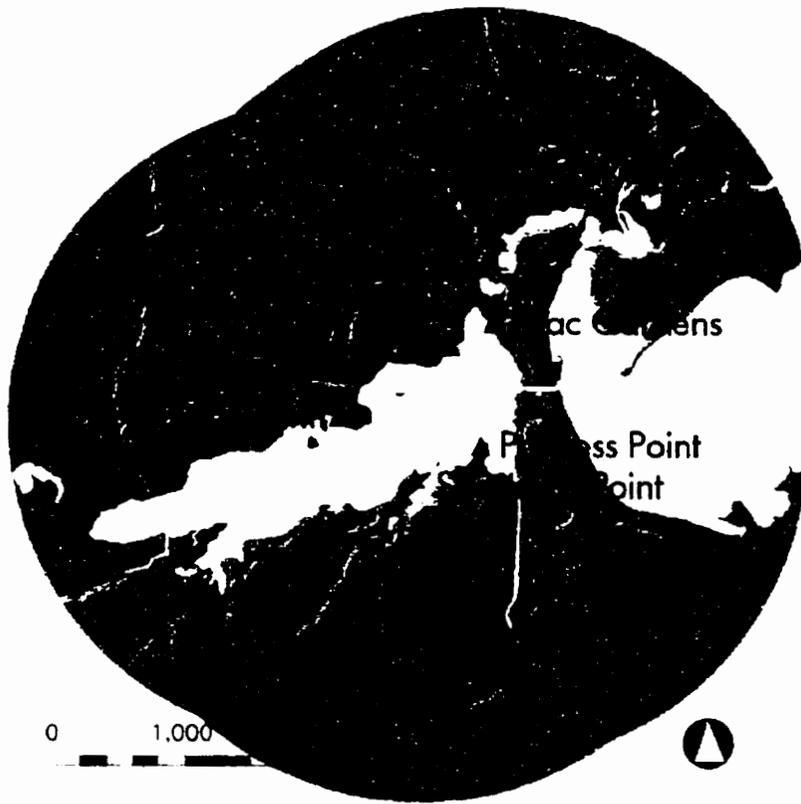
Most of the Princess Point sites in Cootes Paradise lack extensive investigations (Crawford and Smith 1997:20) (see Table 4.4). The two largest sites, Princess Point and Sassafras Point, are on low-lying peninsulas on the south shore. The flat Princess Point peninsula, measuring 100 m by 300 m, has been partially disturbed by landscaping. Excavations on the west side of the peninsula in 1968 and 1969 recovered 14 pit features, including 11 hearth pits while the east side of the peninsula was subject to a partially excavation of a bank-side midden. However, in over 900 m of excavation, "no post moulds or other indications of structure could be found" (Stothers 1969:9). UTM field school excavations at Princess Point in the summer of 2000 documented the presence of Princess Point in addition to Middleport and Early Ontario Iroquoian ceramics from the site (D. Smith pers. comm. 2000).

Sassafras Point has the distinction of being investigated twice, once in the late 1960s by McMaster University and again in 1997-98 by UTM field schools. The initial excavation consisted of a pair of 2 m by 2 m test units and revealed the multicomponent nature of the site (Princess Point and Middleport). Excavation of a 36 m<sup>2</sup> area (see Smith and Dieterman 1999b) revealed substantial settlement pattern data, including 17 features and 137 posts, although no association of posts and features to a particular culture has yet been made. Princess Point-style decorations comprise the majority of the rim sherds.

On the east shore on a small, flat, sandy peninsula, Lilac Gardens was subject to salvage excavations in 1961 and additional mitigation excavations in 1969 and 1984. Although a 50 m<sup>2</sup> area was excavated and the artifacts revealed an almost exclusive Princess Point occupation, no settlement information was recovered for Lilac Gardens (Stothers 1969:15-19).

The Arboretum is a north shore multi-component site on a gently rising flat that culminates in steep slopes to the west and north. Within the 150 m of artifact scatter, the excavation of a single 2 m by 2 m test unit in 1969 resulted in limited cultural material and no settlement data (Stothers 1969:23).

The Bull's Point promontory underwent excavation and test pit survey in 1969 by Stothers and again in 1995-96 by a UTM field school. It became apparent during the latter excavations that the 1969 Bull's Point site, in all probability, had been destroyed by recent dam building activities (D. Smith pers. comm. 1999). In a small, flat, ravine area near the water's shore, Stothers dug a 2 m by 2 m test unit in a rich undisturbed habitation midden. Ceramics indicated a single component Princess Point site, although the ceramic style is apparently not



**Figure 4.4: Princess Point sites in the Cootes Paradise cluster.**

**Table 4.4: Cootes Paradise sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Arboretum (AhGx-8)	no date	camp (test excavation 1969)	Plateau along north shore of lacustrine/wetland
Bull's Point 2 (AhGx-9)	980 (1040) 1220	camp (excavated 1995-96)	Bottom of a glacial ravine adjacent to lacustrine/wetland
Lilac Gardens (AhGx-6)	no date	camp (mitigative excavation 1969, 1984)	Low peninsula jutting into lacustrine/wetland
Princess Point (AhGx-1)	no date	- (test excavation 1968-69)	Low peninsula adjacent to lacustrine/wetland
Sassafras Point 1 (AhGx-3)	no date	- (test excavation 1969, 1997-98)	Low peninsula adjacent to lacustrine/wetland

typical of Princess Point, and may be perhaps a very late manifestation or possibly very early Glen Meyer. Faunal remains included fish, deer, turtle and small game (Stothers 1969:25-26).

The second site discovered at the Bull's Point promontory is on a gentle slope in a glacial ravine adjacent to the water's edge. Unlike the other sites in Cootes Paradise, Bull's Point 2 revealed Princess Point settlement pattern data, although a small sample of Early Ontario Iroquoian ceramics was also recovered. The UTM excavations encompassed a total of 37 m<sup>2</sup> resulting in 97 post moulds and three small shallow features, of which none were hearths. This may represent a structure 3.5 by 4 m in size and approximately 10 m from the current water's edge (Smith 1997, Smith and Crawford 1997, Smith *et al.* 1996). A single AMS radiocarbon date on a maize kernel yielded a mid-eleventh-century A.D. date. Smith cautions that the association of the kernel and the deposits within the structure are unsubstantiated, and therefore so is the association of the structure with the returned date (Smith 1997:14).

### **Middle Woodland Clusters and Sites**

The Middle Woodland sites used in the landscape settlement model are from two clusters associated with recent systematic surveys. Notably, these two Middle Woodland clusters represent only a sample of the areas exploited by Middle Woodland groups in southern Ontario.

#### *Delaware Cluster*

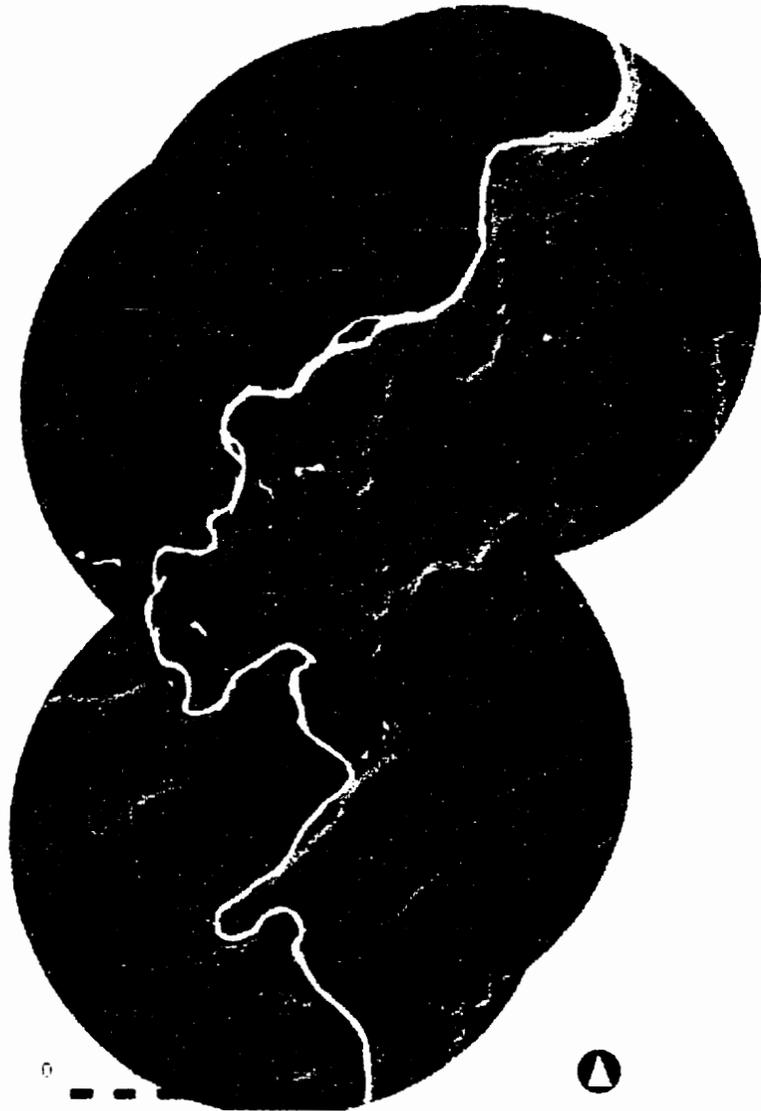
The Delaware cluster is a grouping of Middle Woodland sites in the middle Thames River valley: Brodie (AfHi-27), Boresma (AfHi-21), Sibelius (AfHi-13), PUC, and Site A (not

registered). Site information is sparse for this cluster and depends on a few published summaries of surveys and data from MCzCR site record forms. The Boresma site is the only dated site from this cluster, with dates ranging from the third-century to the tenth-century A.D. Currently, the site is 175 m from the east bank of the Thames River, on a small, elevated flat. Historic maps indicate that the site actually sits in the apex of a now abandoned channel. Large riverine occupations, such as Boresma, served as base camps occupied on and off throughout the year, providing a focal point for local groups from which they scheduled and conducted various activities. The faunal assemblage at Boresma, comprising 21 mammals, six reptiles, seven birds, clam, fish, and amphibians, does not indicate a special purpose site (Wilson 1991:10, 16).

There are few details available on the other sites of the Delaware cluster. Sibelius is on a low ridge on a terrace 10 to 15 m from the Thames River, approximately 1 km downstream from the Boresma site. From the ridge down to the river bank, visible archaeological material consists of lithic manufacturing debris and a few finished pieces. Deer elements, the majority lower limb and foot bones, dominate the faunal assemblage (Wilson 1991:8). In the northern half of the cluster, the Brodie, PUC and Site A sites are on floodplains adjacent to the Thames River. Little documentation exists for these sites other than the identification of their Middle Woodland status.

### *Pond Mills Cluster*

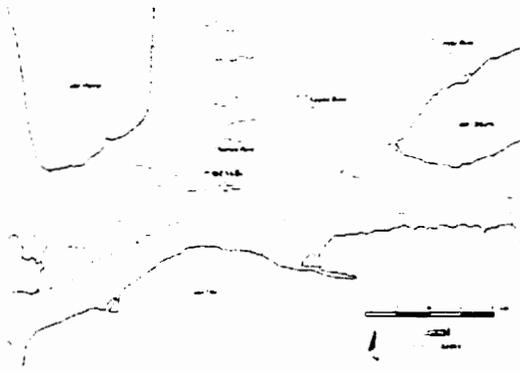
The Pond Mills cluster is a collection of Middle Woodland sites situated to the south of present day London, surrounding a series of kettle ponds central to the cluster, with the Thames River to the north and Dingman Creek to the south. The sites are Bradley Avenue (AfHh-73),



**Figure 4.5: Middle Woodland sites in the Delaware cluster.**

**Table 4.5: Delaware sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Brodie (AfHi-27)	no date	base camp	On floodplain adjacent Thames River
Boresma (AfHi-21)	220 (350,360,370) 450 260 (440) 640 630 (780) 980	base camp	On slight rise in floodplain, 2m above abandoned channel Thames River 175m west
Sibelius (AfGv-13)	no date	short-term camp	On low terrace overlooking Thames River 10m
Site A	no date		On low terrace overlooking Thames River
PUC	no date		On floodplain adjacent Thames River



**Figure 4.6: Middle Woodland sites in the Pond Mills cluster.**

**Table 4.6: Pond Mills sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Bradley Avenue AfHh-73)	no date	camp (1984)	Disturbed, adjacent to small creek
East Bog (AfHh-83)	440 (660) 880	hunting and gathering camp	On a series of sand-gravel-clay knolls and ridges on 3 sides of bog, adjacent small stream
Pond Mills (AfHh-2)	670 (880) 1010	hunting and gathering camp	south of kettle pond, relatively flat
Robert Baty (AfHh-4)		camp (collected 1979, 1985)	Relatively flat land clay soil, overlooking southern pond
Site A (AfHh-50)	no date	camp (collected 1982)	On low clay-loam ridge, gentle slope towards small ponds to north-west
Site B (AfHh-52)	no date	camp (collected 1982)	On a sandy ridge, small creek 500 metres to west
West Bog (AfHh-82)	no date	hunting and gathering camp workshop (test pitting 1986)	On elongated knoll overlooking bog

Pond Mills (AfHh-2), Robert Baty (AfHh-4), West Bog (AfHh-82), East Bog (AfHh-83), Site A (AfHh-50), and Site B (AfHh-52).

The multi-component Pond Mills site includes a Middle Woodland Saugeen camp, overlooking a kettle pond to the north. Lithic debris and Middle Woodland ceramics comprise this cultural component of the site. The function of the site during the Middle Woodland period remains to be demonstrated (Poulton 1985:126). To the north and east, two large kettle ponds bound the Robert Baty site, to the west of Pond Mills. A large although thin scatter of artifacts on relatively flat land and clay soil defines the site. The surface collection of artifacts to date is limited to three projectile points, chert flakes and cores.

Further to the south and west is the disturbed Bradley Avenue site. Indications, based on surface collection, are that the site encompassed some 250 m<sup>2</sup>. All 75 pieces of Middle Woodland ceramics occurred in the northeast corner of site. North of the kettle ponds, on a series of sand-gravel-clay knolls surrounding what was once a portion of the northerly kettle pond, are the East Bog and West Bog sites. To the east of the sites is a small stream. On brown clay loamy terrain, sloping gently downward to the north and east, is the unnamed Site A. A low ridge crosscuts the terrain from east to west, south of the site, and a series of small ponds is 360 m to the northwest. The unnamed Site B is to the southeast, on a low poorly defined west-east running sandy ridge. This ridge forms the highest land in the immediate area. The nearest water source is a small creek 550 m to the south.

## **Glen Meyer Clusters and Sites**

Based on the availability of data, this landscape analysis uses the Caradoc, Dorchester, and Wentworth clusters from the eight Glen Meyer clusters previously identified. The Caradoc cluster analysis is of the five village sites, while the Dorchester and Wentworth data sets use both village and camp locales.

### *Caradoc Cluster*

The Caradoc cluster represents a significant grouping of sites on the Caradoc Sand Plain investigated between 1979 and 1980 (see Williamson 1983). Of the 25 or more surveyed sites, I will use the five identified village sites within the Caradoc cluster: Caradoc 13 (AfHk-26), Smale (AfHj-18), MiV18 (AfHj-19), Caradoc 10 (AfHj-24), and Roeland (AfHj-14).

Caradoc 10 is a 1.5 ha site, situated on sandy loams west of a swampy area, consisting of a wide yet thin scatter of ceramics, projectile points, and debitage. Caradoc 13, the most northerly village within the Caradoc cluster, occupies the western boundary of the sand plain, downstream from the Smale and MiV18 sites. The site is on loam soil near a large swampy area and an east-west running creek. The thin surface scatter spreads out over a hectare, with concentrations on the crests of small sandy knolls. Wet soil conditions help define some surface features. Smale occupies a fairly flat to slightly sloping area of sandy loam soil near a small stream and sits adjacent to a large swampy region. Artifacts were recovered in two locales; however, the site is now destroyed. The MiV18 site is across a stream from Smale, on sandy loam soil, over a series of knolls and ridges. Scattered over a 1.3 ha area are a fairly high density of lithic debitage and ceramics, with the greatest concentrations found on ridge crests. More than

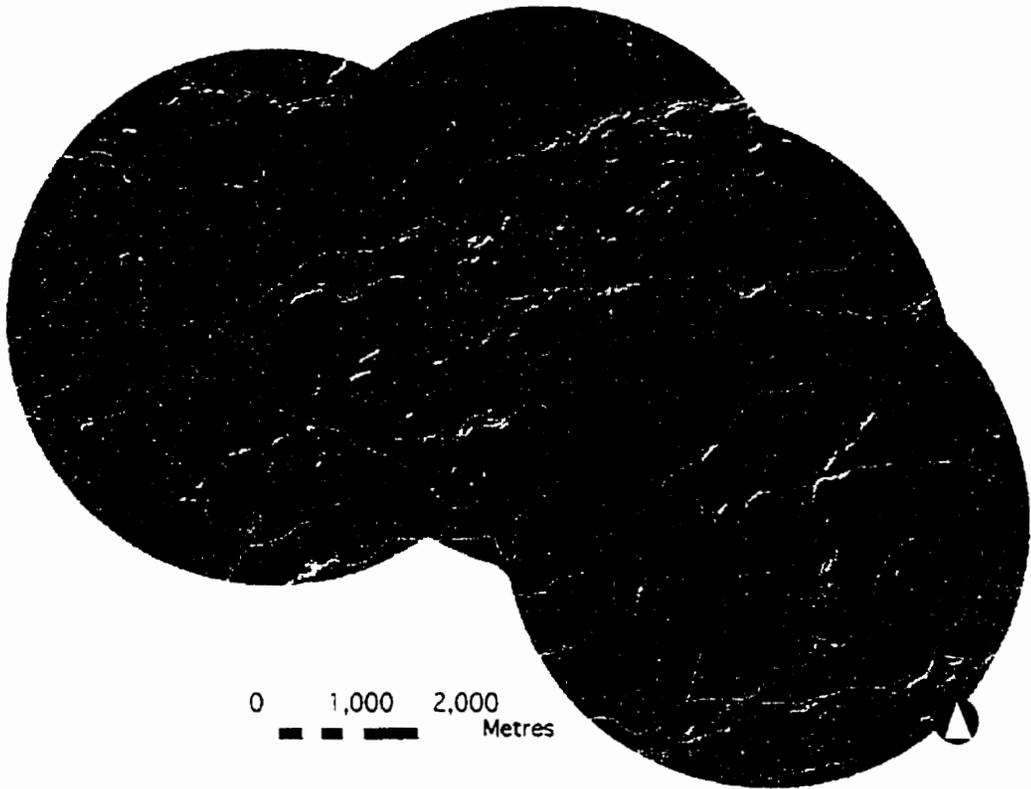
70% of the ceramics have cord-wrapped stick decoration, indicating an early site in the sequence possibly dating to A.D. 1100-1200 (similar to the Smale site). Testing at MiV18 revealed a possible housewall and several features in one area and perhaps an earlier component in another area (Williamson 1983:165-169).

The Roeland site is the only one of the five villages to undergo extensive excavation. Situated on the west-central side of the sand plain on sandy loam, south of a now-dry stream, the artifact scatter extends over 1.5 ha. The site is typical of a Glen Meyer village with large storage refuse features around the site's perimeter and a confusing settlement pattern (Williamson 1983:173-175). Moreover, "a great deal of morphological variation in house structures and probable evidence of long-term occupation in the form of overlapping settlement patterns" (Williamson 1983:178).

### *Dorchester Cluster*

The sites of the Dorchester cluster include a village, Calvert (AfHg-1), and five surrounding satellite sites; Keith (AfHg-19), Andrew (AfHg-18), Larch Lookout (AfHg-17), Mustos (AfHg-2), and Cedar Ravine (AfHg-32)(Timmins 1997). All of the sites are on very fine sandy soil at the eastern extent of the Caradoc sand plain. At this juncture, the sand plain narrows and culminates at the Thames River. Surrounding the Dorchester cluster are till plains and a moraine comprised of loams and clay.

The Calvert site is a Glen Meyer village dating from A.D. 1150 to 1250. It has undergone extensive excavation and interpretation (see Timmins 1997). The site is on a sandy plateau overlooking the Dorchester swamp to the southeast, and adjacent to a former small creek



**Figure 4.7: Selected Glen Meyer sites in the Caradoc cluster.**

**Table 4.8: Caradoc sites data.**

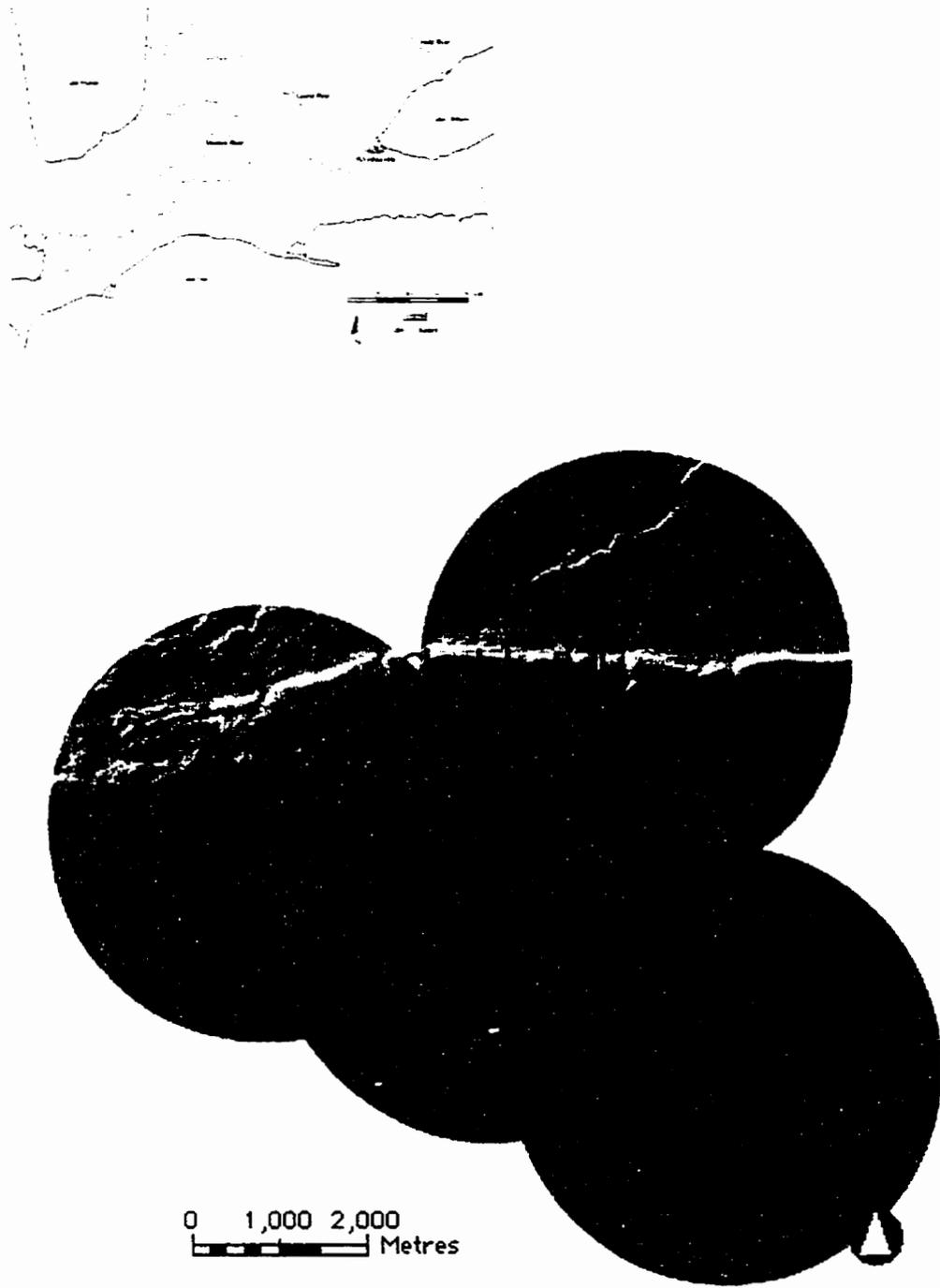
<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Caradoc 10 (AfHj-24)	no date	village	Sandy loam field west of swamp
Caradoc 13 (AfHj-26)	no date	village	
Smale (AfHj-18)	no date	village (surface collected, tested)	Fairly flat land with a slope to the southwest, close to a creek
Roeland (AfHj-14)	1160 (1280) 1400 1210 (1290) 1410	village (partially excavated 1985)	
MiV18 (AfHj-19)	no date	village (surface collected, tested)	On sandy field dotted with many small sand knolls, near a creek



**Figure 4.8: Glen Meyer sites in the Dorchester cluster.**

**Table 4.9: Dorchester sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Andrew (AfHg-18)	no date	unknown (surface collected)	Crest of ridge overlooking Thames River
Calvert (AfHg-1)	1000 (1170) 1290 1020 (1210) 1290 1030 (1230) 1300 1040 (1250) 1380 1170 (1280) 1400	village (excavated 1981- 82)	Uplands, sand hills over- looking Dorchester Swamp, Thames River
Cedar Ravine (AfHg-32)	no date	hamlet./work sta- tion? (sur- face collected)	Interior
Keith (AfHg-19)	no date	unknown (surface collected)	Crest of ridge overlooking Thames River
Larch Lookout (AfHg-17)	no date	unknown (surface collected)	Crest of ridge overlooking Thames River
Mustos (AfHg-2)	no date	village/special pur- pose camp? (surface collected)	On sandy knoll



**Figure 4.9: Selected Glen Meyer sites in the Wentworth cluster.**

**Table 4.7: Wentworth sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Chedoke Falls (AhGx-265)	no date	village (surveyed 1989)	On Niagara Escarpment near stream
Clish (AhGx-95)	no date	hamlet (surveyed 1986)	On slight ridge above a small stream
Olmstead (AhGx-32)	no date	village (1983)	Height of land adjacent to a creek
Wade (AhGx-19)	no date	village (1975)	Adjacent to a stream on a high point of land

flowing north to the Thames River. The village witnessed construction activities both expanding and contracting the village over the 100-year period of occupation, as evidenced by 14 overlapping longhouses, palisade, and features.

The Mustos site, defined as either a small village or special purpose camp, is on a sandy knoll 300 m southwest of Calvert. It is unknown if the site postdates or is contemporaneous with Calvert. To the northeast, destroyed and documented only to record cursory information regarding location and surface materials, are Larch Lookout, Andrew and Keith. The Cedar Ravine site, located 1.3 km south of Calvert, is on a small secondary watercourse draining into the Dorchester swamp. Surface collection at this site led to its interpretation as a hamlet or work station.

### *Wentworth Cluster*

The Wentworth cluster represents a group of nine Glen Meyer sites, situated at the south-west end of Lake Ontario, consisting of sites distributed both on and off the Niagara Escarpment to the south and east of Cootes Paradise. Two small camps or special purpose sites Gnarly Willow and Mint Julip (Warrick pers. comm. 1999) and two villages, Kings Forest Park and Pergantile, are below the escarpment. On the escarpment are the villages Wade (AhGx-19), Olmstead (AhGx-32), and Chedoke Falls (AhGx-265), and a hamlet, Clish (AhGx-95). For this research, I focus on sites situated on the escarpment. Information from the MCzCR database for these sites consists only of site structure and interpretation, with little in the way of settlement data or material culture.

Wade occupies a high point of land, adjacent to a stream, as indicated by a large amount of surface material. The site has not been subject to any archaeological assessment. Excavation of the Olmstead site, similarly situated on a height of land south of a spring or creek, documents a single longhouse, containing two hearths and shallow refuse pits, and a single-row palisade. Middens dominate the north slope of the rise and are scattered throughout the site. Clish, destroyed in 1987, was on a slight clay loam ridge, the southern portion sloped gently towards a small stream. The Chedoke Falls site covers 1.3 ha as determined by a limited surface collection in 1989. The site although is listed as a village based on the extent and nature of the artifact scatter.

## **Grey Sites**

### *Porteous*

The 1 ha Porteous site (AgHb-1), approximately 70% of which was excavated before its destruction in 1969, was on the summit of well-drained sandy hill approximately 1.2 km from the Grand River (Figure 4.10). It is believed that Porteous represents one of the earliest demonstrations of a movement away from riverine river flats to elevated sandy knoll locations postulated for the Glen Meyer settlement system (Noble and Kenyon 1972). A re-investigation of the Porteous data attributed it to a late Princess Point manifestation, ancestral to Glen Meyer (Stothers and Kenyon 1970), but has since reverted to Glen Meyer based on its identification as a village site (Fox 1990, Williamson 1990). The five radiocarbon dates from Porteous do little to clarify the situation, with calibrated dates extending from A.D. 610 to 1170 (Smith 1997:51).

Excavations over 1,600 m<sup>2</sup> resulted in the recovery of five overlapping house patterns that Noble and Kenyon termed, incipient longhouses, or proto-longhouses, in addition to a single circular structure with a central hearth, a rectangular structure complete with an undisturbed living floor (Noble and Kenyon 1972:30, Stothers 1977:124), and presumably, an encircling, although not fully exposed, double palisade.

The controversy surrounding Porteous can be dispelled if the belief that Porteous represents a single component site is re-evaluated. If viewed instead as a multi-component Princess Point and Glen Meyer occupation, supported by calibrated radio carbon dates (see Smith 1997), the site may represent a Princess Point occupation dating from ca seventh-century A.D. and a Glen Meyer habitation dating to ca late twelfth-century A.D. However, the occupation from ca ninth- to tenth-century A.D. remains indeterminate and hence the inclusion of Porteous in the grey sites category.

### *Holmdale*

Holmdale (AgHb-191) is a 0.5 ha village in Brantford that underwent salvage excavation in the summer of 1996. The site occupies a low terrace, overlooking a large flat on the Grand River, with remnant backwater channel and marshland to the immediate east (Figure 4.11). Detailed settlement data include the recovery of 63 cultural features, including twelve hearths, five deep storage or refuse pits, and a complex and overlapping settlement pattern with more than 700 post moulds that suggest a palisade, several fence lines, and poorly defined small house structures (Pihl 1999:13). The interpretation of the site is debatable, in the same manner as Ca-

yuga Bridge, Grand Banks, and Meyer, in that it indicates either several repeated short-term occupations or a single, year-round occupation (Pihl 1999:13, 101).

Houses are somewhat similar in size and design to those recovered at Porteous. Radiocarbon dates obtained for the Holmdale site include a calibrated A.D. 1020 AMS date on a maize kernel and a calibrated A.D. 1080 AMS date on a walnut fragment (1999:96). Paleoethnobotanical studies indicate that maize significantly contributed to the diet at Holmdale (Pihl 1999, Pihl *et al.* 1998:31-32). Although assigned to Princess Point, based on settlement patterns, it is more likely representative of grey site.

### *Lone Pine*

Lone Pine (AfGx-113), approximately 2 km from the Grand River, occupies a fork of Roger's Creek, on a low plateau, surrounded by creek beds on three sides (Figure 4.12). Although artifacts are readily visible over 0.5 ha, settlement patterns are difficult to recover in the heavy clay of the undisturbed site. Settlement features include two hearth floors but no discernible post moulds, although Smith and Crawford (1997:18-20) infer the presence of living structures. Maize kernels yielded calibrated dates of A.D. 1010 and A.D. 1270. Whereas the latter date was initially rejected as too late (Smith and Crawford 1995:63), it is now acknowledged that the site is atypical of Princess Point in regards to its geographic location (Smith and Crawford 1997:20) and may represent a later cultural manifestation in the region. Indeed, assigning village status to Lone Pine is the most reasonable interpretation at present, based on its "geographic location...typical of later Iroquoian village sites" (Smith and Crawford 1997:20).

However, pottery styles from Lone Pine (and Porteous) indicate “clearer affinities with Princess Point than with later Glen Meyer ceramics” (Smith and Crawford 1997:20).

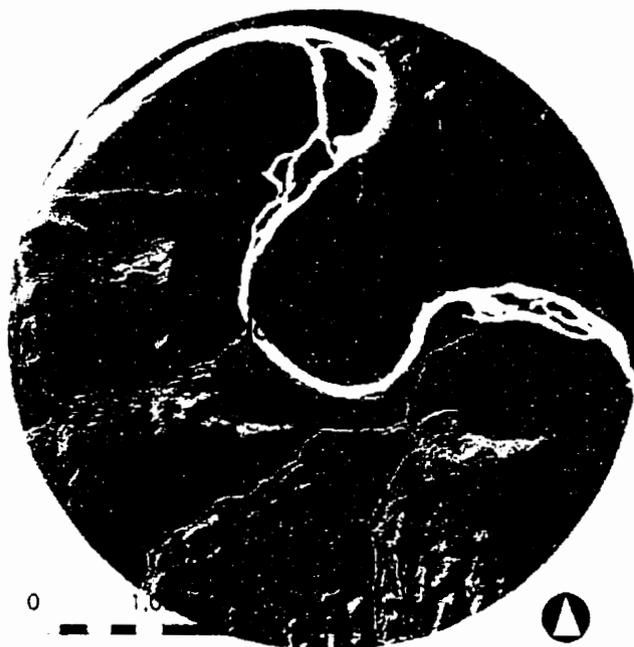
Assigning Lone Pine to the grey category is based on three facts; rim sherd seriation, indicating that the site is chronologically later than the Porteous site (Bekerman 1995), the relatively late radiocarbon dates, and a lithic analysis concluding that the Lone Pine assemblage shares characteristics of both Princess Point and Glen Meyer assemblages (Ormerod 1997a:28). From the last, the resource base at Lone Pine did not require transportable, versatile, or multi-functional tools, suggesting that the residents of Lone Pine were fairly sedentary (Ormerod 1997b:32).

### **Control Group Random Locations**

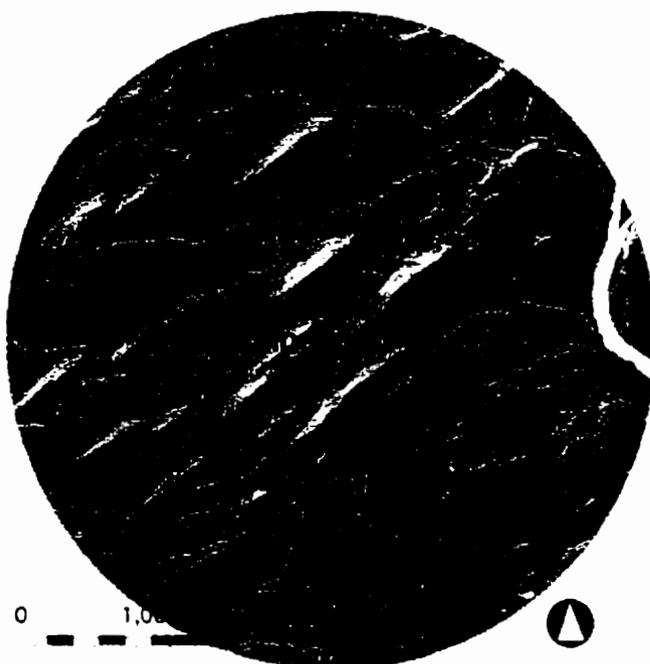
The Control Group is a set of ten random locations, or non-sites, in the lower Grand River valley (Figure 4.13). The lower Grand River area represents the focus of the University of Toronto research activities to date, both archaeologically and geophysically. The geographic area represents a combination of the Indiana and Cayuga clusters, extending from Caledonia south to Dunnville, and centered on the Grand River. The random locations were GIS generated and modelled using the same parameters as sites in the following analysis. The control group provides a landscape background or standard to measure against the lower Grand River Princess Point sites of the Cayuga and Indiana clusters.



**Figure 4.10: Porteous site.**



**Figure 4.11: Holmdale site.**



**Figure 4.12: Lone Pine site.**

**Table 4.10: Grey sites data.**

<i>Site</i>	<i>Calibrated radiocarbon dates (A.D.)</i>	<i>Site type (archaeological activities)</i>	<i>Environment</i>
Holmdale (AgHb-191)	980 (1020) 1050 890 (1080) 1020	village (mitigative excavation 1996-97)	On a loamy raised por- tion of a river flat adja- cent to the Grand River
Lone Pine (AfGx-125)	890 (1010) 1200 1150 (1270) 1300	village (test excavation 1994)	On a tributary of Roger's Creek
Porteous (AgHb-1)	680 (900, 910, 960) 1160 1010 (1170) 1280	village (limited excavation 1969-71)	On a sandy ter- race/height of land above a small creek 1km. from Grand River



**Figure 4.13: Control Group random locations in the lower Grand River valley.**

## Summary

The sites data set are not exhaustive for the regions chosen but rather are sites, or clusters, that, for the most part, have undergone past research through survey, testing, and full-scale excavation. As a result, the 48 selected Princess Point, Middle Woodland, and Glen Meyer sites, comprising nine cultural clusters, have a documented cultural affiliation. The majority of the remaining sites of the clusters identified in Chapter 3 have not undergone similar archaeological and analytical scrutiny, and therefore represent, in part, less secure cultural affiliations.

A total of 48 archaeological sites (and ten non-sites) comprise the sites data set for the landscape model: 18 Princess Point, 12 Middle Woodland, and 15 Glen Meyer sites, as well as three 'grey' sites spanning the tenth- and eleventh-centuries A.D., and 10 random locations generated within the lower Grand River valley watershed (in an area comparable with the Princess Point Cayuga and Indiana clusters).

## **CHAPTER 5**

### **ANALYSIS OF THE LANDSCAPE MODEL**

This chapter presents the data from the substantive and inferential approaches of the landscape settlement model, detailed in Chapter 2. Analyses of Princess Point, Middle Woodland and Glen Meyer sites, the three Grey sites, and random locations in the lower Grand River valley, are conducted through geographic, topographic, water, and soil landscape data. The landscape model makes use of a multiscale and heterarchical analytical structure, moving from cultural clusters, to site viewsheds, to mobility group isochrons. Appendix A contains the full set of site viewsheds used in the analysis of the landscape model.

#### **Section 5.1**

##### **Geographic Landscapes**

The geographic landscapes analysis interprets the human-environment relationship between the extent of land coverage for each cluster, viewshed, and isochron, as well as view form, in both ha and as a percentage.

##### *Cultural Clusters*

The geographic landscapes of the nine clusters used in this research display marked variation, ranging from riverine environments to lacustrine, escarpment and sand plains

settings. The number of modelled sites comprising any given cluster ranges from three to seven. Cluster size ranges from highs of 68 and 64 km<sup>2</sup> for the six sites comprising the Oxbow cluster, and the four sites of the Wentworth cluster, respectively, to a low of 29 km<sup>2</sup> for the five sites of the Cootes Paradise cluster. The average cluster size is 40 km<sup>2</sup>.

The areas of the Princess Point clusters are 3,281 ha for Cayuga, 3,306 ha for Indiana, 2,933 ha for Cootes, and 6,859 ha for Oxbow, for an average of slightly over 4,000 ha. The Middle Woodland clusters measure 4,632 ha for Delaware and 3534 for Pond Mills, also averaging slightly over 4,000 ha. The areas of the Glen Meyer clusters are 3,602 ha for the Dorchester, 4,892 for Caradoc, and 6,361 for Wentworth. The Glen Meyer average is slightly under 5,000 ha per cluster.

### *Site Viewsheds*

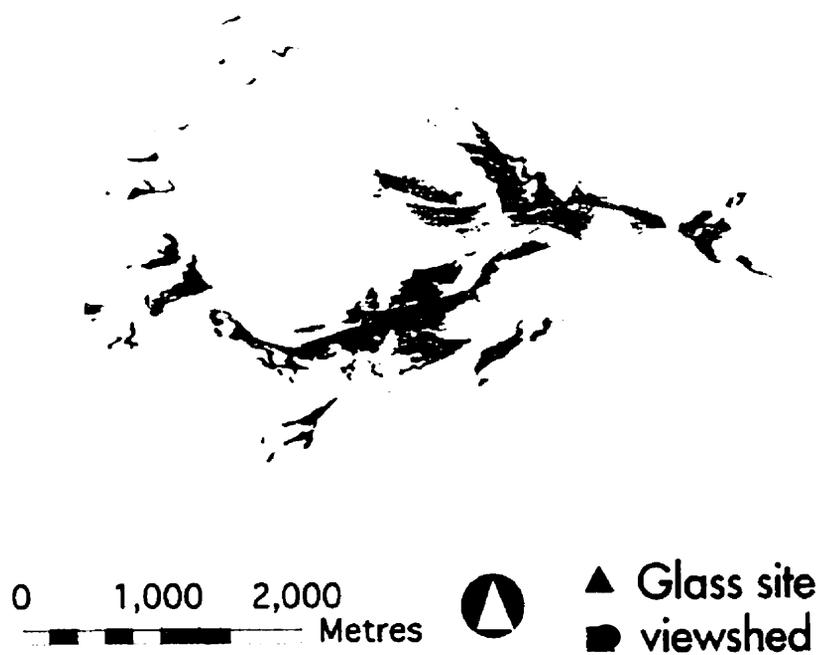
For each site, the viewshed is compared to the 5 km landscape catchment to obtain a value of relative coverage, with the catchment as the dependent variable or constant (Table 5.1.1). The results from the viewshed comparisons for the Princess Point culture group reveal that, on average, sites viewsheds consist of 135.1 ha of land area, or 6.8% of the 5 km catchment (Figure 5.1.1). In comparison, the Control Group viewshed mean is 219.0 ha (11.0% of the catchment), one-third larger than the Princess Point average. Larger still are the Middle Woodland viewsheds, with an average of 249.2 hectares (12.5% of the catchment), and the Glen Meyer viewsheds, averaging 365.6 ha (18.2% of the catchment) (Figures 5.1.2 and 5.1.3).

The initial impression is that, as percentages of the 5 km catchment, the Middle Woodland viewsheds are, on average, double the surface area of Princess Point site viewsheds, while

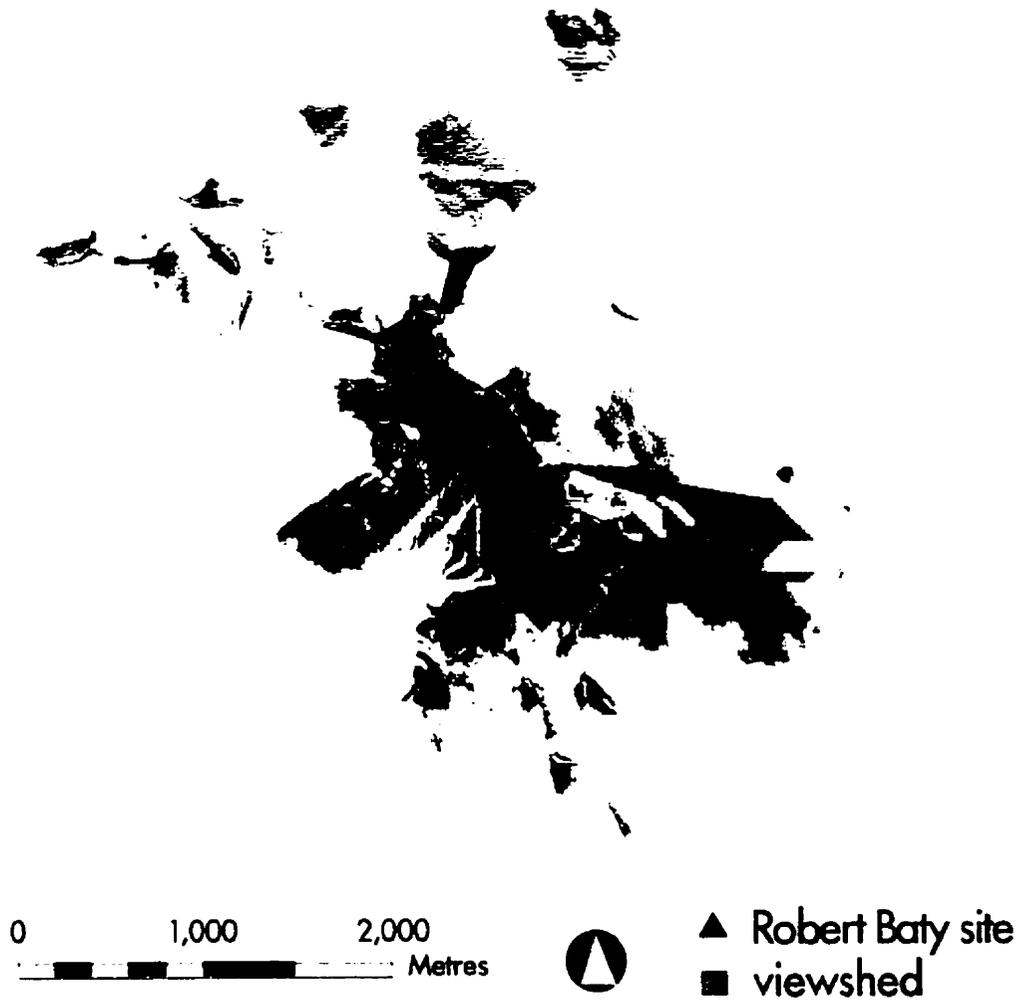
Meyer viewsheds are triple the surface area. The Control Group viewsheds are roughly equal to those of the Middle Woodland.

The use of paired t-test statistics (assuming normal distributions) demonstrate the significance of the values in Table 5.1.1. The difference in mean viewshed, as a percentage of the 5 km catchment, between Princess Point, at 6.8%, and Middle Woodland, at 12.5%, is significant ( $t = -2.94$ ,  $0.01$ ,  $p = 0.005$ ). Likewise, as a percentage of the 5 km catchment, the difference in mean viewshed between Princess Point, at 6.8%, and Glen Meyer, at 18.2%, is also significant ( $t = -5.67$ ,  $p = 0.001$ ).

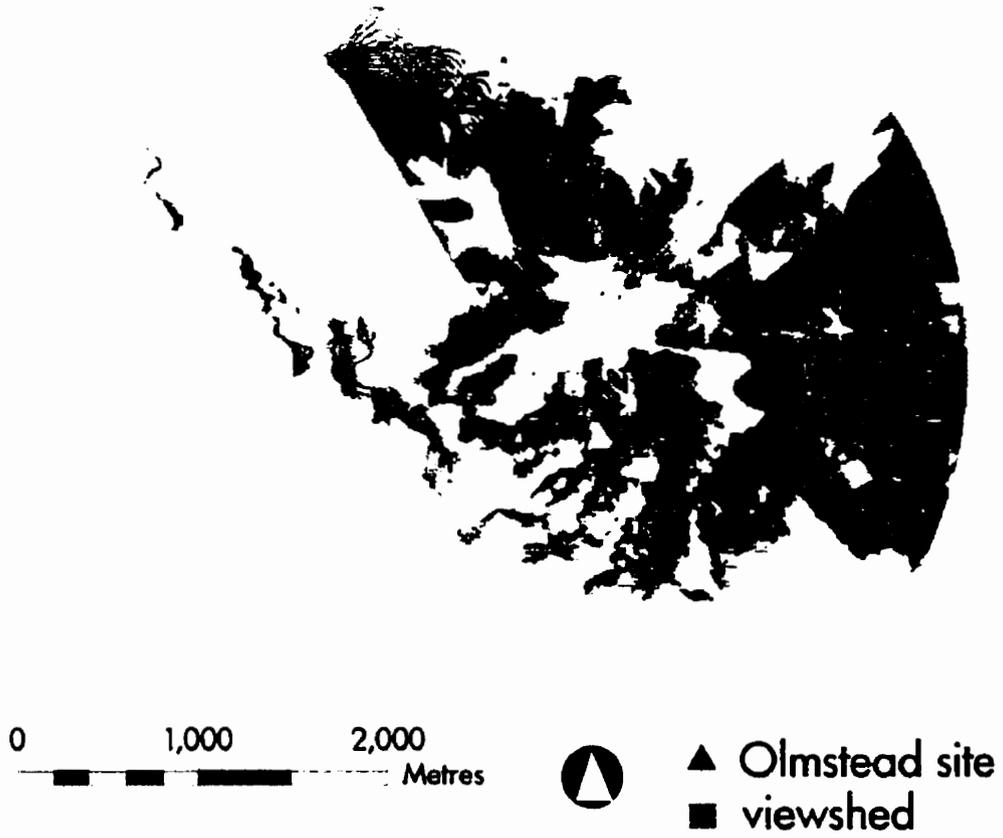
The 18 Princess Point sites (Table 5.1.2), grouped by the four clusters and expressed as a percentage of each site's 5 km catchment, reveal mean viewshed areas of 11.5%  $\pm$  2.08% for Cootes Paradise, 4.6%  $\pm$  0.86% for Cayuga, 6.7%  $\pm$  1.52 for Indiana, and 3.8%  $\pm$  1.95% for Oxbow. As a group, Princess Point viewsheds do not comprise a large portion of the catchment, with viewsheds ranging from a low of 2% to a high of 13.6% of the catchment (Table 5.1.2). The largest viewsheds are found in the Cootes cluster, for the Princess Point type site, Bull's Point, and Sassafras Point. Sites on the Grand River have less expansive viewsheds. The smallest viewsheds are both in the Oxbow cluster, for Mohawk Chapel and Bow Park. Moreover, the viewsheds of each site in the four Princess Point clusters display a degree of constancy, demonstrated by the low standard deviations for each of the four clusters, ranging from 0.86% to 2.08%. That all the Princess Point viewsheds measure under 15% of the total site catchment indicates a consistency in the determination in the location of sites in the landscape. This suggests that landscape cognition, in terms of the recognition of similarly bounded areas, represents one component of the Princess Point site selection process.



**Figure 5.1.1: Typical Princess Point viewshed: Oxbow cluster Glass site.**



**Figure 5.1.2: Typical Middle Woodland viewshed: Pond Mills cluster Robert Baty site.**



**Figure 5.1.3: Typical Glen Meyer viewshed: Wentworth cluster Olmstead site.**

**Table 5.1.1: Viewshed statistics for all sites.**

<i>Princess Point (n=18)</i>			<i>Control Group (n=10)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>
Mean	135.1	6.8	Mean	219.0	11.0
Range	230.4	11.6	Range	352.5	17.7
Standard Deviation	68.6	3.5	Standard Deviation	130.3	6.5
Mean – SD	66.5	3.3	Mean – SD	88.7	4.5
Mean + SD	203.7	10.3	Mean + SD	349.3	17.5

<i>Middle Woodland (n=12)</i>			<i>Glen Meyer (n=15)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>
Mean	249.2	12.5	Mean	365.6	18.2
Range	483.8	24.2	Range	548.4	27.2
Standard Deviation	139.9	7.0	Standard Deviation	153.3	7.6
Mean – SD	109.3	5.5	Mean – SD	212.3	10.6
Mean + SD	389.1	19.0	Mean + SD	518.9	25.8

**Table 5.1.2: Princess Point viewsheds by ha and percentage of catchment.**

<i>Cootes Paradise cluster</i>	<i>Viewshed in ha</i>	<i>% of Catchment</i>	<i>Cayuga cluster</i>	<i>Viewshed in ha</i>	<i>% of Catchment</i>
Arboretum	188.9	9.6	Cayuga Bridge	72.3	3.6
Bulls Point	255.1	12.9	Grand Banks	101.2	5.1
Lilac Gardens	174.3	8.8	Young 1	100.7	5.1
Princess Point	269.7	13.6	<i>Mean</i>	<i>91.4</i>	<i>4.6</i>
Sassafras Point	236.3	12.0	<i>Range</i>	<i>28.9</i>	<i>1.5</i>
<i>Mean</i>	<i>224.9</i>	<i>11.4</i>	<i>St. dev.</i>	<i>16.5</i>	<i>0.8</i>
<i>Range</i>	<i>95.4</i>	<i>4.8</i>			
<i>St. dev.</i>	<i>41.6</i>	<i>2.1</i>			

<i>Indiana cluster</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>	<i>Oxbow cluster</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>
Indiana	161.1	8.1	Bow Park	43.3	2.2
Lester	113.9	5.7	Glass	121.9	6.1
Meyer	102.0	5.1	Mohawk Chap.	39.3	2.0
York 1	158.0	7.9	Oxbow Flats	62.8	3.1
<i>Mean</i>	<i>133.8</i>	<i>6.7</i>	Stratford Flats	113.2	5.7
<i>Range</i>	<i>59.1</i>	<i>2.4</i>	Tutela	117.8	5.9
<i>St. dev.</i>	<i>30.2</i>	<i>1.5</i>	<i>Mean</i>	<i>83.1</i>	<i>4.2</i>
			<i>Range</i>	<i>82.6</i>	<i>4.1</i>
			<i>St. dev.</i>	<i>38.8</i>	<i>1.9</i>

**Table 5.1.3: Middle Woodland viewsheds by ha and percentage of catchment.**

<i>Delaware cluster</i>	<i>Viewshed in ha</i>	<i>% of Catchment</i>	<i>Pond Mills cluster</i>	<i>Viewshed in ha</i>	<i>% of Catchment</i>
Boresma	148.4	7.4	Baty	314.2	15.7
Brodie	282.9	14.1	Bradley	372.2	18.6
PUC	180.9	9.0	East Bog	105.9	5.3
Sibelius	117.3	5.9	Pond Mills	146.8	7.3
Site A	152.5	7.6	Site A	252.5	12.6
<i>Mean</i>	<i>176.4</i>	<i>8.8</i>	Site B	327.6	16.4
<i>Range</i>	<i>165.6</i>	<i>8.2</i>	West Bog	589.7	29.5
<i>St. dev.</i>	<i>63.7</i>	<i>3.18</i>	<i>Mean</i>	<i>301.3</i>	<i>15.1</i>
			<i>Range</i>	<i>483.8</i>	<i>24.2</i>
			<i>St. dev.</i>	<i>159.9</i>	<i>8.0</i>

**Table 5.1.4: Glen Meyer viewsheds by ha and percentage of catchment.**

<i>Caradoc cluster</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>	<i>Dorchester cluster</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>
C10	219	10.9	Andrew	407.2	20.3
C13	424	21.1	Calvert	547.9	27.4
MiV18	236.9	11.8	Cedar Ravine	196.7	9.8
Roeland	683	33.9	Keith	434.4	21.7
Smale	211.3	10.5	Larch	447.3	22.4
<i>Mean</i>	<i>354.8</i>	<i>17.6</i>	Mustos	319.3	16.0
<i>Range</i>	<i>471.7</i>	<i>23.4</i>	<i>Mean</i>	<i>392.1</i>	<i>19.6</i>
<i>St. dev.</i>	<i>203.4</i>	<i>10.10</i>	<i>Range</i>	<i>351.2</i>	<i>17.6</i>
			<i>St. dev.</i>	<i>120.7</i>	<i>6.0</i>
<i>Wentworth cluster</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>			
Chedoke	470.9	23.7			
Clish	272.8	13.7			
Olmstead	479	24.1			
Wade	134.6	6.8			
<i>Mean</i>	<i>339.3</i>	<i>17.1</i>			
<i>Range</i>	<i>344.4</i>	<i>17.3</i>			
<i>St. dev.</i>	<i>166.5</i>	<i>8.4</i>			

**Table 5.1.5: Control Group viewsheds by ha and percentage of catchment.**

<i>Lower Grand River cluster</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>
R1	55.7	2.8
R2	299.6	15.0
R3	408.2	20.5
R4	341.7	17.1
R5	372.6	18.7
R6	96.1	4.8
R7	188.7	9.5
R8	116.3	5.8
R9	228.3	11.5
R10	83.0	4.2
<b>Mean</b>	<b>219.0</b>	<b>11.0</b>
<b>Range</b>	<b>352.5</b>	<b>17.7</b>
<b>St. Dev.</b>	<b>130.3</b>	<b>6.5</b>

**Table 5.1.6: Grey site viewsheds by ha and percentage of catchment.**

<i>Grey sites</i>	<i>Viewshed in ha.</i>	<i>% of Catchment</i>
Porteous	290.1	14.5
Holmdale	638.1	31.8
Lone Pine	58.4	2.9
<b>Mean</b>	<b>328.9</b>	<b>16.4</b>
<b>Range</b>	<b>579.7</b>	<b>28.9</b>
<b>St. dev.</b>	<b>291.8</b>	<b>14.5</b>

The 12 Middle Woodland viewsheds (Table 5.1.4) are generally larger than those of Princess Point. The viewsheds of the Delaware sites average 176 ha and those of Pond Mills average 301 ha. When expressed as a percentage of each 5 km catchment, the two clusters' viewshed means are  $8.8\% \pm 3.18\%$  and  $15.1\% \pm 8.0\%$ , respectively. Standard deviations are larger for Middle Woodland than Princess Point, implying a greater viewshed variation on a site by site basis. Middle Woodland viewsheds range between 5.3% and 24.2% of each 5 km catchment. Within clusters, viewshed consistency is less than that demonstrated for Princess Point. The range for the Delaware viewsheds is 165.6 ha and 438.8 ha for the Pond Mills viewsheds. In comparison, Princess Point viewsheds range from 28.9 ha for Cayuga, to 59.1 ha for Indiana, to 95.4 ha for Oxbow and Cootes Paradise.

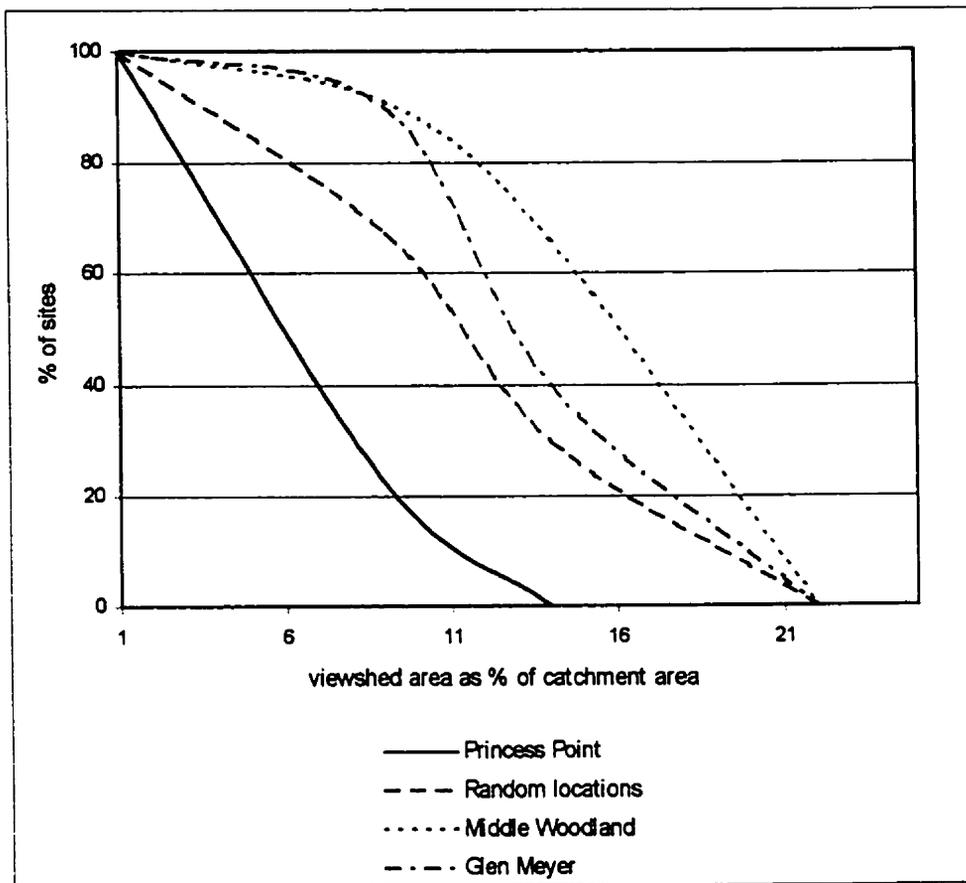
The 15 Glen Meyer viewsheds (Table 5.1.4) reveal an increase in total area covered over both the Princess Point and Middle Woodland groups. The Glen Meyer mean viewshed, measured as a percentage of the 5 km catchment, is  $18.2\% \pm 7.62\%$ . Individual cluster means are  $17.6\% \pm 10.1\%$  for Caradoc,  $19.6\% \pm 6.0\%$  for Dorchester, and  $17.1\% \pm 8.4\%$  for Wentworth. The Wade and Roeland viewsheds represent the extremes of the Glen Meyer data, with a low value of 134.6 ha and a high value of 683 ha, respectively. The remaining thirteen Glen Meyer viewsheds range from 196.7 ha to 547.9 ha, or 9.8% to 27.4% of the catchment. These values, while similar to the Middle Woodland, are well above the Princess Point values.

The viewsheds of the ten Control Group random locations, on the lower Grand River, have a mean area of  $11.0\% \pm 6.54\%$  of the 5 km catchment (Table 5.1.5). The t-test result for the difference in mean viewshed between the Princess Point sites of the Lower Grand River valley (consisting of the seven Cayuga and Indiana sites) with a  $5.8\% \pm 1.63\%$  mean and stan-

dard deviation, and the Control Group, is significant ( $t = -2.03$ ,  $p = 0.05$ ), although to a marginally lesser degree than the variation between culture groups. These results aid in the recognition that Princess Point groups display a uniform selection for site locations that yield small viewsheds across a variety of natural landscapes.

The above observations suggest cultural patterning when the viewshed means of the 45 sites, grouped by culture, and the random locations, are plotted as percentages of the 5 km catchment. The interpretation of the resulting cumulative frequency chart (Figure 5.1.4) begins with the observation that all viewsheds share a minimum of 1% of each 5 km catchment. However, as noted above, none of the Princess Point viewsheds are larger than 13% of the total catchment. In comparison, nearly two-thirds of the random locations, and almost all of the Middle Woodland and Glen Meyer viewsheds, are larger than 10% of the catchment. Over half of the Middle Woodland viewsheds, and more than one-third the Glen Meyer, register 20% of the catchment. Even the random location viewsheds of the lower Grand River valley are consistently larger than the Princess Point viewsheds. However, for Middle Woodland, Glen Meyer, and the random locations, no viewshed measures greater than one-third of the 5 km catchment. On average, non-Princess Point viewsheds measure slightly over 20% of the catchment compared to the 13% average for Princess Point viewsheds.

Grouping viewshed means by cluster reveals that Princess Point cluster means are lower than those of other culture groups (Figure 5.1.5) All of the cluster viewsheds, however, overlap with at least one other culture group's range. Calculating a mean value for all culture groups results in a value of  $11.4\% \pm 5.56\%$ , similar to the Control Group random locations mean of  $11.0\% \pm 6.54\%$ .



**Figure 5.1.4: Viewshed means by culture group.**

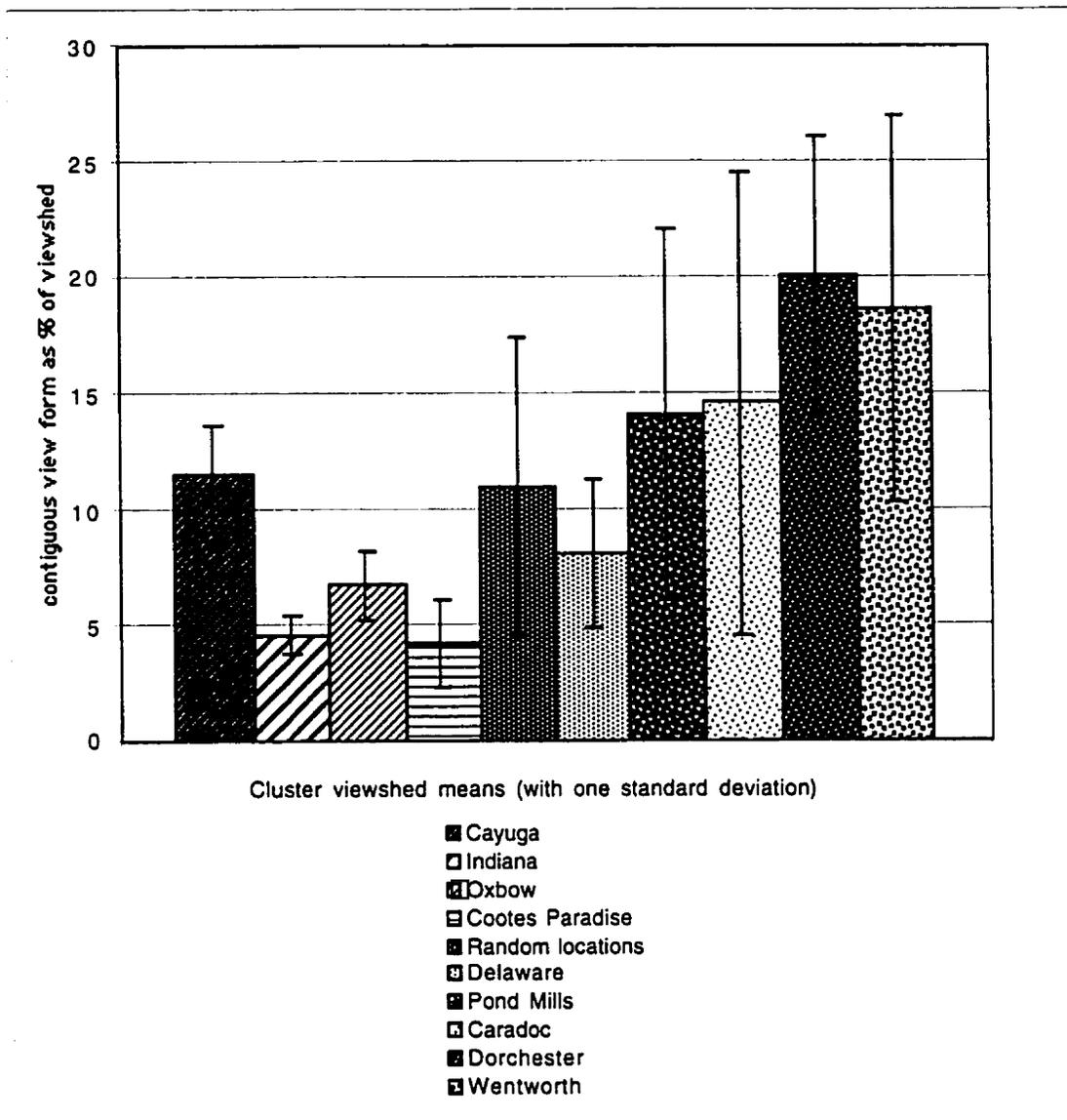


Figure 5.1.5: Viewshed means, with one standard deviation, by cluster.

The viewsheds for the three Grey sites, Holmdale, Porteous, and Lone Pine vary from a low of 58 ha for Lone Pine, to 290 ha for Porteous, to a high of 638 ha for Holmdale (Table 5.1.6). The area covered by the Holmdale viewshed matches that of Roeland, the largest Glen Meyer viewshed. Conversely, Lone Pine's viewshed ranks above only two sites, the Princess Point Mohawk Chapel and Bow Park sites, and a random location viewshed. As catchment percentages, the viewsheds register values of 2.9%, 14.5% and 31.8% for Lone Pine, Porteous, and Holmdale, respectively.

The Porteous viewshed falls outside of the Princess Point range, but is within that of Glen Meyer, falling below the mean but situated near the Glen Meyer viewshed median. The viewsheds of the three Grey sites display little uniformity and provide inadequate grounds to place them as either a separate group within the context of the three culture groups or within the established trends of the Princess Point and Glen Meyer groups.

### *View Form*

View form is a comparative analysis of adjoining areas within a viewshed, identified as a contiguous value and measured in ha (see Chapter 2). The analysis of view form by culture group suggests that there is discernable variation between Princess Point, Middle Woodland, and Glen Meyer view forms (Figures 5.1.6 and 5.1.7, Table 5.1.7). Contiguous areas for Princess Point view forms average 93%  $\pm$ 5.06% of viewsheds for the Cayuga and Indiana sites, 81%  $\pm$ 11.35% for the Oxbow sites, and 99.6%  $\pm$ 0.34% for the Cootes Paradise sites. The Middle Woodland contiguous view forms, as a percentage of viewsheds, average 82.4%  $\pm$ 13.18% for the Pond Mills sites and 62.4%  $\pm$ 21.96% for the Delaware sites. The Glen Meyer

contiguous view forms, somewhat less variable, average  $82.4\% \pm 13.18\%$  of viewsheds for the Dorchester sites,  $73.3\% \pm 21.96\%$  for the Caradoc sites, and  $82.0\% \pm 14.08\%$  for the Wentworth sites. The Grey sites have an average contiguous view form of  $95.5\% \pm 4.14\%$  of the three viewsheds, in the mid-range of Princess Point sites and the upper range of Glen Meyer sites. The view forms of the Control Group random locations average  $65.5\% \pm 25.05\%$ . This value, even with the addition of the large standard deviation, is below the view form value for the Princess Point lower Grand River sites of the Cayuga and Indiana clusters, suggesting that the landscape parameters underlying viewshed for the Princess Point sites of the lower Grand River are far from random.

The Princess Point view forms are the smallest of all the culture groups and Control Group, averaging 71 ha, with a 183 ha range, likely because their viewsheds are the smallest. In comparison, the Middle Woodland view form average is 187 ha, with a 252 ha range, and the Glen Meyer view form average is 247 ha, with a formidable range of 486 ha. Large standard deviations for these averages reduces their analytical value (Table 5.1.7).

Princess Point viewsheds are also the most contiguous of the all culture groups, and of the Control Group, when charted as a percentage of the viewshed (against the viewshed as a percentage of the catchment) (Figure 5.1.8). Nearly all Princess Point view forms, save for the three Cayuga cluster sites, include at least 85% of the viewshed in association with a viewshed measuring consistently less than 13% of the catchment. The Cayuga site view forms vary between two-thirds and three-quarters of the viewshed. The range of the view forms, however, for all 18 Princess Point sites, at  $91.39\% \pm 9.91\%$ , is the least variable of the three culture groups. In comparison, the random location view forms range from one-quarter to nearly all

of the viewshed and, in addition, the random location viewsheds range from 4% to 20% of the catchment. The variation in view forms of the Princess Point lower Grand River sites and the random locations is significant ( $t = 2.83, p = 0.01$ ).

The Middle Woodland and Glen Meyer contiguous view forms are less uniform in their distribution (Figures 5.1.9 and 5.1.10). The Middle Woodland view form values, as a percentage of viewshed, range from less than one-third to almost complete viewsheds. Likewise, the Glen Meyer view form values range from 40% to 98.9% of the viewshed. The Grey sites contiguous view forms are less uniform when charted against the Grey site viewsheds as a percentage of catchment (Figure 5.1.11). The result, for the viewsheds of the Grey sites, is a range between 3% to 31% of the catchment, against a much more controlled variation in view form, between 91% and 98% of the viewshed. Similar to the variation between Princess Point and random locations, the variation between Princess Point and Middle Woodland ( $t = 2.56, p < 0.01$ ) and Glen Meyer ( $t = 2.58, p < 0.02$ ) view forms are also significant. The lone deviation in the above trend of high significance is observed for the variation between the Grey sites and Princess Point sites on the lower Grand River, consisting of the seven Cayuga and Indiana cluster sites. The view form variation for these two groups ( $t = -1.26, p = 0.2$ ) is insignificant (for this research, the t-test threshold for values of insignificance is  $p = 0.10$ ).

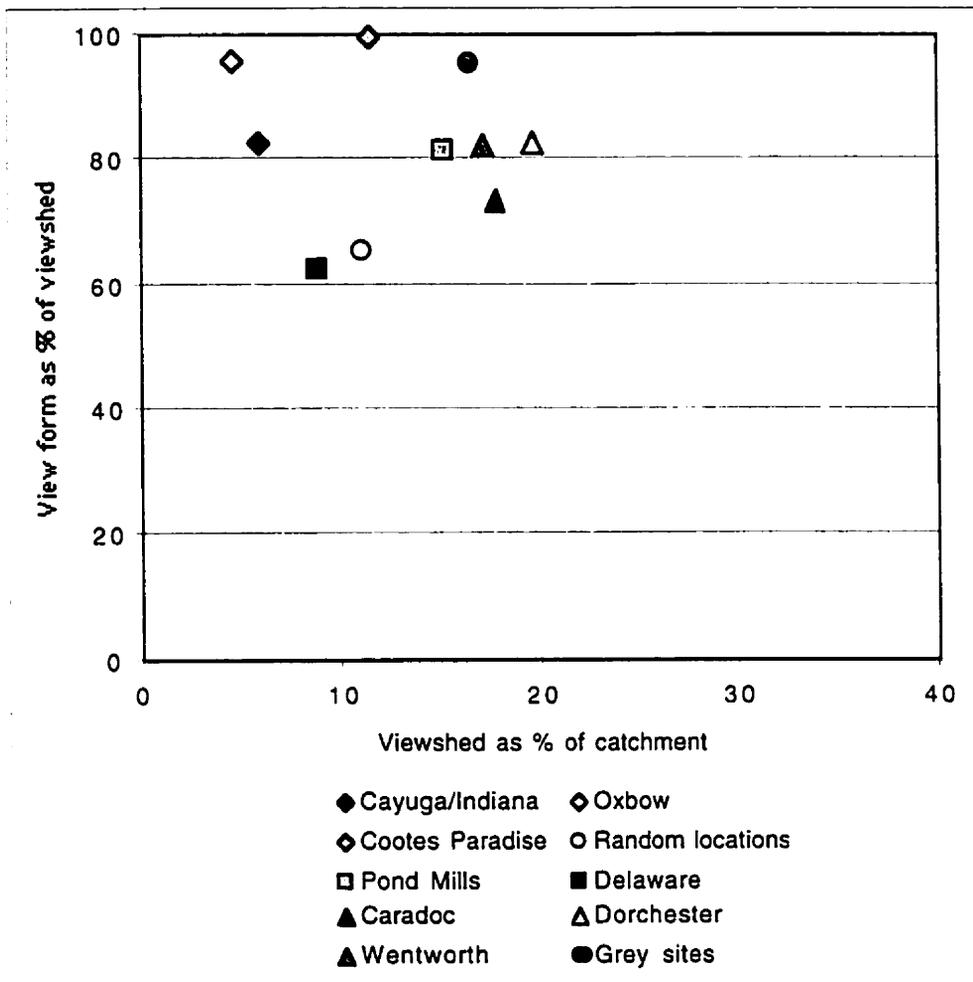


Figure 5.1.6: View form by culture group.

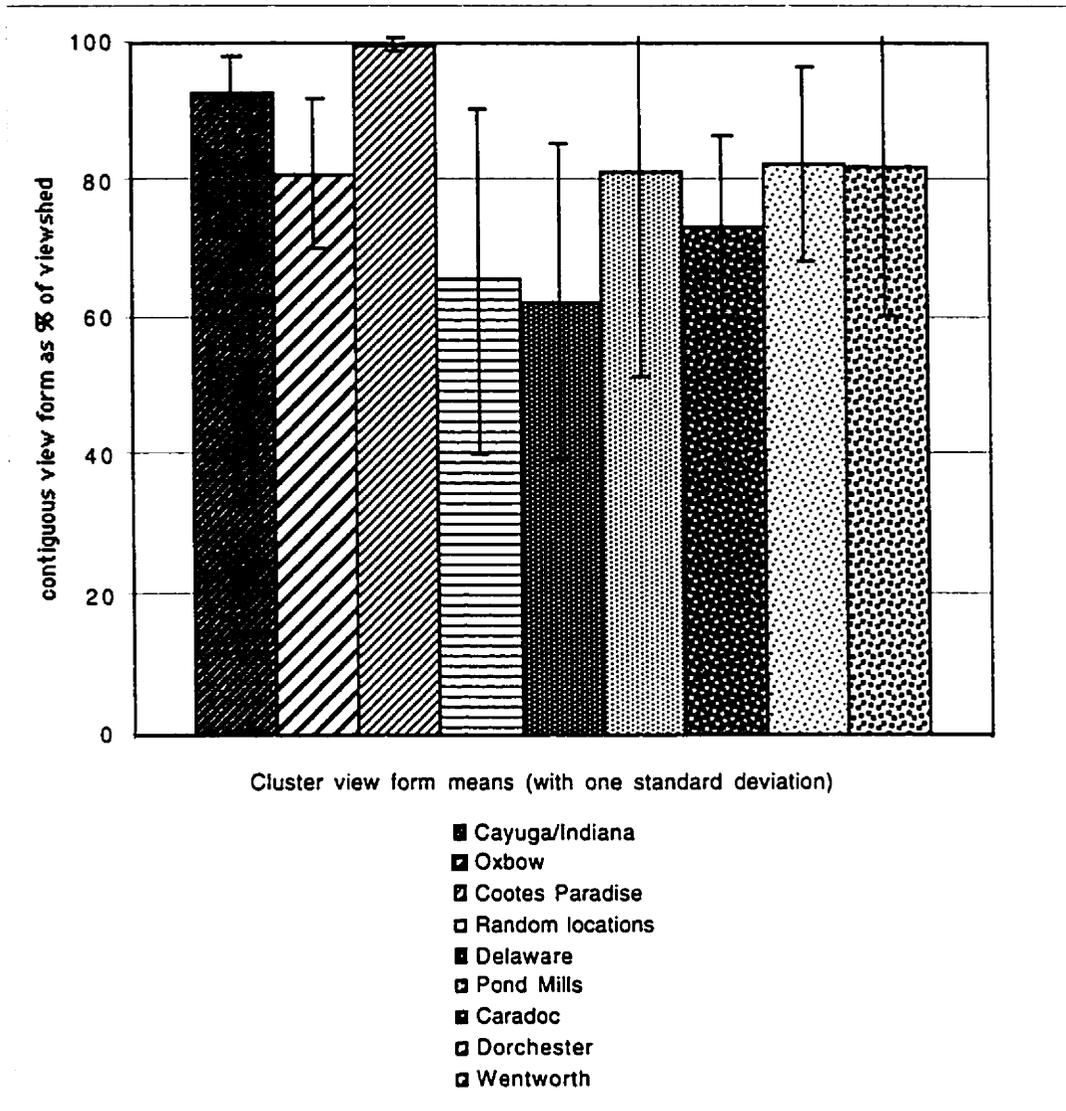


Figure 5.1.7: View form means, and one standard deviation, by cluster.

**Table 5.1.7: View form statistics for all sites.**

<i>Princess Point (n=18)</i>			<i>Control Group (n=10)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>
Mean	71.1	91.4	Mean	68.9	65.5
Range	183.7	33.2	Range	75.2	71.5
Standard Deviation	66.7	9.9	Standard Deviation	79.2	25.1
Mean – SD	4.4	80.4	Mean – SD	0.0	40.5
Mean + SD	137.8	100.0	Mean + SD	148.1	90.6

<i>Middle Woodland (n=12)</i>			<i>Glen Meyer (n=15)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>
Mean	187.1	73.4	Mean	247.5	79.3
Range	252.6	62.7	Range	486.0	53.8
Standard Deviation	163.8	26.7	Standard Deviation	163.6	16.2
Mean – SD	23.3	46.7	Mean – SD	84.0	63.1
Mean + SD	351.0	100.0	Mean + SD	411.1	95.5

<i>Grey sites (n=3)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of catchment</i>
Mean	137.7	95.5
Range	250.3	7.5
Standard Deviation	125.2	4.1
Mean – SD	12.6	91.4
Mean + SD	162.9	99.7

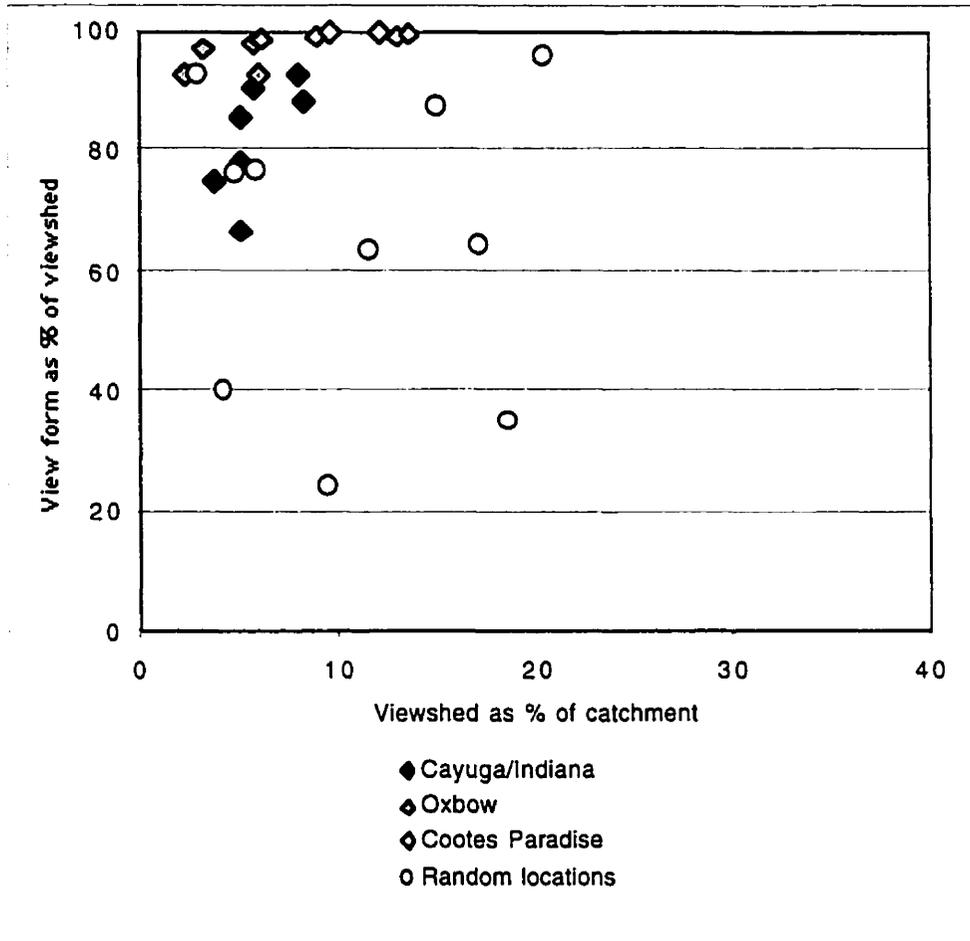


Figure 5.1.8: View forms for Princess Point sites and Control Group random locations.

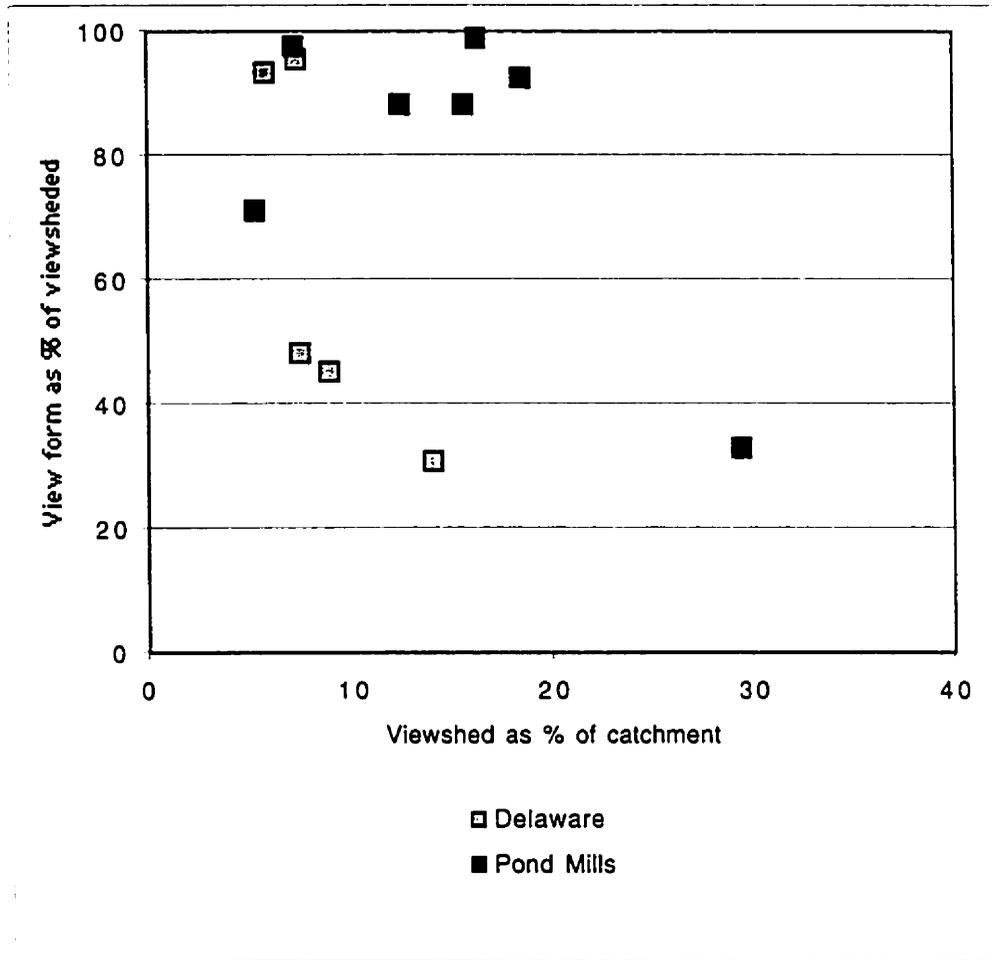


Figure 5.1.9: View forms for Middle Woodland sites.

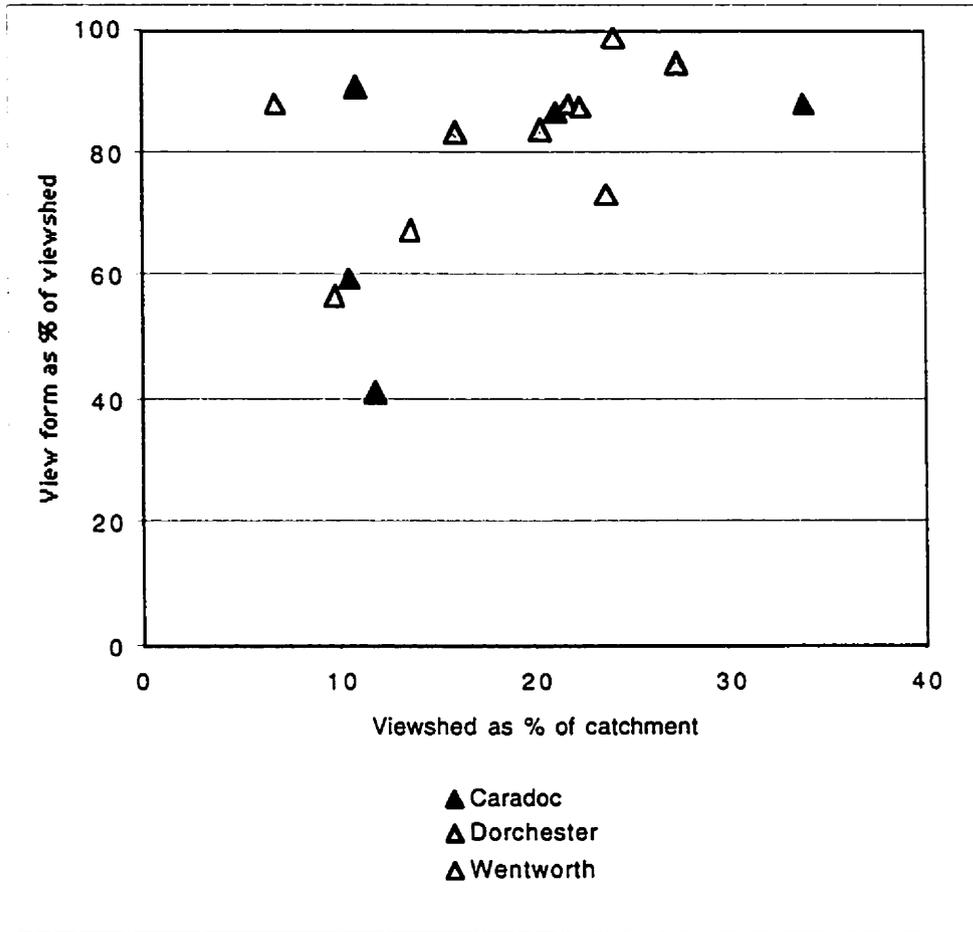


Figure 5.1.10: View forms for Glen Meyer sites.

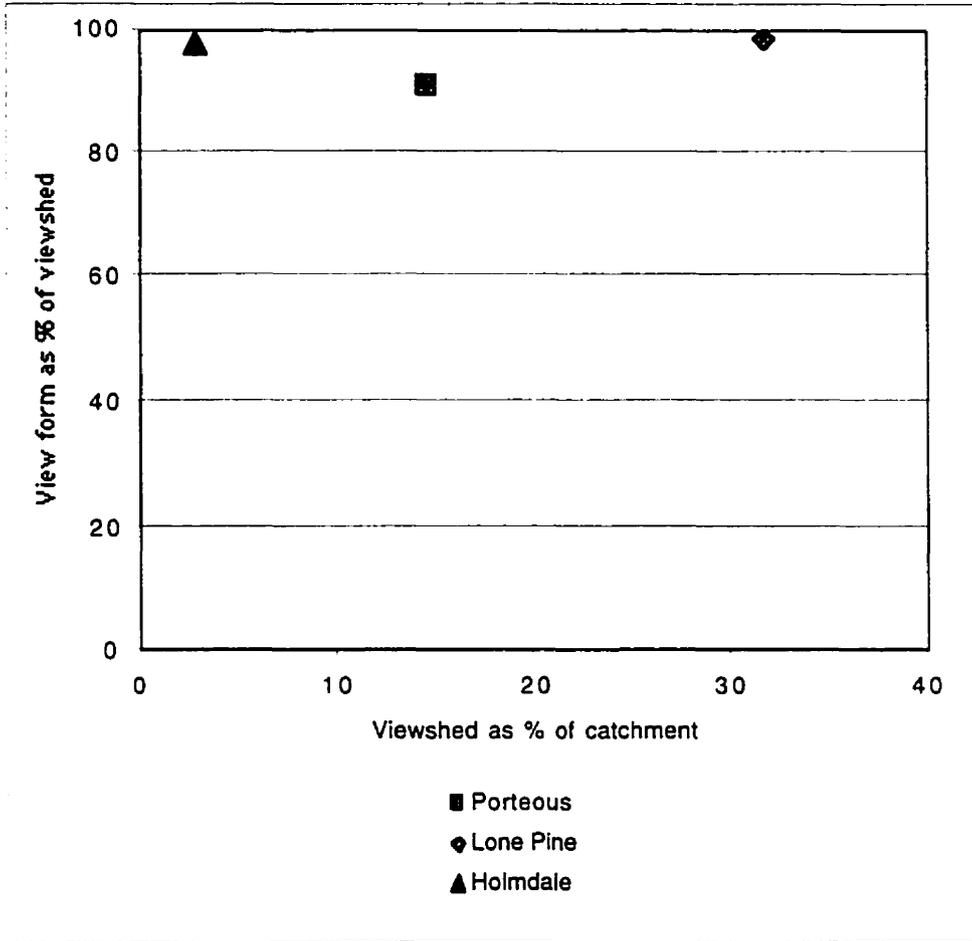


Figure 5.1.11: View forms for Grey sites.

### *Residence and Habitat Isochrons*

The geographic landscapes of the residence and habitat isochrons reveal unique patterning, both across and between culture groups. As percentages of the 1 km residence catchment, Princess Point and Glen Meyer residence groups both average 40% and Middle Woodland residence groups average 50%. In comparison, habitat group values, as a percentage of the 1 km to 5 km habitat catchment, are 8% for Princess Point, 10% for Middle Woodland, and 16% for Glen Meyer. These values suggest a similar role for habitat group activities during the Middle Woodland and Princess Point periods, followed by an increase in the habitat group role for Glen Meyer groups.

For all sites, when grouped by cluster, the residence group isochrons range from one-half to two-thirds of the residence catchment (Table 5.1.8). The range of the habitat group isochrons range from less than one-fifth to one-tenth of the habitat catchment (Table 5.1.9). Although each mobility group demonstrates a wide range in area, the percentage of viewshed for the mobility groups do not overlap.

The mobility group isochrons reveal a pattern documenting an increase in land area for the Princess Point residence group when compared to the land area for the habitat group. The Princess Point residence groups account for one-third to two-thirds of residence catchments while the habitat group consists of one-tenth or less of the habitat catchments (Figure 5.1.12). In comparison, the Middle Woodland residence group isochron average is half that of the residence catchment, and the habitat group ranges between 5% and 15% of its catchment (Figure 5.1.13). The Glen Meyer residence group isochrons are grouped between one- and

two-thirds of the residence catchment, similar to Princess Point, however the habitat group data is spread between one-tenth and one-third of the habitat catchment (Figure 5.1.14).

A comparison of lower Grand River valley Princess Point sites with the Control Group random locations only serves to highlight the clustering of the lower Grand River valley Princess Point residence and habitat isochron data against the random locations background (Figure 5.1.15). The above relationships exhibit significant variation between Princess Point and Middle Woodland residence group isochrons ( $t = -2.33, p > 0.02$ ). Similar comparisons for Princess Point and Glen Meyer residence groups ( $t = -0.33, p > 0.5$ ), as well as the lower Grand River Princess Point sites and the random locations ( $t = 0.28, p > 0.5$ ), result in insignificant variations. It is, however, not necessarily insignificant that the Princess Point and Glen Meyer residence group data are less variable. The residence group values for these two culture groups may indicate a relationship between the Princess Point and Glen Meyer data resulting from a shift to maize cultivation activities.

The variations between Princess Point habitat group data and the habitat group isochrons and catchments of the Middle Woodland ( $t = -2.73, p = 0.01$ ) and Glen Meyer ( $t = -5.08, p = 0.001$ ) groups, and random locations ( $t = -2.16, p = 0.05$ ), are all statistically significant. The decrease in area under the habitat isochron for Princess Point runs counter to the trend indicated by both Middle Woodland and Glen Meyer groups.

The geographic landscape reveals that there is significant variation in both the land area coverage of the viewsheds and isochrons, and of the relative area as a percentage of the site and mobility group catchments. The view form data exhibits Princess Point's adherence to a contiguous experienced landscape that embrace the greatest percentage of the viewshed in

**Table 5.1.8: Residence isochron statistics for all sites.**

<i>Princess Point residence group (n=18)</i>			<i>Control Group residence group (n=10)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of 1 km catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of 1 km catchment</i>
Mean	35.7	40.1	Mean	31.0	36.0
Range	52.2	54.6	Range	51.5	95.2
Standard Deviation	16.5	12.8	Standard Deviation	30.0	34.7
Mean – SD	29.2	27.3	Mean – SD	1.0	2.7
Mean + SD	51.2	52.9	Mean + SD	60.5	70.7

<i>Middle Woodland residence group (n=12)</i>			<i>Glen Meyer residence group (n=15)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of 1 km catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of 1 km catchment</i>
Mean	44.4	51.5	Mean	35.8	41.4
Range	56.0	37.5	Range	25.5	28.1
Standard Deviation	11.4	13.2	Standard Deviation	7.2	8.0
Mean – SD	33.0	38.3	Mean – SD	10.3	33.4
Mean + SD	55.8	64.7	Mean + SD	61.3	49.4

<i>Grey sites residence group (n=3)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of 1 km catchment</i>
Mean	44.5	51.7
Range	23.8	27.6
Standard Deviation	12.0	14.0
Mean – SD	56.5	37.7
Mean + SD	32.5	65.7

**Table 5.1.9: Habitat isochron statistics for all sites.**

<i>Princess Point habitat group (n=18)</i>			<i>Control Group habitat group (n=10)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of 1-5 km catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of 1-5 km catchment</i>
Mean	97.9	7.7	Mean	178.1	9.3
Range	180.1	9.7	Range	301.0	15.7
Standard Deviation	54.1	2.9	Standard Deviation	107.0	5.6
Mean – SD	43.8	5.5	Mean – SD	71.1	3.7
Mean + SD	152.0	10.6	Mean + SD	285.1	14.9

<i>Middle Woodland habitat group (n=12)</i>			<i>Glen Meyer habitat group (n=15)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of 1-5 km catchment</i>	<i>Measurement</i>	<i>ha</i>	<i>% of 1-5 km catchment</i>
Mean	192.6	10.1	Mean	328.3	17.1
Range	492.5	14.9	Range	554.7	22.3
Standard Deviation	137.9	7.2	Standard Deviation	156.2	8.2
Mean – SD	54.7	2.9	Mean – SD	172.1	8.9
Mean + SD	330.5	17.3	Mean + SD	484.5	25.3

<i>Grey sites habitat group (n=3)</i>		
<i>Measurement</i>	<i>ha</i>	<i>% of 1-5 km catchment</i>
Mean	278.8	14.6
Range	574.7	30.0
Standard Deviation	289.9	15.1
Mean – SD	0.0	0.0
Mean + SD	568.7	29.7

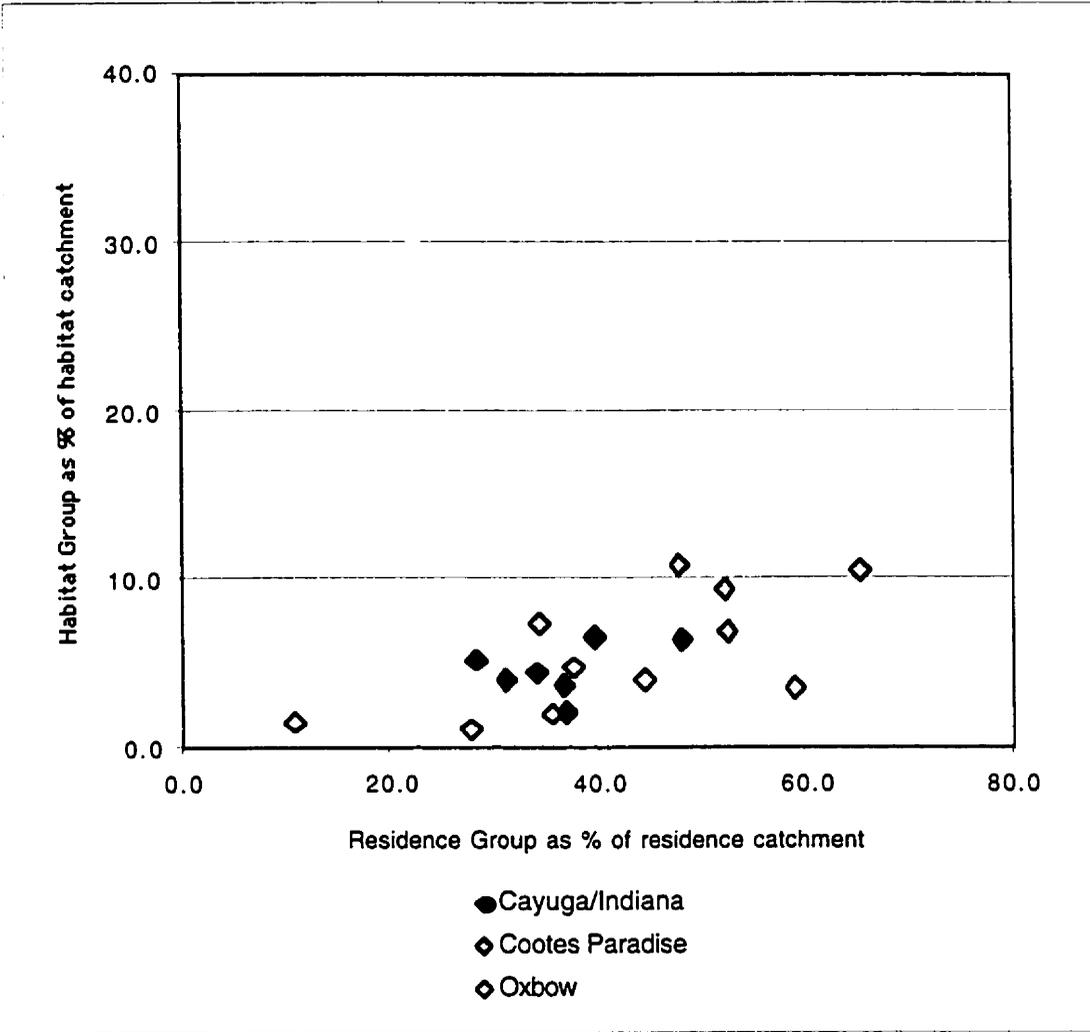


Figure 5.1.12: Residence and habitat isochrons for Princess Point sites.

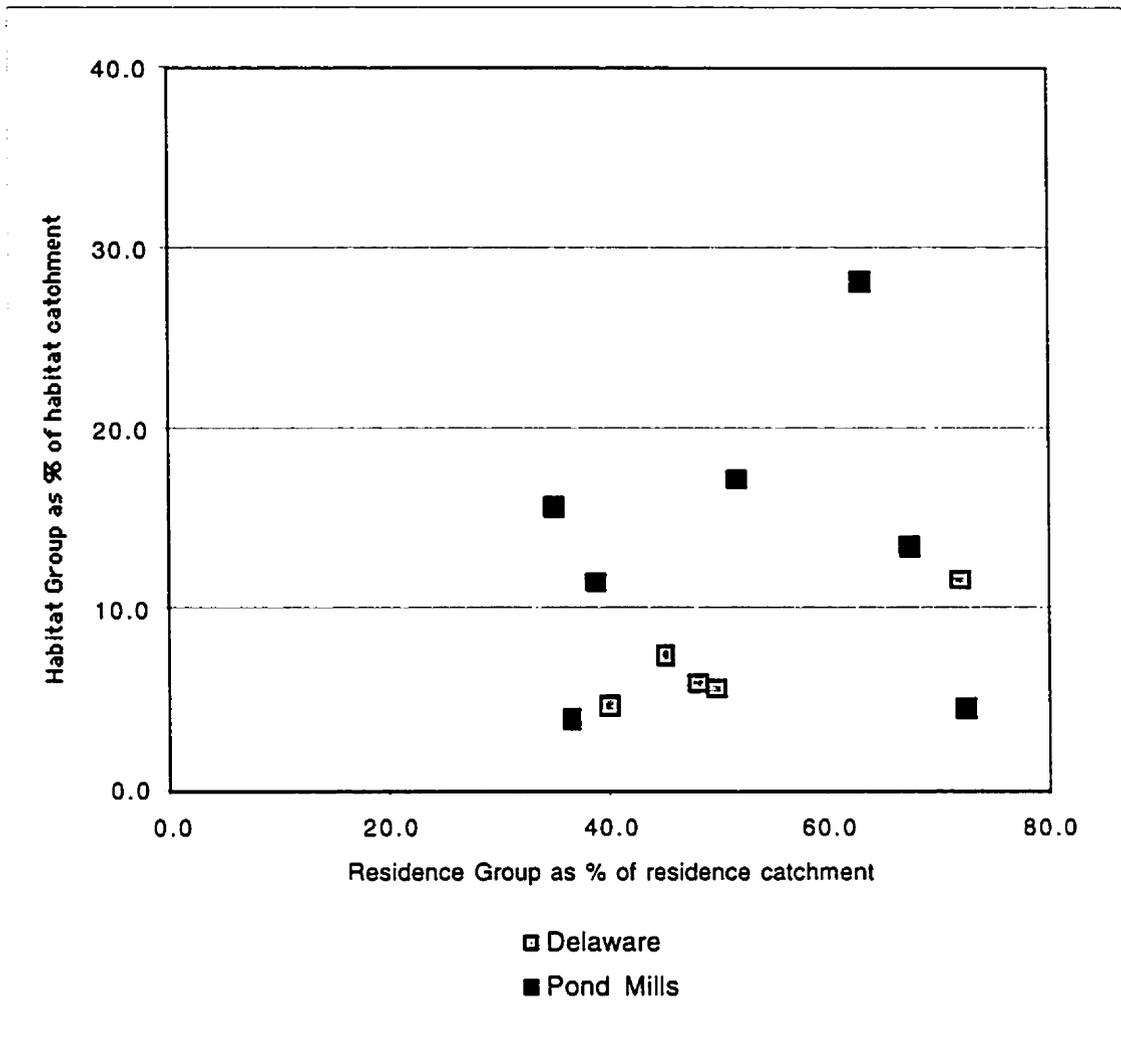


Figure 5.1.13: Residence and habitat isochrons for Middle Woodland sites.

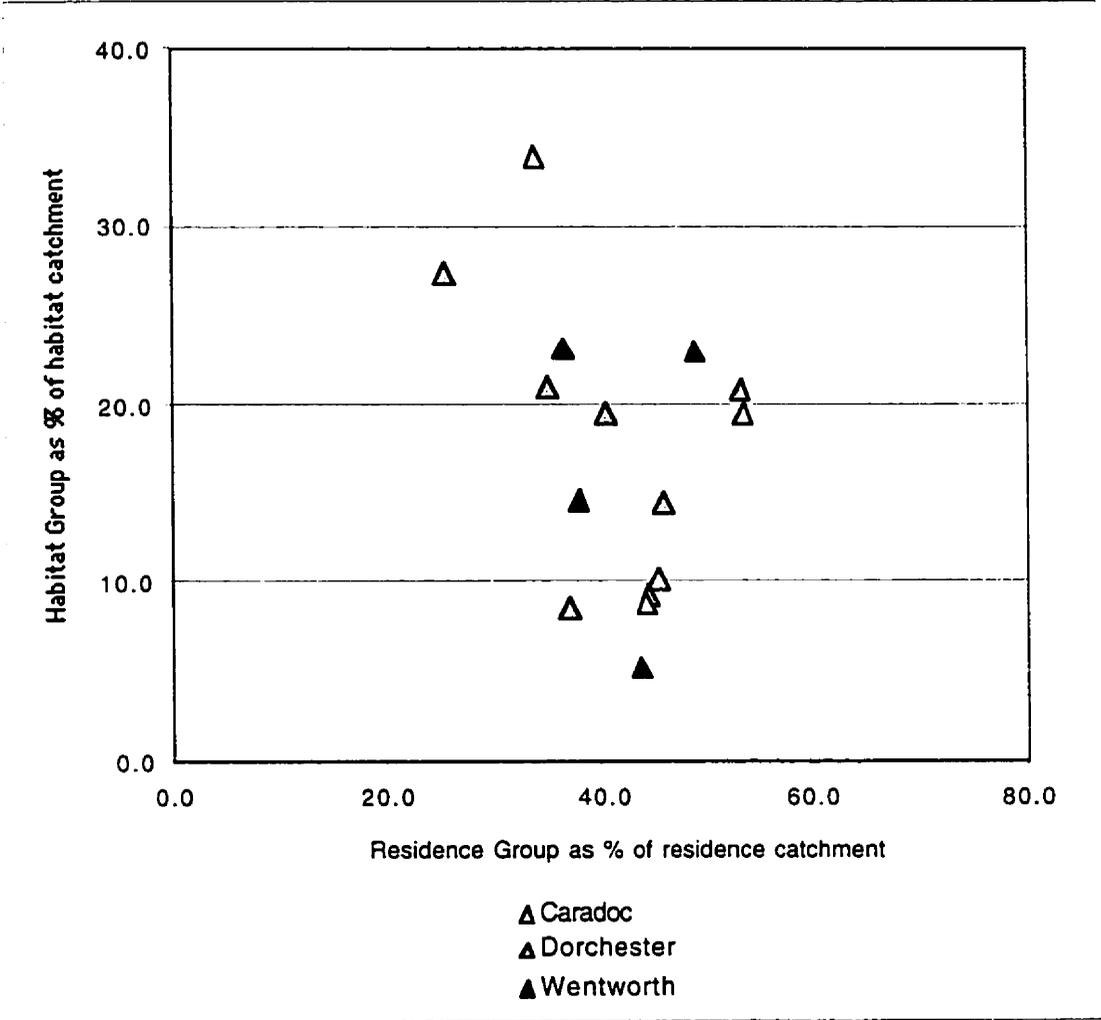
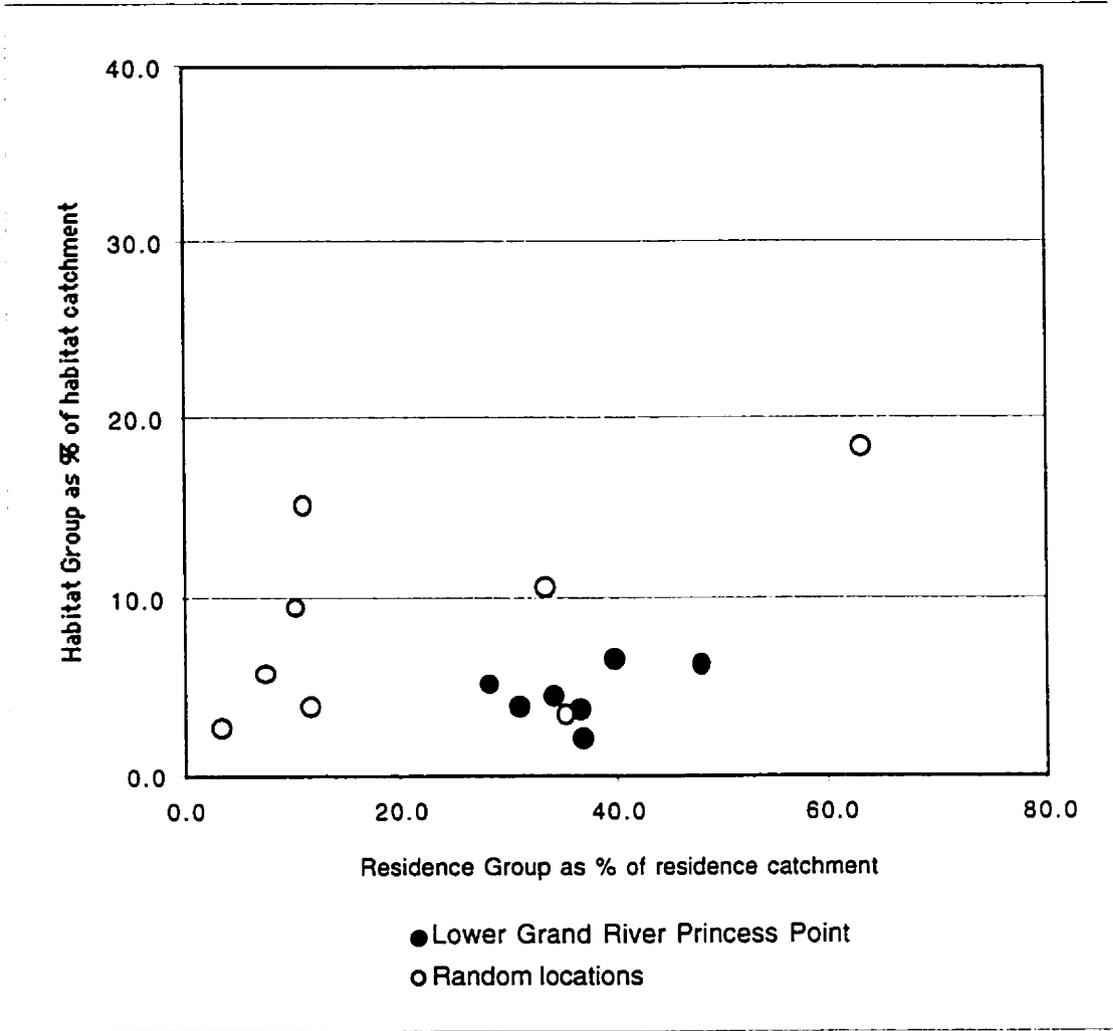


Figure 5.1.14: Residence and habitat isochrons for Glen Meyer sites.



**Figure 5.1.15: Residence and habitat isochrons for lower Grand River Princess Point sites and Control Group random locations.**

association with the smallest viewshed area, compared to Middle Woodland and Glen Meyer data. Moreover, the Control Group random locations in the lower Grand River valley do not replicate the data set of the Princess Point sites in the same landscape, suggesting that the Princess Point site decision-making process was, on some level, using landscape cognition as a selection parameter, likely in association with other attributes.

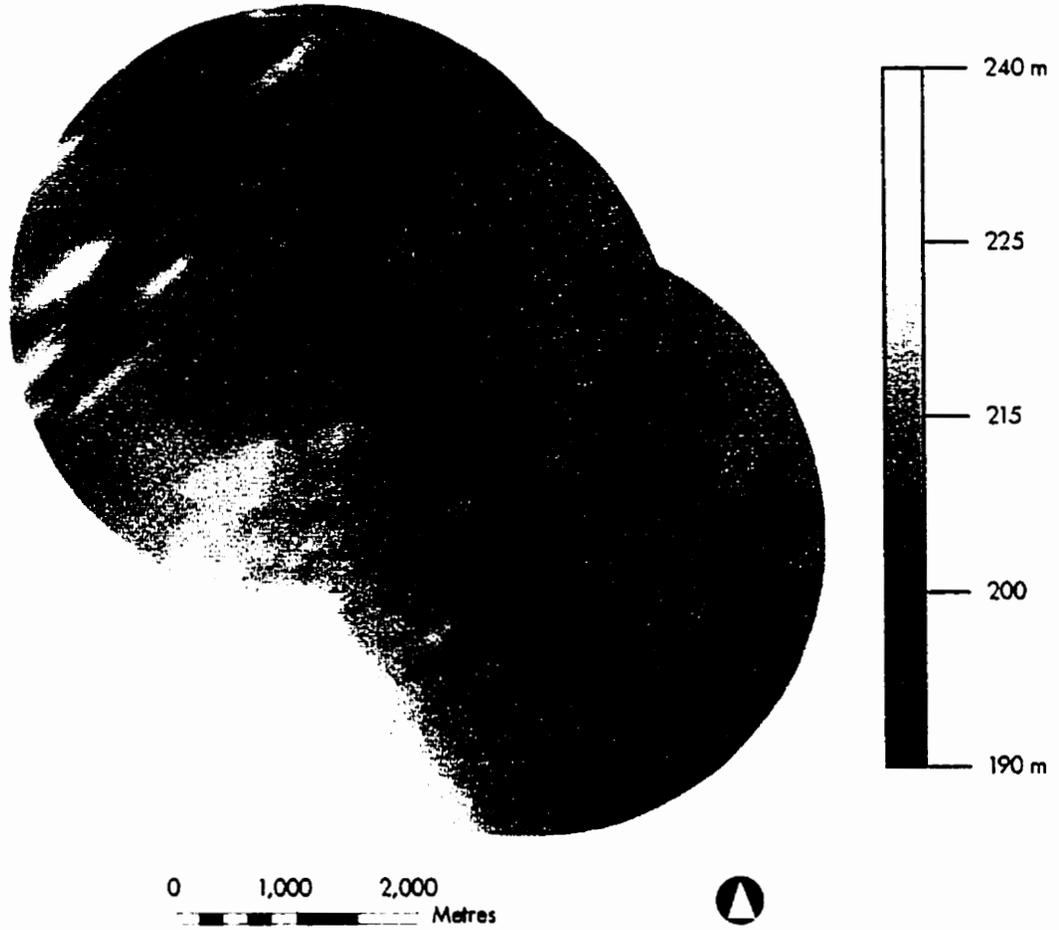
## Section 5.2

### Topographic Landscapes

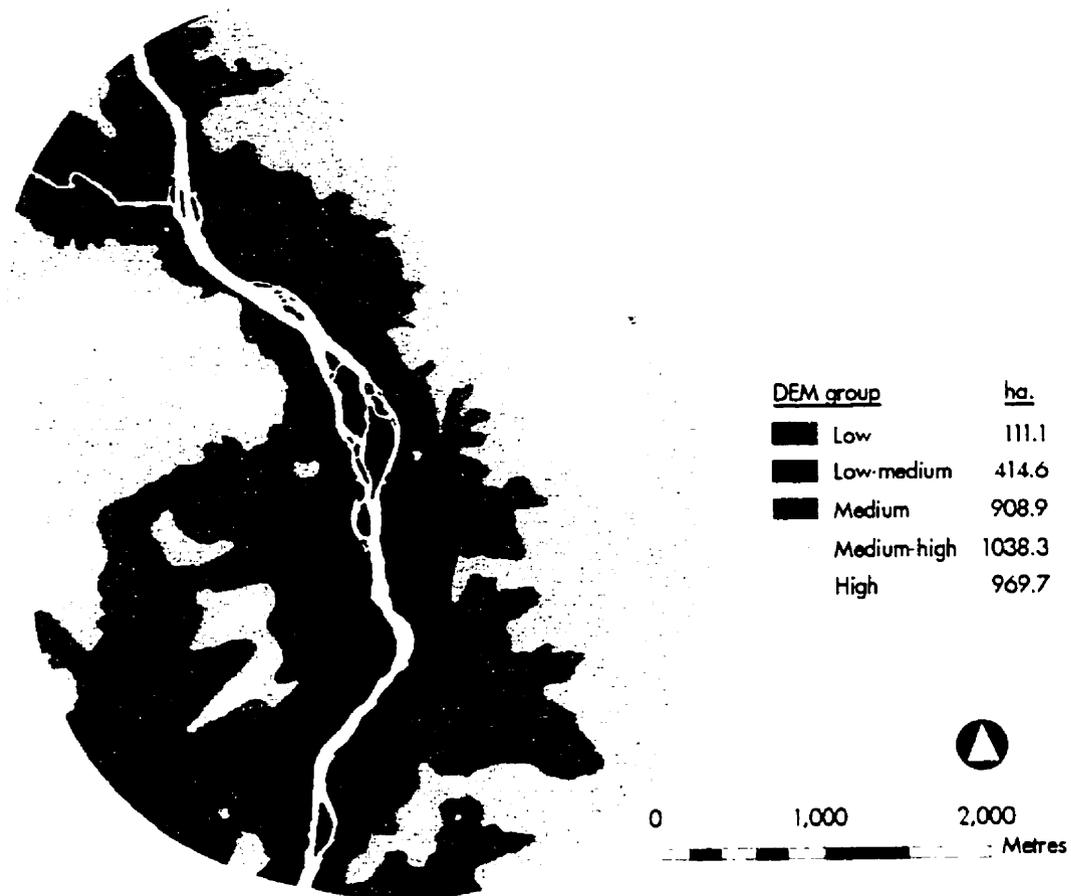
Topographic landscapes consist of measurements derived from digital elevation models (DEM). DEM data are modelled in two formats: as substantive data by means of an absolute elevation continuum using DEM maps (Figure 5.2.1), measured in metres above mean sea level (ASL), and as inferential data, unique to each site, consisting of a suggested compartmentalisation of space by an ordering of the notion of elevation. The former are plotted by means of cumulative elevation, displayed as hypsometric curves. The latter groups DEM elevation data into five zones, unique to the elevation data for each cluster of sites (Figure 5.2.2), representing an inferential observation of space by means of an ordinal scale ranging from low to middle to high ground, with intermediary levels. The use of this latter methodology, for cluster, viewshed, and isochron data, allows for the comparison of otherwise disparate elevation data.

### *Cultural Clusters*

There is little patterning evident for the Princess Point group at the cluster scale of enquiry. No single cluster stands out as unique besides the fact that the Cootes cluster elevation data ranges from 70 m to 170 m ASL and the other three clusters range from 180 to 250 m ASL. The latter are shown in Figure 5.2.3, as elevation by percentage of cluster. The lower Grand River Princess Point sites display relatively similar hypsometric curves for the Cayuga and Oxbow clusters, comprised of low elevations corresponding to the proximity of the Grand



**Figure 5.2.1: DEM map of the Cayuga cluster.**



**Figure 5.2.2: Ordinal elevation group map of the Indiana cluster.**

River and higher elevations in the surrounding drumlins and hillocks of the associated uplands. The cumulative elevation data for the Indiana cluster reveals an even more pronounced orientation towards low-lying land. This is likely the result of the large river flats on both sides of the Grand River at this locale. When the elevation data for the four Princess Point clusters are charted as a single group, on average, 70% of the cumulative elevation data falls under 200 m ASL.

The elevation data associated with the Middle Woodland clusters are similar to those of Princess Point (Figure 5.2.4). The Middle Woodland Delaware and Pond Mills clusters cumulative elevation curves reveal an orientation similar to that of the three Grand River Princess Point clusters. The Pond Mills cluster displays a orientation favouring lower elevations, nearly replicating the curve plotted for the Princess Point Indiana cluster, while the Delaware cluster curves falls midway between the two trends charted for the Grand River Princess Point clusters.

The Glen Meyer data falls into a similar pattern as observed for the other two culture groups. The Caradoc and Dorchester clusters reveal nearly identical cumulative elevation plots, indicating a fairly straight line from low to high elevation in metres ASL. The observation that more than three-quarters of the Wentworth cluster is situated above 200 m ASL, in comparison to less than half of the Caradoc and Dorchester clusters, can be readily explained by recognizing that the Wentworth cluster is located on the Niagara Escarpment, and that a portion of the cluster's 5 km catchment is represented by land below the escarpment. This topographic feature is indicated by the abrupt rise in elevation values between 200 and 220 m ASL (Figure 5.2.5).

Grouping the elevation data into ordinal scale bands does not reveal any patterning with regards to cluster orientation in the topographic landscape (Figures 5.2.6 and 5.2.7). The ordinal representation of each cluster follows that of the respective cumulative elevation charts. The Princess Point clusters reveal between one- to two-thirds low to medium-low elevation per cluster, similar to the Glen Meyer clusters. The Middle Woodland cluster data show that the range for low to medium-low elevation is less, and that both clusters average slightly over two-thirds for the first two ordinal elevation groups. The medium-high to high elevation groups account for half to one-third of the Princess Point clusters. For Middle Woodland, this value drops to less than one-fifth of both clusters, and rises to range from one-third to less than one-fifth for Glen Meyer clusters. For the random locations, the medium-high and high categories account for one-third of the elevation data, compared to less than one-fifth for the lower Grand River Cayuga and Indiana clusters while the low to medium-low elevation data represents over 40% of the random locations and over 60% of the lower Grand River Princess Point sites. As with the cumulative elevation data, the general trend observed in the ordinal elevation group charts is one of lower and middle elevation orientations over that of higher elevation orientations. No conclusive statistics can be drawn from these results.

### *Site Viewsheds*

Viewsheds depicted as cumulative elevation in m ASL for Princess Point sites are uniformly similar across the four clusters. That the Princess Point viewsheds reveal little to no variation when charted as cumulative elevations suggests that, regardless of location, a

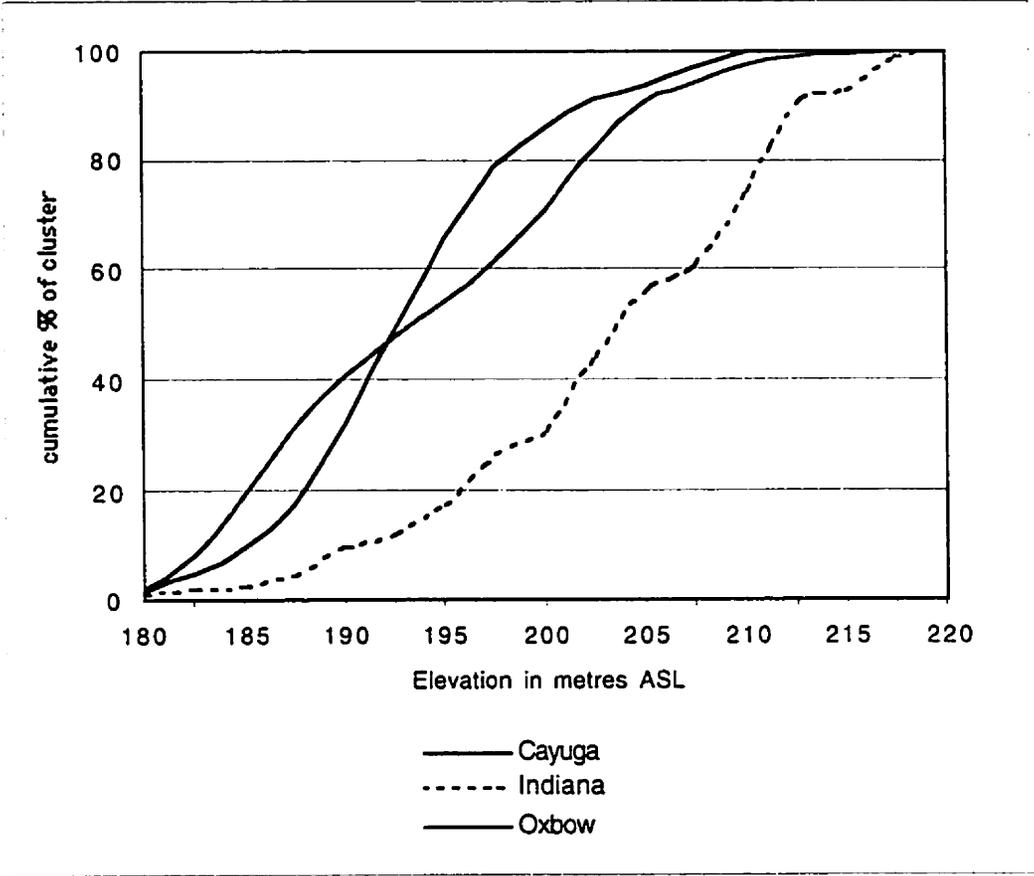


Figure 5.2.3: Elevation in metres ASL for Princess Point clusters.

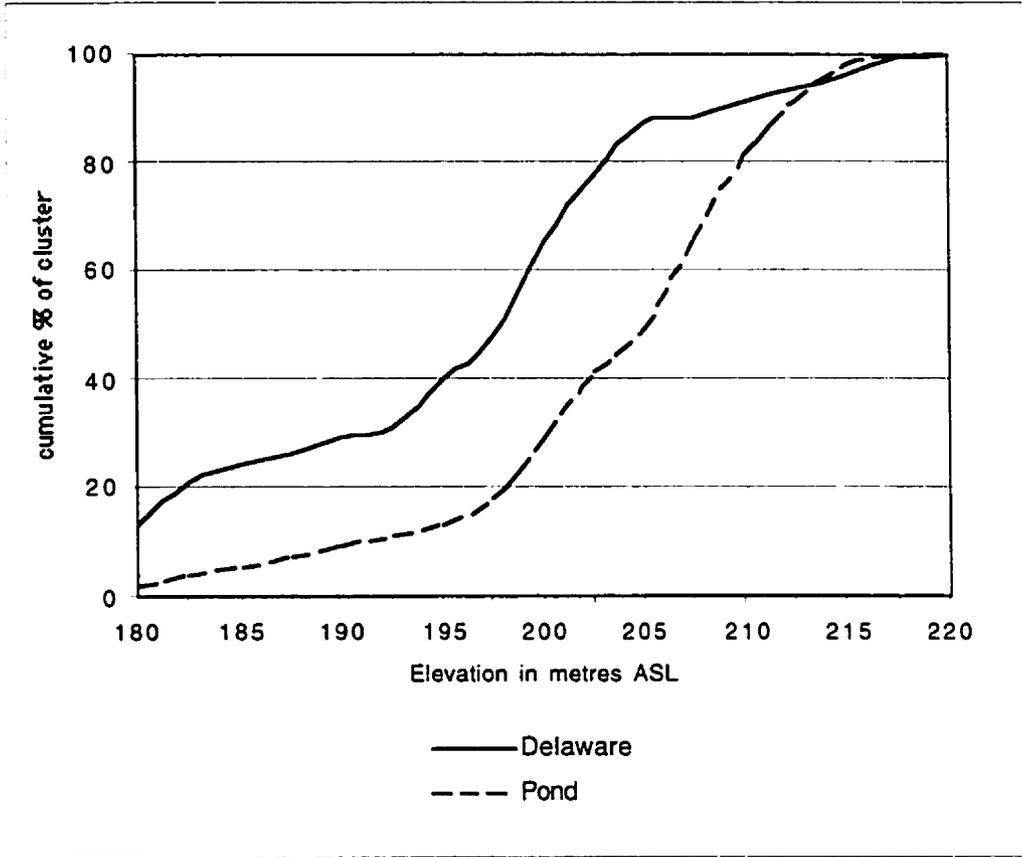


Figure 5.2.4: Elevation in metres ASL for Middle Woodland clusters.

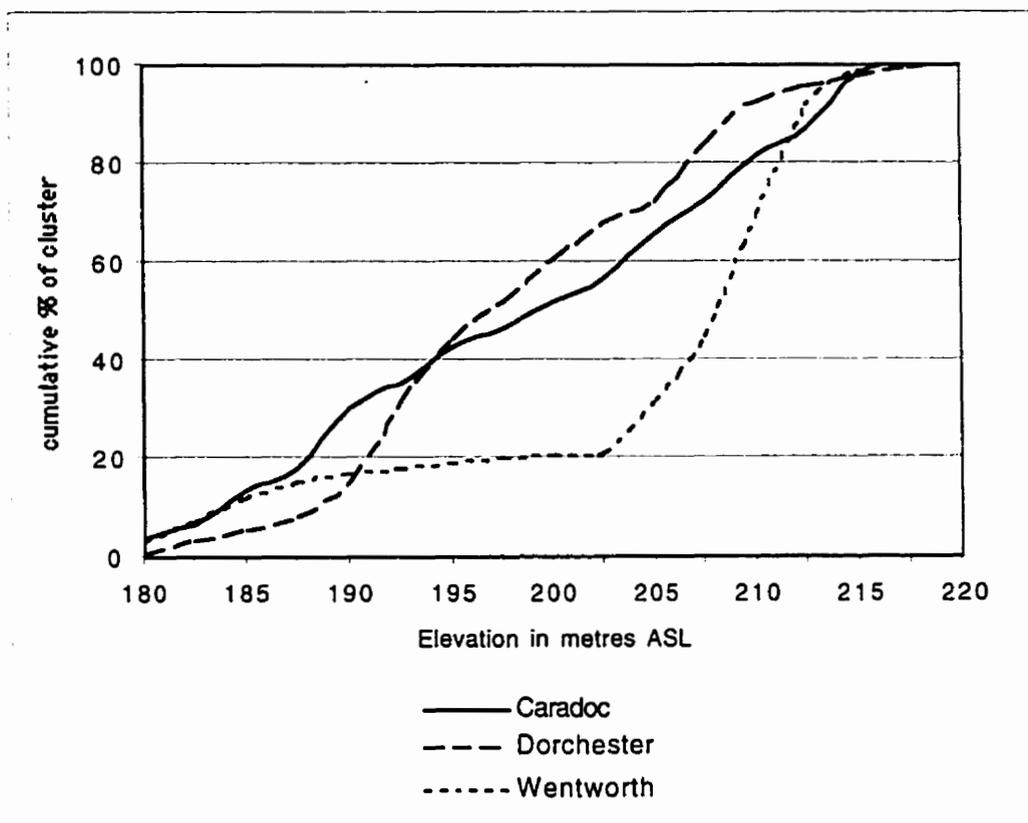
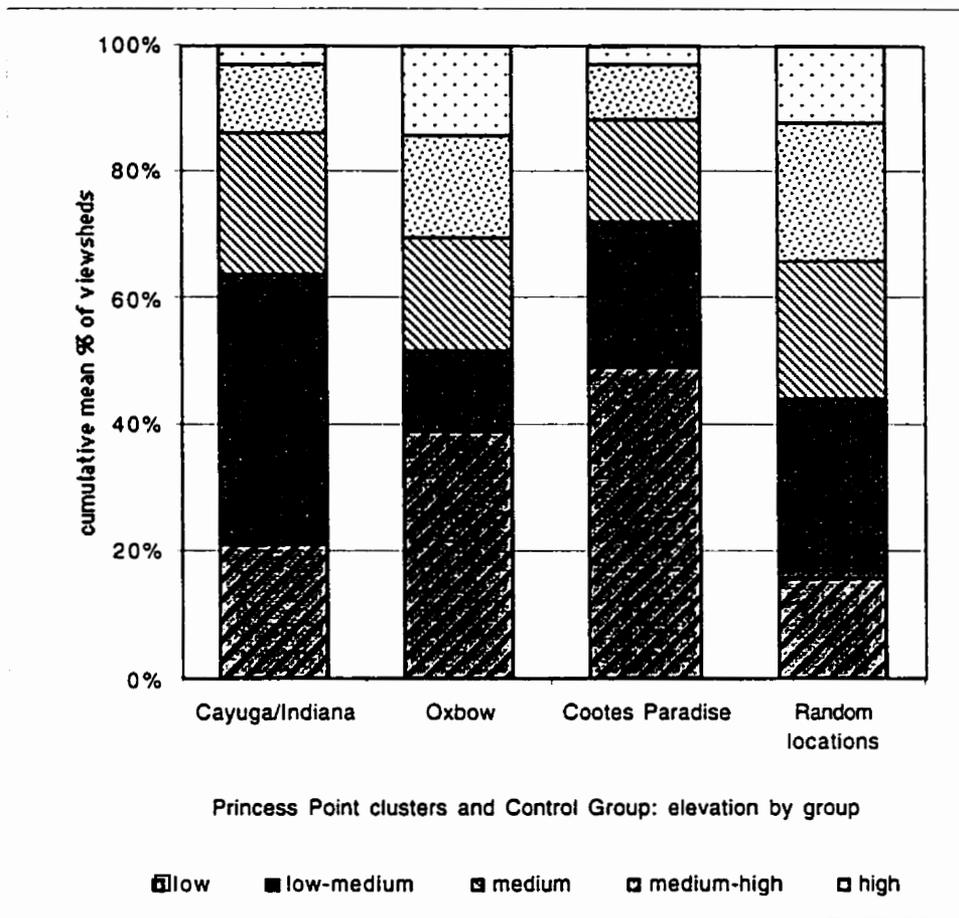


Figure 5.2.5: Elevation in metres ASL for Glen Meyer clusters.



**Figure 5.2.6: Ordinal elevation groups for Princess Point clusters and Control Group random locations.**

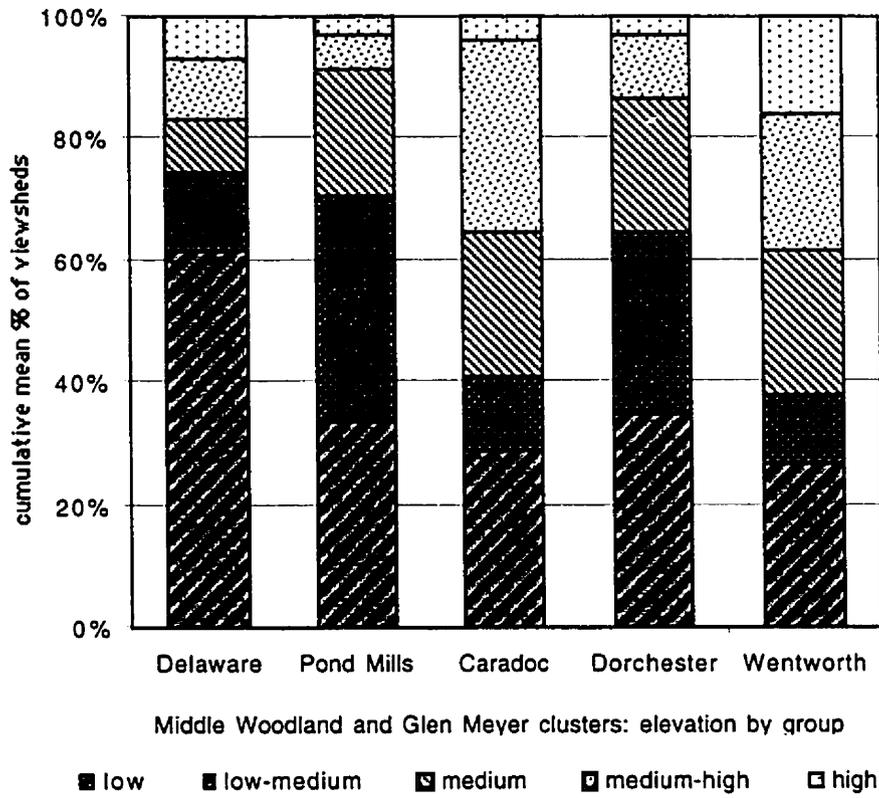


Figure 5.2.7: Ordinal elevation groups for Middle Woodland and Glen Meyer clusters.

conformity of topographic landscape was selected for by Princess Point groups. The cumulative elevations for the lower Grand River sites are shown in Figure 5.2.8. The natural landscape cumulative elevation of the lower Grand River valley does not correspond to the seven Princess Point sites, instead indicating a more gradual rise in elevation, paralleling the Princess Point data curves.

The cumulative elevations for the viewsheds of the Cayuga and Indiana sites are the most similar of the Princes Point data. All of the sites in these two clusters fall within 90% confidence intervals for the two-cluster mean. Moreover, these intervals do not extend into the 90% confidence intervals of the natural landscape, provided as a base line against which to measure the viewshed data. The sites of the Cootes Paradise cluster, save the Princess Point site and, to a lesser degree, the Bull's Point site, also fall within 90% confidence intervals as determined by the viewshed mean curve. Of the four site clusters, the Oxbow sites display the greatest variation in cumulative elevation by viewshed.

Princess Point viewsheds, however, show less variation in cumulative elevation than those of Middle Woodland or Glen Meyer. The relative uniformity of the Princess Point data contrasts with the Middle Woodland and Glen Meyer cumulative relative elevation data sets. While the cumulative elevation viewsheds of Middle Woodland Delaware cluster sites reveal a similar, although less structured pattern to that of the Princess Point sites (Figure 5.2.9), the Pond Mills cluster displays a wide range of site viewsheds as relative cumulative elevations. Glen Meyer sites are even more variable. The Dorchester sites show two distinct trends (one favouring low elevation, the other, relatively high). The Caradoc viewsheds display no patterning, either in relation to the natural landscape of the Caradoc Sand Plain, or to each other

(Figure 5.2.10), other than to note that, in general, Glen Meyer sites indicate less of an emphasis on lower elevations. A similar assessment can be made regarding the Wentworth viewshed data. The viewsheds for the Holmdale, Porteous, and Lone Pine Grey sites do present some comparative uniformity as cumulative relative elevations, displaying a preference for low elevations, an orientation more similar to the Princess Point sites. The viewsheds of the Control Group random locations indicate ten different cumulative elevations with no evident commonality.

The same viewsheds, depicted as ordinal elevation categories, exhibit a variety of percentages for each of the elevation groups within each cluster. The complete data are shown in Figures 5.2.11, 5.2.12, and 5.2.13, for Princess Point Cayuga/Indiana, Cootes Paradise, and Oxbow viewsheds, Figure 5.2.14 for Control Group random locations in the lower Grand River valley, Figures 5.2.15 and 5.2.16 for Middle Woodland Delaware and Pond Mills viewsheds, Figures 5.2.17, 5.2.18, and 5.2.19, for Glen Meyer Caradoc, Dorchester, and Wentworth viewsheds, and 5.2.20 for the Grey site viewsheds.

Elevation data, taken from the above figures and analysed by correlation statistics (Table 5.2.1), indicates that the Cayuga and Indiana viewsheds have predominantly high correlations for the majority of the ordinal elevation group data in these two clusters. These strong correlations are carried through to the Cootes Paradise viewsheds, which also display strong correlations for the majority of the data. However, the Oxbow viewsheds, less uniform in their elevation group data, display a mixture of moderate to poor correlations for the ordinal elevation group data.

When the lower Grand River valley sites and the random locations elevation data are compared, the result is also a strong correlation ( $r = 0.816$ ). The extent of this correlation is lessened when the values and standard deviations for the five elevation groups are compared between the two data sets. For Princess Point, the group elevations, as percentages of the total viewshed, are: low 21.2%  $\pm$ 10.1%, low-medium 42.4%  $\pm$ 10.3%, medium 22.5%  $\pm$ 4.8%, medium-high 10.6%  $\pm$ 4.1%, and high 3.3%  $\pm$ 1.7%. For the Control Group viewsheds, the group elevations are: low 16.2%  $\pm$ 16%, low-medium 28.0%  $\pm$ 18.1%, medium 21.6%  $\pm$ 12.4%, medium-high 21.4%  $\pm$ 21.0%, and high 12.3%  $\pm$ 12.0%. The one standard deviations for the Control Group ranges from 16% to 21.0%, indicating the relative variability within the Control Group data set.

The Princess Point range in standard deviation is not only lower, but drops noticeably, as do the viewshed data, as the viewshed approaches medium and high elevations. As well, the correlation data for the Control Group viewsheds indicate that there is no correlation between the ordinal elevation data for each of the random location viewsheds in the lower Grand River valley (Table 5.2.4). This result reinforces the Princess Point data, that the relationship between site location and relative elevation suggests that Princess Point groups selected similar locations within a wider topographic landscape.

The Middle Woodland correlation data for the viewsheds of the Delaware and Pond Mills cluster sites show strong correlations for the viewsheds of the former, and moderate to weak correlations for the viewsheds of the latter (Table 5.2.2). A similar result is noted for viewshed correlation data in the Glen Meyer clusters, in which the number of values depicting

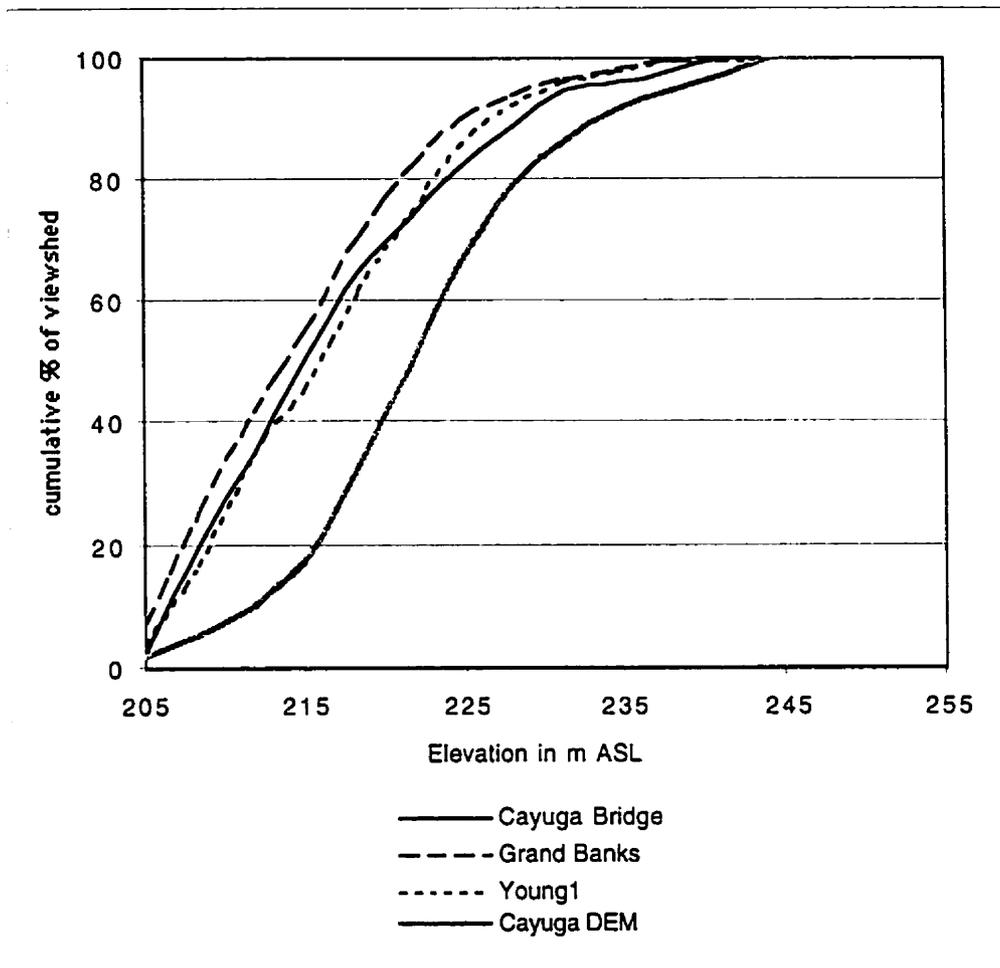


Figure 5.2.8: Elevation in metres ASL for Cayuga viewsheds.

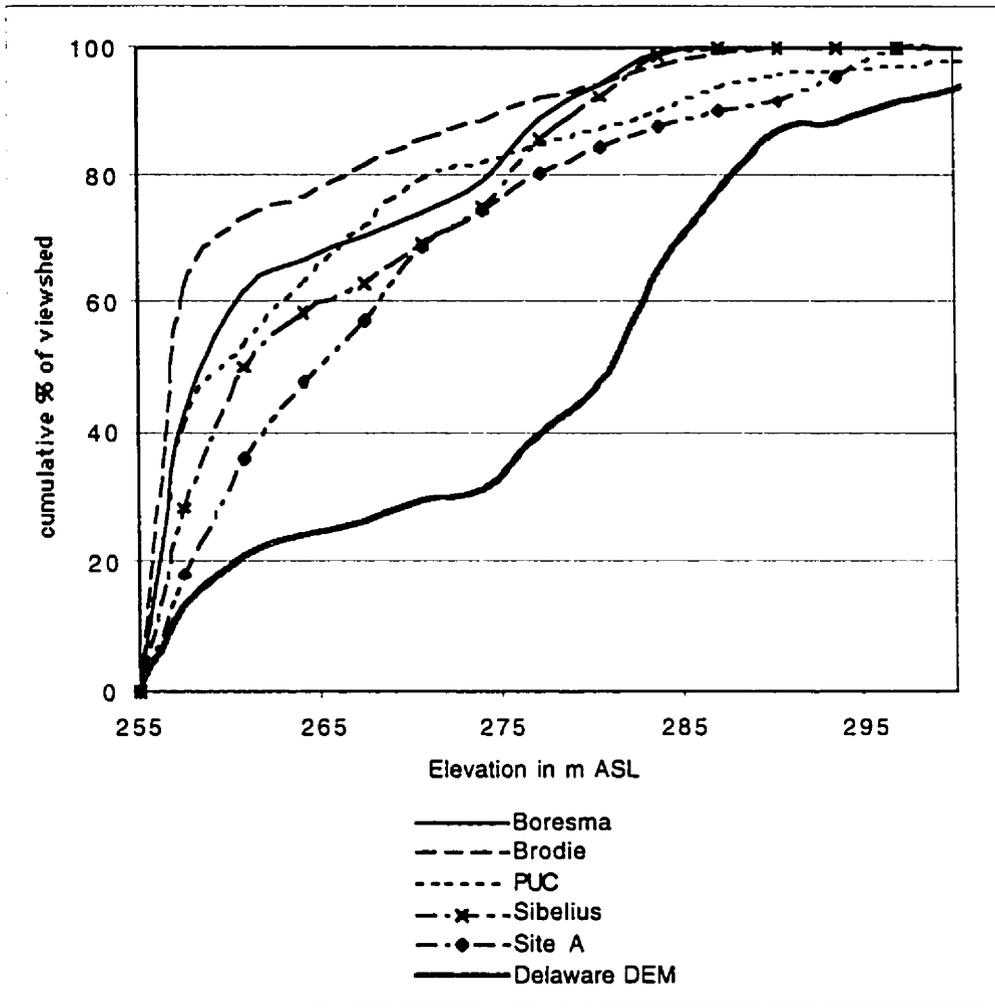


Figure 5.2.9: Elevation in metres ASL for Delaware viewsheds.

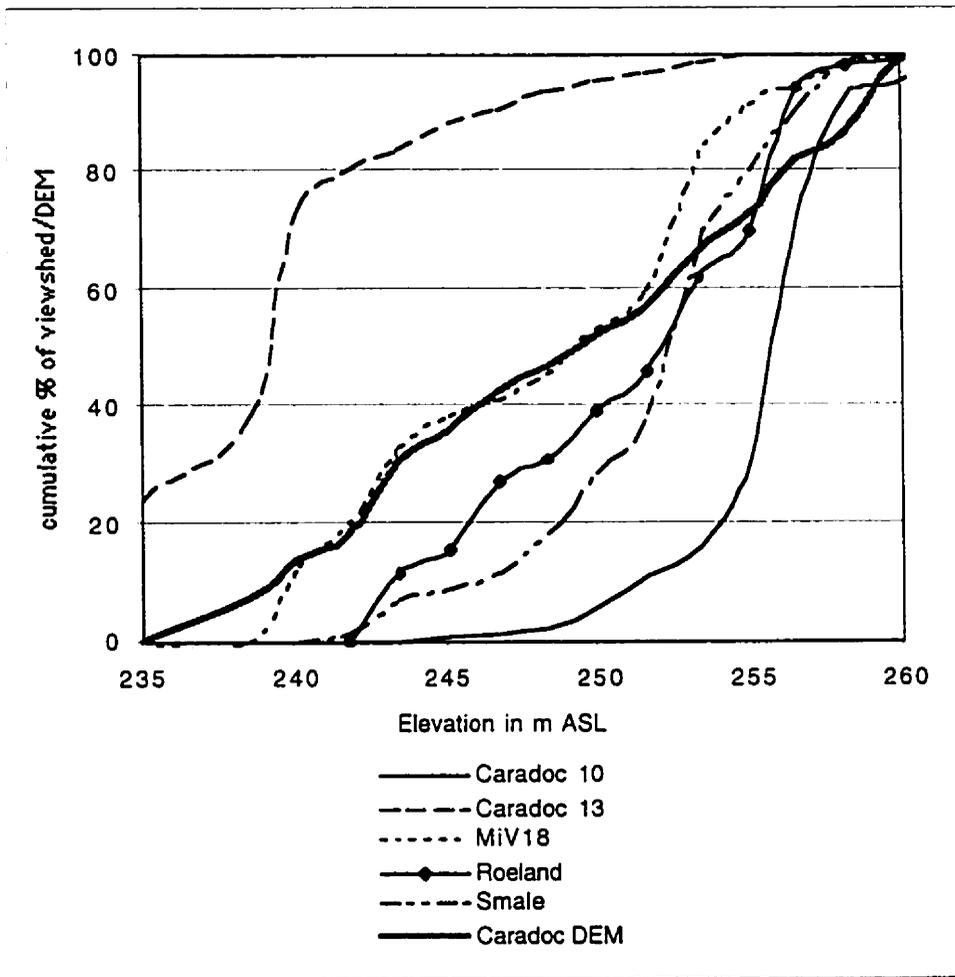


Figure 5.2.10: Elevation in metres ASL for Caradoc viewsheds.

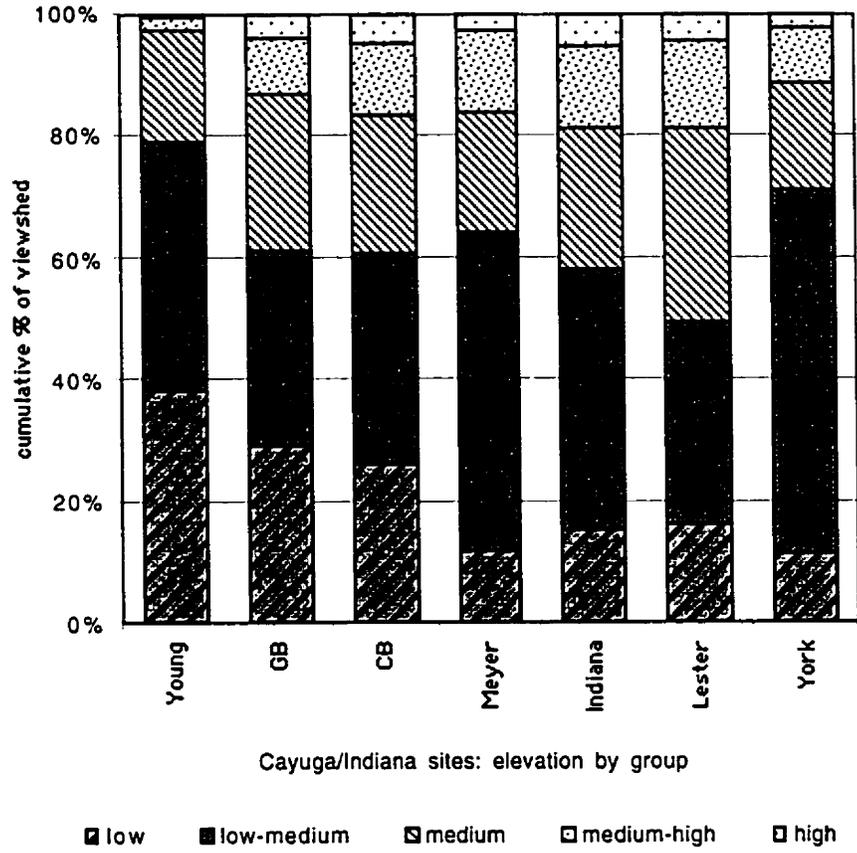


Figure 5.2.11: Ordinal elevation groups for lower Grand River valley viewsheds.

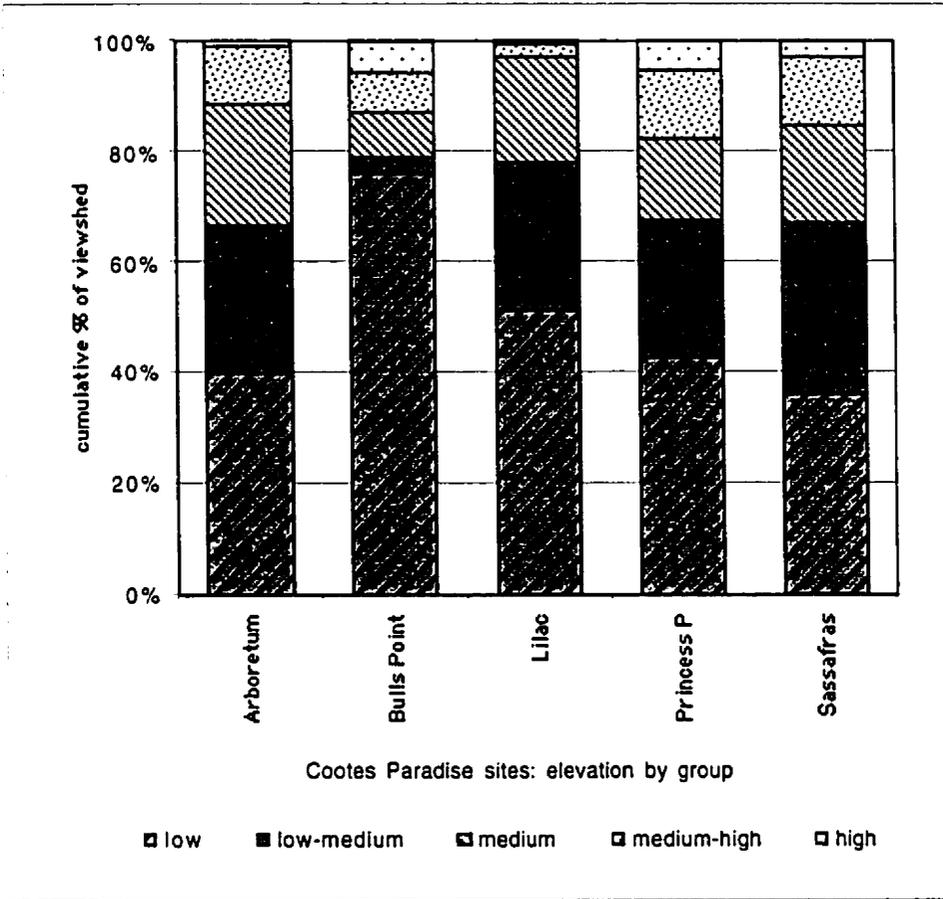


Figure 5.2.12: Ordinal elevation groups for Cootes Paradise viewsheds.

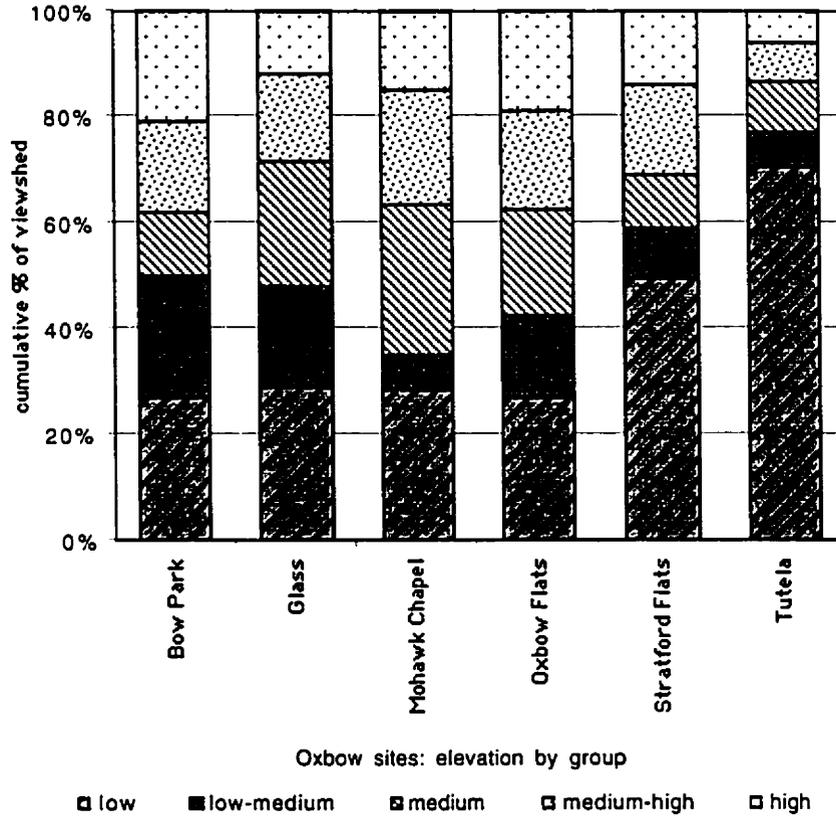
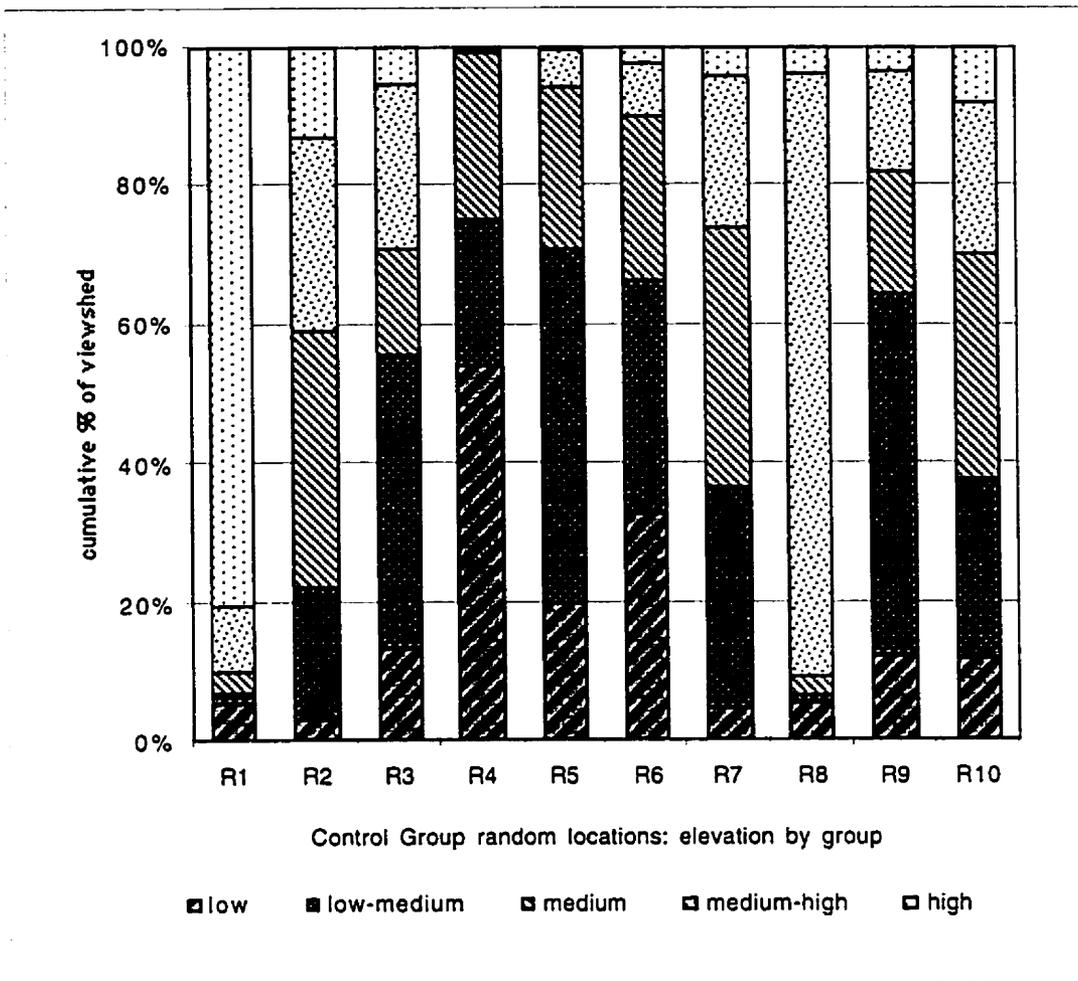


Figure 5.2.13: Ordinal elevation groups for Oxbow viewsheds.



**Figure 5.2.14: Ordinal elevation groups for Control Group random location viewsheds.**

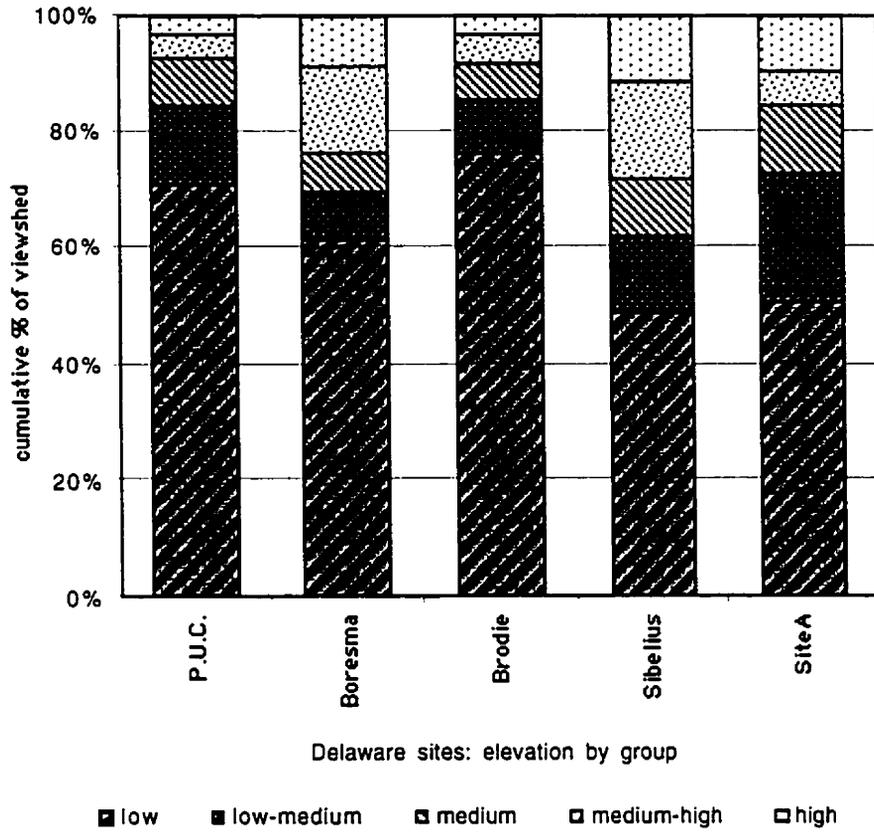


Figure 5.2.15: Ordinal elevation groups for Delaware viewsheds.

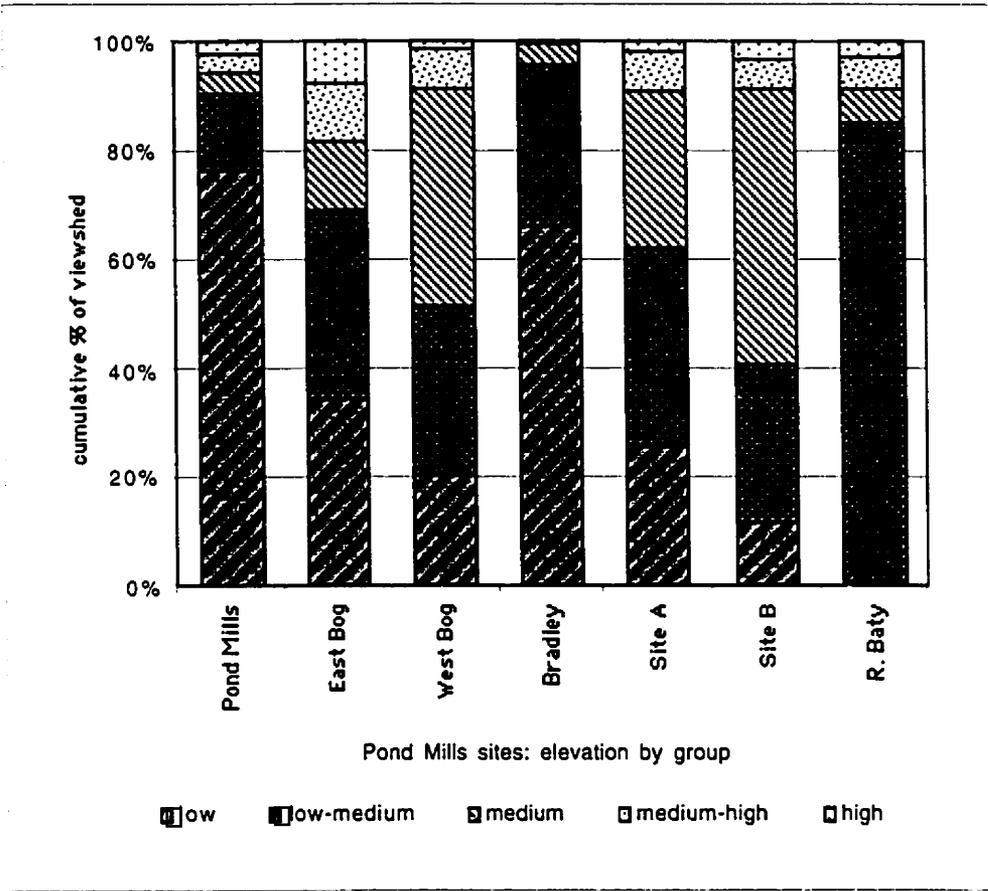
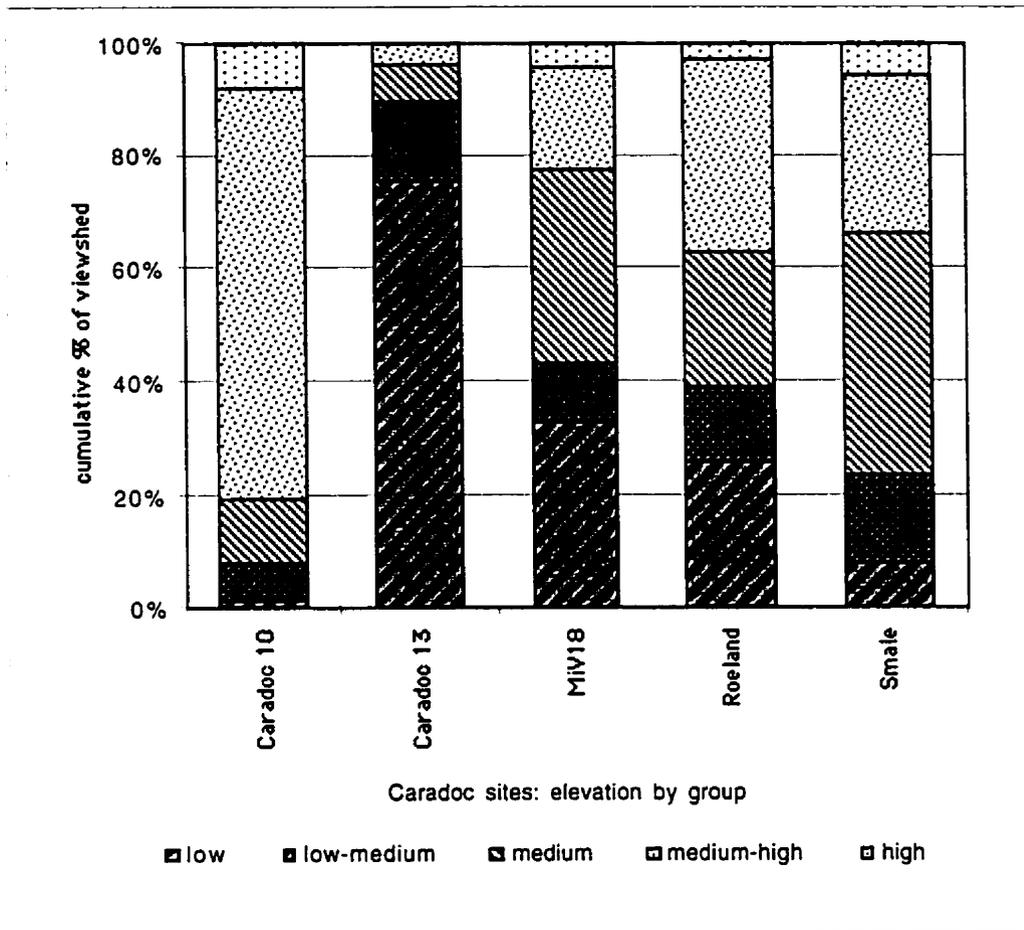


Figure 5.2.16: Ordinal elevation groups for Pond Mills viewsheds.



**Figure 5.2.17: Ordinal elevation groups for Caradoc viewsheds.**

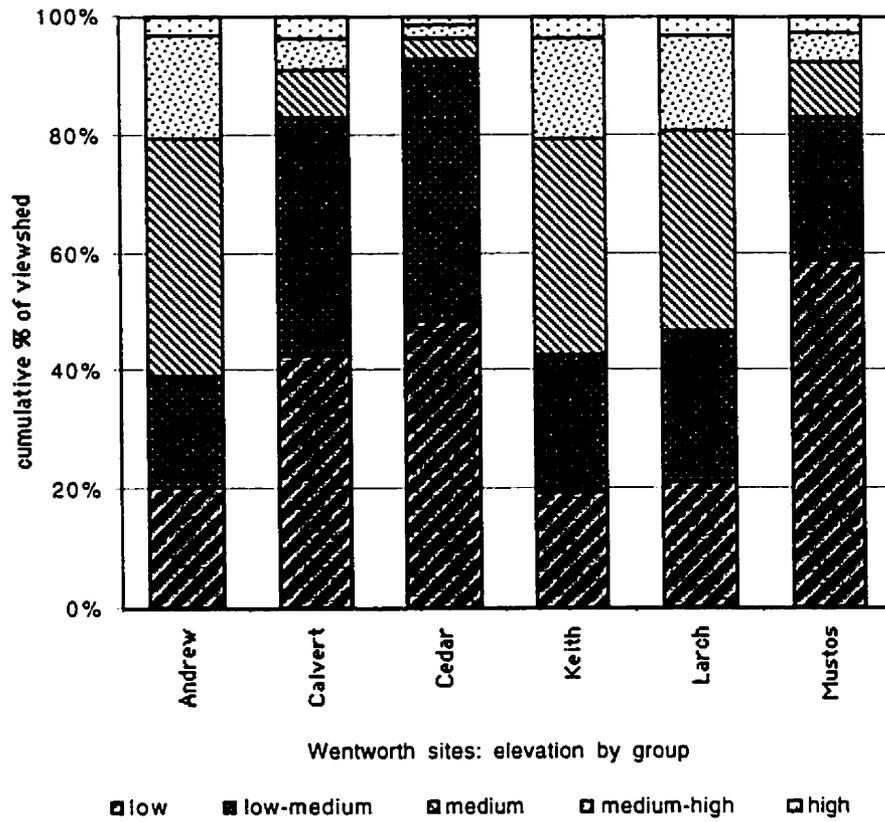


Figure 5.2.18: Ordinal elevation groups for Dorchester viewedsheds.

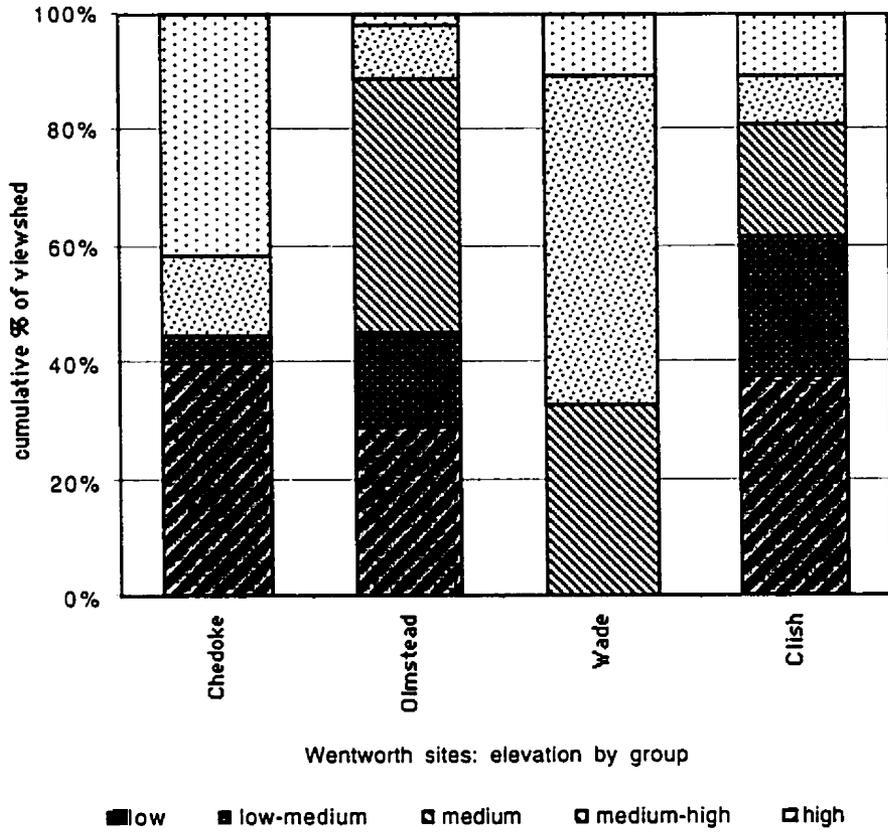


Figure 5.2.19: Ordinal elevation groups for Wentworth viewsheds.

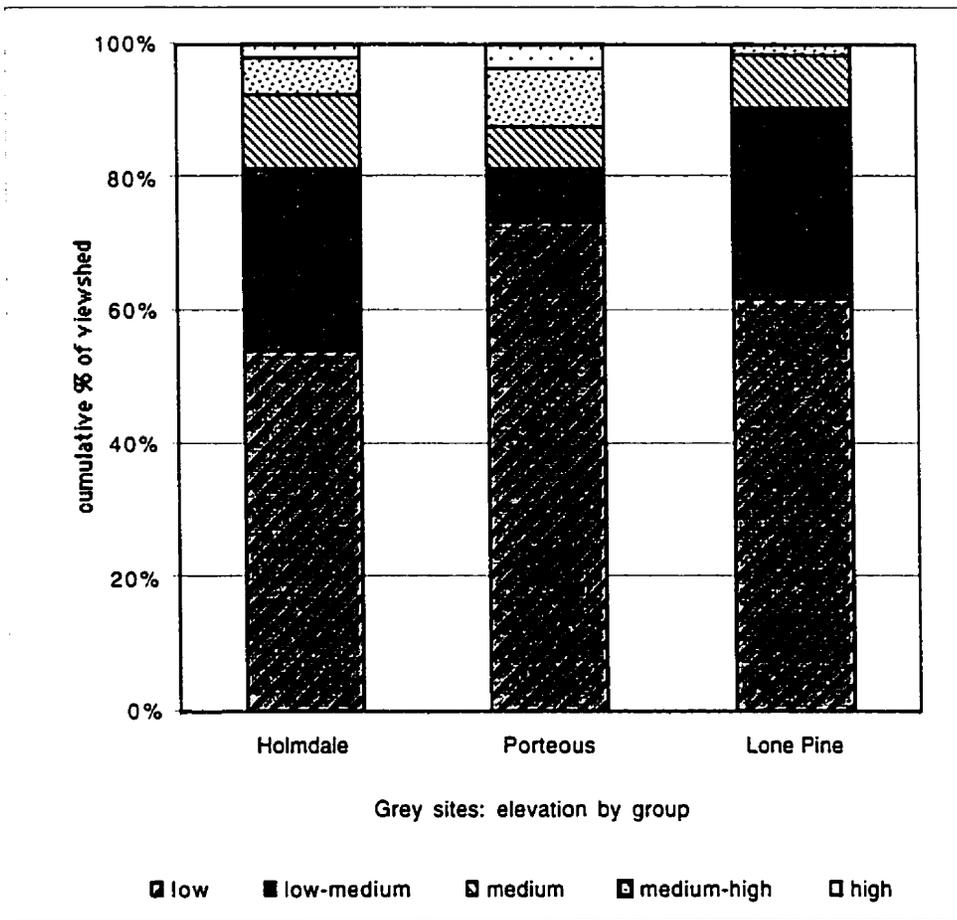


Figure 5.2.20: Ordinal elevation groups for Grey site viewedsheds.

Table 5.2.1: Ordinal elevation group correlation data for Princess Point viewsheds.

Cayuga & Indiana	Young I	Grand Banks	Cayuga Bridge	Meyer	Indiana	Lester	York
Young I	1						
Grand Banks	0.948	1					
Cayuga Bridge	0.947	0.969	1				
Meyer	0.681	0.707	0.842	1			
Indiana	0.722	0.778	0.886	0.991	1		
Lester	0.644	0.822	0.842	0.832	0.896	1	
York	0.692	0.689	0.828	0.993	0.975	0.779	1

Cootes Paradise	Arboretum	Bulls Point	Lilac Gardens	Princess Point	Sassafras Point
Arboretum	1				
Bulls Point	0.736	1			
Lilac Gardens	0.968	0.832	1		
Princess Point	0.948	0.865	0.968	1	
Sassafras Point	0.965	0.634	0.926	0.934	1

Oxbow	Bow Park	Glass	Mohawk Chapel	Oxbow Flats	Stratford Flats	Tutela
Bow Park	1					
Glass	0.245	1				
Mohawk Ch.	-0.227	0.634	1			
Oxbow Flats	0.402	0.703	0.796	1		
Stratford Flats	0.687	0.669	0.545	0.924	1	
Tutela	0.670	0.779	0.555	0.920	0.983	1

**Table 5.2.2: Ordinal elevation group correlation data for Middle Woodland viewsheds.**

<i>Delaware</i>	<i>PUC</i>	<i>Boresma</i>	<i>Brodie</i>	<i>Sibelius</i>	<i>Site A</i>
<i>P.U.C.</i>	1				
<i>Boresma</i>	0.970	1			
<i>Brodie</i>	0.997	0.986	1		
<i>Sibelius</i>	0.972	0.998	0.985	1	
<i>Site A</i>	0.941	0.881	0.921	0.897	1

<i>Pond Mills</i>	<i>Pond Mills</i>	<i>East Bog</i>	<i>West Bog</i>	<i>Bradley</i>	<i>Site A</i>	<i>Site B</i>	<i>R. Baty</i>
<i>Pond Mills</i>	1						
<i>East Bog</i>	0.725	1					
<i>West Bog</i>	0.085	0.453	1				
<i>Bradley</i>	0.952	0.897	0.231	1			
<i>Site A</i>	0.332	0.778	0.905	0.537	1		
<i>Site B</i>	-0.190	0.137	0.941	-0.079	0.721	1	
<i>R. Baty</i>	-0.160	0.555	0.418	0.146	0.628	0.288	1

**Table 5.2.3: Ordinal elevation group correlation data for Glen Meyer viewsheds.**

<i>Caradoc</i>	<i>Caradoc 10</i>	<i>Caradoc 13</i>	<i>MiV18</i>	<i>Roeland</i>	<i>Smale</i>
<i>Caradoc 10</i>	1				
<i>Caradoc 13</i>	-0.387	1			
<i>MiV18</i>	-0.083	0.557	1		
<i>Roeland</i>	0.626	0.281	0.683	1	
<i>Smale</i>	0.381	-0.409	0.505	0.545	1

<i>Dorchester</i>	<i>Andrew</i>	<i>Calvert</i>	<i>Cedar</i>	<i>Keith</i>	<i>Larch</i>	<i>Mustos</i>
<i>Andrew</i>	1					
<i>Calvert</i>	0.054	1				
<i>Cedar</i>	-0.004	0.998	1			
<i>Keith</i>	0.976	0.179	0.119	1		
<i>Larch</i>	0.932	0.353	0.295	0.983	1	
<i>Mustos</i>	0.104	0.865	0.869	0.123	0.261	1

<i>Wentworth</i>	<i>Chedoke</i>	<i>Olmstead</i>	<i>Wade</i>	<i>Clish</i>
<i>Chedoke</i>	1			
<i>Olmstead</i>	0.932	1		
<i>Wade</i>	-0.015	0.164	1	
<i>Clish</i>	0.509	0.681	0.834	1

**Table 5.2.4: Ordinal elevation group correlation data for Control Group viewsheds.**

Control Group	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
<i>R1</i>	1									
<i>R2</i>	-0.288	1								
<i>R3</i>	-0.599	0.172	1							
<i>R4</i>	-0.526	-0.455	-0.006	1						
<i>R5</i>	-0.610	0.037	0.818	0.401	1					
<i>R6</i>	-0.730	-0.185	0.503	0.828	0.841	1				
<i>R7</i>	-0.605	0.829	0.600	-0.122	0.587	0.334	1			
<i>R8</i>	-0.161	0.303	0.111	-0.473	-0.439	-0.503	0.021	1		
<i>R9</i>	-0.534	0.117	0.949	0.114	0.941	0.638	0.617	-0.204	1	
<i>R10</i>	-0.684	0.837	0.536	-0.028	0.542	0.369	0.986	0.059	0.303	1

**Table 5.2.5: Ordinal elevation group correlation data for Grey site viewsheds.**

Grey sites	<i>Holmdale</i>	<i>Porteous</i>	<i>Lone Pine</i>
<i>Holmdale</i>	1		
<i>Porteous</i>	0.909	1	
<i>Lone Pine</i>	0.999	0.914	1

no correlation outnumber the few instances of elevation group correlation between viewsheds (Table 5.2.3). The data, as a whole, would indicate that there is little to no correlation for the ordinal elevation group viewsheds for the Glen Meyer sites. The Grey sites reveal a strong correlation for all three viewsheds (Table 5.2.5), matching that of the lower Grand River valley Princess Point viewsheds and the Cootes Paradise viewsheds. The Oxbow cluster data, in which two of the Grey sites are situated, also show a strong correlation to the Grey site viewsheds ( $r = 0.850$ ), but not to the same degree as the Grey sites do among themselves.

### *Residential and Habitat Isochrons*

The topographic landscapes of the residence and habitat isochrons exhibit little change from the data sets generated by the viewsheds. The mean viewshed values of the culture groups reveal a wide variation between groups (Figure 5.2.22). By ordinal elevation groups, the Princess Point residence isochrons average more than one-third of the viewshed for the low elevation group, compared to over two-fifths for the Middle Woodland group, and slightly over one-fifth for the Glen Meyer groups. The medium group's range is less, with each culture group averaging one-fifth of the viewshed. The high elevation group completes the viewshed data, ranging from under 5% for Princess point to nearly 20% for Middle Woodland, to less than 10% for Glen Meyer groups. The habitat isochron values for Princess point are similar in distribution. The Middle Woodland and Glen Meyer habitat isochron values are dissimilar to their counterpart residence values, the former showing an increase in lower elevation values and the latter showing an increase in higher elevation values.

From Table 5.2.6, the ordinal elevation groups for Princess Point residence group indicate a strong correlation with the Middle Woodland residence group and no correlation with the Glen Meyer residence group. Additionally, the Middle Woodland residence group reveals a weak correlation with that of Glen Meyer. For habitat isochrons, the results are similar. There is a strong correlation between the relative elevations of the Princess Point and Middle Woodland habitat isochrons, almost identical to that of the residence groups. The remaining correlations, between Princess Point and Glen Meyer, and Middle Woodland and Glen Meyer, indicate weak correlations for each.

The strength in the relationship between the Princess Point and Middle Woodland data is contrary to the geographic landscape data for the three culture groups, which exhibited a stronger Princess Point-Glen Meyer relationship for land area within the residence group. It appears that the Princess Point residence isochrons, although exhibiting a reduced land area from that of the Middle Woodland groups, are selecting similar topographic landscapes. The presence of each group within a riverine landscape may account for some degree of similarity between the two culture groups.

These data further demonstrate the significance of the affordances selected by the residence group in the topographic landscape. Residence group decisions regarding affordances relating to elevation apparently are prominent during the Princess Point culture, building upon a demonstrated presence during the Middle Woodland. By the Glen Meyer period, the residence group's influence had waned, at least in terms of topography in relation to the viewshed, perhaps replaced by more influential affordances and non-landscape criteria.

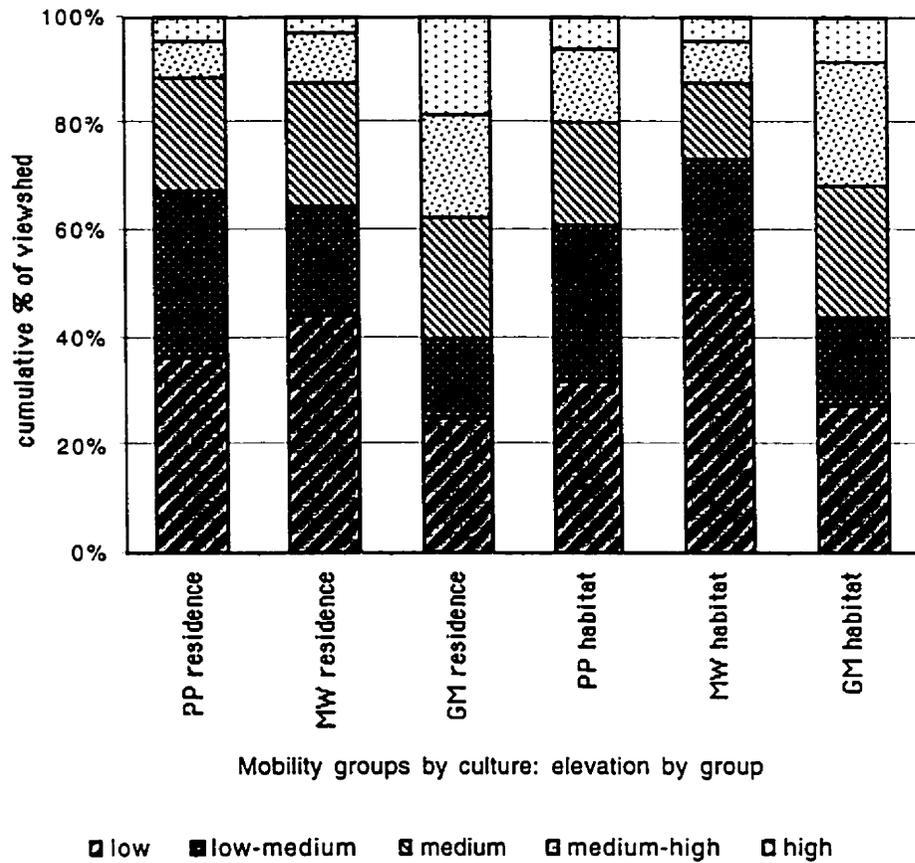
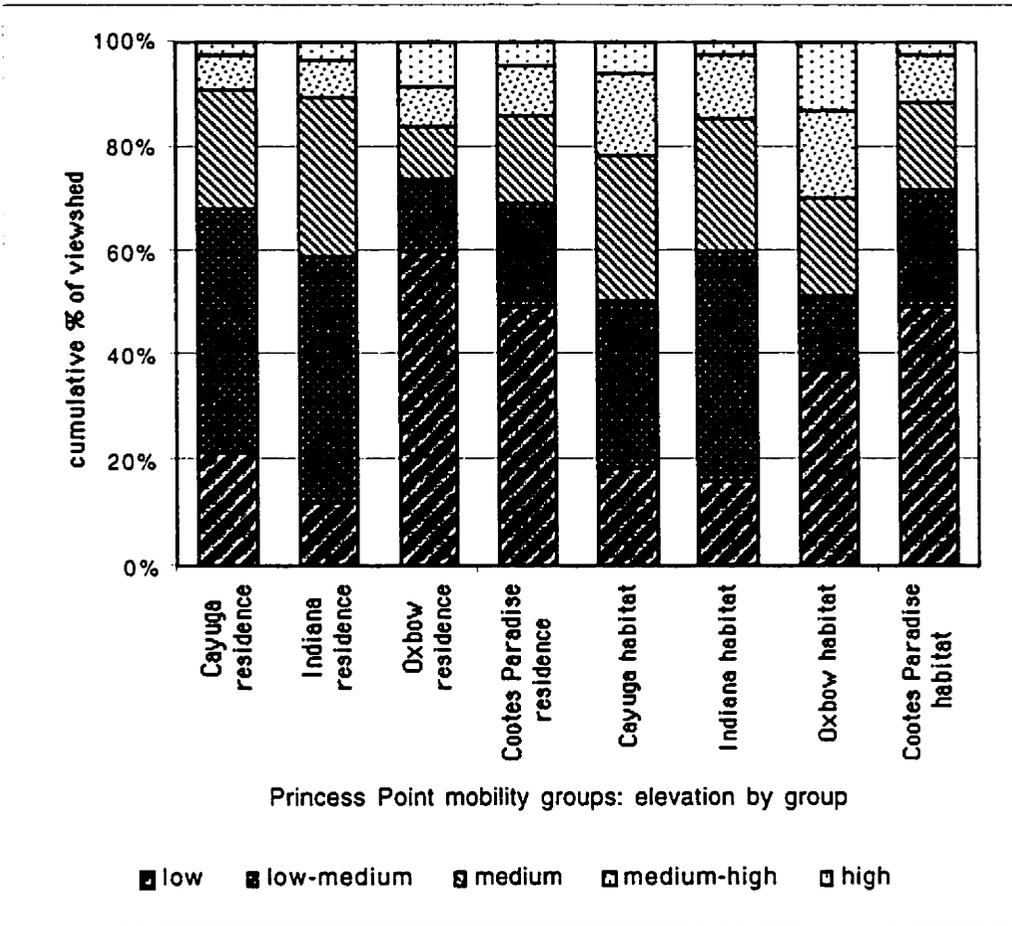


Figure 5.2.21: Ordinal elevation group means for residence isochrons by culture group.

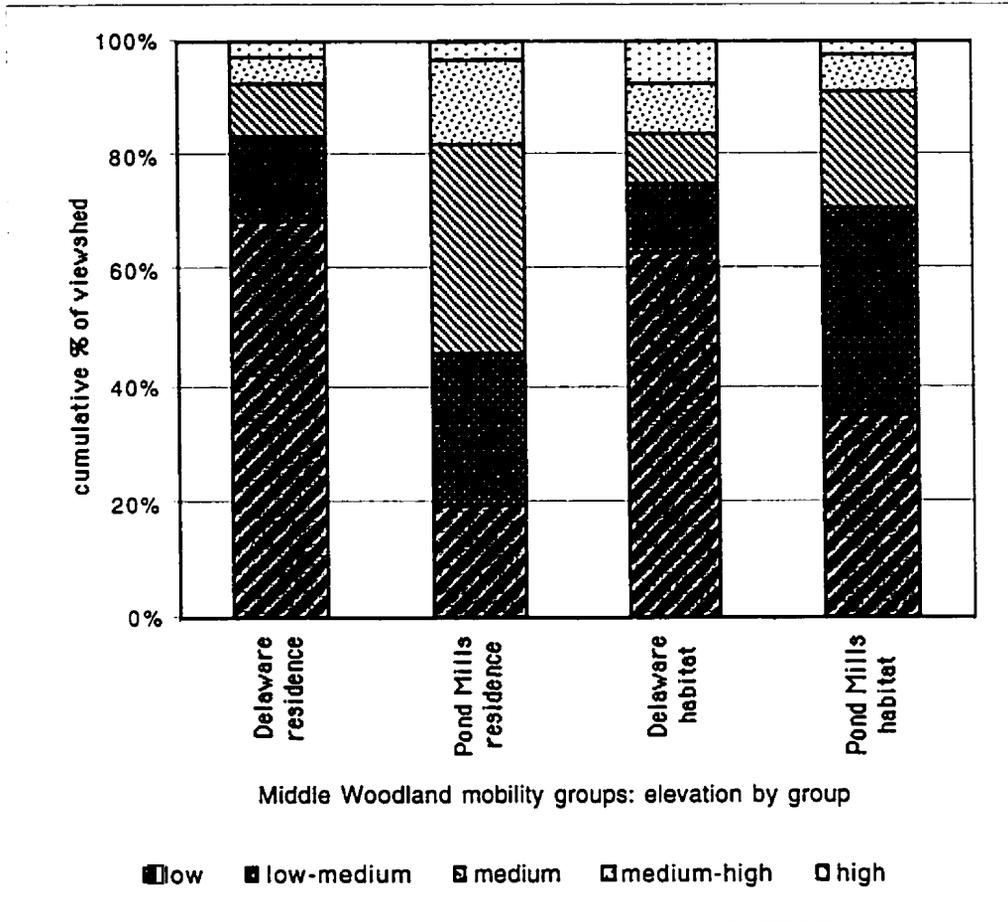
**Table 5.2.6: Ordinal elevation group correlation data for residence and habitat isochrons: all cultures.**

Residence Isochron	<i>Princess Point</i>	<i>Middle Woodland</i>	<i>Glen Meyer</i>
<i>Princes Point</i>	1		
<i>Middle Woodland</i>	0.898	1	
<i>Glen Meyer</i>	0.288	0.659	1

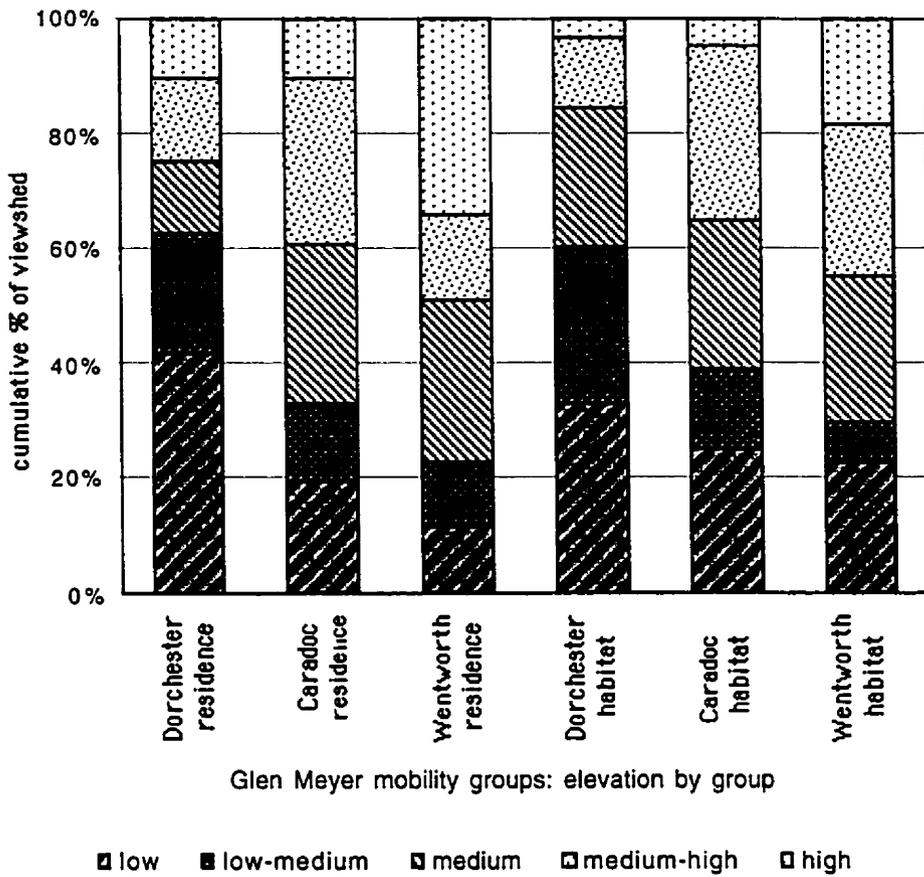
Habitat Isochron	<i>Princess Point</i>	<i>Middle Woodland</i>	<i>Glen Meyer</i>
<i>Princes Point</i>	1		
<i>Middle Woodland</i>	0.883	1	
<i>Glen Meyer</i>	0.564	0.558	1



**Figure 5.2.22: Ordinal elevation groups for Princess Point residence and habitat isochrons.**



**Figure 5.2.23: Ordinal elevation groups for Middle Woodland residence and habitat isochrons.**



**Figure 5.2.24: Ordinal elevation groups for Glen Meyer residence and habitat isochrons.**

The topographic landscape analysis reveals that the natural elevation of the landscape has little if any influence on the location of Princess Point, or, for that matter, Middle Woodland and Glen Meyer sites. When the natural elevation is modelled as relative elevation unique to each site, conformity emerges between Princess Point and Middle Woodland groups in that the majority of sites are oriented towards lower elevations. The Glen Meyer data reveals no such orientation for these sites, which display a trend similar to that of the natural landscape. The Princess Point orientation is more pronounced than that of the Middle Woodland at the viewshed stage of analysis; however, this trend is not borne out through the isochron data sets. The latter demonstrate no orientation preference for residence or habitat groups across all three culture groups. This conclusion would suggest that the riverine environments of the Princess Point and Middle Woodland groups contributed to the viewshed data sets, indicating a topographic orientation that could not be connected to practices relating to the mobility groups, or if so oriented, were not based on a single relative elevation variable.

## Section 5.3

### Water Landscapes

Water landscapes include both the extent of coverage by water-based resources and the combined affordances offered by low (first and second) and high (third and fourth) order water resources. Water resources are measured by area, in ha, and percentages of water-based resources by clusters, viewsheds, and mobility group isochrons. Ordered water resources are derived from the method of numbering streams as part of a drainage basin network. I modified this method in this research by representing streams, ponds, bogs, and marshlands as a low order water landscape group, and the Grand River and the Thames River as a high order water landscape group.

The rationale for including water landscapes stems from the observation that distance to water is the most important variable in all of the predictive models and in a majority of the locational models that other researchers have used (see Chapter 2). Curiously, the significance of water, for all manners of activities, resources, and transportation, is frequently overlooked in landscape models. This research not only rectifies this oversight but provides a measurement of the appropriateness of modelling the distance to water variable, by cluster, viewshed, and isochron. An explanatory model, such as the landscape model, enables the researcher to gauge the effect of water resources on changing cultural and physical attributes associated with sites, and to identify “the shape of the distribution [as] one descriptive measure of the settlement process” (Bellhouse *et al* 1996:85).

### *Cultural Clusters*

Although Princess Point sites appear to aggregate around either riverine, lacustrine, or wetland resources, this hypothesis has not been rigorously tested. In Chapter 3, I examine similarly untested statements that Middle Woodland sites align with lacustrine environments for macroband locales and Glen Meyer village locales occupy high points of land. The water landscape analysis quantifies these commonly held assumptions for each of the three cultures by documenting the relationship between water resources and site location. The water resource data analysis, identified as coverage in hectares and as a relative percentage of the total area for each cluster, results in patterning within and among the Princess Point, Middle Woodland, and Glen Meyer clusters.

The Princess Point water resources range from 133 ha and 135 ha for the Cayuga and Indiana clusters to 230 ha for the Oxbow cluster. The Cootes Paradise cluster is anomalous because of the large 560 ha Cootes Paradise lacustrine resource. As noted previously, the current open-water situation at Cootes Paradise is modern and the water value represents an exaggeration of the resource due to historic circumstances. An 18<sup>th</sup> century map depicts Cootes Paradise as a smaller lacustrine resource (Gentilecore and Head 1983:228). Pollen core samples taken from the region demonstrate that marshlands or low-lying ground likely comprised the dominant Cootes Paradise environment (D. Smith pers. comm. 1999).

The water landscapes for the Princess Point clusters support the observation that Princess Point settlement oriented towards significant riverine or lacustrine resources. Princess Point clusters display, per cluster, a water resource value in excess of that for each of the

**Table 5.3.1: Land-water resources by cluster.**

<i>Culture / Cluster</i>	<i>Total area ha</i>	<i>Land area ha</i>	<i>Water area ha</i>	<i>Water as % of cluster</i>
<i>Princess Point</i>				
Cayuga	3,281	3,148	133	4.1
Indiana	3,306	3,170	136	4.1
Cootes	2,933	2,373	560	19.1
Oxbow	6,859	6,629	230	3.4
<i>Middle Woodland</i>				
Delaware	4,632	4,501	131	2.8
Pond Mills	3,534	3,460	74	2.1
<i>Glen Meyer</i>				
Caradoc	4,892	4,850	42	0.9
Dorchester	3,602	3,532	70	1.9
Wentworth	6,361	6,303	58	0.9

Middle Woodland and Glen Meyer clusters (Table 5.3.1). The mean of the four Princess Point cluster water areas is 7.65% with a standard deviation of 7.63%, indicating a wide data spread. However, if the aberrant Cootes Paradise cluster is omitted from the calculations, the mean for the Princess Point Grand River clusters (combined Cayuga, Indiana, and Oxbow clusters) drops to exactly half of the previous value. The Grand River clusters' mean water area value is 3.84%  $\pm$ 0.42%, compared to the Middle Woodland mean value of 2.46%  $\pm$ 0.52% and a Glen Meyer mean value of 1.24%  $\pm$ 0.61%. This suggests that the land to water relationship remains unique for each group, with Princess Point demonstrating the strongest water resource orientation.

The water landscape data variation between Grand River Princess Point and Thames River Middle Woodland cluster sites indicates a 95% confidence that the observed variation between Princess Point and Middle Woodland values is significant ( $t = 3.3, p = 0.05$ ). Likewise, the difference in water area means between Princess Point and Glen Meyer is significant ( $t = 6.06, p = 0.002$ ). This demonstrates that the Princess Point group orientation towards water resources is stronger than the water resource affiliation of both Middle Woodland and Glen Meyer.

An analysis of the water resource or affordances as unique landscapes associated with low (first and second order water resources) and high (third and fourth order water resources) order water resources suggests a trend among the Princess Point clusters on the lower Grand River not apparent within the Control Group (Table 5.3.2). The high order water affordances average more than three-quarters of the water resources for all Princess Point site clusters, compared to less than two-thirds of the high order water resources attributed to the

Control Group natural landscape. This suggests that high order resources in the lower Grand River valley are not as predominant in the region despite the presence of the Grand River.

The Cootes Paradise cluster values, which are higher than those of the other three Princess Point clusters, are an artifact of the modern landscape. The present open water and wetland situation emphasises the open water aspect to the detriment of the surrounding streams and creeks, most notably Dundas Creek, of which the course ran through the north side of the former marshland. A larger amount of low order affordances would have been associated with the landscape of the Cootes Paradise sites, unlike today's situation. The ca A.D. 1000 landscape at Cootes Paradise would likely have observed a ratio of high order water affordances to low order water affordances, likely similar to those observed in Table 5.3.2 for the Cayuga, Indiana, and Oxbow clusters.

The Middle Woodland clusters high order water resource values are less than those of Princess Point, but reveal an increase in low order resource orientation. This suggests that the Middle Woodland groups were selecting for a larger resource base from which to obtain their subsistence needs. In contrast, the Glen Meyer groups display a complete abandonment of high order water affordances as a resource, with only low order resources observed within the Caradoc and Wentworth clusters. The Dorchester cluster, with the Thames River in its catchment, differs from the other Glen Meyer data, but with a value of half the high order resources, is not comparable to the high order values of either the Middle Woodland or Princess Point clusters.

**Table 5.3.2: High and low order water resources by cluster.**

<i>Cluster</i>	<i>High order (ha)</i>	<i>Low order (ha)</i>	<i>High order (%)</i>
<i>Princess Point</i>			
Cayuga	111.2	22.2	83.4
Cootes	549.3	10.6	98.1
Indiana	104.5	31.1	77.1
Oxbow	173.9	56.1	75.6
<i>Control Group</i>			
Random locations	238.8	165.5	59.1
<i>Middle Woodland</i>			
Delaware	89.6	41.5	68.3
Pond Mills	55.2	18.9	74.5
<i>Early Ontario Iro- quoian</i>			
Caradoc	0.0	41.6	0.0
Dorchester	34.3	35.5	49.1
Wentworth	0.0	58.4	0.0

### *Site Viewsheds*

The water resource trend observed in the cluster data is intensified when analysed as viewshed data. Table 5.3.3 lists average water resource values, as coverage in hectares and as a relative percentage of the 5 km catchment, for sites within each cluster, and Figures 5.3.1 through 5.3.4 plot the water resources for each cluster of sites as a land-water ratio.

The Princess Point sites display large variations in the amount of water resources available within the viewshed of each site (Table 5.3.3). The water resources of the Princess Point viewsheds are varied. The Cootes Paradise viewsheds contain two-thirds water resources, the Cayuga and Indiana viewsheds contain one-third water resources, and the Oxbow viewsheds have but one-tenth water resources. However, Figure 5.3.1, shows that the viewshed land area for these clusters is not greater than 120 ha for any given site ( $79.3 \text{ ha} \pm 30.9 \text{ ha}$ ). The water resources for the viewsheds within a given cluster are tightly grouped around the mean values in Table 5.3.3. From Tables 5.3.1 and 5.3.3, the variation between water resources from the viewsheds of the Cayuga and Indiana sites and those from the Cayuga and Indiana clusters is significant ( $t = 5.31, p = 0.001$ ). The variation is also significant between the Cootes Paradise viewshed and cluster water resources ( $t = 3.75, p = 0.02$ ). The variation in the Oxbow water resources data, however, is not significant ( $t = 0.91, p = 0.2$ ).

The Middle Woodland average for water resources is less than one-tenth of the viewshed, ranging from 4.1% to 7.1% for the Pond Mills and Delaware sites, respectively. Figure 5.3.2 shows that the Middle Woodland land area values average 238 ha, but range widely, from less than 100 ha to almost 600 ha viewsheds. Conversely, water resources consistently account for less than 25 ha, or  $5.9\% \pm 4.6\%$ , of the viewshed. There is no significant variation

between the respective water resources of the viewsheds of the Delaware and Pond Mills sites and the clusters ( $t = 1.09, p = 0.2$ ;  $t = 0.48, p < 0.5$ ).

The water resources for the Glen Meyer sites are very limited in area, with averages of 2% or less for the three site clusters (Figure 5.3.3). The only area with water resources comparable to either Princess Point or Middle Woodland viewsheds are the sites of the Dorchester cluster, for which three of the six sites overlook a portion of the lower Thames River. The remaining three sites' water resource values are comparable to Glen Meyer sites of the Caradoc and Wentworth clusters. Similar to the Middle Woodland data, the Glen Meyer viewshed land areas range from 133 to 678 ha, in comparison to the water resources which average only  $1.1\% \pm 1.0\%$  of the viewshed. Likewise, there is no significance between the water resources of the cluster and viewsheds of the three Glen Meyer site clusters, with t-test statistics resulting in a 50% probability of significance for Caradoc ( $t = -0.55$ ) and Dorchester ( $t = 0.02$ ), and an 80% probability of significance for the Wentworth cluster ( $t = -1.73$ ).

A comparison of viewsheds from the lower Grand River valley Princess Point sites and Control Group random locations (Figure 5.3.4) supports a site-centred water orientation for Princess Point. The water resources for the random location viewsheds mirror that of the Glen Meyer data. No single viewshed registers a water resource greater than 8 ha, and averaging 2.3 ha for the ten random locations, or only  $1\% \pm 0.7\%$  of the viewshed. The land area values, similar to Middle Woodland and Glen Meyer sites, indicate a wide range for the random location viewsheds, from 50 ha to 400 ha. The land area average of 218 ha for the random locations is dissimilar to the 83 ha average for the viewsheds of Cayuga and Indiana sites in the lower Grand River valley. A comparison of the Control Group and Princess Point water

**Table 5.3.3: Water resources by viewshed.**

<i>Culture / Cluster</i>	<i>Mean water area (ha)</i>	<i>Water as % of viewshed</i>	<i>Standard Deviation (%)</i>
<i>Princess Point</i>			
Cayuga/Indiana	32.9	28.7	7.6
Cootes	130.6	59.7	11.24
Oxbow	8.3	9.6	3.4
<i>Control Group</i>			
Random locations	2.3	1.0	0.7
<i>Middle Woodland</i>			
Delaware	14.5	7.1	5.8
Pond Mills	9.4	4.1	5.0
<i>Glen Meyer</i>			
Caradoc	2.5	0.6	0.4
Dorchester	8.0	2.0	1.1
Wentworth	1.3	0.3	0.2

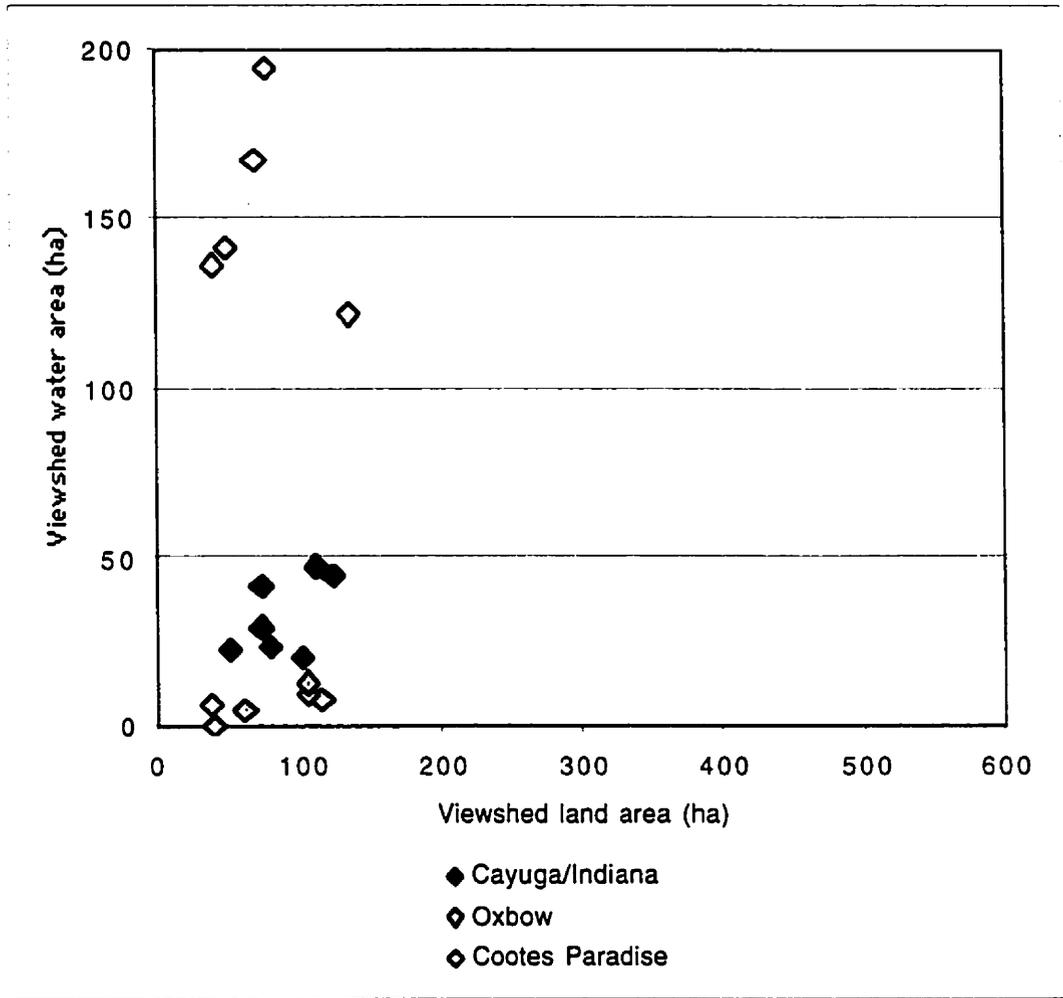
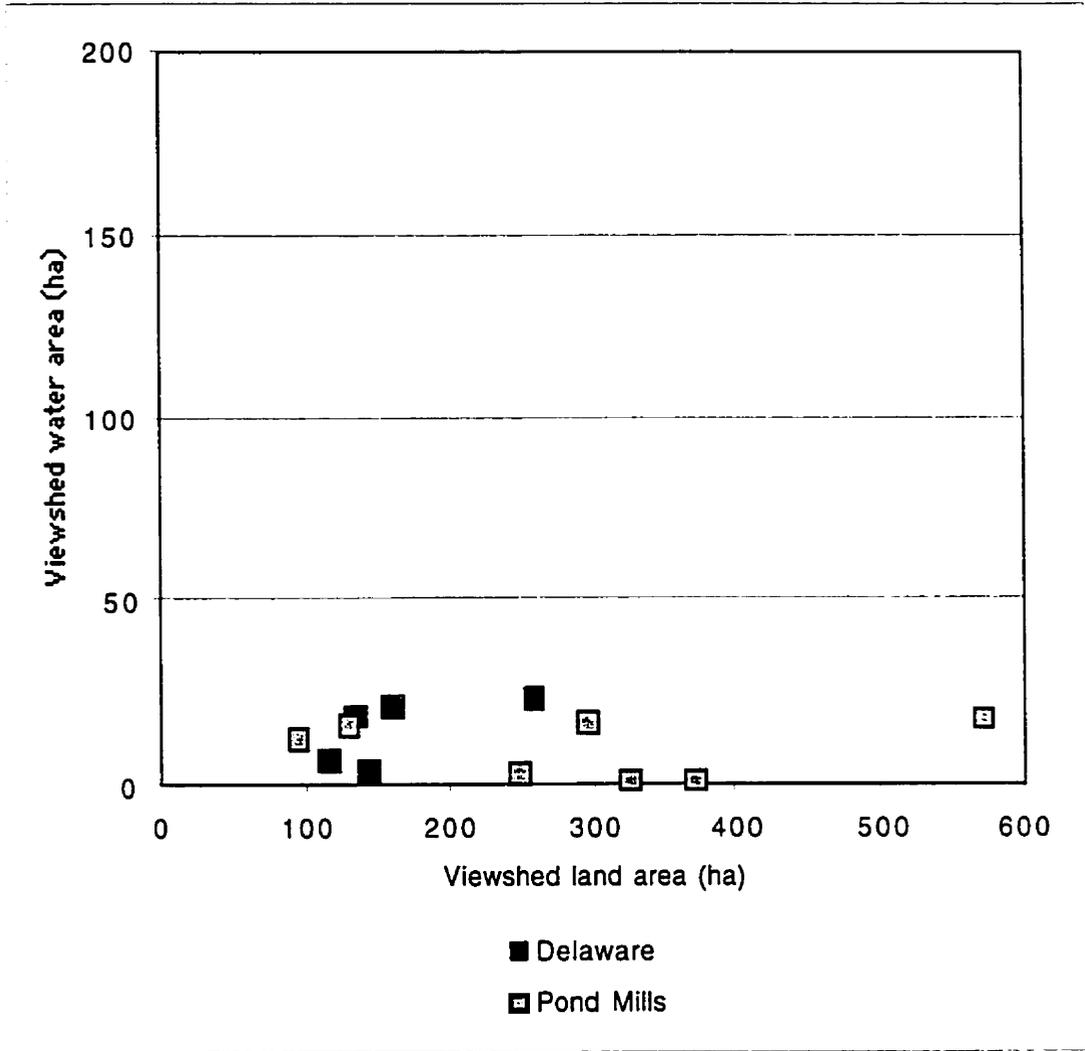
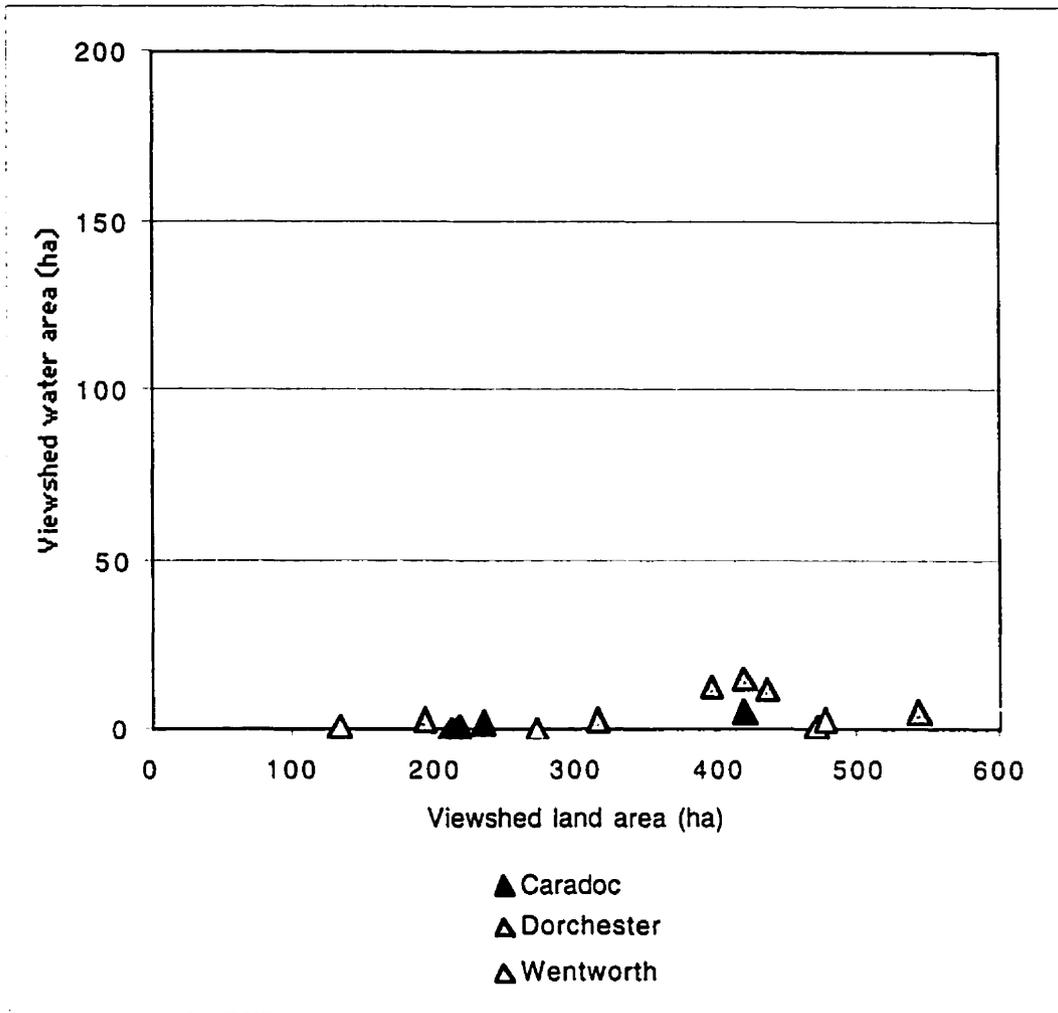


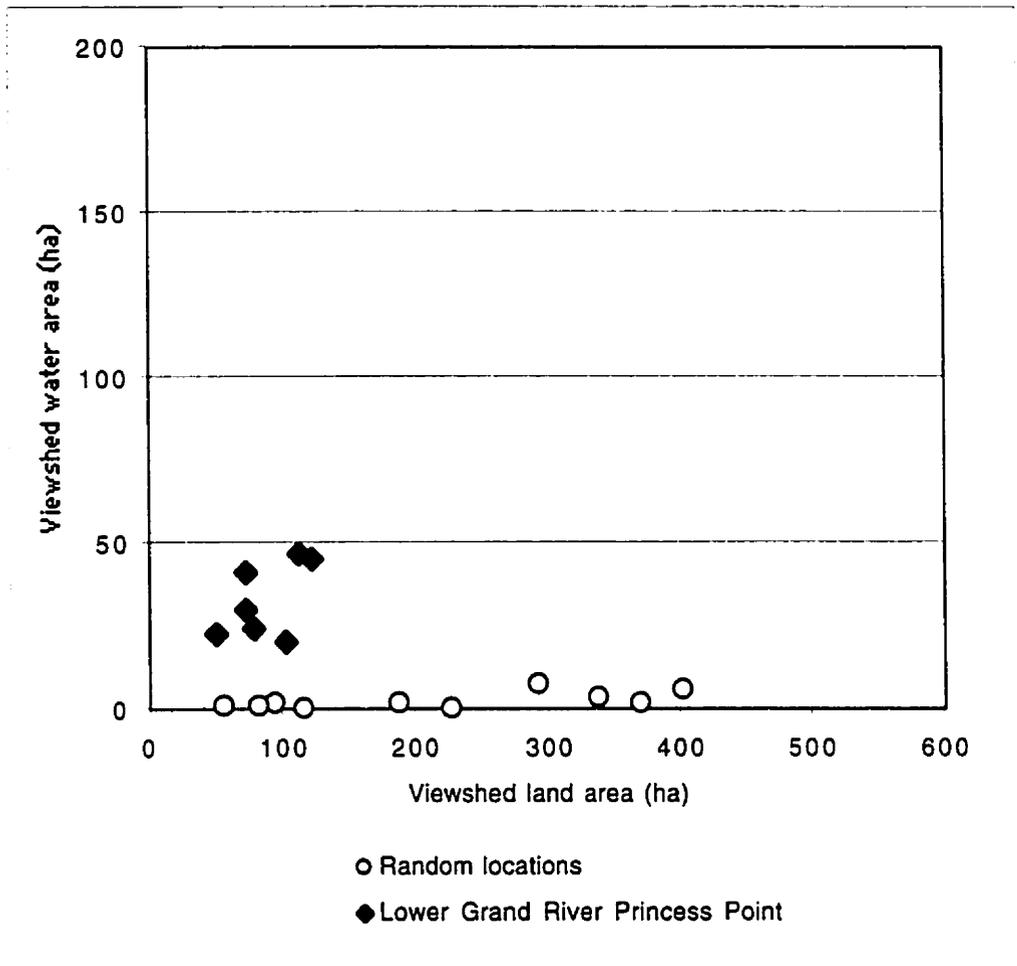
Figure 5.3.1: Land-water relationship for Princess Point viewsheds.



**Figure 5.3.2: Land-water relationship for Middle Woodland viewsheds.**



**Figure 5.3.3: Land-water relationship for Glen Meyer viewsheds.**



**Figure 5.3.4: Land-water relationship for Control Group random locations and lower Grand River viewsheds.**

resources reveals that the variation in viewshed water resources is significant ( $t = 3.95$ ,  $p = 0.001$ ), supporting the argument for a Princess Point group orientation towards water resources. As further support, the water resources variation between Princess Point viewsheds and those of either the Middle Woodland ( $t = 3.64$ ,  $p = 0.001$ ), or Glen Meyer ( $t = 4.85$ ,  $p = 0.001$ ), are also significant.

The water resources for the Grey sites, Holmdale, Porteous, and Lone Pine, reveal greater variation than the data from the 45 sites of the three culture groups. Water resources for Porteous and Holmdale, at 7.2% and 4.0% of the viewshed, place them well above the mean for the same locale Princess Point Oxbow cluster, and also above the Princess Point water resource mean for the Grand River sites. Conversely, the Lone Pine water resource, measured at 0.04%, falls below not only the range of the Princess Point Cayuga cluster, in which the site is located, but also that of Glen Meyer.

An analysis of high and low order water resources demonstrates a predominance of high order water resources over low order within Princess Point viewsheds. Calculated as relative percentages of viewshed, average values range from 98.7%  $\pm$ 0.4% to 99.9%  $\pm$ 0.1% for high order resources (Table 5.3.4). The significance of the Princess Point data set is augmented by the Control Group data. In the same landscape, the random location viewsheds generate a near reversal of the Princess Point pattern in that only a small percentage, 5.7%  $\pm$ 10.2%, of the random location viewsheds include a high order water resource.

The viewsheds for Middle Woodland sites include four-fifths and two-thirds high order affordances for the respective viewsheds of the Pond Mills and Delaware cluster sites. Middle Woodland viewsheds vary from those of Princess Point through their increase in low order

resource representation. The trend, observed in the cluster data, of an orientation towards streams and other small watercourses is stronger in the viewshed data. However, this variation between the Princess Point and Middle Woodland viewshed low order water resources is insignificant ( $t = -1.57, p < 0.5$ ).

For Glen Meyer, not associated with high order water resources for the three clusters under study, have principally low order resources in the Caradoc and Wentworth viewsheds. In the Dorchester viewsheds, a split exists between a total low order resource alignment for the main village site, Calvert, as well as Mustos and Cedar Ravine, and the viewsheds of the Andrew, Larch Lookout, and Keith sites, situated on a sandy crest overlooking both the high order Thames River and low order upland stream resources. I suggest that the orientation to low order water affordances is more representative of Glen Meyer, as demonstrated by the Caradoc and Wentworth sites, and the Calvert village site in the Dorchester cluster.

The Grey sites reveal that Holmdale has a strong resemblance to Princess Point, as demonstrated by a high order value of 97% (Table 5.3.4) within the viewshed. The Porteous and Lone Pine viewsheds, like the three sites of the Dorchester cluster, are split between high and low order resources, resulting from the inclusion of a small section of the Grand River within their 5 km catchments. The Porteous and Lone Pine sites do not conform to the Princess Point pattern. The water resource data for the Grey sites indicate that the best fit for Porteous and Lone Pine is with Glen Meyer, while Holmdale is more similar to Princess Point.

**Table 5.3.4: High and low water resources by viewshed means.**

<i>Cluster</i>	<i>High order (ha)</i>	<i>Low order (ha)</i>	<i>High order (%)</i>	<i>Standard Deviation (%)</i>
<i>Princess Point</i>				
Cayuga/Indiana	32.5	0.4	98.7	0.4
Cootes	130.5	0.1	99.9	0.1
Oxbow	8.2	0.1	98.9	1.1
<i>Control Group</i>				
Random locations	0.2	2.1	5.7	10.2
<i>Middle Woodland</i>				
Delaware	17.6	1.2	89.4	11.8
Pond Mills	8.4	1.0	65.8	45.0
<i>Glen Meyer</i>				
Caradoc	0.0	2.5	0.0	-
Dorchester	4.9	3.2	38.0	41.7
Wentworth	0.0	1.2	0.0	-
<i>Grey sites</i>				
Holmdale	42.1	1.0	97.0	-
Porteous	0.2	9.3	2.0	-
Lone Pine	0.0	0.6	0.0	-

### *Residence and Habitat Groups*

The residence and habitat isochron data conform to the findings of the cluster and viewshed water landscapes analyses. The isochron data illustrate the distribution of water resources through the relationship between the residence and habitat mobility groups. The water resources for the residence and habitat mobility groups are shown in Tables 5.3.5 and 5.3.6.

For the Cayuga, Indiana, and Oxbow sites, residence isochrons account for half of the water resources observed in the viewshed. The water resource values for residence isochrons associated with random locations are not consistent with the lower Grand River Princess Point sites. The average residence isochron size for the Princess Point sites and the random locations is similar, at 30.8 ha  $\pm$  5.5 ha, and 24.3 ha  $\pm$  9.6 ha, respectively, and no significant variation is noted for the two sets of values ( $t = 1.60, p < 0.1$ ). However, the variation in water resources between the residence isochrons is significant, at 57.3 ha  $\pm$  7.9 for Princess Point and 2.8 ha  $\pm$  3.9 ha for the random locations ( $t = 18.88, p = 0.001$ ). Although it is possible that the high percentage of water resources may be a by-product of sites situated on river bars, in association with other affordances (see section 5.4), the lower Grand River residence group values suggest that water resources (and their related affordances, such as river bars on the Grand River) represent a component of the Princess Point settlement strategy.

The data in Tables 5.3.3 and 5.3.5 indicate that the Middle Woodland groups occupy a middle ground, with residence group water resources deviating slightly from the observed viewshed pattern. Values for habitat group isochrons are also higher than their viewshed counterparts. This may signify a slight preference for water resources over affordances offered by land. Glen Meyer residence and habitat isochrons offer little variation, from both the general

cluster and viewshed values, for water resources in the landscape (Tables 5.3.1, 5.3.3, and 5.3.5). The Glen Meyer isochron data support the previous cluster-based conclusion that Glen Meyer sites do not display a water-based resource orientation.

With respect to the Grey sites, Lone Pine and Porteous are similar to Glen Meyer, indicating a residence group preference for land over water affordances (or combined with factors contributing to a land resource preference). A land over water preference is also noted for the Lone Pine habitat group isochron. The Holmdale site is most similar to the Princess Point Oxbow cluster, within which Holmdale is located. Both Holmdale and the Oxbow site's average 14.4% for residence group water resources. Of the four Princess Point clusters, Oxbow has the lowest value for water resources in the residence group. The habitat group water resource value of Holmdale is larger than those of the Oxbow sites, in terms of area, but falls within the Oxbow cluster's one standard deviation when calculated as a percentage of the habitat isochron.

The variation in viewshed data for high and low order resources increases in the residence and habitat isochron groups (Figures 5.3.5 through 5.3.8). The water resources in the residence group isochrons for Cayuga, Indiana, and Oxbow sites consist of 40% or greater high order water resources, compared to less than 20% for the residence catchments (Figure 5.3.5). This variation between the residence group and residence catchment values for high order water resources is significant ( $t = 6.15$ ,  $p = 0.001$ ). For the lower Grand River Princess Point sites, high order water resources range from one-fifth to four-fifths of the resources for the habitat group, but consistently account for two-thirds of the habitat catchment, well above the residence group average (Figure 5.3.6). The variation in high order water resources,

**Table 5.3.5: Land-water resources by residence isochron means.**

<i>Culture / Cluster</i>	<i>Average land area (ha)</i>	<i>Average water area (ha)</i>	<i>Residence Group water (%)</i>	<i>Standard Deviation (%)</i>
<i>Princess Point</i>				
Cayuga/Indiana	17.7	13.1	42.7	7.9
Cootes	8.0	36.2	81.4	5.6
Oxbow	20.9	4.2	14.4	8.5
<i>Control Group</i>				
Random locations	23.6	0.7	2.8	3.9
<i>Middle Woodland</i>				
Delaware	40.1	4.3	9.6	3.5
Pond Mills	38.7	6.3	12.6	11.8
<i>Glen Meyer</i>				
Caradoc	39.0	0.4	0.9	0.7
Dorchester	33.1	1.3	3.5	2.8
Wentworth	35.8	0.1	0.4	0.1
<i>Grey sites</i>				
Holmdale	45.0	6.5	14.4	-
Porteous	55.0	0.4	0.0	-
Lone Pine	32.6	0.1	0.0	-

**Table 5.3.6: Land-water resources by habitat isochron means.**

<i>Culture / Cluster</i>	<i>Average land area (ha)</i>	<i>Average water area (ha)</i>	<i>Habitat Group water (%)</i>	<i>Standard Deviation (%)</i>
<i>Princess Point</i>				
Cayuga/Indiana	68.7	19.7	22.0	7.0
Cootes	64.6	116.1	65.7	13.7
Oxbow	39.3	1.0	2.7	3.4
<i>Control Group</i>				
Random locations	192.9	1.8	0.9	0.6
<i>Middle Woodland</i>				
Delaware	103.0	8.8	7.6	4.8
Pond Mills	253.1	3.1	2.0	2.3
<i>Glen Meyer</i>				
Caradoc	313.3	2.1	0.6	0.4
Dorchester	351.0	6.8	1.8	1.0
Wentworth	216.1	1.0	0.5	0.2
<i>Grey sites</i>				
Holmdale	550.0	36.6	6.7	-
Porteous	225.6	9.0	4.0	-
Lone Pine	12.3	0.1	0.0	-

between the habitat group and catchment is also significant ( $t = -3.69$ ,  $p = 0.001$ ). For both of the Princess Point mobility groups, a high level of significance is associated with the presence of the Grand River resource.

High order water resources for the Middle Woodland residence isochrons average one-tenth of the residence group, compared to one-third for the residence catchment, a significant variation ( $t = 2.33$ ,  $p < 0.05$ ) (Figure 5.3.5). The Middle Woodland habitat group values for high order resources are almost the same as the habitat catchment values, approximately two-thirds of the water resources for the Delaware habitat group and catchment, and one-third each for the Pond Mills sites (Figure 5.3.6). For both the Glen Meyer residence and habitat groups, of the available water resources, high order water resources are effectively zero, and therefore do not register (Figures 5.3.5 and 5.3.6).

Princess Point low order water resources in the residence group and catchment register minimal to zero values, indicating their scarcity within the residence catchment compared to the high order resources (Figure 5.3.7). For the habitat group and catchment, low order resources range between zero and 30% of the habitat catchment's water resources, whereas the habitat group values remain at or near zero (Figure 5.3.8). The variation between Princess Point habitat group and catchment is significant ( $t = -4.67$ ,  $p = 0.001$ ), providing more data supporting the contention that Princess Point groups were selecting for high order resources.

The mobility group isochrons of the Middle Woodland indicate that low order resources were very minor contributors to the residence group and residence catchment, less than 5% except for a 15% value for the Pond Mills residence catchment (Figure 5.3.7). The Middle Woodland habitat group and catchment values are unlike their counterpart residence

values for low order water resources. Within the habitat group, one-third to one half of the water resources consist of low order resources, compared to 10% to 20% of the habitat catchment (Figure 5.3.8). This variation for low order resources in the habitat group and catchment is significant ( $t = -4.53$ ,  $p = 0.001$ ). The presence of numerous streams and other low order water resources in the habitat group isochrons suggest that the hypothesised Middle Woodland base camp and resource or extractive camp settlement strategy is, in part, supported by the water landscape data.

The Glen Meyer low order water resources data, for each of the residence and habitat group and habitat catchment, do not reveal any significant trends. The residence group average for low order resources is 4% of the isochron, while the residence catchment average approaches 15% of the catchment (Figure 5.3.7). For the habitat group, low order resources are frequently the only water resource, thereby increasing their percentage in the group and catchment due to the lack of high order resources. From this, the low order resources in the habitat group and catchment ranges from under one-half to over four-fifths of the water resources in the habitat group and catchment (Figure 5.3.8). This variation between habitat group and catchment, however, is not significant ( $t = -0.55$ ,  $p = 0.5$ ).

When compared to the Control Group data, the extent of the Princess Point orientation to high order water resources becomes evident. The high order water resources of the random locations are typically less than 2% of the resources of both the residence group and catchment (Figure 5.3.5). For the habitat group and catchment, high order water resources account for only one-fifth of the habitat isochron, and one-sixth of the resources of the catchment (Figure 5.3.6). Less than 3% of low order water resources are located within the

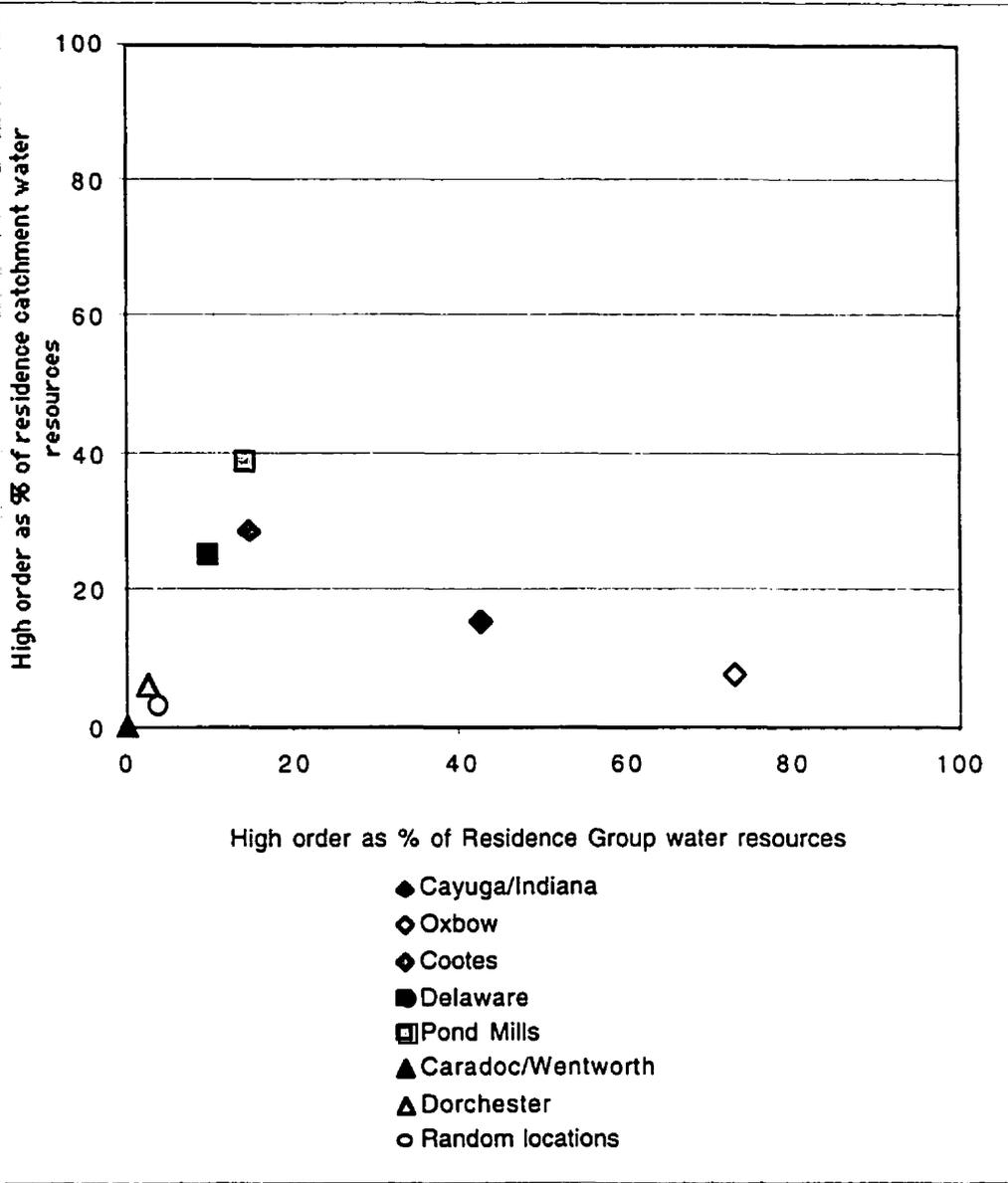
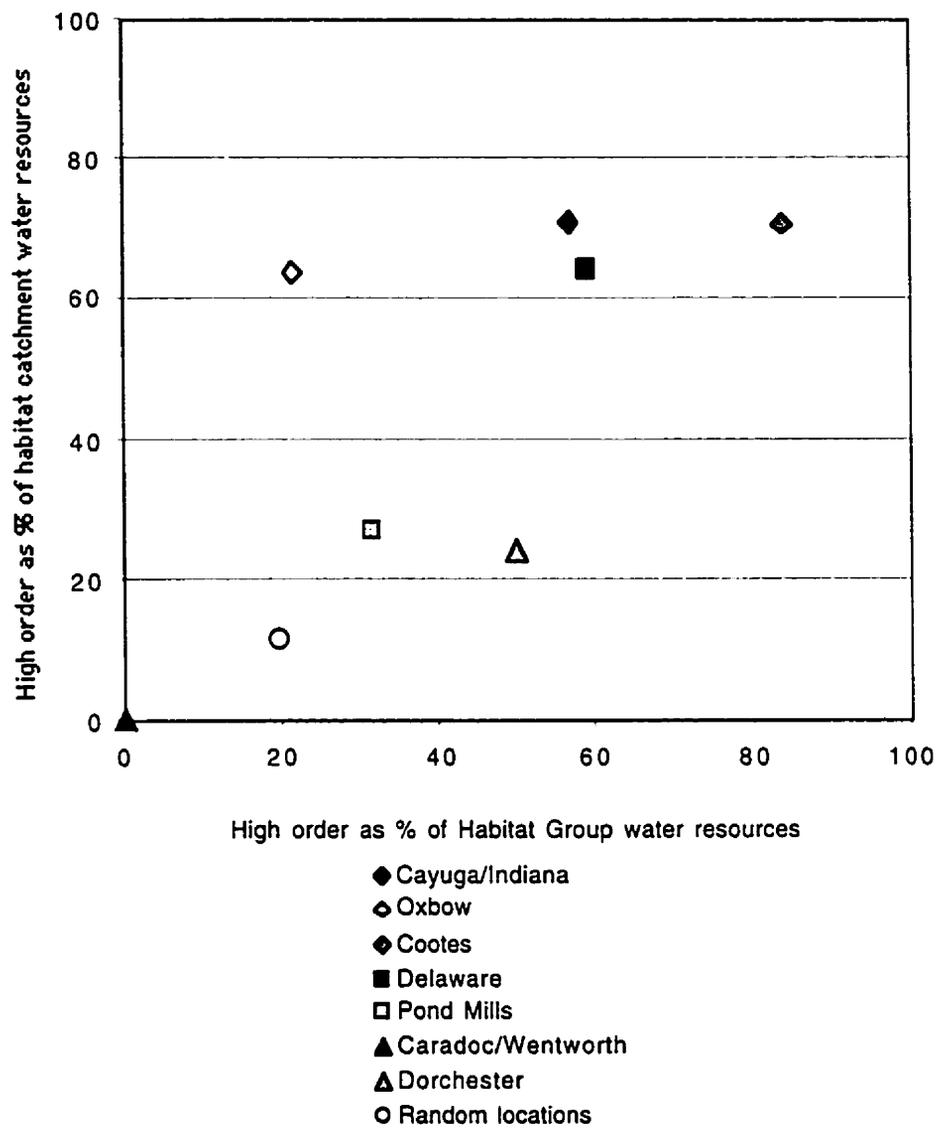
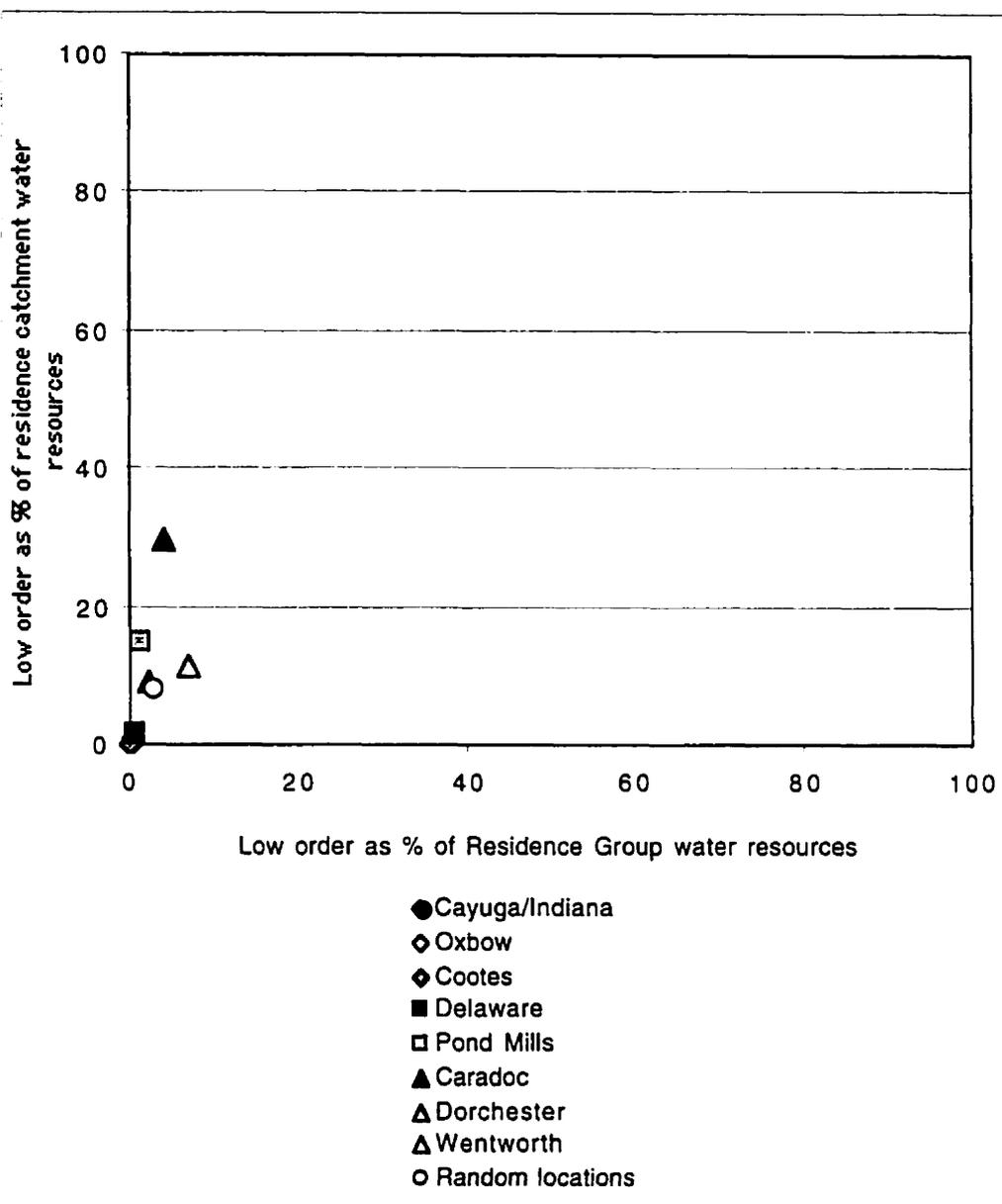


Figure 5.3.5: High order water resources by residence group.



**Figure 5.3.6: High order water resources by habitat group.**



**Figure 5.3.7: Low order water resources by residence group.**

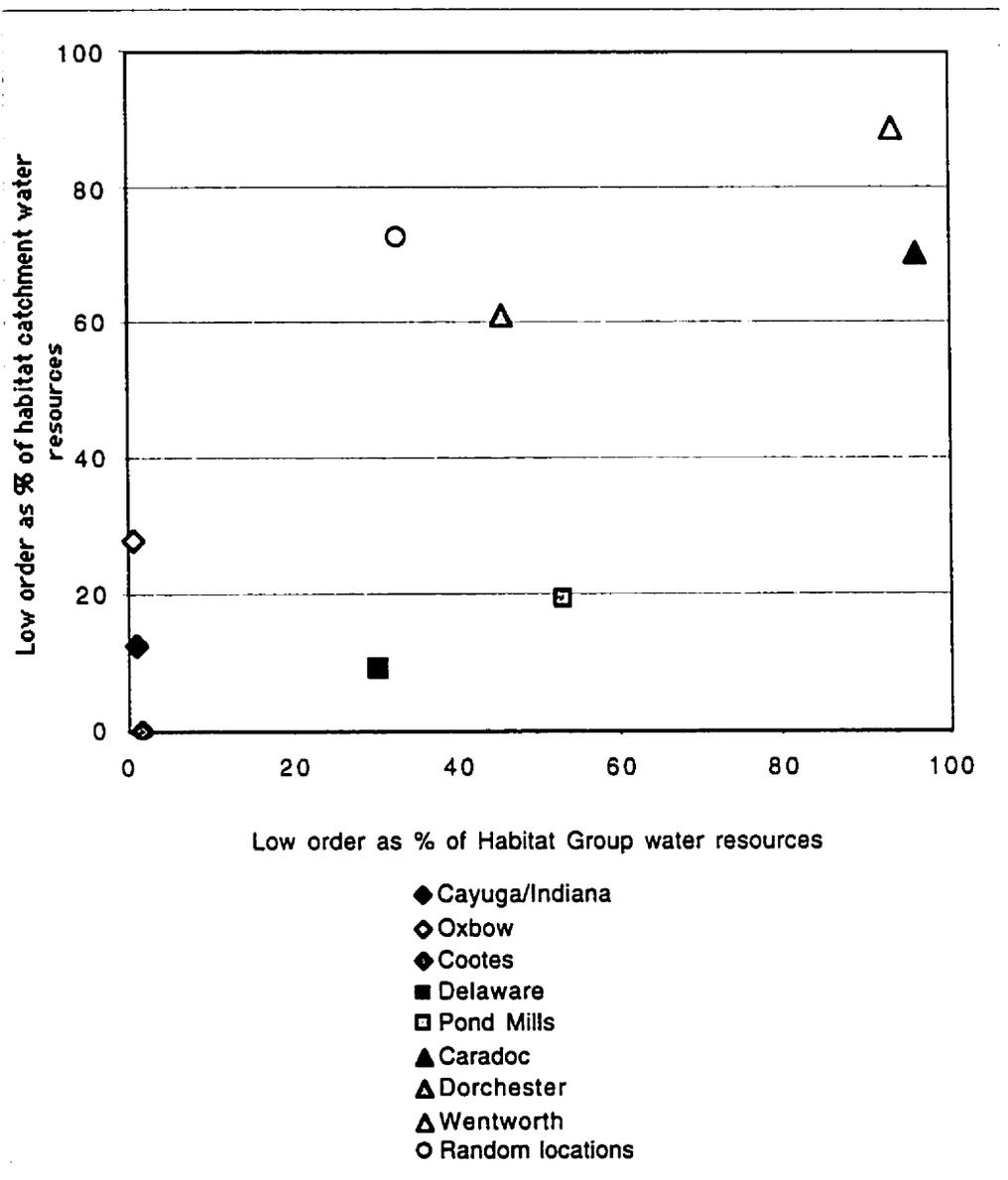


Figure 5.3.8: Low order water resources by habitat group.

residence group, and only 8% of the low order resources are found within the residence catchment (Figure 5.3.7). It is only within the habitat isochron and catchment for low order water resources that any significant variation appears in the random locations data. Low order resources account for one-third of the water resources in the habitat group, and for over two-thirds of the habitat catchment resources (Figure 5.3.8). The variation in this data is significant ( $t = -5.07, p = 0.001$ ). The random location emphasis on low order resources in the landscape of the lower Grand River valley, bears no resemblance to Princess Point sites in the same area.

Holmdale, Lone Pine, and Porteous isochron results for water resources are inconsistent. For the Grey sites residence groups and catchments, only low order resources are represented at Porteous and Lone Pine, while only high order resources are found at Holmdale. The habitat group values range from zero at Lone Pine, for both high and low order resources, to an even split at Holmdale, to a predominance of low order water resources at Porteous. There is no evidence of patterning among the Grey sites.

Modelling the water landscape has shown the strength of Princess Point's association with high order water resources, most notably within the residence mobility group. In comparison, the random locations of the Control Group contrast with Princess Point sites in the lower Grand River valley. The Middle Woodland orientation to water resources may be a precursor to that of Princess Point, with a difference in the influence, and probable use, of secondary resources by both Middle Woodland mobility groups. Glen Meyer data do not show any significant orientation to high order resources. Glen Meyer's dependency on low order resources constitutes a very small water resource base when compared to the large base enjoyed by Princess Point, and even the smaller base of the Middle Woodland groups.

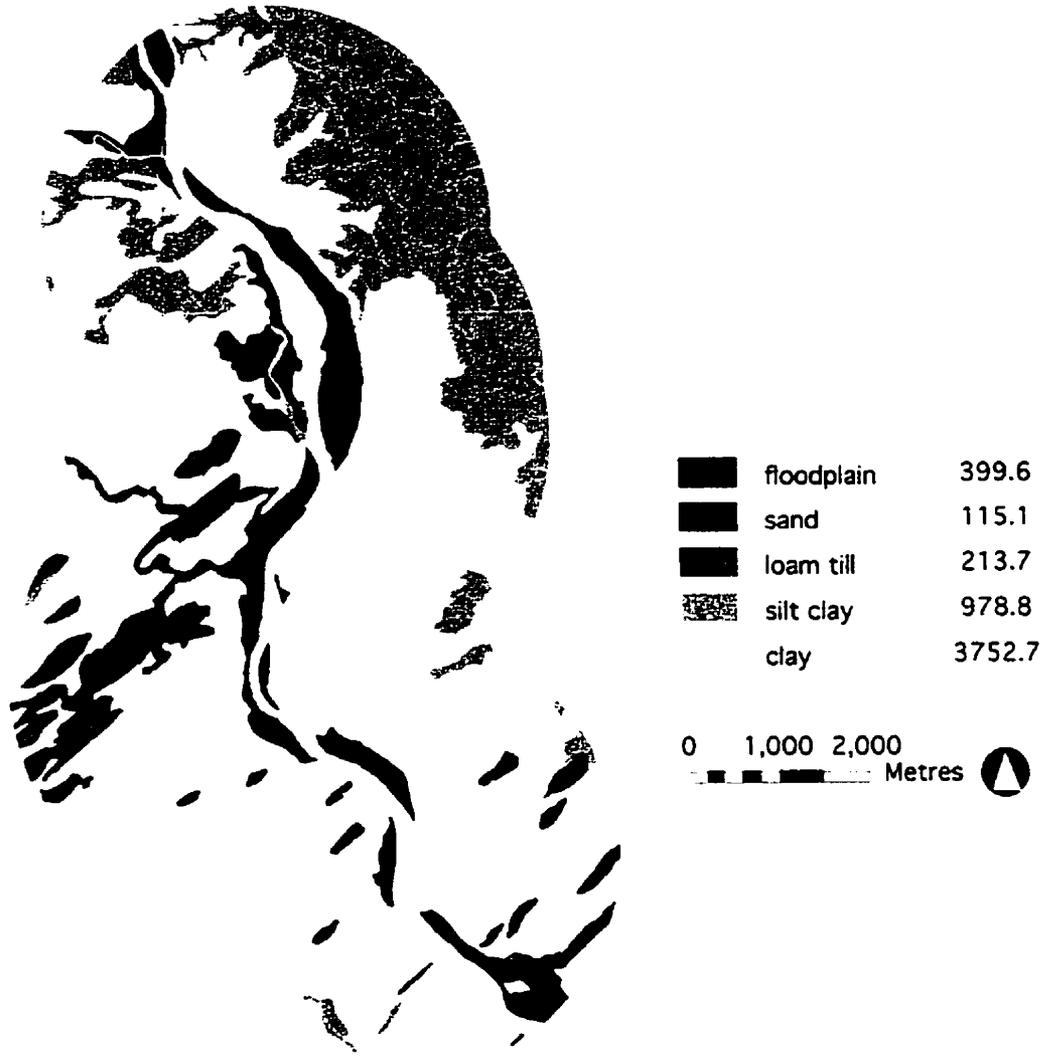
## Section 5.4

### Soil Landscapes

Soil landscapes detail local conditions using Ontario government soil survey reports. The first analysis documents the existing soil groups and their distribution across the research area. A second analysis suggests a relative index of plant cultivation suitability based on soil group attributes. The modelling of soil landscapes use data from the lower Grand River valley, the middle Thames River valley, and the Caradoc Sand Plain. These regions were chosen for their the completeness of soil data coverage within the research area, incorporating the combined Cayuga and Indiana clusters for Princess Point (Figure 5.4.1), the Dorchester cluster for Middle Woodland, the Caradoc cluster for Glen Meyer, and the Control Group random locations in the lower Grand River valley. Soil data are unavailable, due to the immediacy of urban areas, for the remaining clusters, as well as two of the three Grey sites. The soil groups used in this section are the same as those in the soil survey reports, consisting of sand, sand-loam, loam, loam-till (of which till is cobble, gravel, and sand), clay, silt-clay, floodplain (alluvial silt and sands), and channel slope (eroded soils, typically alluvial silt and sands).

### *Cultural Clusters and Site Viewsheds*

In that a single cluster per culture is used for the soil landscapes, there are no analyses for same-culture clusters. Instead, the use of the cluster's soil landscape provides baseline natural landscape data against which viewshed values are compared. The substantive approach, encompassing soil composition by grain size data as reported in the soil surveys, reveals that the soil group landscape for the Indiana and Cayuga clusters of the lower Grand



**Figure 5.4.1: Lower Grand River valley soil groups in ha (Cayuga and Indiana clusters).**

River valley region consists principally of silt clays and compact clays, punctuated by till drumlins and sand pockets and deposits of floodplain material formed in areas cut by the Grand River.

The viewsheds of the lower Grand River Princess Point sites, as percentages of cluster and catchment, reveal soil group values nearly identical to that of the natural landscape (Figure 5.4.2, see Table 5.4.1 for land area by ha). The presence of small pockets of sandy soil, loam till, and variable composition floodplains (alluvial silts and sands) are indicated by roughly equal representations for cluster and site viewsheds alike. Likewise, the combination of clay and silt clay account for like values for both the Cayuga and Indiana clusters, as well as the viewshed means for the Princess Point sites in these clusters. The next largest soil group, floodplains, also demonstrate similar values for viewshed and cluster's natural landscape.

Soil group data for the Middle Woodland Dorchester cluster, in the middle Thames River valley, show a combination of fine sands, sand loams, silt loams, and loam, and an absence of clay (Figure 5.4.3). The Dorchester cluster has a high frequency of sand loams and channels, and a low frequency of loams and floodplains. Middle Woodland group viewsheds within the Dorchester cluster encompass a greater portion of floodplain and channel soils over non-viewshed areas with greater amounts of fine sand and sand-loam soils. Viewsheds also incorporate floodplains and channels at values of 10% and 48% respectively, double that of the cluster, at 5% and 22% respectively. Rather than selecting for sandier soil, the evidence suggests that Middle Woodland groups favoured the riverine associated affordances comprised of floodplains and channels.

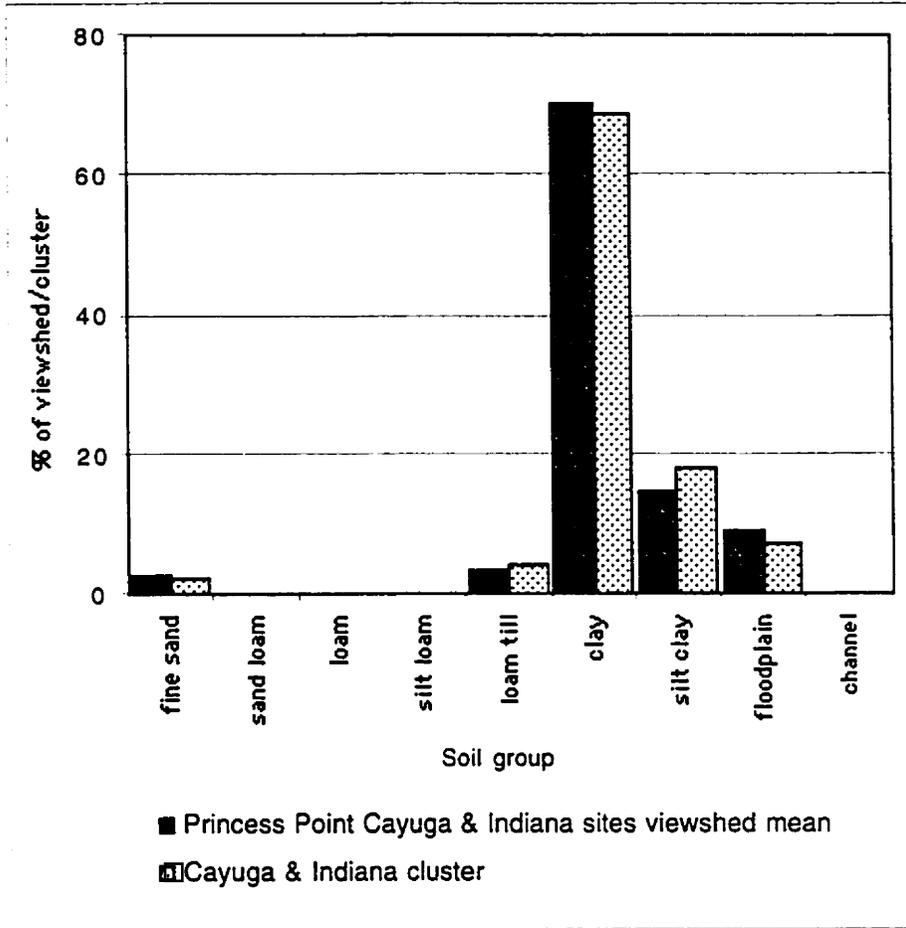


Figure 5.4.2: Soil group means for lower Grand River valley viewsheds and cluster.

The soil landscape for the Glen Meyer Caradoc cluster is in the Caradoc Sand Plain. In this region, as the name implies, soil groups of fine sand and sand loams predominate. Notable within the Caradoc cluster is the absence of clays, loams, and floodplains. Combining the fine sand and sand-loam soil groups in the Caradoc cluster results in a value of 80.1% of the soil landscape for the cluster, and 89.2% for the viewsheds. The only other soil group present within this cluster is silt loam, representing less than one-fifth of both the cluster and viewshed (Figure 5.4.4). With few stream resources present in the cluster, the floodplain and channel categories understandably register a null value.

There is little to no variation among viewsheds within each of the Princess Point, Middle Woodland, and Glen Meyer clusters. For example, the sites of the Indiana and Cayuga clusters vary little in terms of viewshed composition by soil group (Table 5.4.1). In all cases, clay soil comprise over 80% of the total viewshed. Only the Cayuga Bridge and Grand Banks sites display some discrepancy in that neither has fine sandy soil within its viewshed, as do the remainder of the lower Grand River Princess Point sites.

### *Residence and Habitat Isochrons*

The soil groups data for residence and habitat isochrons (Figure 5.4.5), reveal one key variation readily apparent for the Princess Point Cayuga and Indiana clusters: floodplain material averages slightly more than half of the entire residence isochron in contrast to a value of less than 10% for floodplains in the viewshed (Figure 5.4.2). By comparison, the clay soil group accounts for less than half of the Princess Point residence isochron, in a landscape that

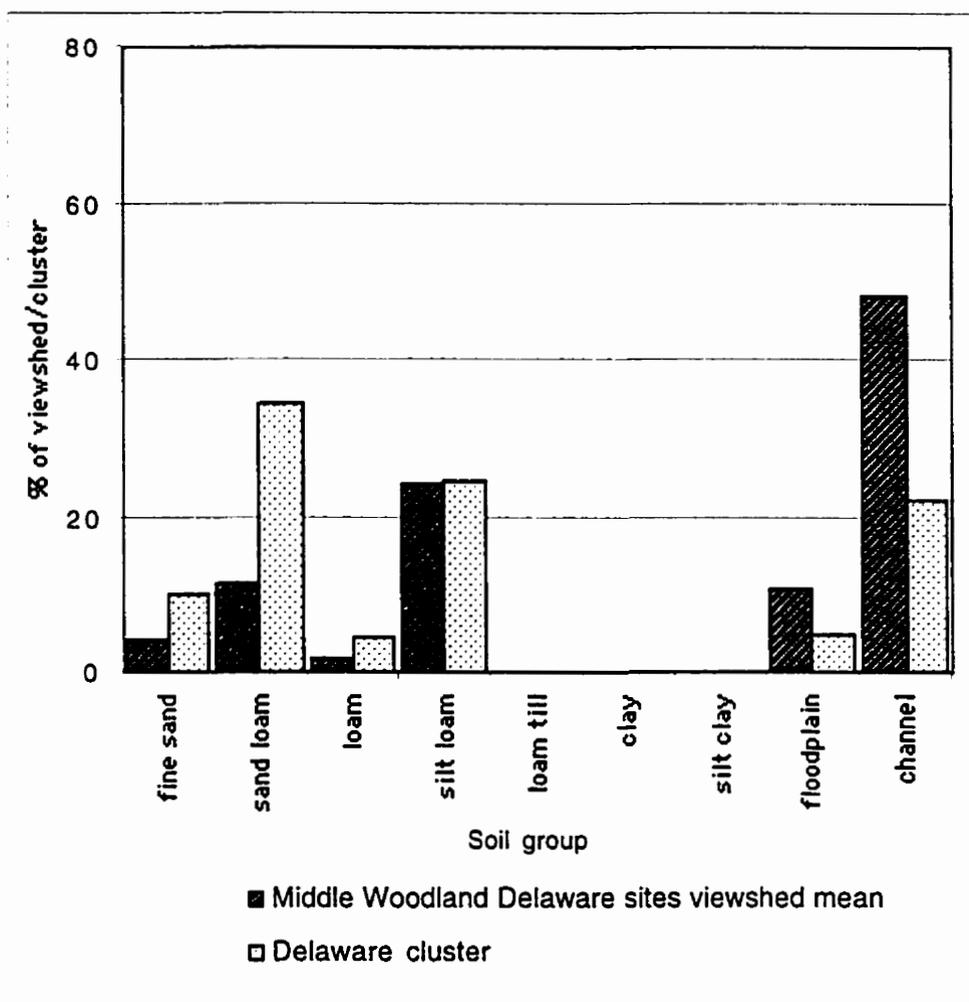
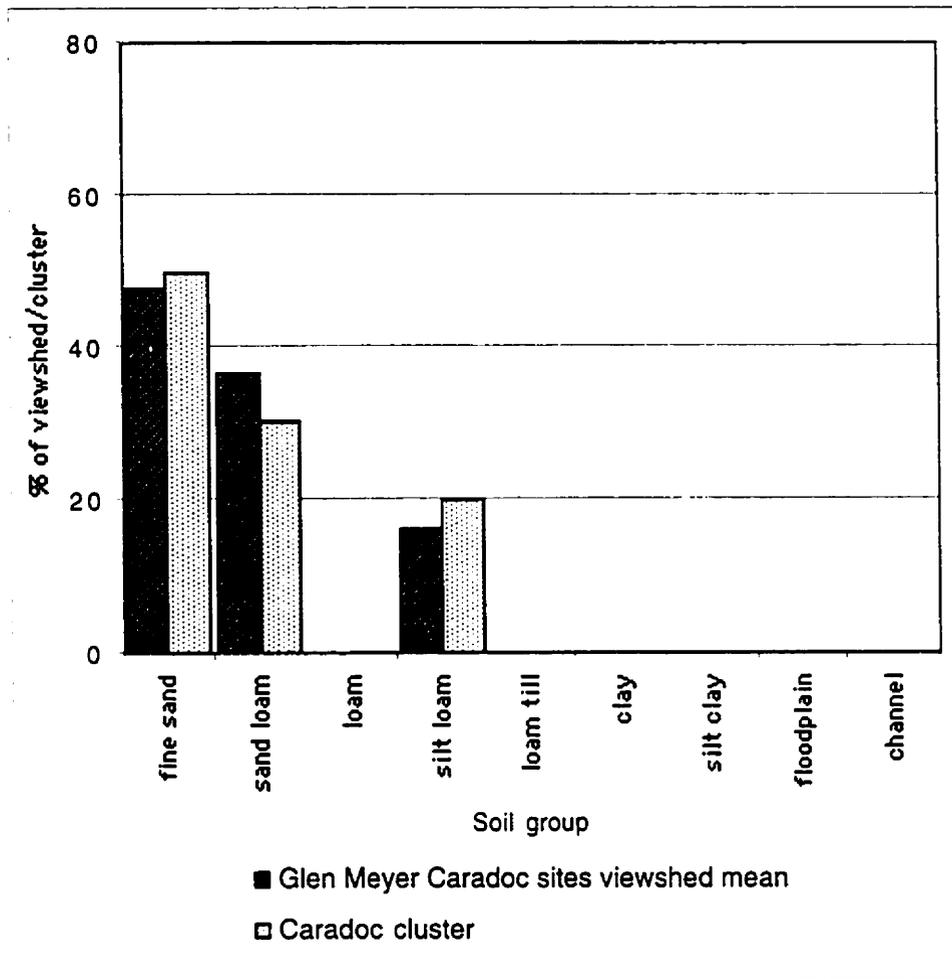


Figure 5.4.3: Soil groups means for Delaware viewsheds and cluster.



**Figure 5.4.4: Soil groups means for Caradoc viewsheds and cluster.**

**Table 5.4.1: Soil group frequencies (ha) for Princess Point Cayuga and Indiana viewsheds and catchments.**

<i>Site</i>	<i>Sand</i>	<i>Sand Loam</i>	<i>Loam</i>	<i>Silt Loam</i>	<i>Loam Till</i>	<i>Clay</i>	<i>Silt Clay</i>	<i>Flood-plain</i>	<i>Channel Slope</i>
<i>Cayuga B.</i>	0.0	0.0	0.0	0.0	1.9	34.3	0.0	8.2	0.0
<i>Grand B.</i>	0.0	0.0	0.0	0.0	3.6	40.9	0.0	20.0	0.0
<i>Youngl</i>	0.0	0.0	0.0	0.0	5.2	46.0	0.0	17.5	0.0
<i>Indiana</i>	9.4	0.0	0.0	0.0	5.9	49.7	9.4	36.6	0.0
<i>Lester</i>	4.2	0.0	0.0	0.0	6.1	28.5	4.4	19.8	0.0
<i>Meyer</i>	3.2	0.0	0.0	0.0	0.0	35.0	5.2	42.3	0.0
<i>York</i>	3.9	0.0	0.0	0.0	0.0	28.0	9.7	52.0	0.0
<i>Average</i>	<i>3.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>3.2</i>	<i>37.5</i>	<i>4.1</i>	<i>28.1</i>	<i>0.0</i>
<i>St. Dev.</i>	<i>3.4</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>2.6</i>	<i>8.4</i>	<i>4.3</i>	<i>15.7</i>	<i>0.0</i>

<i>5 km catchment</i>	<i>Sand</i>	<i>Sand Loam</i>	<i>Loam</i>	<i>Silt Loam</i>	<i>Loam Till</i>	<i>Clay</i>	<i>Silt Clay</i>	<i>Flood-plain</i>	<i>Channel Slope</i>
<i>Cayuga B.</i>	0.0	0.0	0.0	0	72.6	1564.5	35.2	118.2	0.0
<i>Grand B.</i>	0.0	0.0	0.0	0	79.1	1548.4	25.4	143.2	0.0
<i>Youngl</i>	60.6	0.0	0.0	0	143.2	1479.8	12.3	160.6	0.0
<i>Indiana</i>	68.0	0.0	0.0	0	44.4	1195.8	328.9	192.7	0.0
<i>Lester</i>	62.4	0.0	0.0	0	43.8	1052.3	496.2	174.1	0.0
<i>Meyer</i>	73.8	0.0	0.0	0	45.4	1250.4	248.0	202.6	0.0
<i>York</i>	54.5	0.0	0.0	0	6.3	858.6	725.2	160.1	0.0
<i>Average</i>	<i>45.6</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>62.1</i>	<i>1278.5</i>	<i>267.3</i>	<i>164.5</i>	<i>0.0</i>
<i>St. Dev.</i>	<i>31.7</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>42.9</i>	<i>267.8</i>	<i>271.9</i>	<i>28.8</i>	<i>0.0</i>

is composed of nearly 90% clay soil (from Table 5.4.1). Unquestionably, the residence group isochrons indicate a favouring of floodplain affordances in an area of predominantly clay soil.

A preference for floodplain affordances is not evident in the habitat isochron data (Figure 5.4.5). The average Princess Point habitat isochron for the Cayuga and Indiana clusters contains less than 10% of floodplain soil, identical to the background catchment value. In the habitat catchment, the clay soil component, likewise, is nearly identical to the natural landscape value of 87%. As a consequence, the Princess Point residence-habitat relationship registers distinct values for clay and floodplain soils in the lower Grand River valley.

The same comparative analysis for Middle Woodland and Glen Meyer results in almost no variation in soil group data between residence and habitat isochrons. The soil group frequencies for the Middle Woodland and Glen Meyer residence-habitat relationships show virtually no change from the data on viewsheds and clusters for these same groups.

There is excellent contrast in soil affordances available to each of the three culture groups. The substantive variation in soil group data is considerable and, in of itself, suggesting unique soil preferences for each culture group, i.e., floodplains for Princess Point, loams and channels for Middle Woodland, and sands for Glen Meyer. Comparative statistics, using cross-cultural comparisons based on a set of shared ordinal soil landscape features, are made through an inferential soil landscape approach.

One of the predominant features of social and economic variation between the three culture groups is the emergence and establishment of maize cultivation. The second analysis draws from this event through the use of Canada Land Inventory (CLI) suitability classes and

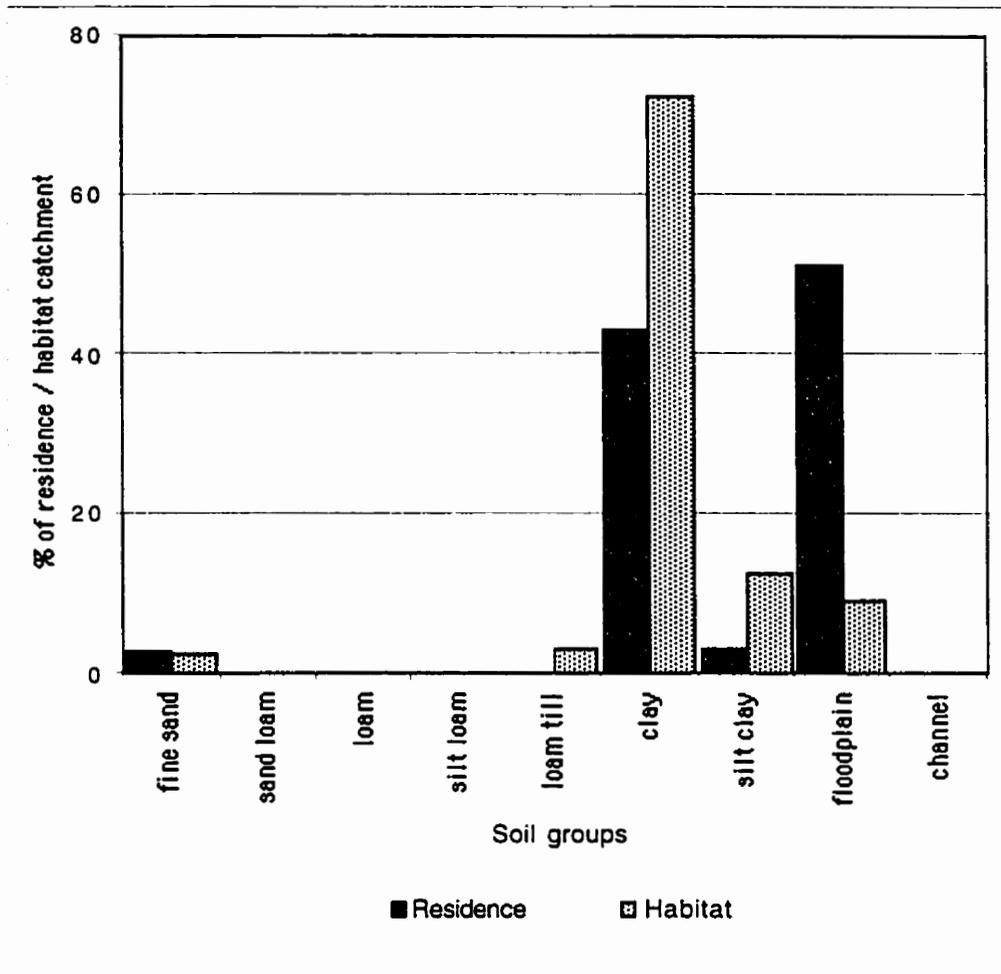


Figure 5.4.5: Soil group means for lower Grand River valley mobility groups.

natural drainage aspects of the soil groups to suggest an interpretation of the soil landscape by assigning an index of cultivation suitability to soil group data. While recognising the modern orientation of the CLI, the suitability index, based on modern cultivation practices, standardises the criteria by which to evaluate the soil landscapes of the Princess Point, Middle Woodland, and Glen Meyer groups.

The CLI classifies soils on the basis of a combination of factors, including drainage, stoniness, composition, and erosion, etc. These features of the soil landscape are readily apparent in the field through the observation of vegetation, water runoff, and soil composition. By A.D. 500, inhabitants of eastern North America, and possibly southern Ontario, had already invested in native plant husbandry, including goosefoot (*Chenopodium berlandieri*), knotweed (*Polygonum erectum*), maygrass (*Phalaris caroliniana*), and marsh elder (*Iva annua*) (see Crawford and Smith 2000, Smith 1992), suggesting an assumption of soil knowledge relating to plant cultivation suitability. Although the categorisation of soils into suitability indices is improbable, the recognition of this knowledge may be assumed.

Under the inferential approach, the soil groups are split into three ordinal classes that prescribe modern horticultural suitability based on modern cultivation practices. This index consists of the representation of good (or suitable), moderate and poor soils for cultivation activities. The three classes span the various soil groups noted previously and subsequently span the three culture groups and Control Group, enabling a cross-cultural analysis of the soil landscape.

The indexed soils are: clays, silt clays, loam tills for poor soils; loam, silt-loam, and channels for moderate soils; and sand-loam, fine sand and floodplains for good or suitable

soils. The analysis involves each site's residence group isochron, residence catchment, and the cluster data.

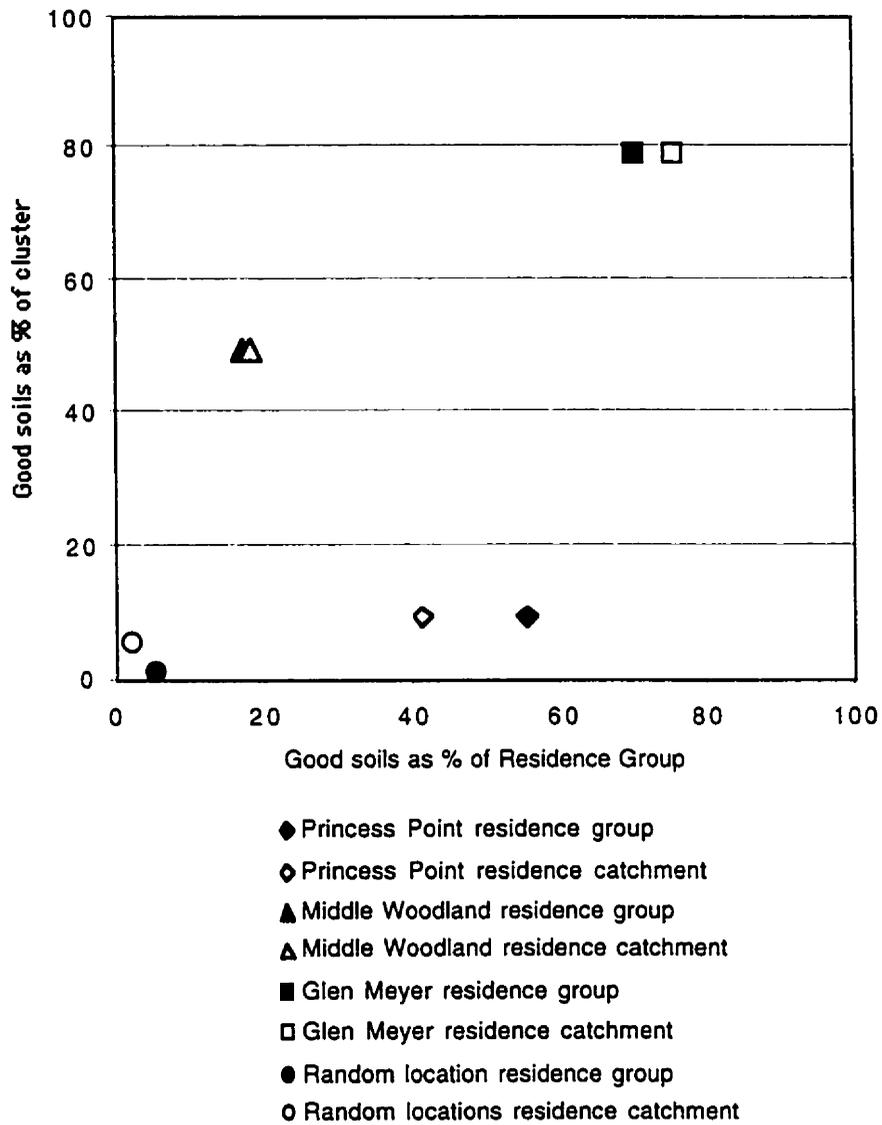
Figure 5.4.6, comparing suitable soils data as a percentage of the residence group against those of the cluster, presents the resulting value means for the three culture groups and control group. The means of the residence isochron and 1 km residence catchment are plotted against the 5 km cluster catchment. The results indicate that, for Princess Point, the residence group incorporates over half of the suitable soils, while the residence catchment includes 40% of the suitable soils. Both values are high given that the suitable soils are represented by only one-tenth of the soil group data for the cluster. In comparison, the Control Group data registers below 5% for each of the residence group, catchment, and cluster values. The Middle Woodland residence group and residence catchment display almost no variation, both at less than one-fifth suitable soils, in contrast to the presence of suitable soils in half of the cluster. Finally, the Glen Meyer data reveal that the residence groups incorporate an average of 70% suitable soils, in a residence catchment and catchment each approaching 80% suitable soils.

The Princess Point residence isochrons of the lower Grand River valley are oriented to encompass a majority of available soils suitable for cultivation, in a landscape that is predominantly void of such lands (Figure 5.4.7). Within the residence group, although the mean percentage of suitable soils as a part of the viewshed has a large standard deviation, 55.2%  $\pm$ 20%, the average coverage is less variable at 8.1 ha  $\pm$ 3.6 ha. In comparison, the residence catchment yields an average value of 41.2%  $\pm$ 25%, with an average coverage of 25.9 ha  $\pm$ 14 ha. The variation in the residence isochron and residence catchment ha values is significant (t

= -3.29,  $p < 0.01$ ). The remainder of the lower Grand River soil landscape are three-quarters poor soil for cultivation practices, and a small percentage of soil rated as moderate suitability.

Only 515 of 5,437 ha in the combined Cayuga and Indiana clusters are classified as suitable for cultivation. In contrast, of the 107 ha comprising the Princess Point Cayuga and Indiana cluster's residence isochrons, 57 ha are considered as soil suitable for cultivation practices. The Princess Point lower Grand River valley residence group isochrons have 11% of the total available soil suitable for cultivation on only 2% of the total cluster land area. This lends considerable support to the argument for cultivation suitability as a selected affordance and, moreover, as a factor in determining Princess Point settlement location.

A comparison of the lower Grand River valley Princess Point residence isochrons to the Control Group random locations yields even greater variation (see Figure 5.4.7). The Control Group catchments contain 715 ha of suitable soil for cultivation practices (for 6% of the total land available), compared to over 8,260 ha of poor soil, and 3,200 ha of moderate soil. The ten random locations residence isochrons possess only 12 hectares of soil suitable for cultivation, in a residence isochron area of 232 hectares. Therefore, random site residence isochrons contain 1.7% of all soil suitable for cultivation on 1.8% of the total cluster area. The plot of the random locations data indicates that, within the residence group, the majority percentage of suitable soils is zero. Likewise, the majority percentage of moderate to poor soils is near or at 100%. The Control Group residence isochron data do not bear any resemblance to the Princess Point residence isochron data, and the variation between the two is significant ( $t = 5.08, p = 0.001$ ). This demonstrates that the relationship between Princess Point sites and the Control Group in the lower Grand River valley is non-random and, therefore, probably



**Figure 5.4.6: Suitable soil means by culture group for residence group and residence catchment.**

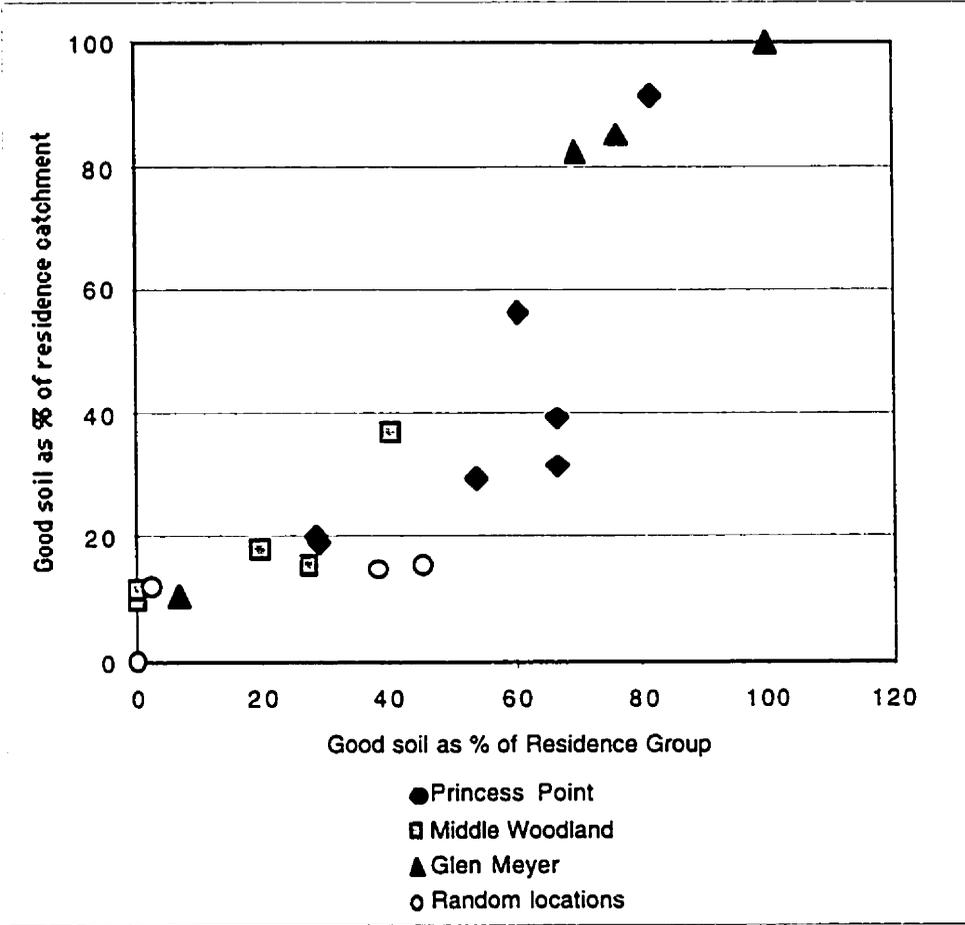
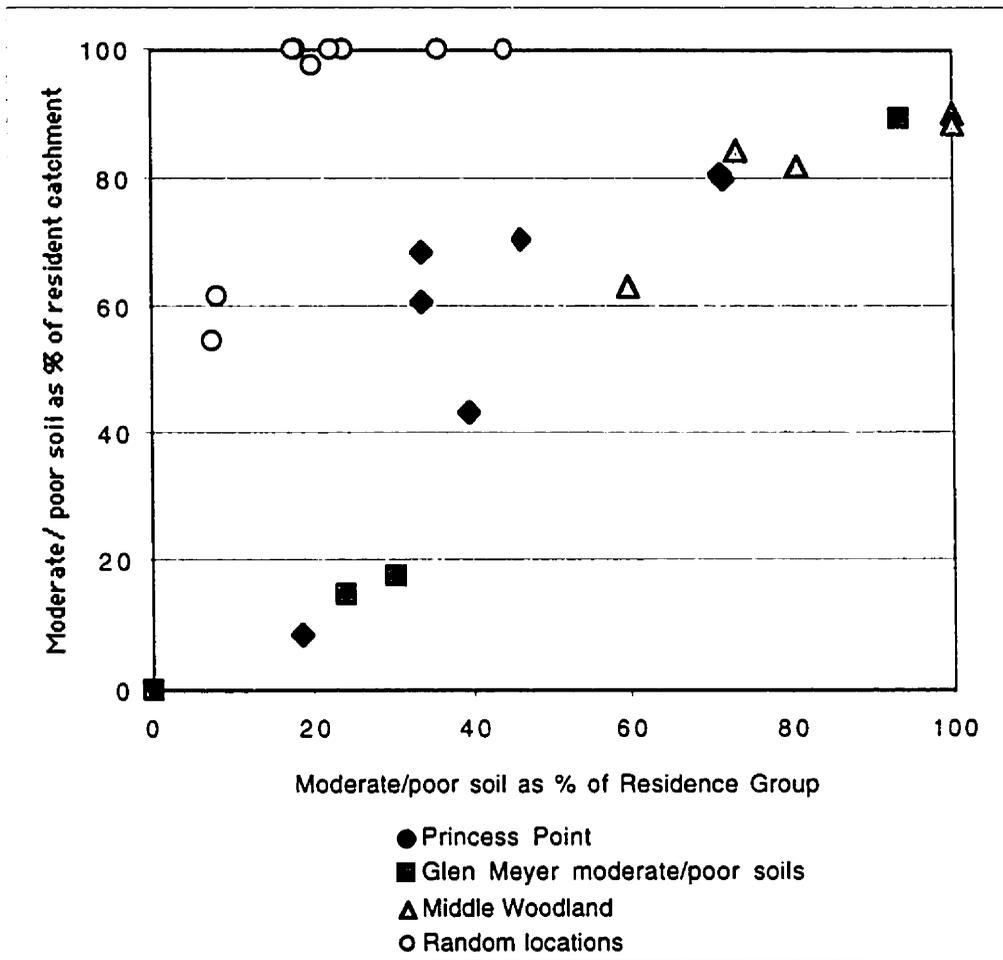


Figure 5.4.7: Suitable soil means by site for residence group and residence catchment.



**Figure 5.4.8: Moderate and poor soil means by site for residence group and residence catchment.**

meaningful. It is suggested that the Princess Point site selection process selected for soils that are defined, in modern terms, as suitable for cultivation.

Equally revealing are the soil landscapes of the Middle Woodland and Glen Meyer cultures. The Middle Woodland residence isochron data suggest that the availability of suitable soil was not a determining factor in site location (see Figure 5.4.9). From the Delaware cluster data, of the 3,320 ha representative of soil suitable for cultivation practices, the residence isochrons occupy only 42 ha. Moreover, the residence isochrons, although each displaying a range from 10% to 40%, have a relatively equal representation of suitable soils as do the residence catchments, on average, at  $17.3\% \pm 17.5$  and  $18.4\% \pm 11\%$ , respectively. This data suggests that the plant husbandry practices of Middle Woodland groups did not require the sandier soil preferred by later groups for maize cultivation. The Middle Woodland subsistence strategy would prosper best in the floodplain and channel environments that the residence isochrons depict as favoured locales. These soils, best suited to the Middle Woodland groups, are not the same ones sought by the Princess Point and Glen Meyer groups, affected by the requirements of the newly introduced maize cultigen.

The Glen Meyer data set reflects a minor trend in a region that consists predominantly of soil suitable for cultivation. In the Caradoc cluster, 3,645 of the 4,600 ha are considered suitable for plant cultivation. The residence isochron data indicate that 126 of 181 ha are classified as suitable for cultivation, with the result that the residence isochron includes 3.4% of suitable soil on 4.5% of the total cluster area. The data in Figure 5.4.10 indicate that over four-fifths of the residence isochron contains suitable soil. The lone variation of this trend for the Caradoc cluster is found at the Caradoc 10 site, where more than nine-tenths of the resi-

dence isochron contain moderate to poor soils (75% silt loam, of moderate suitability). Otherwise, suitable soil is almost equally represented in the residence catchment and the cluster, signifying that, while location is important, suitable soil is a widespread phenomena in the cluster. This would permit fields for maize cultivation to be situated away from the village, and outside of the residence catchment as defined in this research.

The variation between Princess Point and Middle Woodland residence groups, in percentage of soils suitable for cultivation, is significant ( $t = 3.39, p < 0.05$ ), suggesting, among other considerations, a soil selection process for site location. The variation in percentage of soils suitable for cultivation between Princess Point and Glen Meyer residence groups is not significant ( $t = -1.09, p = 0.5$ ). It could be construed that similar soil selection processes were at work for both groups, leading to comparable locations, albeit in different landscapes.

This analysis demonstrates that the soil landscape had a significant role in the placement of Princess Point sites. The lower Grand River valley is primarily a clay plain, with small pockets of sandier soil scattered along the Grand River. Princess Point sites are on, or adjacent to, these pockets in an otherwise unfavourable soil environment. This is highlighted by the uniformly poor soil landscapes for each of the Control Group sites. The initial stages of maize cultivation necessitated suitable soil, comprised primarily of the rich alluvium of the river flats. This condition was not a concern for Middle Woodland groups, which demonstrated that soil were a relatively insignificant factor in site location. The nature of the collecting strategy hypothesised for Middle Woodland groups supports the soil landscape results, indicating that the Middle Woodland groups were moving cyclically to resource areas and not maintaining a plant cultivation resource base in the immediate vicinity of the base camp. Per-

haps the inclusion of garden activities at base camp locales played a role in site determination. The Glen Meyer groups' soil landscape orientation demonstrates a refinement of the Princess Point strategy. Glen Meyer groups shifted to the rich, productive, sand plains upon which sites were situated on or adjacent to the most productive soil in the vicinity. This illustrates the pre-eminence of cultivation activities by Glen Meyer; the best locations were sought out as the immediate environs of the village sites, practising and refining the strategy initiated by Princess Point groups.

### **Summary**

This chapter presents the analysis of the landscape settlement model through each of geographic, topographic, water, and soil landscapes for the Princess Point, Middle Woodland, and Glen Meyer groups. The Control Group of ten random locations within the lower Grand River valley are evaluated against the lower Grand River Princess Point sites. Within each landscape analysis, data are addressed through a heterarchical and multiscalar methodology, beginning with cultural cluster data, moving to viewshed, and ending with mobility group isochrons.

The results of the analysis indicate that Princess Point groups, in terms of site location as interpreted through each of the four landscape approaches, were selecting for particular landscape features that were not ubiquitous in the natural landscape. A detailed interpretation of the results of the analysis is presented in Chapter 6.

The contents of this chapter, and the interpretations in the following chapter, provide a suitable response to the comments that there has been a lack of research into settlement ori-

entation and change, and that the analysis of social organisation typically has depended on stylistic variability while a major source of evidence, past landscape features and environments, has remained relatively unexplored (Spikens 1996:87). The geographic, topographic, water, and soil landscape data in this chapter, modelled through both substantive and inferential landscape approaches, explore the landscape features and environments of the Princess Point group, as well as the Middle Woodland and Glen Meyer groups. I hope this analysis promotes additional research into the landscapes not only of southern Ontario, but also of the larger, relatively untapped, North American resource base.

## CHAPTER 6

### INTERPRETATIONS AND CONCLUSION

The *Landscape of Place* is an interpretation of the proto-Iroquoian Princess Point settlement system as an expression of the surrounding landscape. This dissertation defines and models the Princess Point settlement system, emphasising the relative contributions made by activities associated with a period of sedentarisation, social re-organisation, and subsistence change in the form of incipient cultivation activities. The research compares the Princess Point data with Middle Woodland and Glen Meyer data from southern Ontario.

The research objective of this dissertation calls for a dual strategy to model the variation present within the surrounding landscape: to model settlement systems through a substantive approach as demonstrated by the location of sites in the natural landscape, and to demonstrate, via an inferential approach, the variation in settlement systems through viewshed and isochron analyses. The data sources include a cross section of 45 sites, and 10 random locations, in southwestern Ontario analysed through four approaches: geographic, topographic, water, and soil landscapes.

This research also has two purposes: to formulate a landscape settlement model for Princess Point, and to conduct an analysis of cultural variability in site selection criteria, landscape associations, and cultural activities. The conclusions reached as a result of the analyses provide evidence that landscape played a socially important role in the Princess Point settle-

ment system and provided a setting by which to map out an adaptive landscape strategy for the inclusion of a new cultigen into an established cultural system.

In Binford's "The Archaeology of Place" he argues that, in order to understand the past, we must understand places, that archaeology is concerned with site patterning both "within place" and "between places" and in the way that places are differentiated from one another (Binford 1982:358). An explanation of place differentiation is presented as a *system of past adaptations* (italics mine), which is "related to patterns of seasonal environmental dynamics as well as to longer-term cycles and shifts in environmental conditions" (Binford 1982:377). Binford's 'archaeology of place' is not contiguous with my definition for 'the landscape of place' which is a cultural and contextual relationship between people and the environment. The landscape strategy employed ascertains the degree to which the surrounding environment reflects social change rather than dictating social change. To this end, the landscape model presents an explanatory model of settlement by building on the evaluative nature of predictive and potential models. Within the landscape model, the substantive approach has its roots in site catchment studies, while the inferential approach represents a departure from environmentally determined research by suggesting a social perspective of landscape.

### **Interpretations**

The Princess Point landscape settlement model provides a multiscalar geographical and cultural analysis of selected site locations in southern Ontario. The landscape model demonstrates that the Princess Point site locales differed significantly from those of the culturally

preceding Middle Woodland Saugeen and the subsequent Early Ontario Iroquoian Glen Meyer.

The implementation of a landscape model to investigate Princess Point settlement systems was not a *fait accompli* in terms of guaranteeing statistically significant data sets. The assumption underlying the interpretation of the Princess Point settlement system remained to be tested. To this end, the landscape model tested 15 Princess Point sites in four site clusters with the goal of interpreting the Princess Point culture group settlement system.

### *Evaluating the Landscape Model*

The cluster data indicate geographic, topographic, water, and soil relationships unique to Princess Point groups. Although singular in design in comparison to locational models, the cluster approach shares one trademark of the locational model: an examination of the interrelationships between environment and human activities by testing associations. The variation between the two lies in the value of the association measured. Locational models typically use environmentally determined associations between sites and their surroundings, whereas the cluster data, represented by the sum of site catchments, evaluates and explains relationships through the theory and methodology of the landscape settlement model.

The viewshed data presents a unique opportunity to model landscapes on a site-by-site basis for Princess Point sites, as well as Middle Woodland and Glen Meyer sites. The relationships at the viewshed scale of enquiry lead to hypotheses of settlement and subsistence practices for each of the three culture groups through an examination of both the natural and the experienced landscapes. The methodology permits an analysis of how a culture group in-

interprets its immediate bounded landscape on a site-by-site basis, resulting in unique data for each of the four landscape analyses. The analysis of human-environment interrelationships combines the natural landscape's substantive data detailing the environment-site landscape relationship and the experienced landscape's inferential data explaining the space and place relationship.

The delimitation of mobility and social boundaries by isochrons acutely highlights any cultural variation potentially demonstrated by viewshed data. Isochrons demonstrate the potential for cultural inference from landscape data to a greater degree than that of viewsheds, presenting a level of interpretation both augmenting the interpretative value of the viewshed analyses and forming additional interpretations based on the isochron data sets. As a methodology, isochrons provide finite landscapes, not as restrictive mechanisms, but as windows on culturally imposed restrictions documented as social boundaries. These boundaries were initially practice-based, with restrictions determined by group activities. Over time, boundaries became socio-cultural phenomena that transgressed the practical and were integral components of the metaphysical, spiritual, and ritual lifeways. Thus, the people of the longhouse represent a long-term development of social boundaries that may have originated, in part, with a Princess Point social organisation response to a newly added cultigen. As a result, isochrons trace the phenomena of social boundaries, in tandem with the concept of an viewshed, as an affordance-affiliated zone of influence.

### *Accomplishments of the Landscape Model*

The research objectives form a pair of fundamental questions concerning the fit of the Princess Point settlement system in comparison to Middle Woodland and Glen Meyer settlement, and an ancillary question regarding the role of emergent cultivation practices as part of the Princess Point settlement system. The landscape settlement model answers these questions by an evaluation of the measures of significance of cultural and environmental relationships through clusters, viewsheds, and isochrons. Furthermore, the model structure permits an explanation of the significance of the Princess Point settlement system. This approach is in keeping with the belief that the construction of culture change models should begin with consideration of the social changes that accompanied sedentism and agriculture (Plog 1990:196).

The landscape model's theoretical constructs, set out in Chapter 1, and methodological approaches, set out in Chapter 2, are successfully tested against the data of the four landscape analyses. Integral to the landscape model is the acceptance of the notion that space and place are socially assigned or partitioned and that this information can be identified as part of the archaeological record. To this end, the viewshed concept and its contribution to the landscape model must be viewed through the three tenets set out in Chapter 1. I assert that the model falls within the broad definition of processual archaeology espoused by Charles (1992:909) in that it is concerned with process at multiple levels. In reaching beyond the 1960's substantive archaeological trilogy of form, space, and time, and equally to embrace cultural, ideological, and symbolic inferences as valid forms of analysis, a landscape approach requires a focus on the material culture (inclusive of settlement systems) of particular groups and an acceptance that cultural change takes place within a context of beliefs and practices (human behaviour), not

necessarily driven but potentially influenced by ecological, technological or economic factors (Trigger 1989:292; 1995:450).

I believe that human behaviour is individual, from which sets of accepted behaviours (specific collection or structure of culturally common beliefs and practices) constitute specific cultures, contrary to Binford's (1980) neo-evolutionary, middle-range theory of advocating a search for laws of human behaviour. The difference lies in the landscape model's concept of scale. Rather than rigid general laws, I attempted to model flexible yet culture-specific beliefs and practices. Bourdieu (1977) defines this as the *habitus*. Explicitly not a set of norms or expectations (Thrift 1996:15), the *habitus* plays a major role in the appearance, acceptance, or adoption of new traits (Charles 1992:918). Therefore, actualized human behaviour, i.e., decision making, is integral to the functioning of the landscape model as depicted through the analysis of ideational or social processes (represented by viewsheds and isochrons) as factors in culture history. Contra Charles (1992:909), the merging of both viewpoints can exist, as demonstrated by this research and also witnessed in the works of, among others, Duke (1991), Holl and Levy (1993), Llobera (1996), McGlade (1995) and Renfrew and Zubrow (1994). The result is a unified and coherent explanation of data sets stemming from a synthesis of substantive and inferential landscape approaches.

In Chapter 1, I note that landscapes reflect human-environment relationships for each of the material, social, and cognitive realms by displaying variation in landscape patterning. Moreover, the affordances, or the potential that affordances offer, as used by a subsistence-oriented group mobility are visualised in the experienced landscape. An experienced landscape attempts to place dynamic elements, relating to societal and cognitive actions, into an archaeo-

logical landscape. The data sets resulting from the implementation of the landscape model for Princess Point, as well as Middle Woodland and Glen Meyer cultures, reveal significant landscape-related distinctions in site location. These distinctions are measurable by a comparison of the affordances associated with viewsheds and mobility groups.

*The Princess Point Settlement System: Explaining the Human-Environment Relationship*

The analysis of Princess Point, Middle Woodland, and Glen Meyer landscapes reveals an increasingly abstract ideological and physical representation of boundaries. The belief that mobile communities associate with natural features in the landscape, while sedentary communities tend to represent natural features in their built environment (Wilson 1988:139) is demonstrated by the human-environment and the space-place relationships. Princess Point, as a data set, falls squarely between the two. Using this as a basis for the following discussion, I summarise the landscape model findings in chronological order.

For Middle Woodland groups, the importance of the experienced landscape is a focus on resource locales (i.e., affordances in the natural landscape), reflecting an emphasis on readily and seasonally available resources. This is indicated by the high relative importance placed on high and low order water resources in the experienced landscape, over and above the natural landscape, and the relatively low priority placed on suitable soils for cultivation, in favour of floodplains and channels more likely to support plant husbandry activities. The Middle Woodland experienced landscape is focus-oriented, displaying almost no boundary effects that are attributable to cultural manifestations. The view forms for Middle Woodland sites, ranging

from less than one-third to almost complete viewsheds, do not reveal any patterning. For the Middle Woodland, the landscape reflects a practice-based subsistence economy.

In contrast, Princess Point groups practised a constriction of their experienced landscape, either by conscious decision or as a by-product of other decisions. Societal boundaries were formed through restriction of the landscape in response to (or as a result of) decreased social group mobility and the influence of new resources. In part, this is the result of overarching requirements set out by incipient maize cultivation activities on the positioning of sites. This is a confirmation of the view that Princess Point's change in subsistence strategy appears to have affected mobility (Shen 1997:293). The subsistence strategy also affected the experienced landscape, which was bounded, not by artificial means, for longhouses and palisades were not present on Princess Point sites, but rather by a combination of geographic and topographic landscapes, and the likely proliferation of anthropogenic plant communities. This is an indication that societal boundaries were not architecturally oriented at this time.

The landscape model results indicate that the isochrons of the Middle Woodland sites, within the soil and water landscapes, depict practice-based boundaries with little or no consideration of contiguous view form as a sociocultural counterpart. The Princess Point isochrons also depict practice-based boundaries, however, the associated view form represents a boundary not evident in the Middle Woodland, demonstrated by a consistent placement of sites in the landscape by building a natural boundary through topography and landscape perception (i.e., view form). By Glen Meyer, the boundary phenomena had become purely sociocultural, with the abandonment of practice-based isochrons and landscape-based viewforms.

Princess Point landscape view forms emphasise contiguous, compact, riverine locales to the complete exclusion of panoramas, as exhibited by Glen Meyer view forms. The Princess Point experienced landscape, as a view form, favours restrictive views in association with the best available soils in a clay plain, and the immediacy of high order water resources. This landscape highlights the cultural dichotomy of place and space by placing an emphasis on place while space is bounded, in part, by the social and physical restrictions of newly integrated cultivation activities into the day-to-day lifeways.

An apparent loss of cohesion in the experienced landscape is the initial conclusion reached upon the analysis of Glen Meyer sites. Natural boundaries are not present for Glen Meyer. In their place are artificially bounded landscapes, not only recreating but further restricting the experienced landscape of the community. Glen Meyer community organisation supplants the use of the natural landscape as a boundary through a built environment seen in the ubiquitous presence of fully formed longhouses and planned villages. The initiation of palisade construction is viewed as the advent of architectural, social, and physical boundary markers supplementing and replacing natural boundaries that first appeared with Princess Point cultivation activities. The stability of the Glen Meyer settlement system over a wide geographic range requires an *a priori* settlement strategy demonstrably successful in its orientation to both cultivated and wild resource collection, in perhaps a smaller range of site locales. This represents a cultural extension of the landscape orientation demonstrated by Princess Point.

I noted previously that palisades mirror and stimulate natural succession and anthropogenic growth. This trait was used by Princess Point groups at site peripheries; the archaeologi-

cal plant remains from Princess Point sites on the Grand River include a wide variety of fleshy fruits that indicate anthropogenesis, fruits that otherwise are almost exclusively associated with Glen Meyer and later predominately horticultural groups (Crawford *et al.* 1998:133). It is reasoned that these and other plants served as a form of boundary for Princess Point communities, supplementing, and possibly replacing the natural landscape boundary. Eventually, the anthropogenic boundary itself was replaced by palisades, further fulfilling the role of a societal border by excluding, controlling, and dominating the natural border through the imposition of a human-modified cultural boundary. Moreover, a palisade as a societal border is expressed year-round, unlike the inherent seasonality of natural borders. Both Porteous and Holmdale have multiple rows of posts interpreted as palisade segments. As well, eleven of nineteen Early Ontario Iroquoian villages have either single or double rows of palisades, not always fully encircling the village (see Table 1 in Williamson 1990). This evidence signifies a local emergence of the adoption of an architectural environment in replacement of the natural boundaries previously sought by Princess Point.

The Princess Point strategy, refined over a 500-year period, provided the systemic and potentially ideological infrastructure on which Glen Meyer groups could intensify their cultivation base while at the same time transfigure their social relations to ideologically and architecturally emulate the natural landscape relationships. This New World replacement of a natural landscape with an architectural landscape has a parallel, albeit unrelated, development in the Old World, with the supplanting of nature-based animistic religions by cathedral-based House of God Christianity.

Determining the effect of landscape cognition on the Princess Point settlement system requires acceptance that a settlement system is a cultural process to which landscape cognition is a constant contributor. It is hypothesised that experienced landscape cognition shifts from practice-based to culture-based during the period A.D. 500 to 1050. Landscape is used as both a socially determined and physically practiced settlement parameter. The landscape model illustrates that the Princess Point settlement system is significantly different from that of the preceding and antecedent cultures. A principle component of the Princess Point settlement system is a culturally identifiable landscape, identified by the site location practices of Princess Point. Cluster, viewshed, and isochron analyses document uniform site selection across nearly the entire slate of Princess Points sites in this research.

As site clusters, the Princess Point groups targeted areas where water resources, and the associated affordances, exceed any neighbouring resource. While Middle Woodland groups targeted the middle Thames floodplains, or the terraces and hills associated with the wetlands and kettle bogs of Pond Mills, the Princess Point focus was on the single largest riverine system in southern Ontario, and did not exploit the greater secondary riverine resources. At Cootes Paradise, a prominent wetland locale was similarly used. This shift was reflected in the Princess Point clusters' selection of the best situation, in terms of soil productivity, from a relatively poor selection pool. The small, sandy terraces and fertile river bars on which Princess Point sites in the Grand River region are found represent the vast majority of the optimal locales for an investment in cultivation practices.

Subsequent practices by Glen Meyer people witnessed a dramatic shift in settlement away from the Grand River. The overwhelming association of suitable soils with Caradoc

cluster villages, demonstrated by the Glen Meyer soil landscape, is similar to associations found in past research on 1 km catchments around Caradoc villages. Previously, it was determined that, of the village sites, “at least fifty percent of their one kilometre catchment contained the best horticultural soils available on the sand plain” (Williamson 1985:326), resulting in an average suitable soils value of 71.3% within the 1 km catchment. This value is nearly identical to the landscape model’s determination that the residence isochrons of the Caradoc cluster, as a whole, contains 70.0% suitable soils.

The extent of strategic settlement shifts from A.D. 500 to 1050 becomes more evident through viewshed analysis. The landscape model illustrates each site’s viewshed as a cognitive extension of the immediate site. The viewshed comprises culturally amenable affordances. Unique to Princess Point is the uniformly small viewshed size. Site after site, the Princess Point consistency in landscape suggests a degree of landscape cognition. Princess Point viewsheds are the least variable data set, both on a site-by-site basis within clusters and across all sites. I attribute this, in part, to the consistency of Princess Point view forms. All Princess Point sites have a compact and mostly contiguous view form. In contrast, non-contiguous view forms are typical of each of the Middle Woodland and Glen Meyer sites, and Control Group random locations.

Princess Point site viewsheds emphasise restrictive views in association with soils suitable for cultivation and the presence of high order water resources (and their accompanying affordances). The bounded nature of the viewsheds highlights the cultural construction of place and space, promoting a constriction of place with an emphasis on residence group activities. The residence activities and associated mobility are similarly bounded by the nature of the

newly integrated cultivation activities into the day-to-day lifeways. Princess Point site viewsheds may represent a cognitive boundary construction, a construction that ultimately manifests itself as palisade construction, artificially creating a restrictive experienced landscape. The perception of Middle Woodland people as living with the environment gives way to the naturally bounded spaces of Princess Point and then to the human-built boundaries of Glen Meyer. The shift from a contiguous view form to one that is non-contiguous for Glen Meyer sites may represent the culmination of the centuries-long shift to sedentism. This substantiates the observation that sedentism involves a transformation from a sociocultural infrastructure founded on a focus to one founded on a border (Wilson 1988).

The archaeological evidence from the Grand River valley indicates that Princess Point groups were settling from the mouth of the river through modern Brant and Waterloo counties. Settlement in the Lower Grand River valley was oriented towards the recently stabilised river bars which provided ample, rich, alluvial soil, supporting the initiation of maize cultivation in the region. Princess Point lifeways were relatively similar to those of the preceding period, representing a variation of the hunter-gather home base expanded to incorporate cultivation practices, which were, at first, a relatively minor addition to a long-established resource base. The inclusion of the newly incorporated cultigen is noted in the isochron data sets by the increase of the residence group area within the viewshed. The landscape data for the residence group isochrons demonstrates a significance in the variation of residence group affordances between Princess Point and Middle Woodland groups. This same relationship is not significant for the Princess Point and Glen Meyer groups, suggesting that the shift to cultivation activities is reflected in affordances associated with the residence group.

Habitat group activities are also reflected in the landscape data. The habitat isochron is smaller during Princess Point in comparison to the Middle Woodland and Glen Meyer data. This may represent the shift from seasonal subsistence practices to that supplemented by maize cultivation. That the reduced Princess Point habitat area once again expands by Glen Meyer supports the contention that hunting and gathering continued to be important for the Glen Meyer Caradoc group (see Williamson 1985). It is suggested that over the entire AD 500 to 1150 period, the relative importance of the habitat group's activities remains stable. The reduction in habitat isochron size during Princess Point suggests that maize cultivation requirements took precedence over other subsistence concerns.

Water landscape data portray the Princess Point groups maximising the established Middle Woodland tradition of using high order water resources and their affiliated affordances, to the exclusion of the low order resources also favoured by Middle Woodland groups. The near complete elimination of secondary resources as an affordance is unique to Princess Point, as witnessed by the highly significant variation with the Control Group data in the lower Grand River valley for high and low order water resources. Similarly, while the Princess Point residence group isochrons encapsulate over three-quarters of the primary water resources in the catchment, the Glen Meyer residence group isochrons do not incorporate any primary water resources. What starts as a plausible transition from Middle Woodland to Princess Point ends in abrupt and polar change in water resource orientation by Glen Meyer, indicating a major cultural adjustment. An alteration of this magnitude in a centuries-old pattern not only suggests social and ideological change, but a change whose cause may lie outside the culture group.

The soil landscape analysis also indicates the landscape selection process underlying the Princess Point settlement system. Prior to Princess Point, Middle Woodland groups in the Delaware cluster were selecting floodplain and channel locations as a condition of settlement, with less of an emphasis on soils suitable for cultivation than the variety of affordances offered by both high and low order water resource landscapes. This is not to say that a wet, lowland region was selected over a well-drained locale in every case, but simply that the cultivation suitability of a soil was not a motivating factor. At the opposite end of the spectrum, even though Glen Meyer groups were in a region that offered only suitable soils for cultivation opportunities, the Caradoc village sites were actively selecting the best of a good situation on the sand plains, choosing locales that contained affordances exceeding that of the surrounding catchment.

Princess Point groups found themselves in a unique predicament, faced with infrequently placed stable river bars, and infrequently observed areas of good soil for cultivation. As a result, the site selection process necessitated seeking a combination of the best soils in the region associated with alluvial river bars. However, proof as to the accessibility of the river bar locales at this time is demonstrated by the long-term occupation of the two Princess Point river bar locales investigated to date. Princess Point residence isochrons indicate that, while only a fraction of the soils in the Grand River Indiana and Cayuga clusters are identified as suitable, the residence isochron encapsulates over half of the good cultivation soils. This ability to select optimal soils, established by Princess Point, was practiced to its full extent by Glen Meyer.

Princess Point site distribution follows a newly evolving pattern, whereby a bounded orientation is repeated at all scales: discretely distributed clusters, comprised of naturally

bounded communities and oriented towards high order water resources; sites with rich, yet restricted, resource zones in association with immediate access to productive soils; and a greater emphasis on immediate resources associated with a near-ranging or residence mobility group in association with the traditional and long-standing assurance of far-ranging or habitat mobility group resources.

Turning to a recent dissertation on Princess Point detailing the change in lithic production from Middle Woodland to Late Woodland (Shen 1997), a number of issues and comments therein have immediate relevance to this research. Shen's (1997:297) postulate that the documented change in lithic technology could have been the result of a shift in primary subsistence strategy is aptly demonstrated by the data sets generated by the landscape model. The belief that economic activities affected the degree of sedentism is likewise established.

Shen (1997:301) notes that with a large population, as the density of archaeological evidence from the Grand Banks, Cayuga Bridge, and Meyer sites suggests, labour allocation and division are to be expected. Shen offers no support for this statement, however, the isochrons of the residence and habitat mobility groups quantitatively support this contention. Princess Point residence groups were well suited to exploit the affordances offered by affordances related to high order water resources and suitable soils, and were situated within bounded landscapes to satisfy the developing architecture of social organisation.

In reference to stone tool productive organisation, Shen notes that that cultivation activities were organised by household units, that "with the emergence of horticulture, households in the foraging societies became basic economic units and started developing the ownership of land and *setting productive boundaries between and within their societies*" (Shen

1997:305, italics mine), adding that it was unlikely that this phenomenon existed in previous foraging societies. The phenomenon of setting productive boundaries both between and within societies is illustrated by the landscape model, the data analysis suggesting organisation beyond that of stone tool production. Just as lithic technology is socially constructed (Sassaman 1994, in Shen 1997:293), the landscape is socially constructed.

I believe that the landscape analysis provides ample proof of the evolving bounded nature of settlements spanning Middle Woodland, Princess Point, and Glen Meyer. Moreover, and contrary to Shen's postulate, it demonstrates that a landscape orientation phenomenon existed to some degree for Middle Woodland foraging groups. The landscape analyses depicts Princess Point and Middle Woodland groups sharing like patterning in reference to the natural and experienced landscapes. By Glen Meyer, these bounded patterns, no longer manifest in the landscape, were architecturally organised through the physical village and by household units through the architecture of the longhouse. Therefore, it is not only that cultivation activities were organised by households, as noted by Shen, but that the nature and location of the cultivation activities facilitated an organisation *into* households through the development of a socially-organised landscape from the previous practice-based landscape.

#### *Outstanding questions and future directions*

Further research on a number of items is required in order to address questions stemming from this research. The claim that "to understand the cultural dynamics associated with the introduction of agriculture to Middle Woodland groups, a sequence of sites dating to the [period A.D. 500 to 1,000] will have to be discovered and excavated" (Spence and Pihl

1984:42) has been partially addressed by recent archaeological activities documented in Chapters 3 and 4. As to Princess Point settlement on the river flats, such as Grand Banks and Cayuga Bridge, or the terraced Meyer site, it is acknowledged that we are unable to state whether clustered sites are contemporary or represent single community moves over a period of time. An understanding of Princess Point site chronologies is required in order to further advance the landscape analyses of site clusters. With a chronology, more fine-grained landscape modelling may aid in documenting the transition from practice-based to culture-based landscapes within the Princess Point group.

With chronological control, population movements, if any, can also be modeled. A pertinent example, without radiocarbon date support, is a study of Iroquoian village movements in southern Ontario from A.D. 900 to 1650. This study concluded that village movements, averaging 2 km, were the result of sanitation concerns more than resource exhaustion (Fecteau *et al.* 1994). Temporally, it is suggested that rebuilding activities at Glen Meyer sites indicate a 50- to 75-year span for each site (Timmins 1997). The complexity of settlement patterns at the Princess Point sites investigated to date lends support to the latter while the former may provide some explanation for the clustering of sites in general. As an example, the Cayuga cluster, with at least six locales in a 5 km radius, at 75 years of occupation for each site, would account for almost 500 years of settlement, the entire time span of the Princess Point culture as currently defined.

Another critical research question stems from the observation that “it is difficult to ascertain if Princess Point people...were Iroquoians. It is even more difficult to link pre-agricultural Middle Woodland peoples to Princess Point” (Bekerman and Warrick 1995:i).

While the latter part of this observation has, in part, been addressed by my landscape analysis, the query regarding Princess Point ancestry remains an open question. Beckerman and Warwick statement, that for the period prior to 1,000 years ago, the pre-Iroquoian picture becomes blurred, echoes the sentiments of J.V. Wright, who remarked nearly two decades earlier that “certainly sites representing [Princess Point] are early post-Middle Woodland and yet they are representative of neither the Pickering nor Glen Meyer branches” (Wright 1966 in Stothers 1976:138).

The origins of Princess Point have been debated since its designation 30 years ago. Either it was an intrusive movement of people originating in the south and replacing existing people or it was an indigenous development. Who, then, were the Princess Point people? Was Princess Point ancestral to Late Woodland Iroquoian societies in southern Ontario, as postulated by a number of researchers (see Crawford *et al.* 1998, Stothers and Graves 1983, Stothers and Pratt 1981)? If so, what of the similarities between the Hunter’s Home group in New York State and perhaps Clemson’s Island sites in Pennsylvania? At this time there are no leads for this line of inquiry but landscape analyses of the two later groups would provide data sets with which to compare Princess Point sites.

### **Conclusion: The Landscape of Place**

My use of landscape modelling addresses a community’s perception of the immediate or experienced landscape and attempts to provide an explanation of the relationships between a community and its surroundings. I suggest how a community might perceive the immediate landscape by presenting these relationships in the format of site clusters, viewsheds, and iso-

chrons. The landscape approach attempts to move beyond environmental determinism by presenting a human-environment relationship approach to modelling of site location, based on requirements fulfilling not only economic needs but also socially determined needs. My application of the landscape model to the Princess Point culture demonstrates the effectiveness of a landscape methodology to pre-contact data sets in southern Ontario.

Princess Point people interpreted their landscapes in a different manner from either Middle Woodland or Glen Meyer groups. Some traits were shared with either group depending upon the affordance under study. An explanation of this sharing of cultural traits involves an intermediate phase of semi-sedentariness (Chapdelaine 1993, Niemczycki 1984:198, Williamson 1985), broadly spanning A.D. 500 to 1200. This would imply a slower pace of change than previously believed (Noble 1975, Stothers 1977) for the adoption and domination of cultivation activities associated with maize. The acceptance of an intermediate phase is accompanied by a caution that archaeologists should watch for an inherent false dichotomy between foragers and farmers. Many subsistence systems, especially in eastern North American Woodland periods, fall somewhere between or incorporate aspects of both systems (Fritz 1999:425). This is apparent in the landscape data analysis, whereby the distinctness of each culture group is complimented by the similarities both between Middle Woodland and Princess Point groups and between Princess Point and Glen Meyer groups.

The stability of the Glen Meyer settlement system required a prior settlement strategy that was successful in its orientation to both cultivated and wild resources. This stability, demonstrated most recently for the Calvert and Roeland sites, is a cultural extension of the Princess Point landscape orientation. The Middle Woodland resource-oriented base camp strategy pro-

vided the foundation for the Princess Point system, a cluster of affiliated sites with one or more base or village locales supporting a group in a restricted or prescribed catchment area. The Princess Point strategy, refined over a 500-year period, provided the systemic and potentially ideological infrastructure on which Glen Meyer groups could intensify their cultivation base, while at the same time transfigure their social relations to emulate the natural and experienced landscape relationships developed by Princess Point groups. By A.D. 1000, the physical and cognitive landscape configuration, as expressed by a natural boundary orientation demonstrated by Princess Point, changed to manifest itself through purely social and related architectural relations when the use of a bounded landscape was no longer a viable alternative (either by choice or external influence).

Decisions relating to settlement location and mobility are complementary and cooperative, based on the acquisition of information (Hudecek-Cuffe 1998). The landscape settlement model documents these decisions. The change from hunter-gatherer decision-making (based on cumulative available affordances in the environment used through a seasonal round subsistence schedule) to cultivation decision-making (based on a more restrictive selection of affordances in a cultivation oriented semisedentary or sedentary lifestyle) occurred gradually over thousands of years. Accompanying the settlement location change was an alteration in mobility and social group strategies from a parallel structure (as demonstrated by Hudecek-Cuffe for hunter-gatherer Palaeoindians) to a heterarchical structure in which the mobility of groups was interdependent yet non-constraining. The mobility of activity-oriented groups is an information source when viewed through the heterarchical landscape analysis. "Complicated networks involving interactions among various categories of people" (Whelan 1995:50) best describes

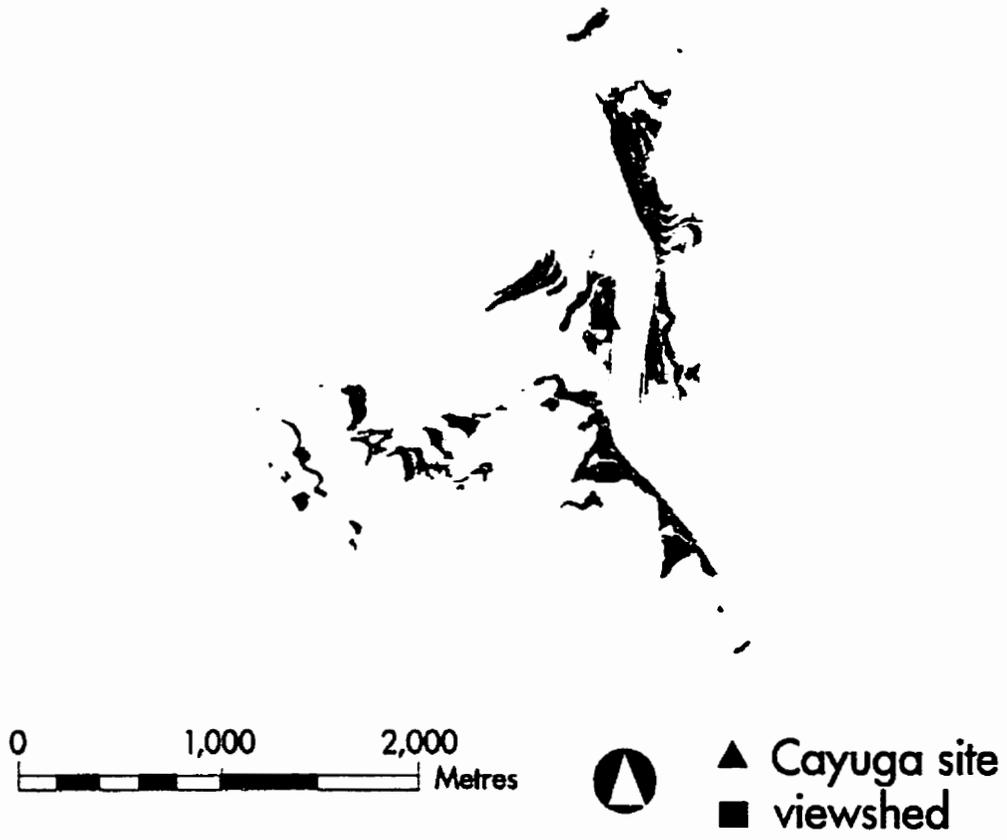
this information source. The residence and habitat isochrons illustrate the conference of categories of people onto the landscape. The potential influence each group exerts is based upon affordances available within unique places.

Archaeological data pertaining to the period A.D. 400 to 800 in Ohio outline a phenomenon that straddles Princess Point and Glen Meyer landscape use. At about A.D. 400-500, a fundamental change in settlement took place at the beginning of a period termed the early Late Woodland. The Middle Woodland practice of valley floor habitations was replaced by nucleated communities (or clusters), which were typically enclosed by embankments. One example of such sites is described as having natural and artificial barriers comprising a ditch and small creek bed, which enclosed the community (Wymer 1993:141). The natural and artificial boundaries, while not necessarily restricting the social boundaries by visual means, act as newly emerging restrictive mechanisms expressed through social re-organisation in the form of an architectural environment.

The determination of the landscape of place is not merely the implementation of a simple cultural equation. The rationale for a culture group's decision-making processes is not a standardised set of guidelines. The landscape of place for Princess Point is not the same as that of Middle Woodland or Glen Meyer. My research analyses the basic principles that are suggested as motivation for decision-making processes leading to site location choice. The sedentarisation of the pre-contact Iroquoians term is an apt description of the Princess Point situation *circa* A.D. 500 to 1050. My research documents the underlying rationale of settlement and subsistence practices as perceived through the relationship between mobility and social organisation. While not an exhaustive investigation nor necessarily exclusive to the culture

groups within, the landscape settlement model's use of a viewshed approach furthers the investigation of settlement and subsistence practices and allows us to quantify mobility and social group activities. The landscape settlement model provides a means of archaeological assessment by way of a methodological and systematic investigation of landscape as both a physical entity documented as the natural landscape and as a socially delineated construction as depicted by the experienced landscape.

## **Appendix A: Viewsheds.**



**Figure A1-1: Princess Point Cayuga cluster: Cayuga Bridge.**

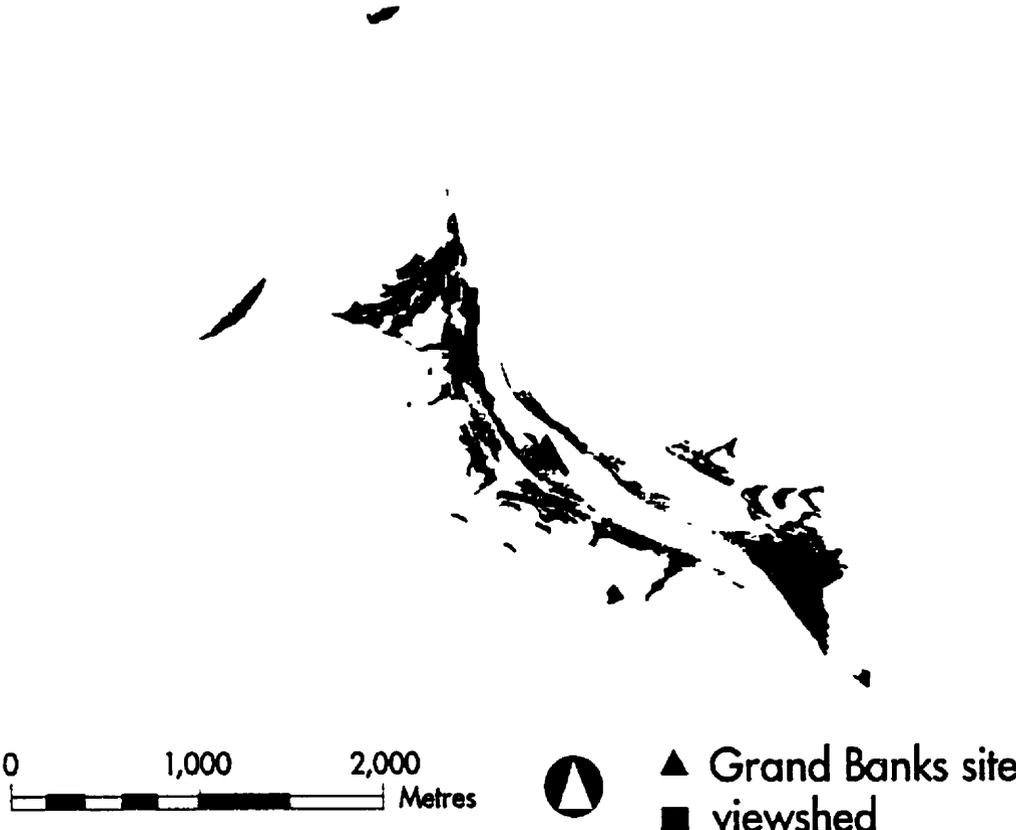


Figure A1-2: Princess Point Cayuga cluster: Grand Banks.

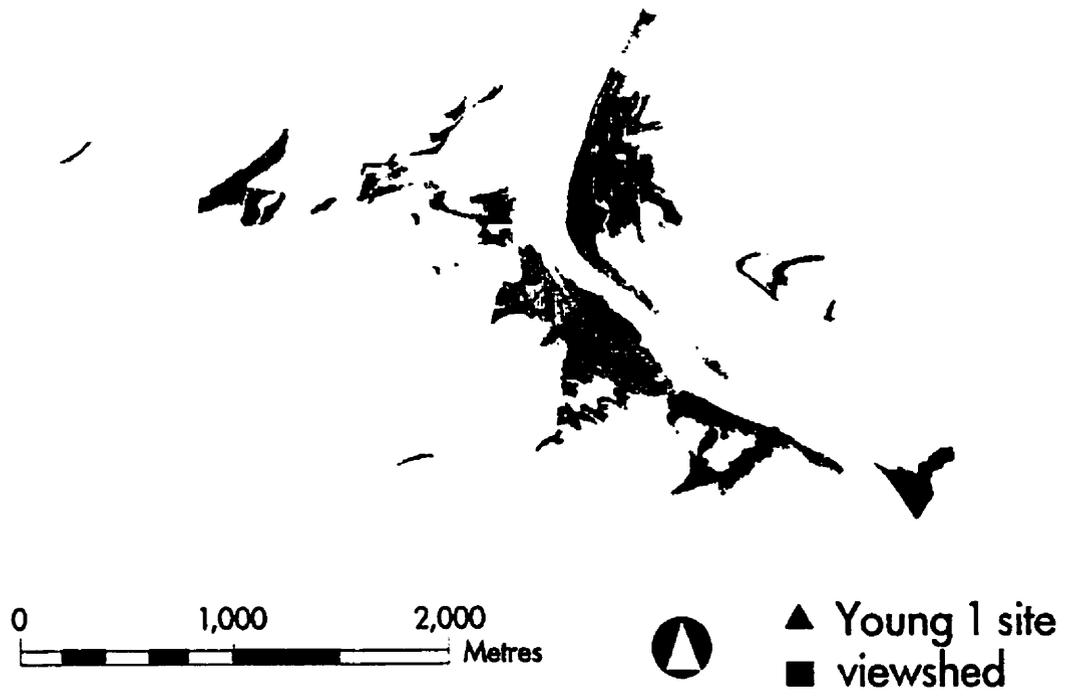


Figure A1-3: Princess Point Cayuga cluster: Young 1.

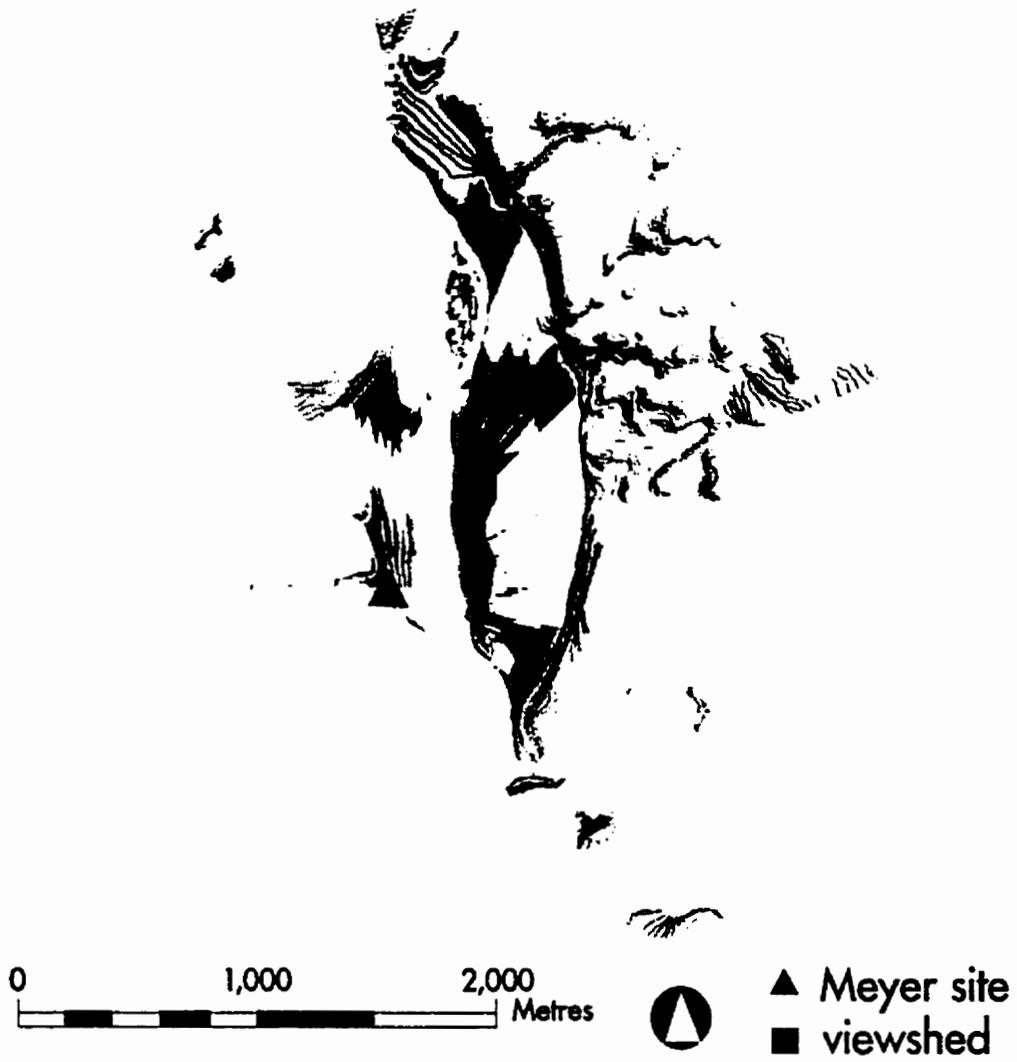
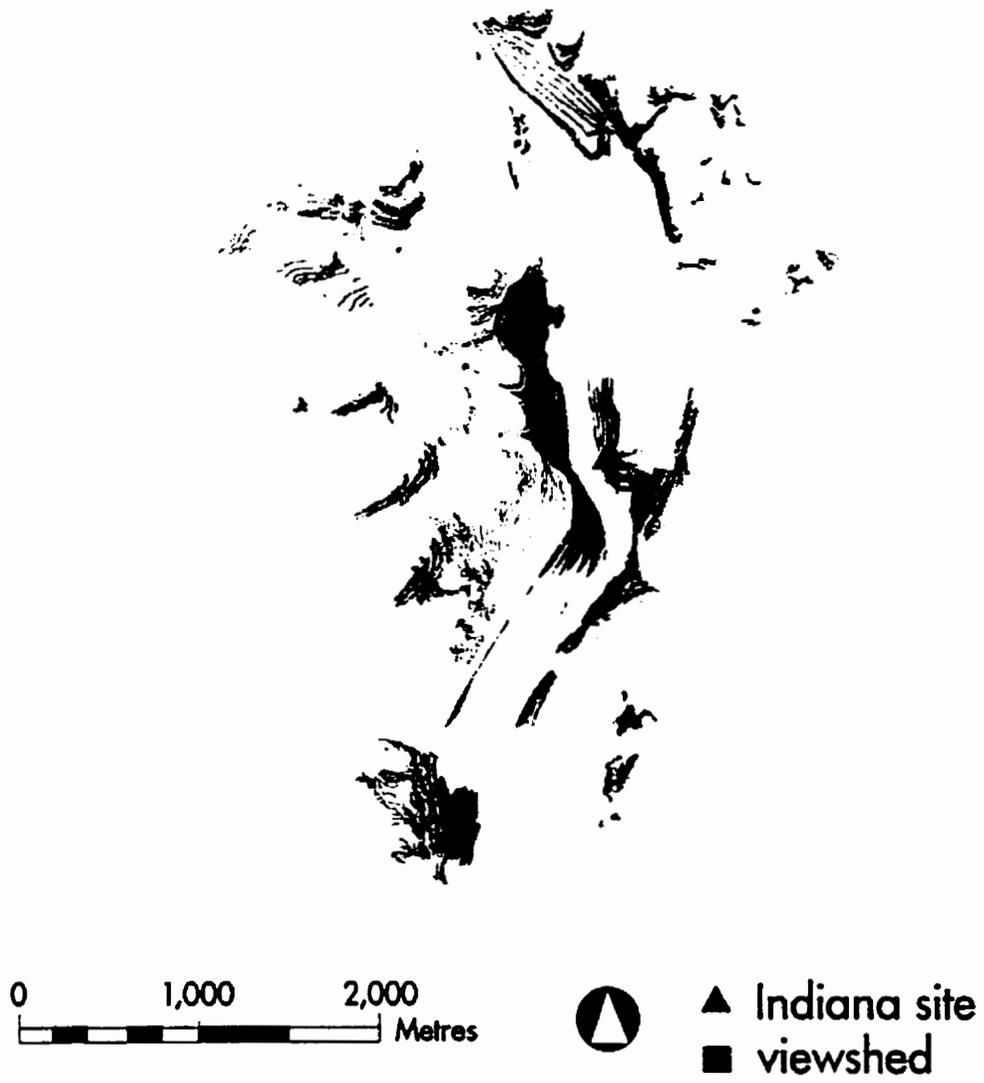


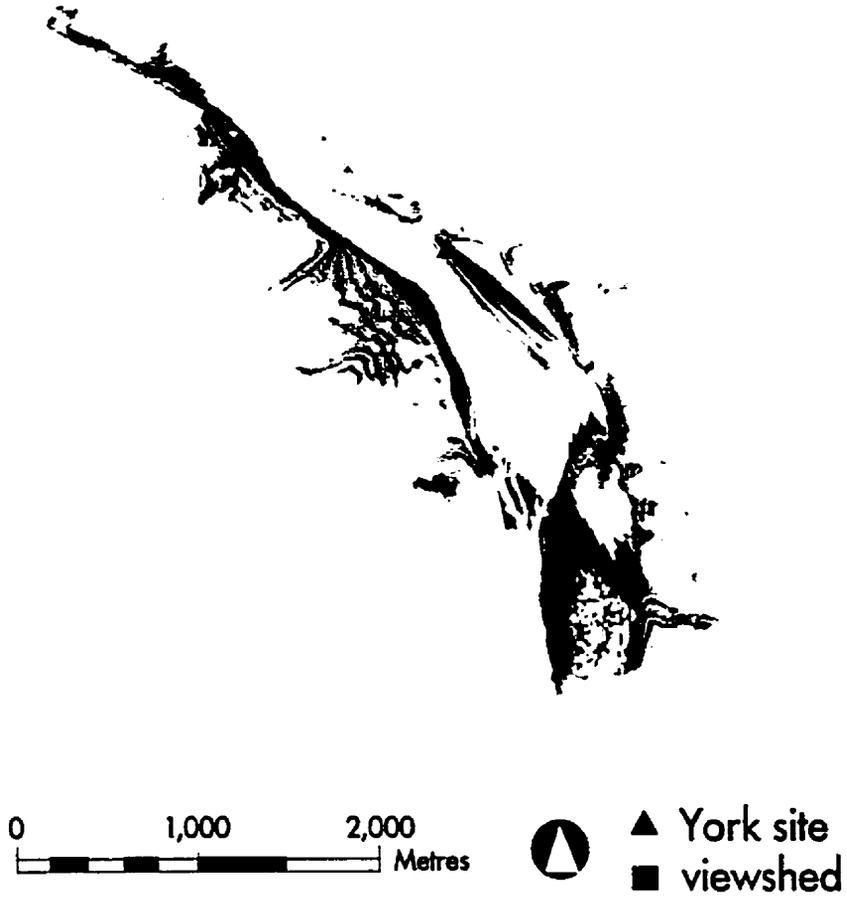
Figure A1-4: Princess Point Indiana cluster: Meyer.



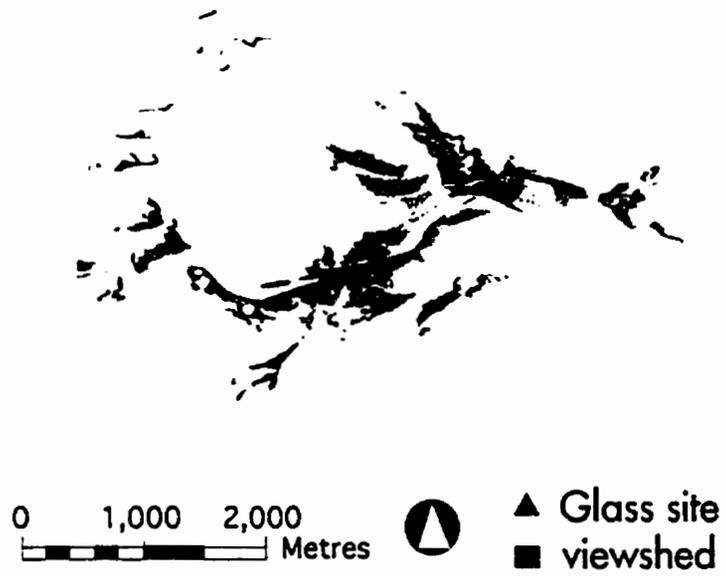
**Figure A1-5: Princess Point Indiana cluster: Indiana.**



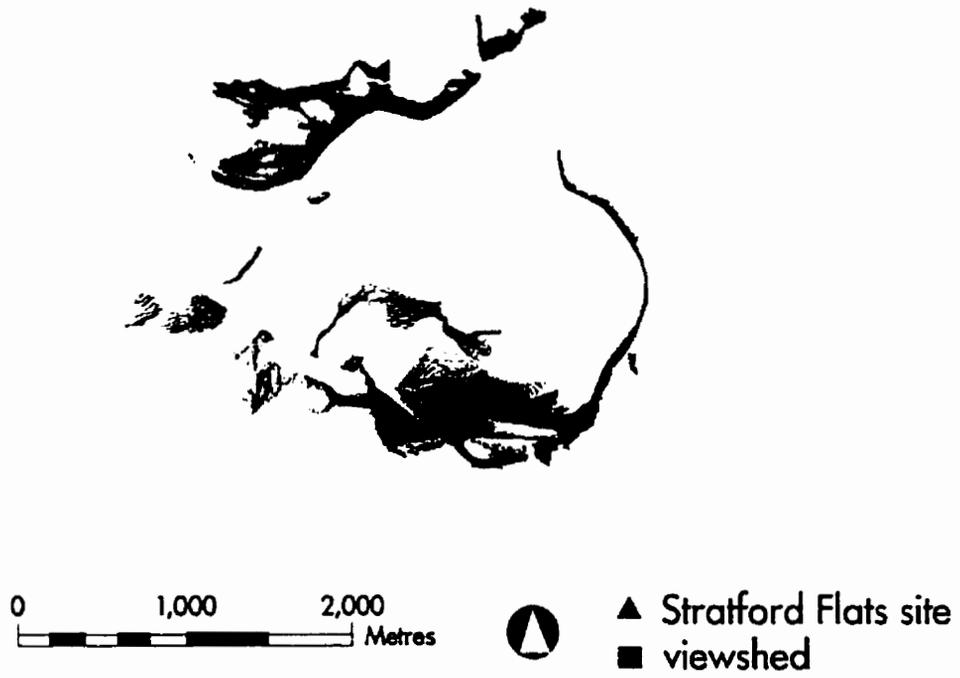
Figure A1-6: Princess Point Indiana cluster: Lester.



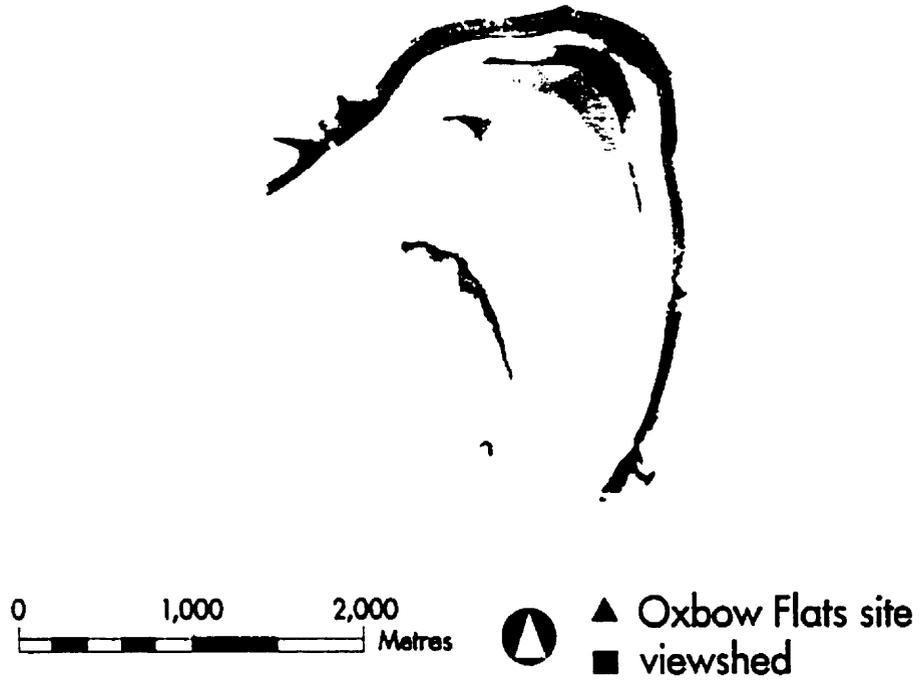
**Figure A1-7: Princess Point Indiana cluster: York.**



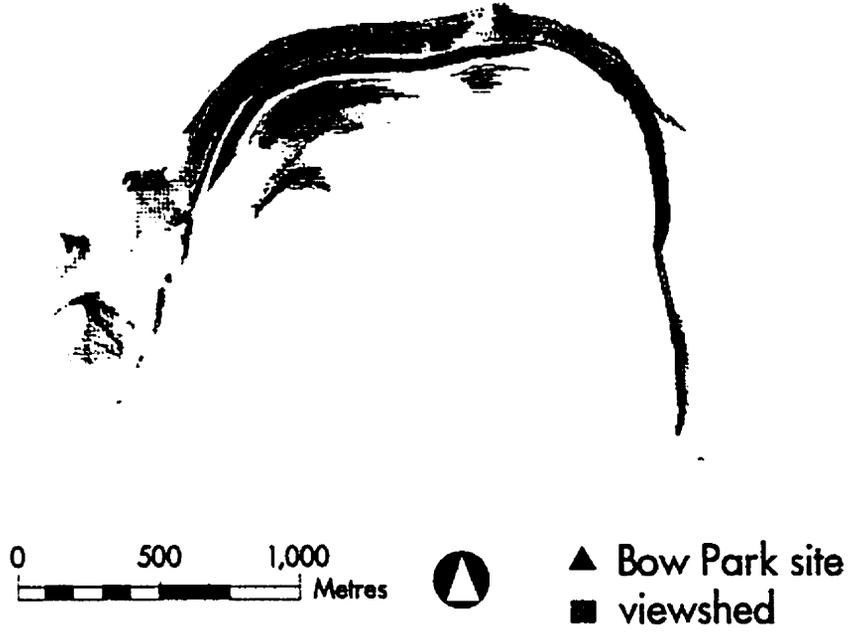
**Figure A1-8: Princess Point Oxbow cluster: Glass.**



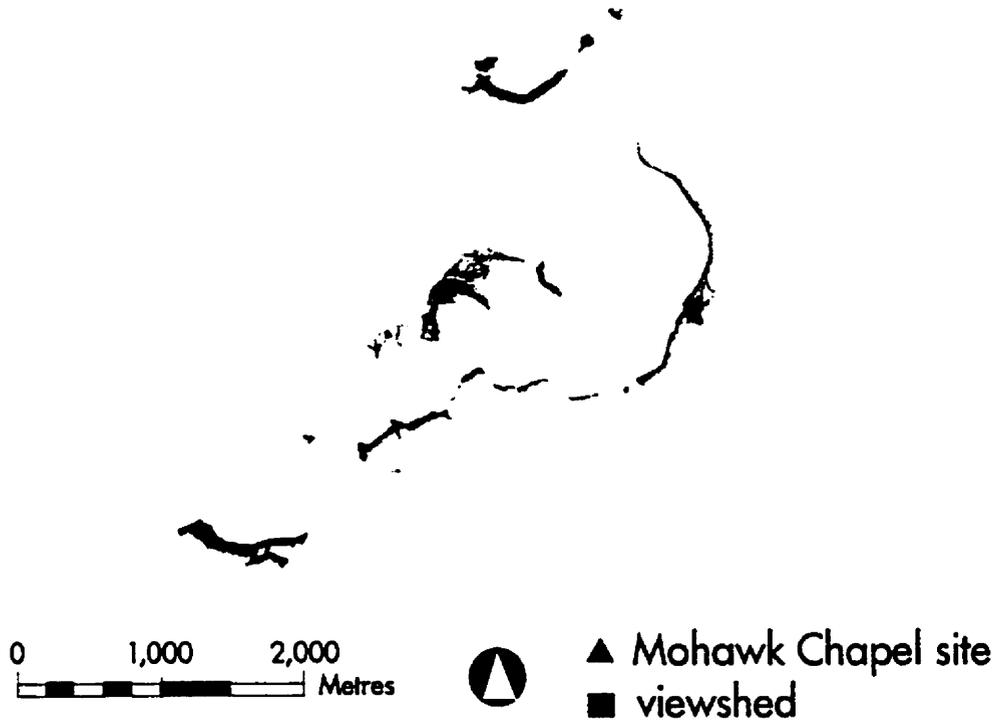
**Figure A1-9: Princess Point Oxbow cluster: Stratford Flats.**



**Figure A1-10: Princess Point Oxbow cluster: Oxbow Flats.**



**Figure A1-11: Princess Point Oxbow cluster: Bow Park.**



**Figure A1-12: Princess Point Oxbow cluster: Mohawk Chapel.**

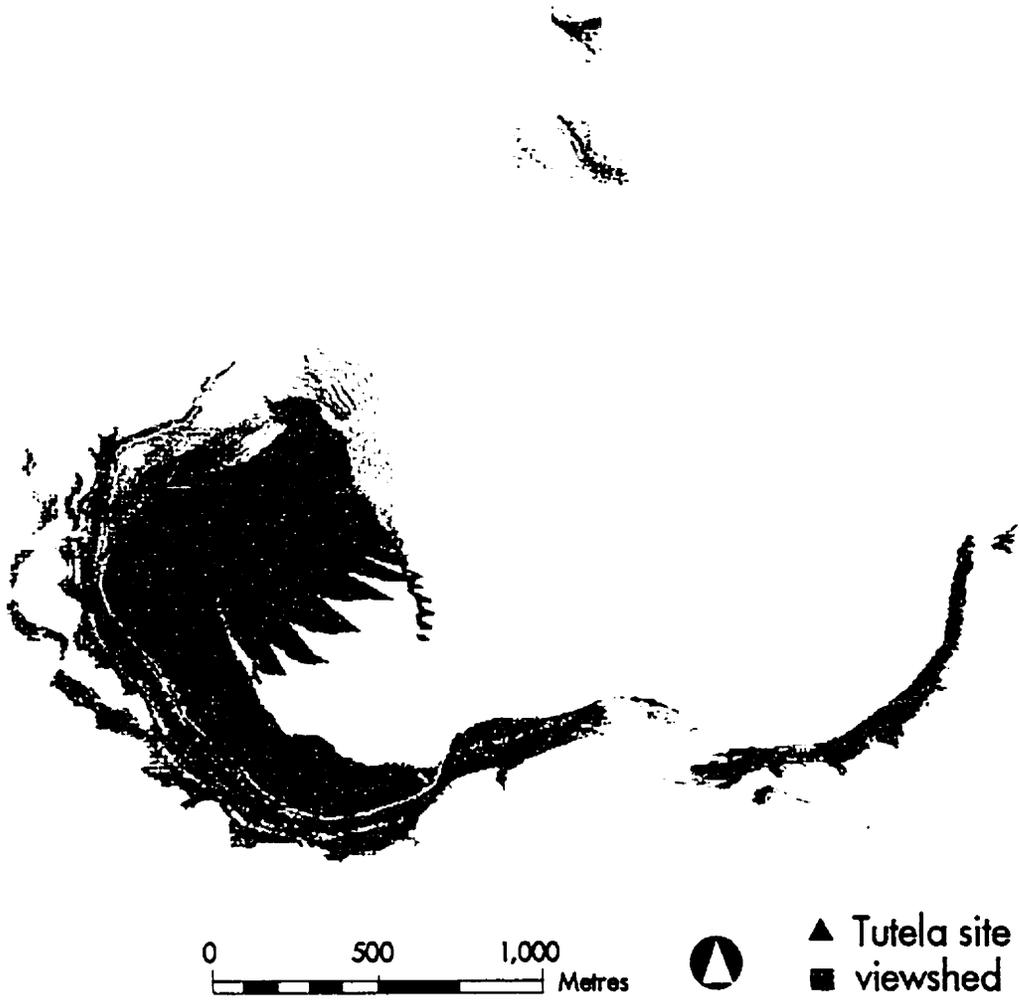
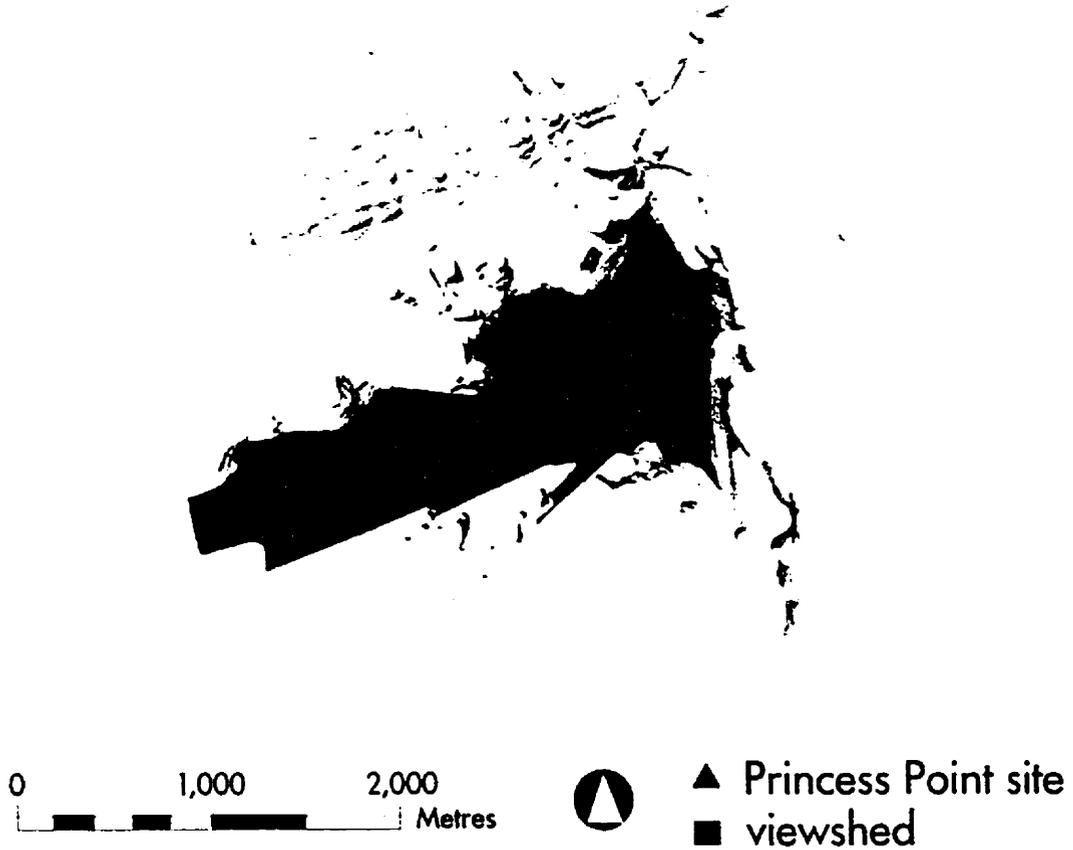
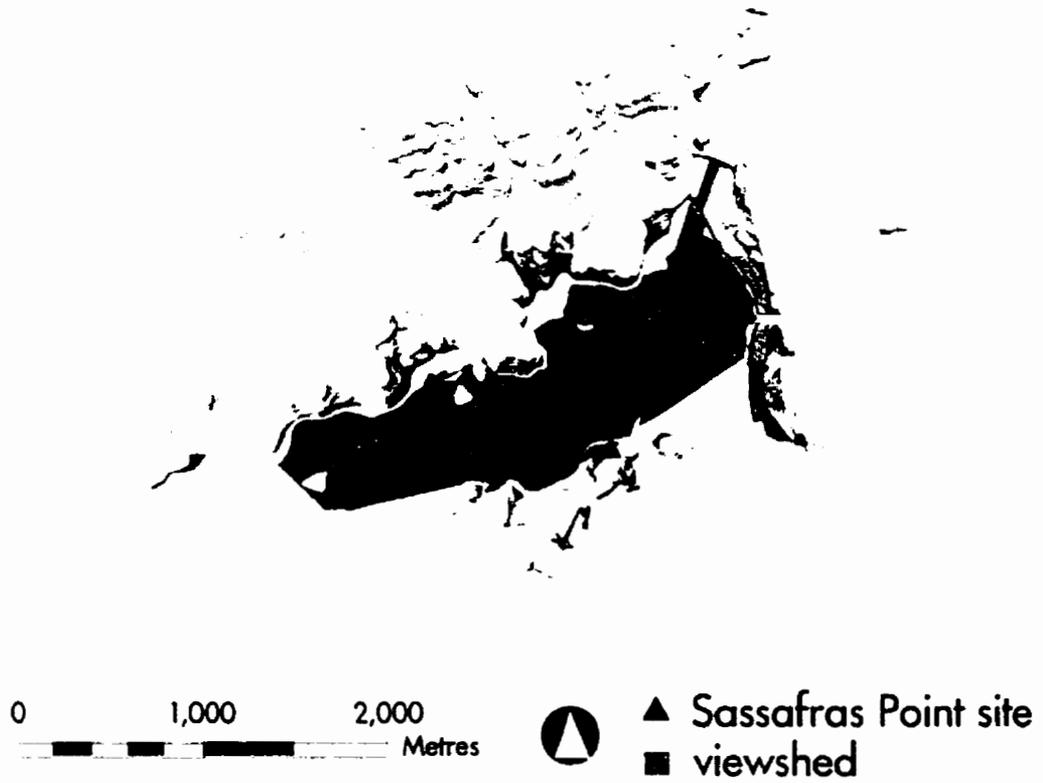


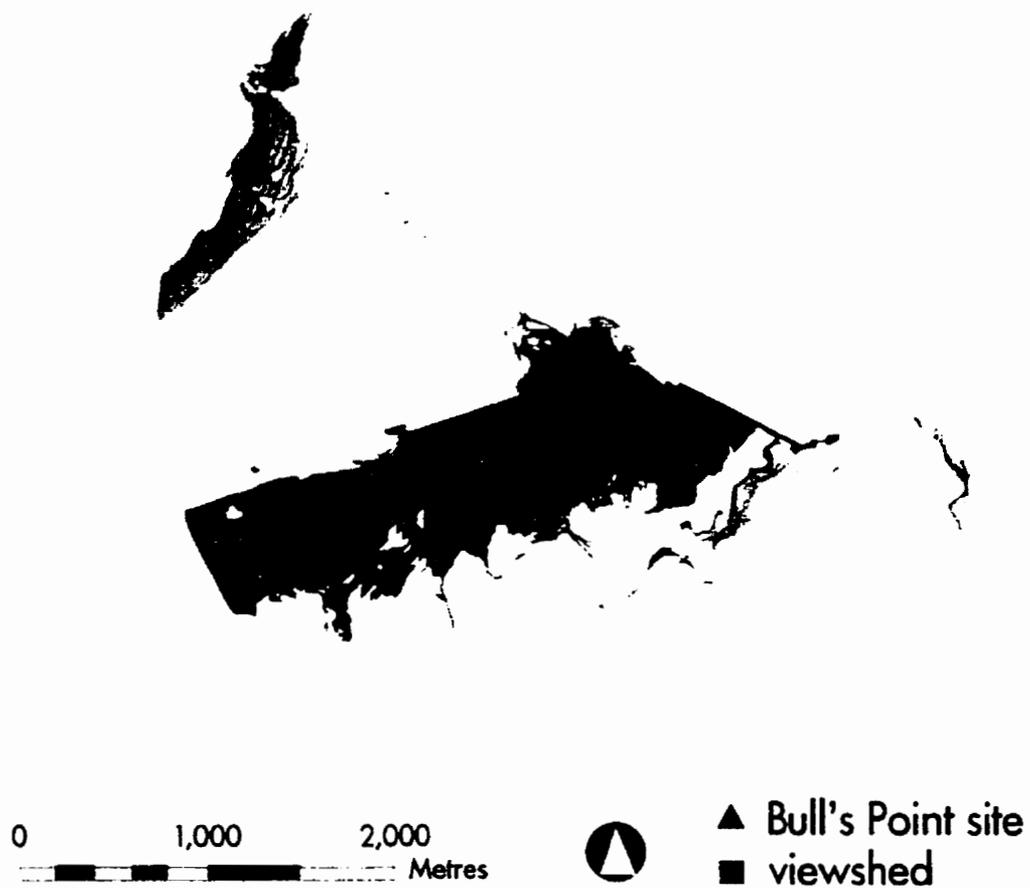
Figure A1-13: Princess Point Oxbow cluster: Tutela.



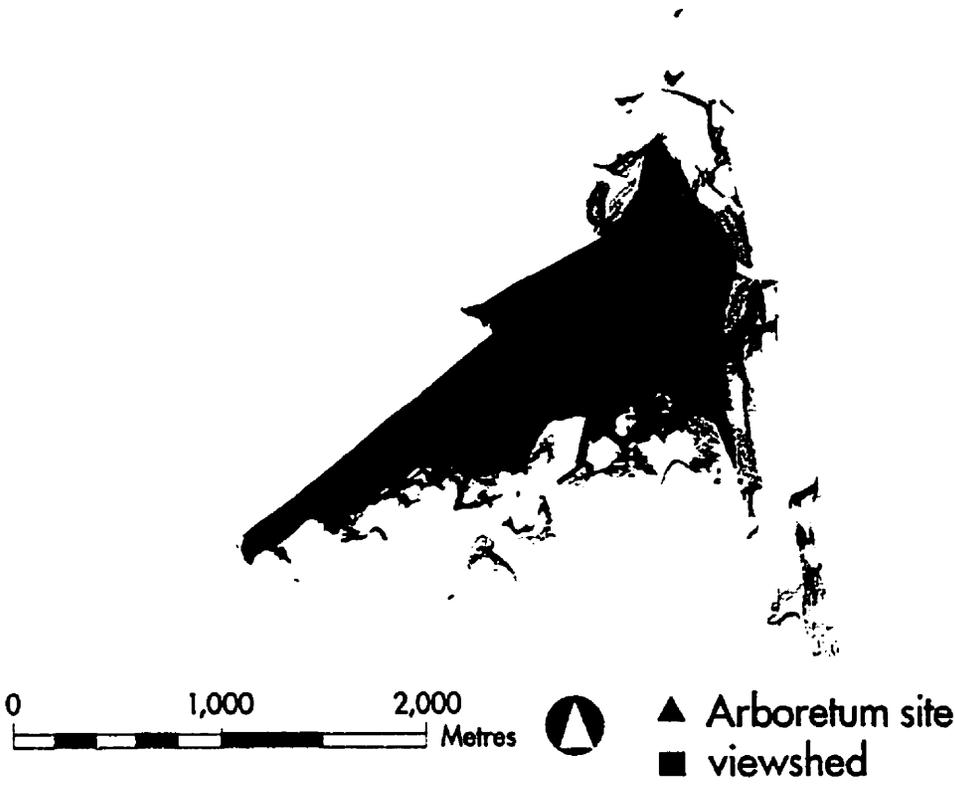
**Figure A1-14: Princess Point Cootes Paradise cluster: Princess Point.**



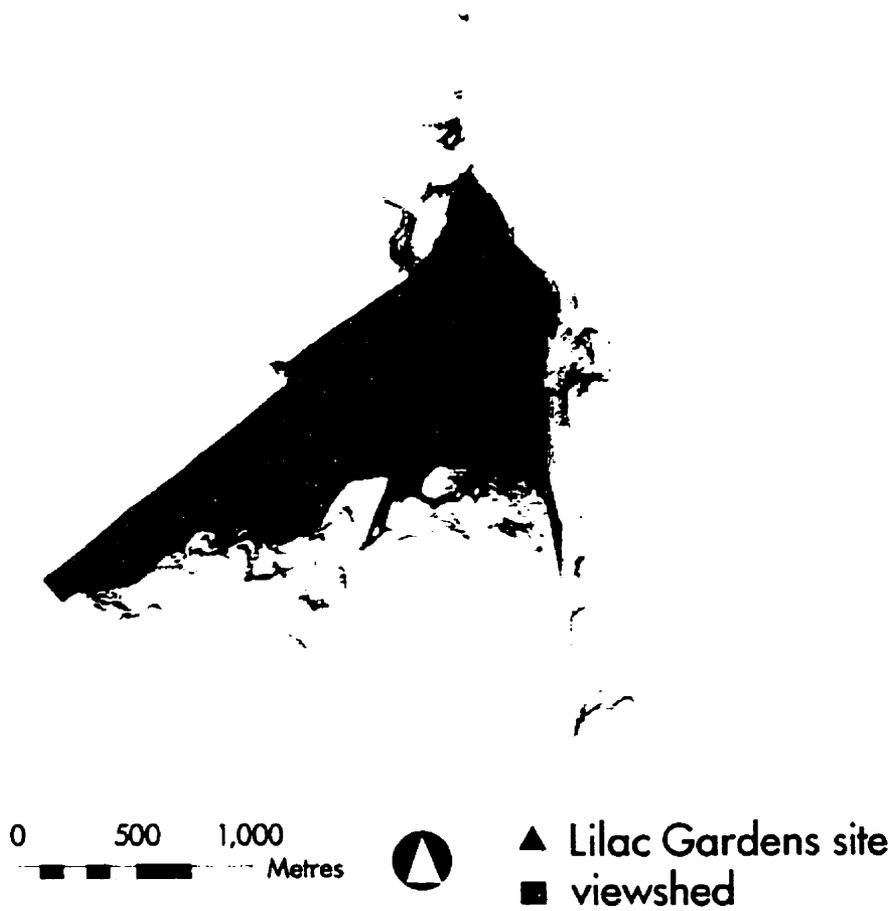
**Figure A1-15: Princess Point Cootes Paradise cluster: Sassafras Point.**



**Figure A1-16: Princess Point Cootes Paradise cluster: Bull's Point.**



**Figure A1-17: Princess Point Cootes Paradise cluster: Arboretum.**



**Figure A1-18: Princess Point Cootes Paradise cluster: Lilac Gardens.**

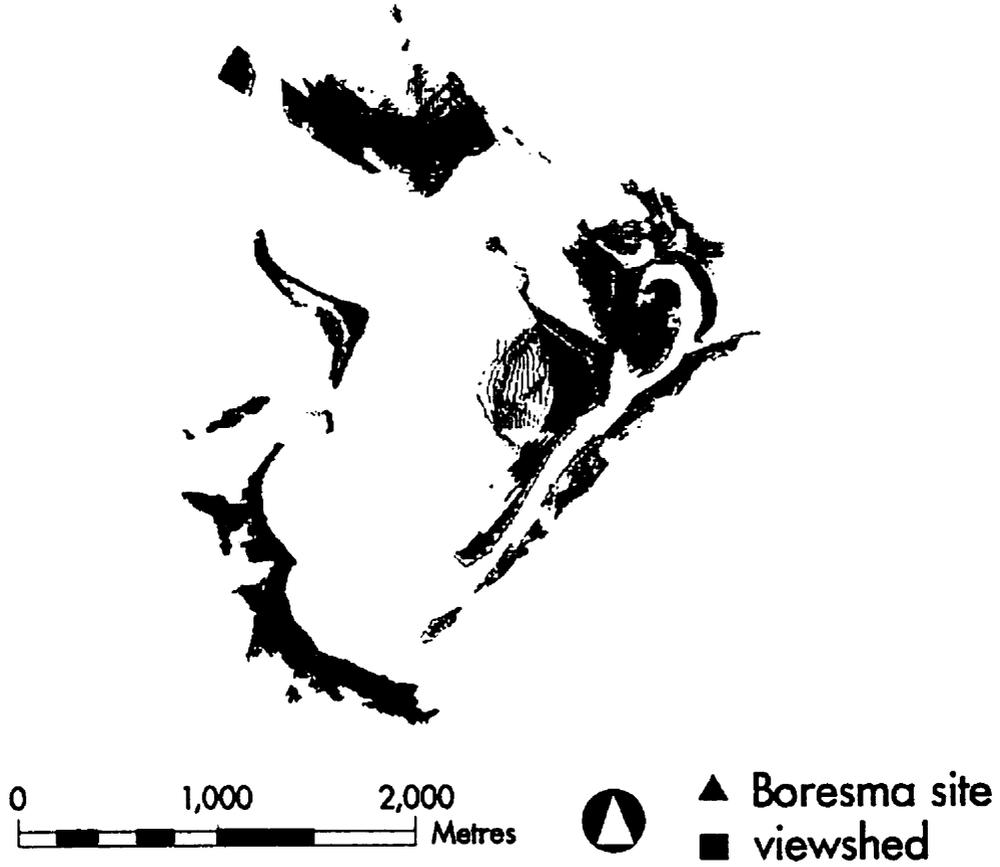


Figure A1-19: Middle Woodland Delaware cluster: Boresma.

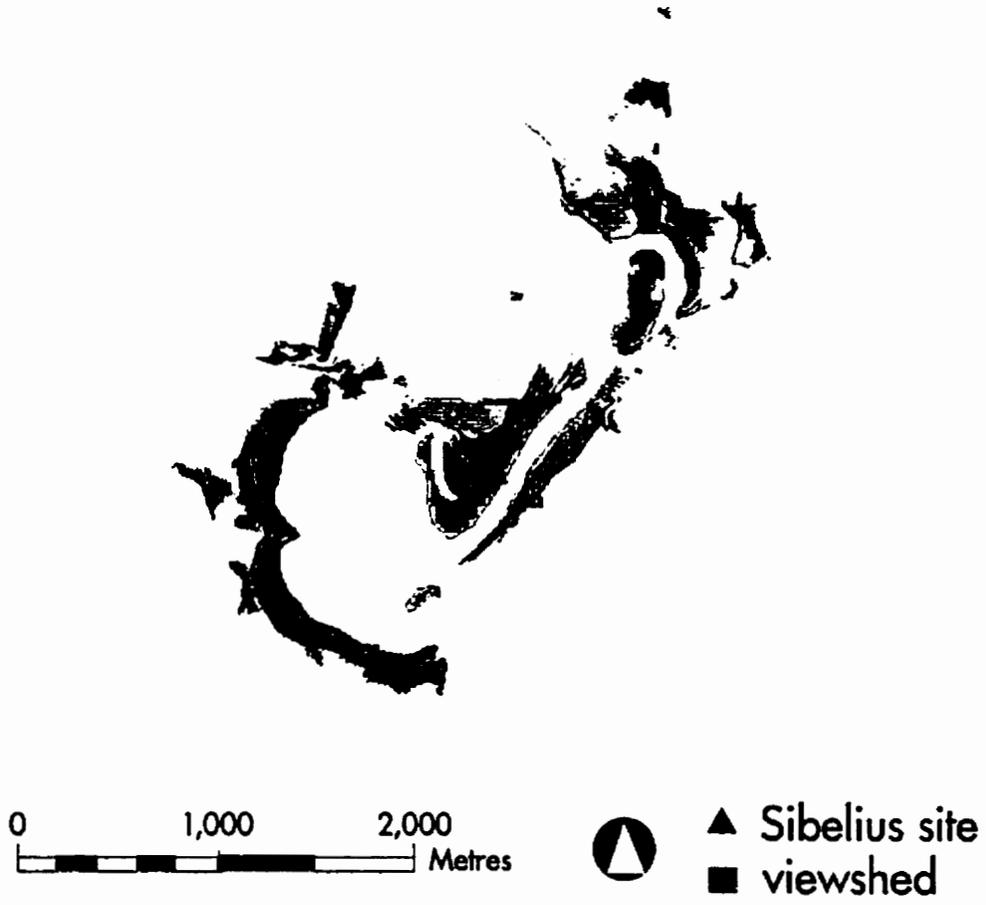


Figure A1-20: Middle Woodland Delaware cluster: Sibelius.

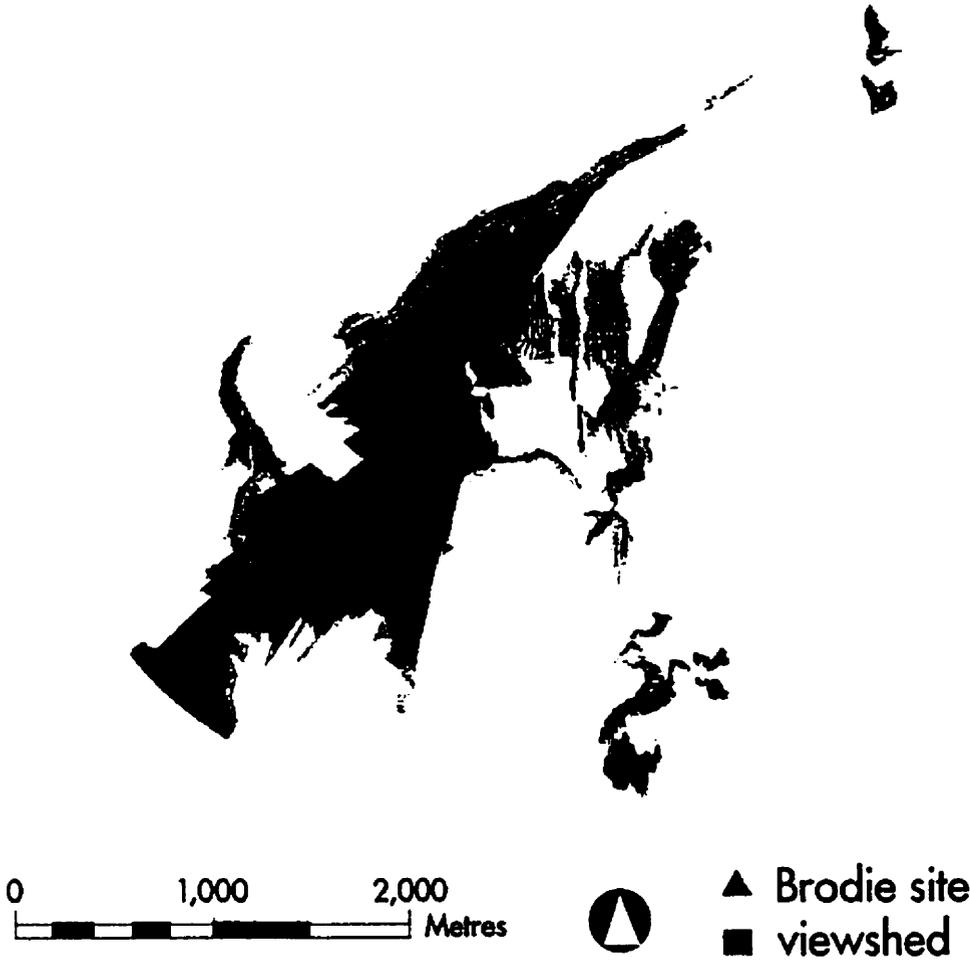


Figure A1-21: Middle Woodland Delaware cluster: Brodie.

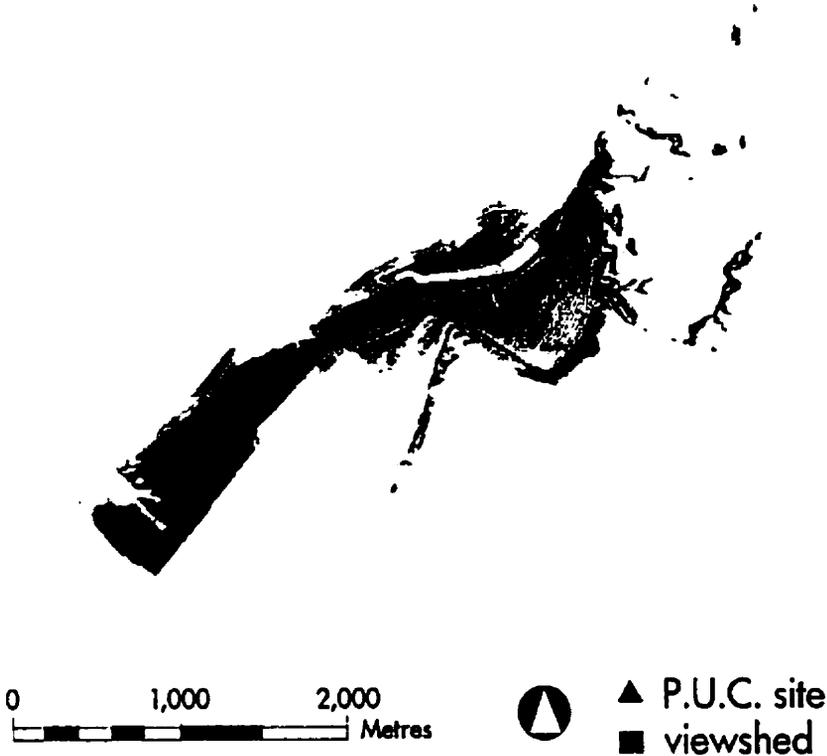
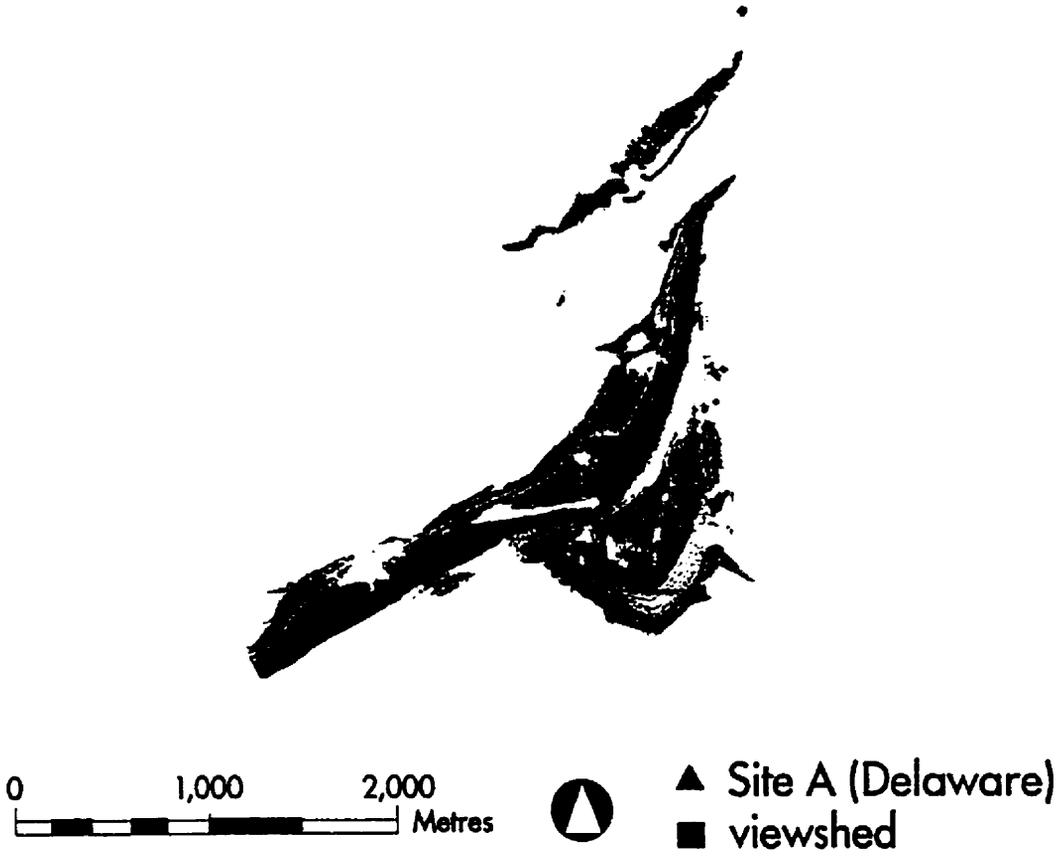


Figure A1-22: Middle Woodland Delaware cluster: P.U.C..



**Figure A1-23: Middle Woodland Delaware cluster: Site A.**

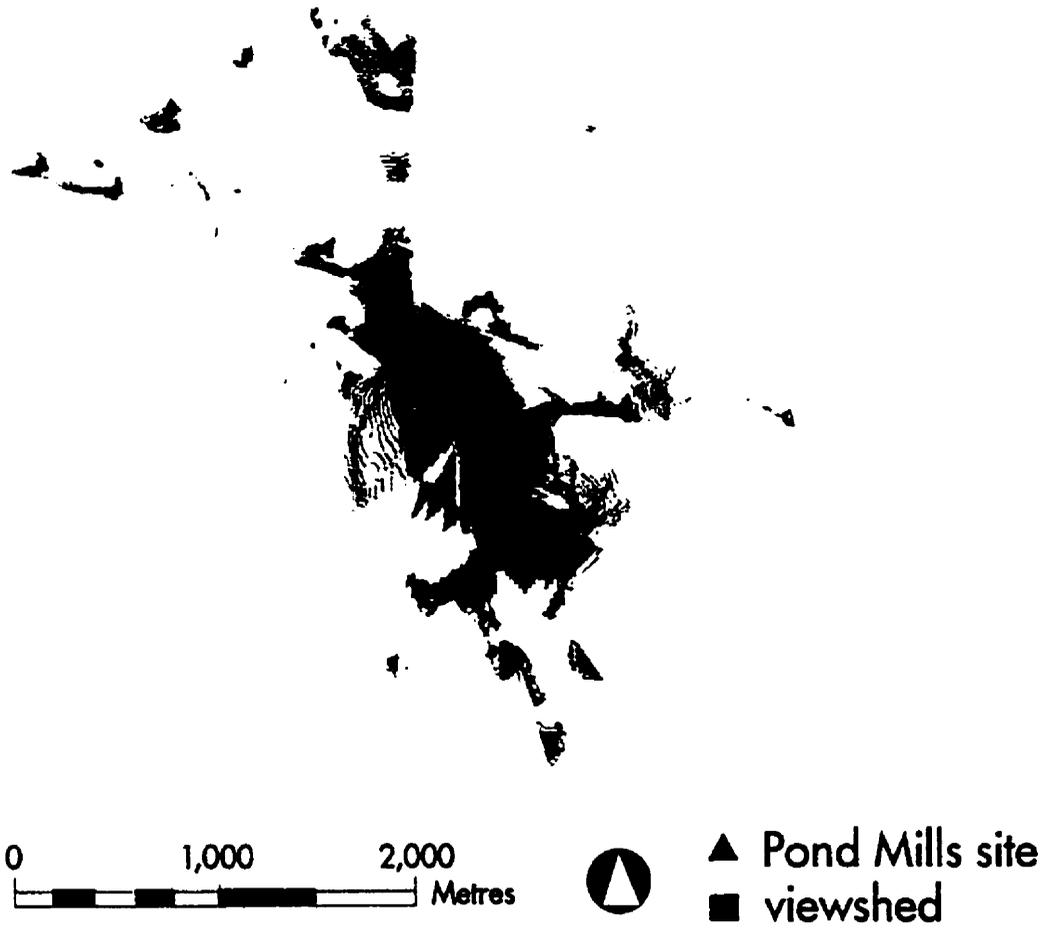


Figure A1-24: Middle Woodland Pond Mills cluster: Pond Mills.

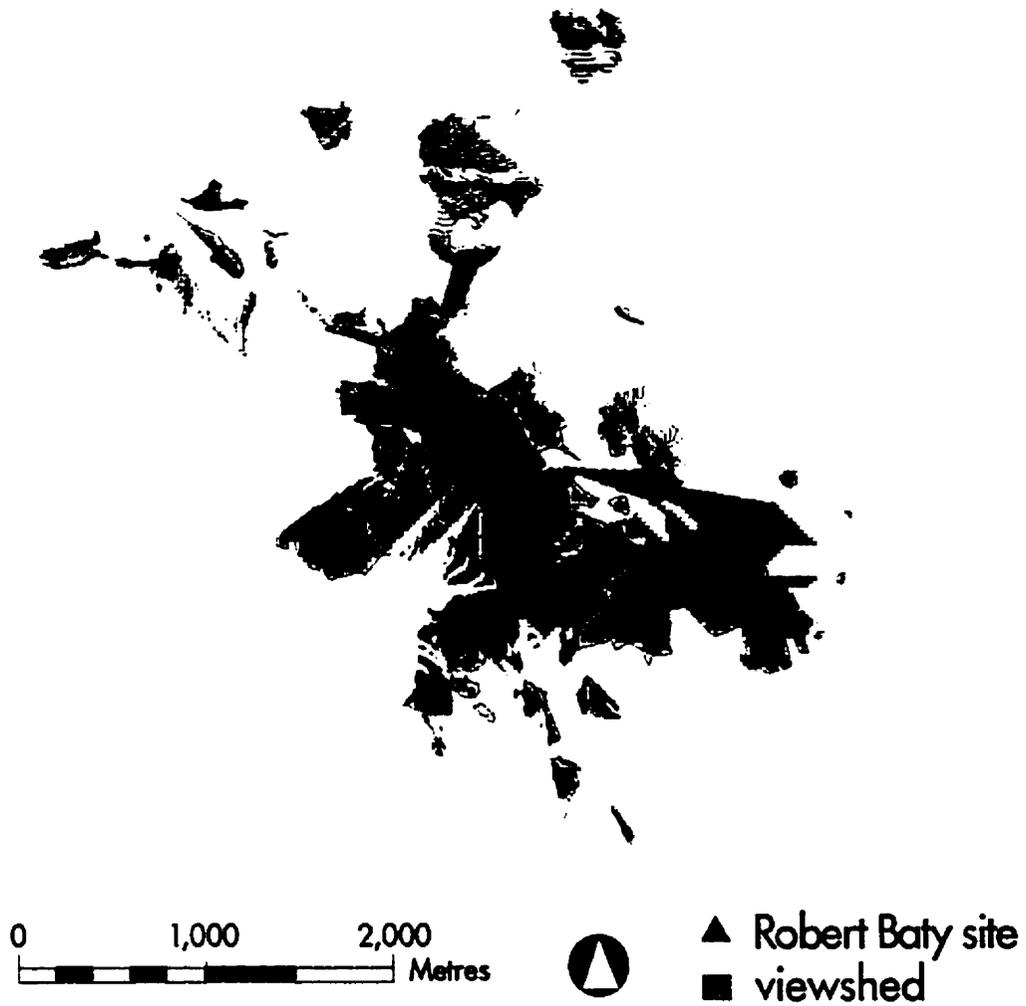
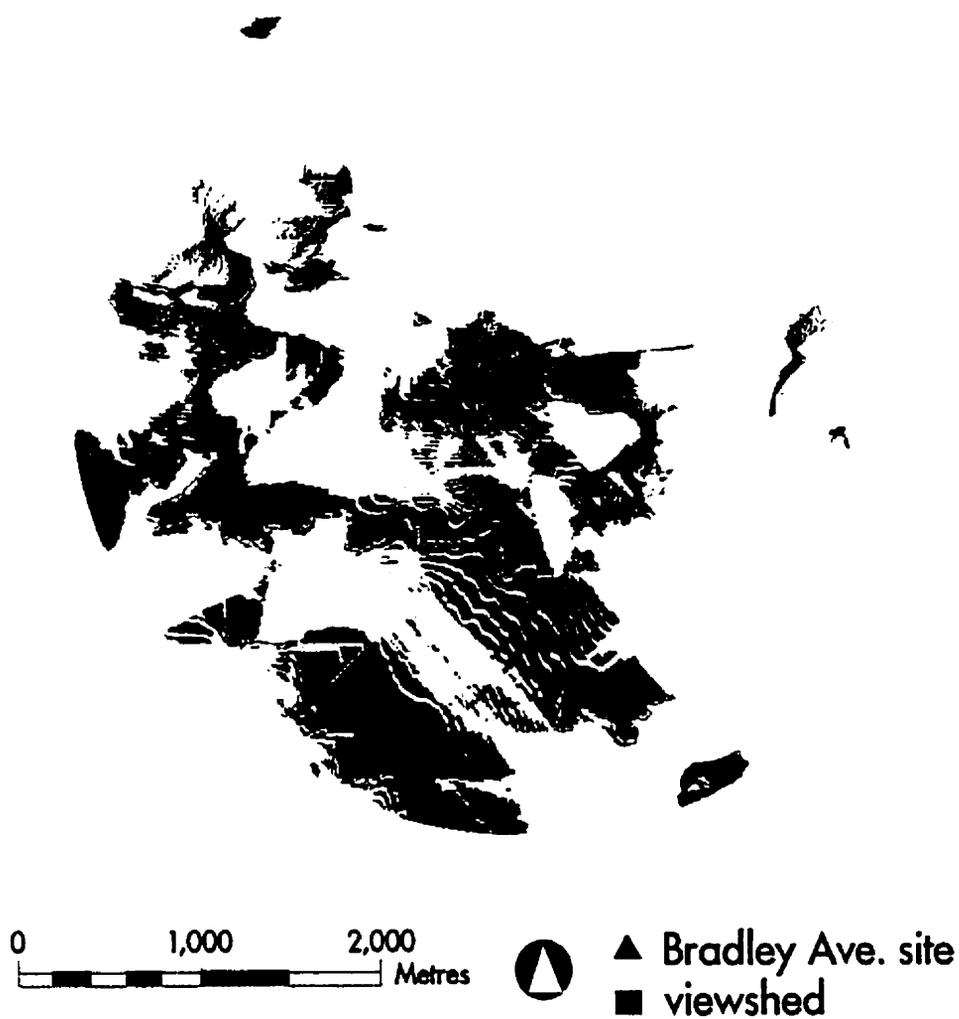


Figure A1-25: Middle Woodland Pond Mills cluster: Robert Baty.



**Figure A1-26: Middle Woodland Pond Mills cluster: Bradley Avenue.**

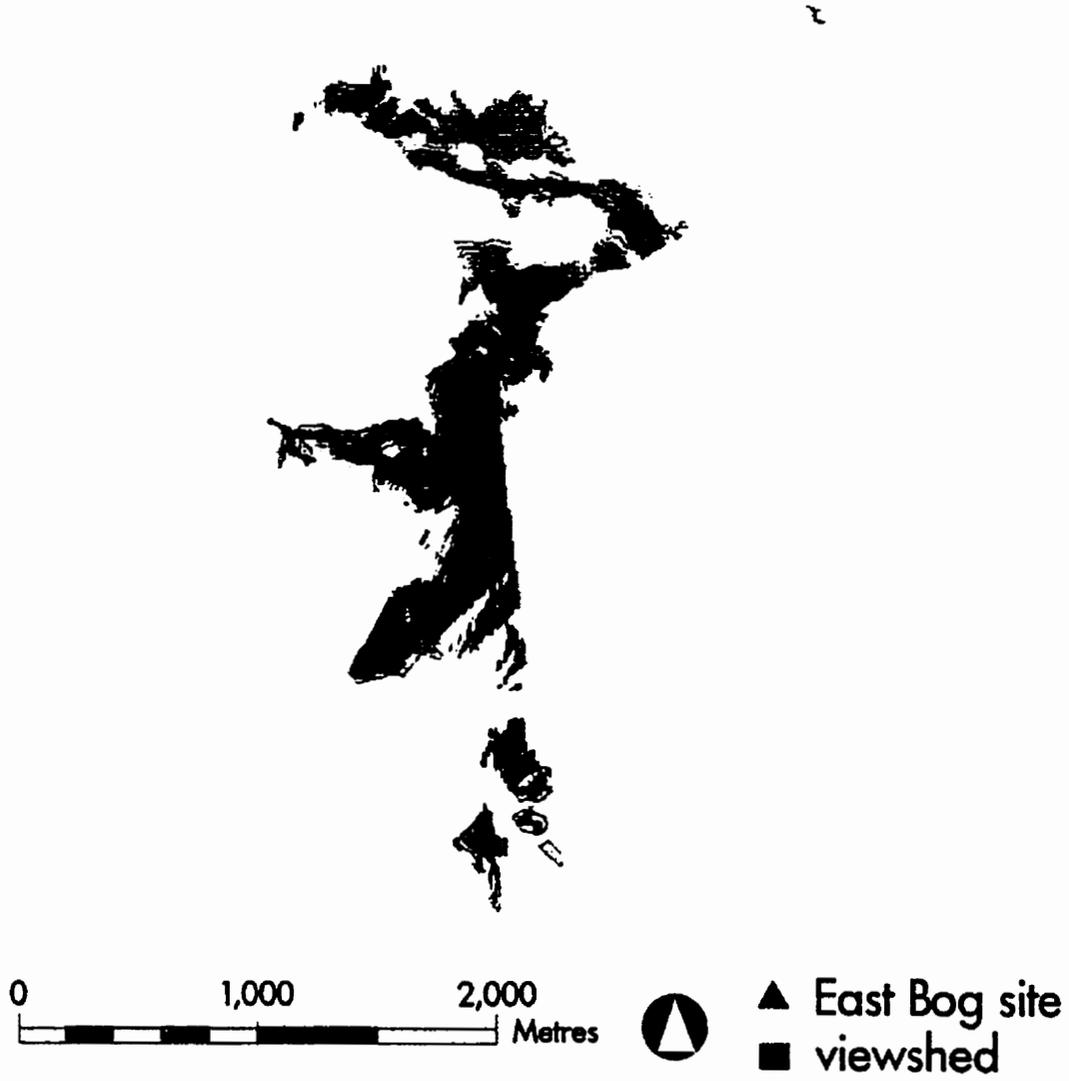


Figure A1-27: Middle Woodland Pond Mills cluster: East Bog.

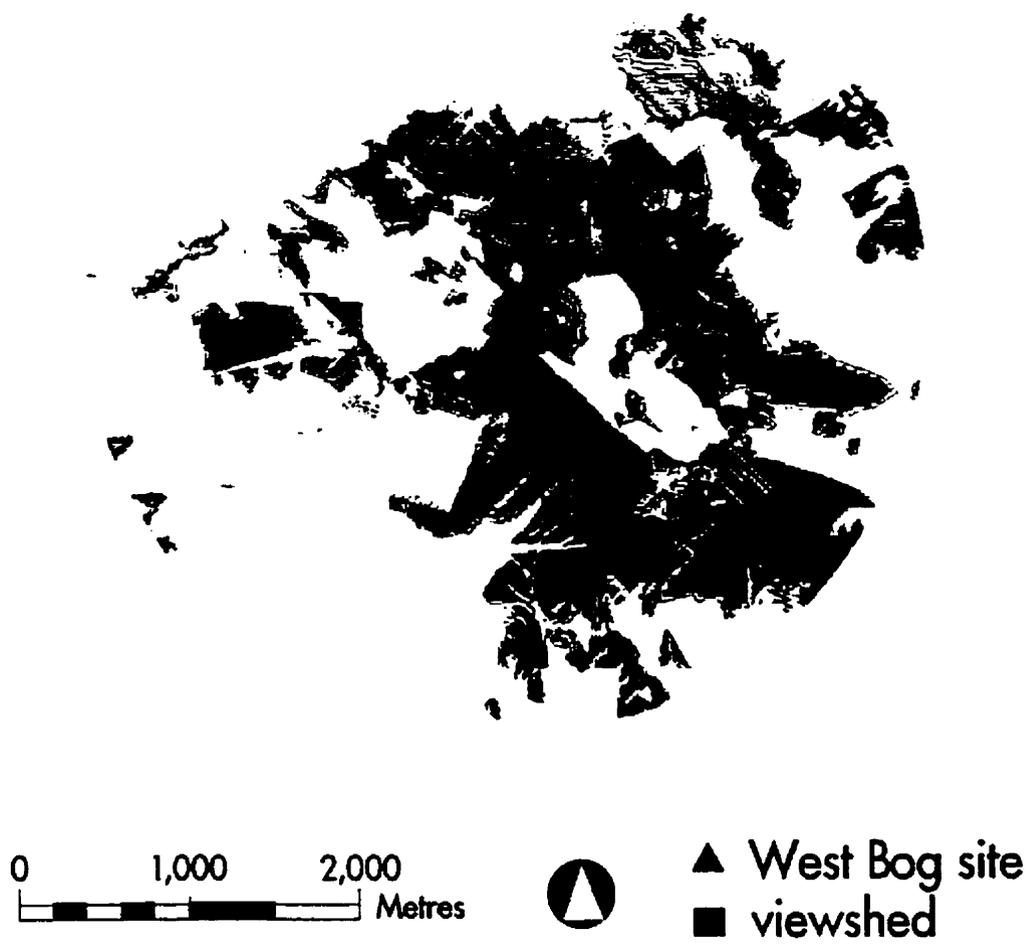


Figure A1-28: Middle Woodland Pond Mills cluster: West Bog.

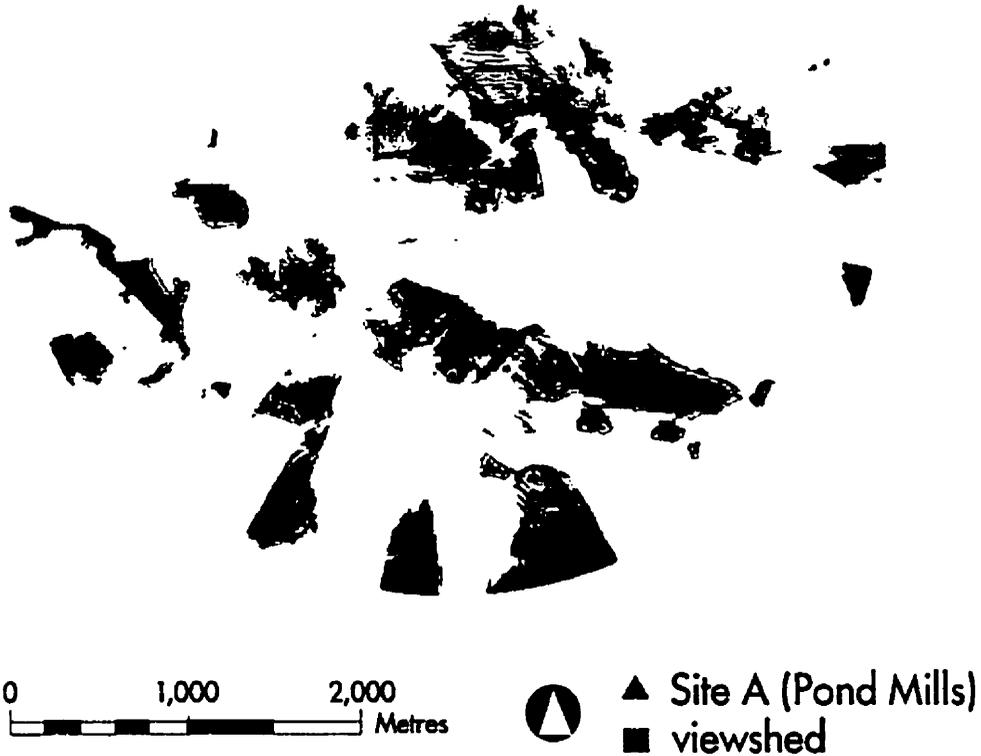
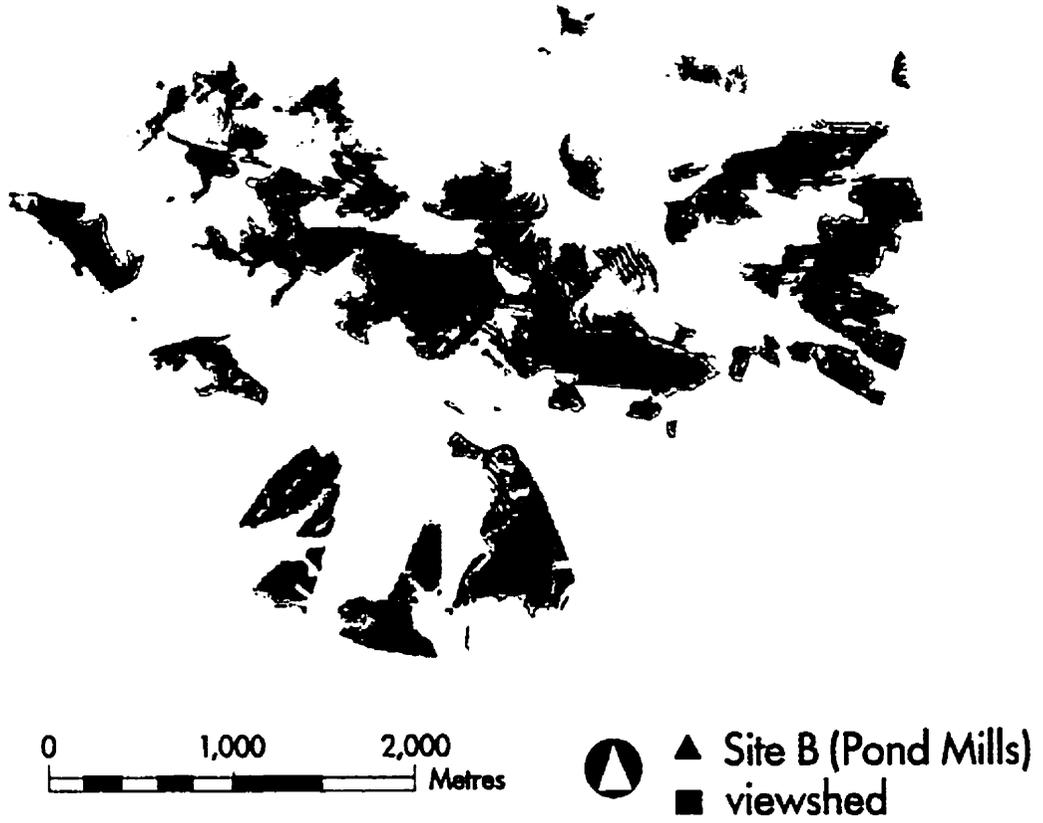


Figure A1-29: Middle Woodland Pond Mills cluster: Site A.



**Figure A1-30: Middle Woodland Pond Mills cluster: Site B.**

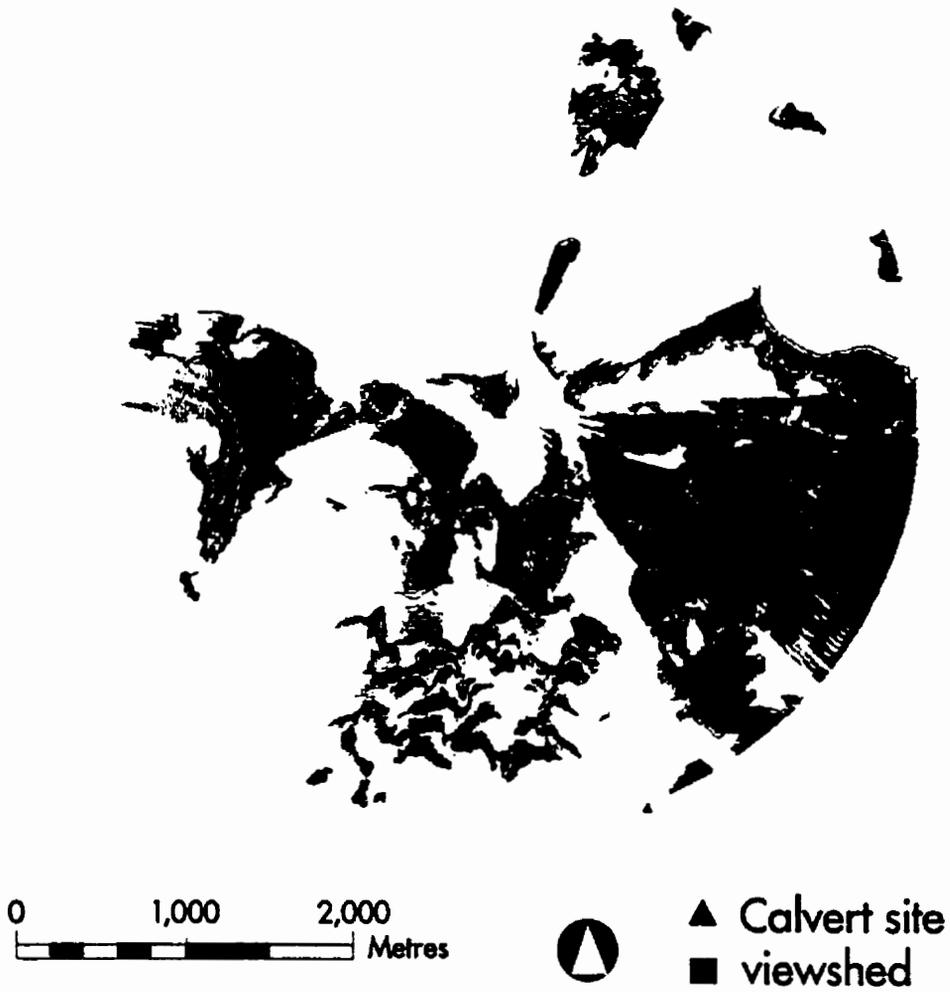
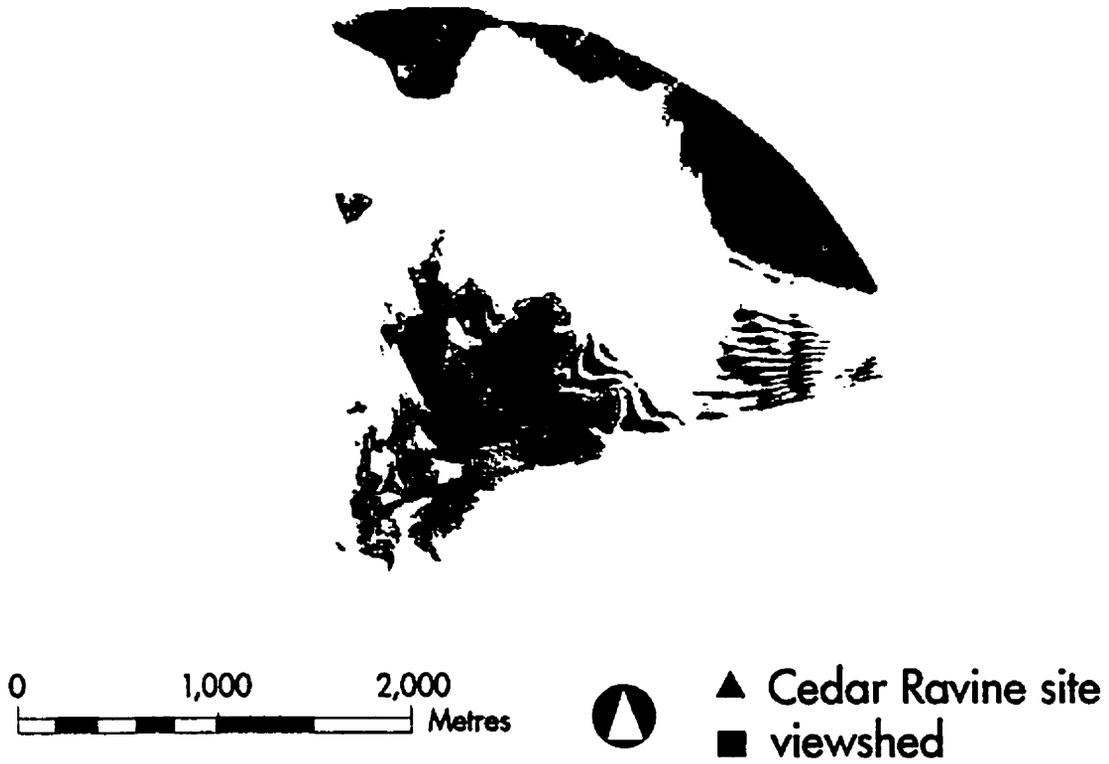


Figure A1-31: Glen Meyer Dorchester cluster: Calvert.



**Figure A1-32: Glen Meyer Dorchester cluster: Cedar Ravine.**

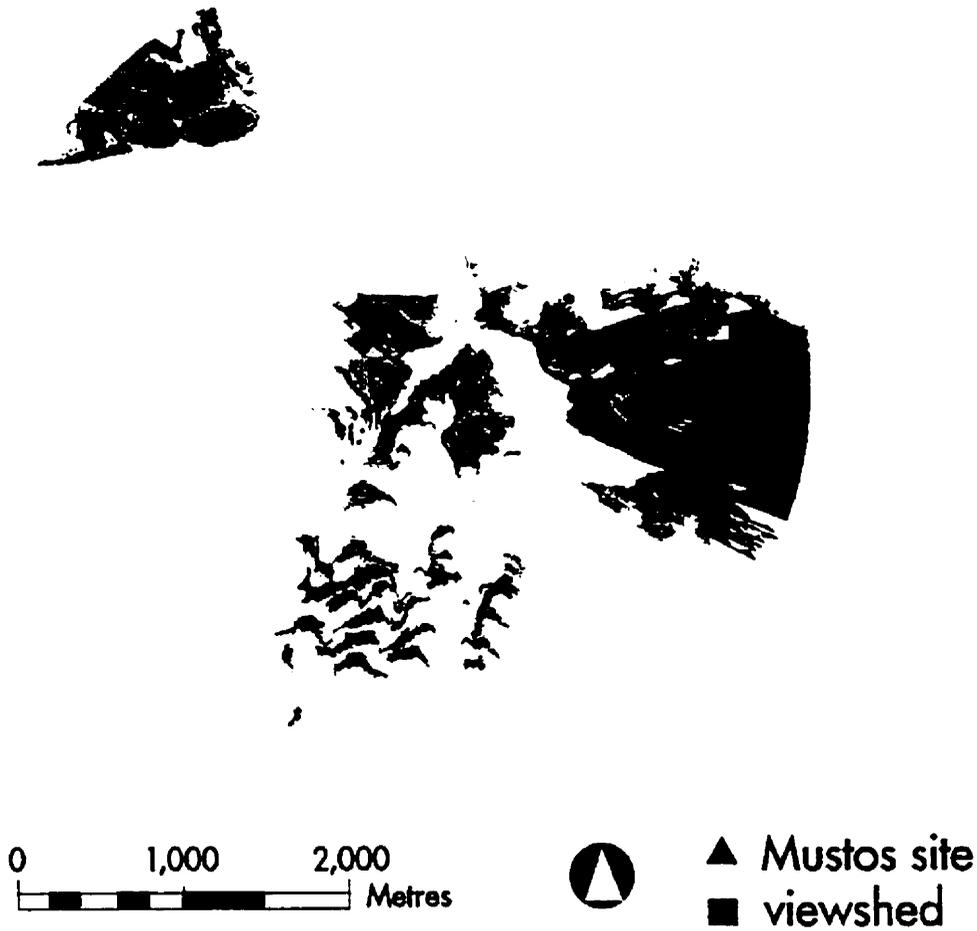


Figure A1-33: Glen Meyer Dorchester cluster: Mustos.

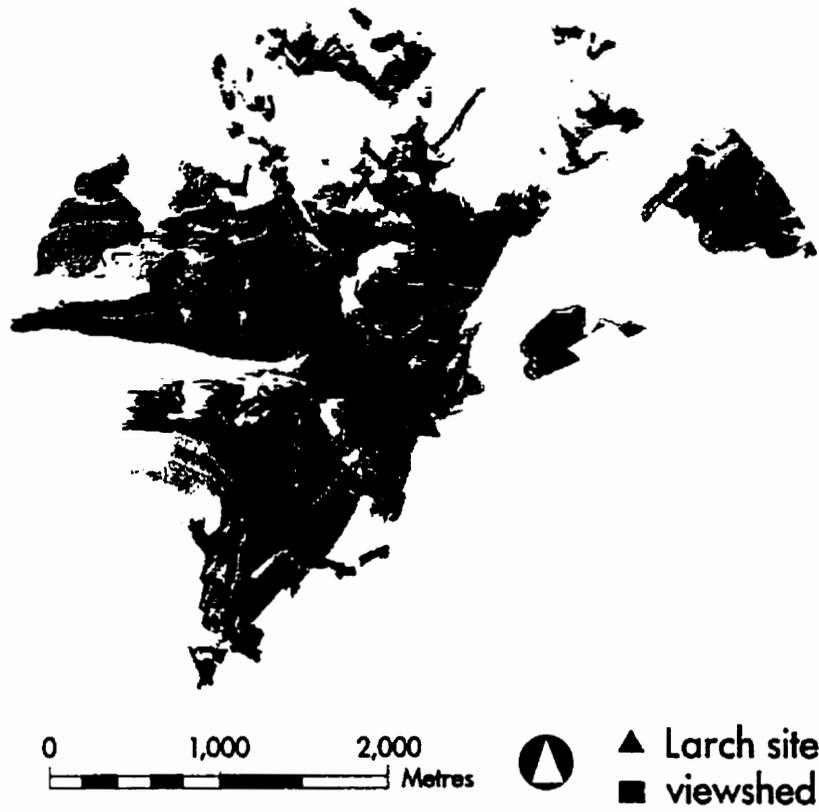


Figure A1-34: Glen Meyer Dorchester cluster: Larch.

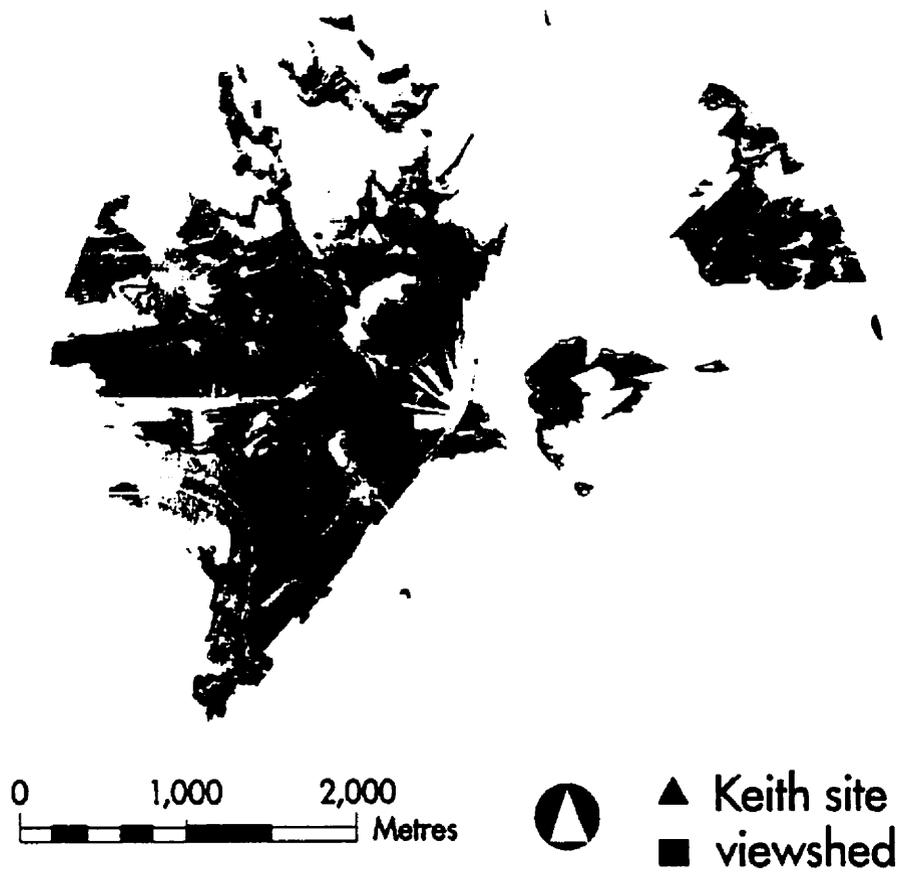
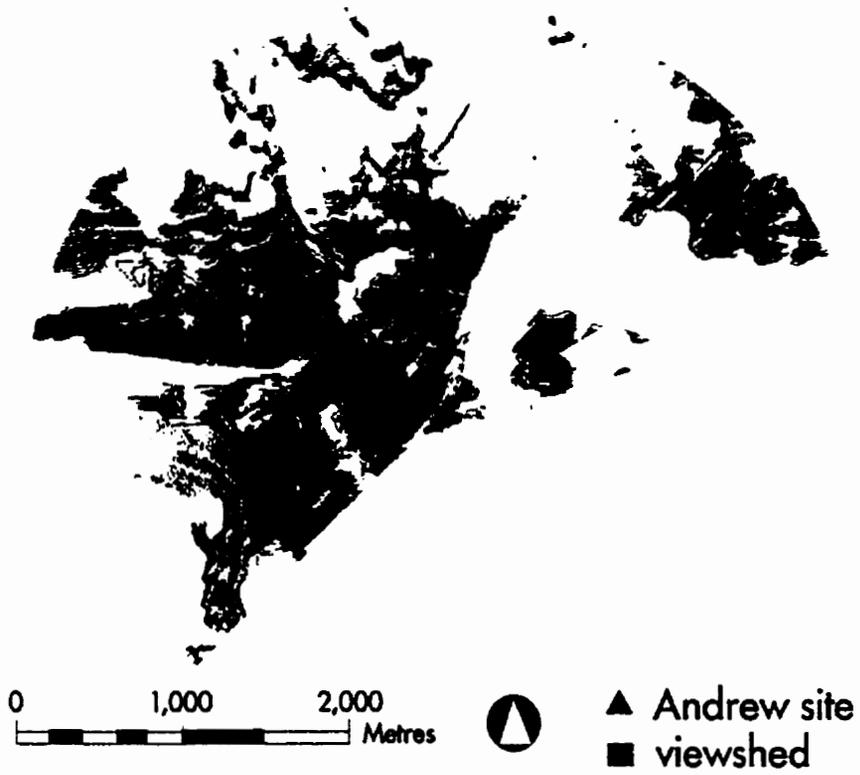


Figure A1-35: Glen Meyer Dorchester cluster: Keith.



**Figure A1-36: Glen Meyer Dorchester cluster: Andrew.**

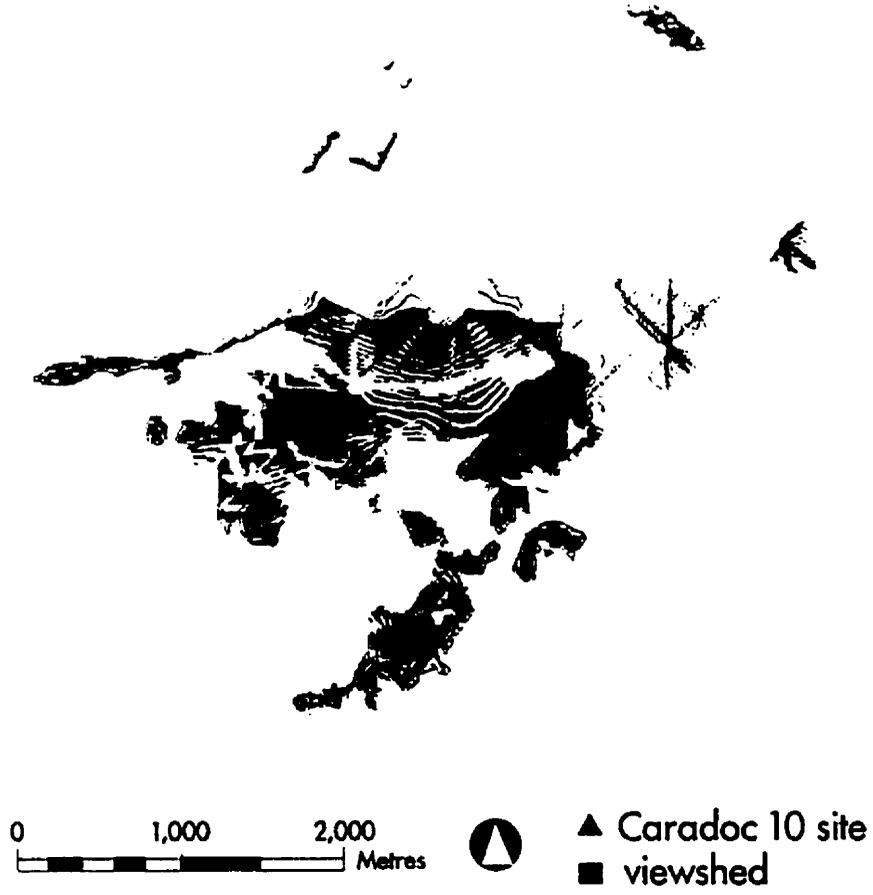


Figure A1-37: Glen Meyer Caradoc cluster: Caradoc 10.

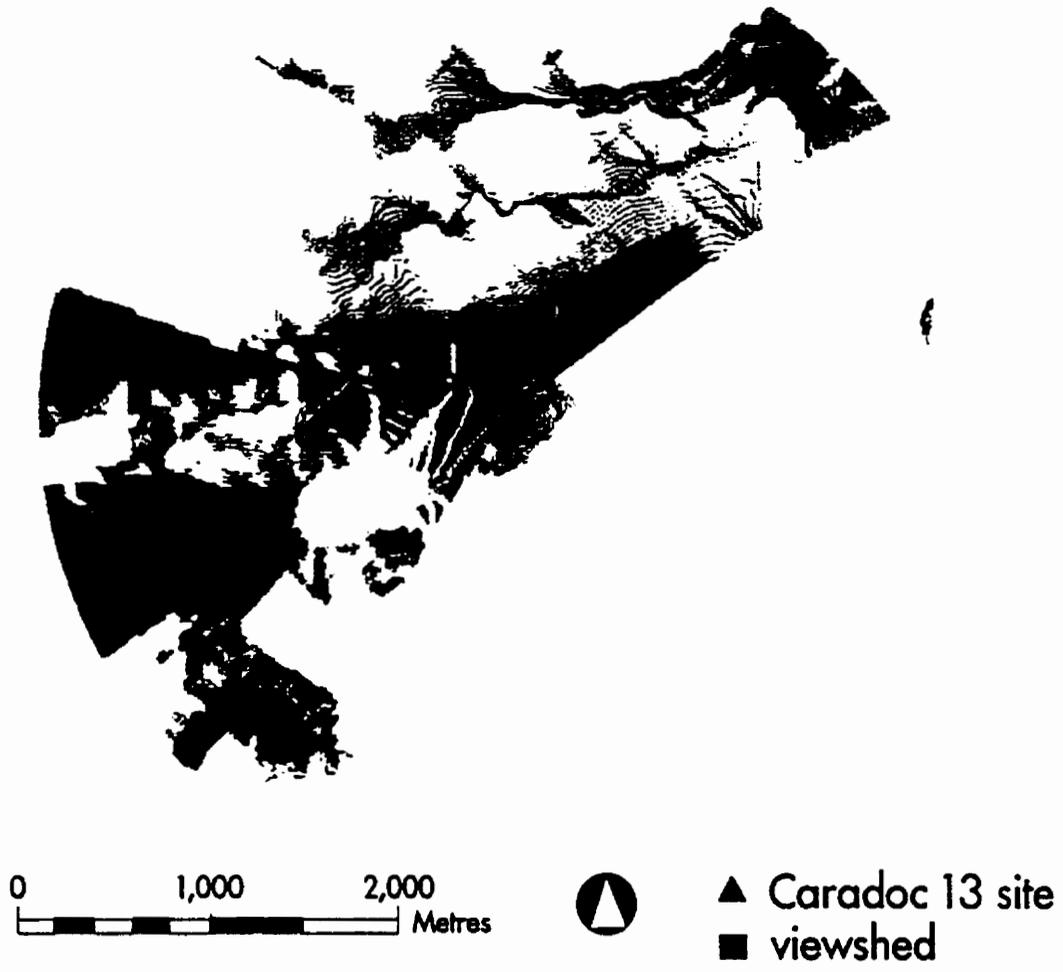


Figure A1-38: Glen Meyer Caradoc cluster: Caradoc 13.

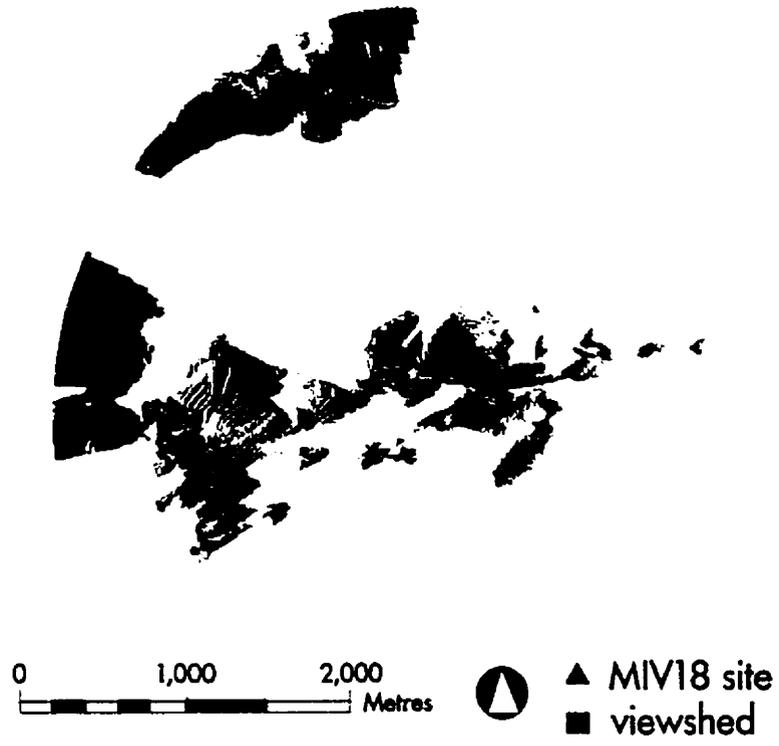
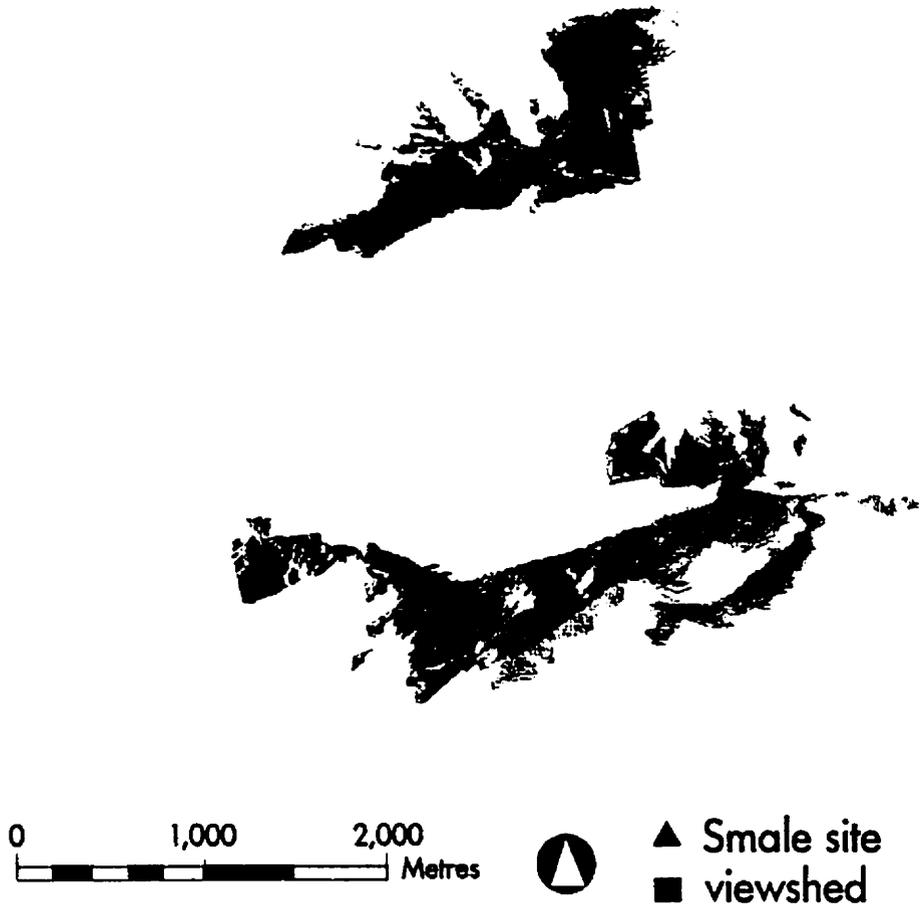


Figure A1-39: Glen Meyer Caradoc cluster: MiV18.



**Figure A1-40: Glen Meyer Caradoc cluster: Smale.**

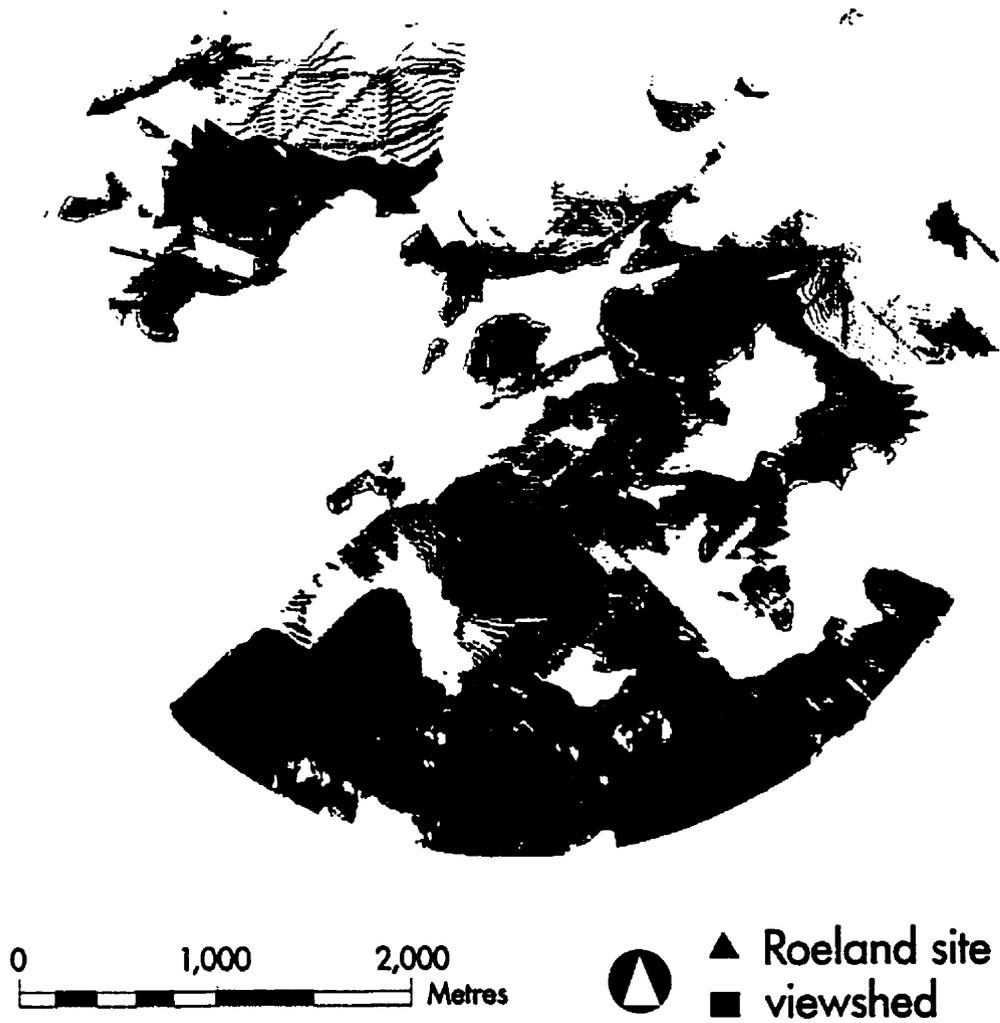


Figure A1-41: Glen Meyer Caradoc cluster: Roeland.

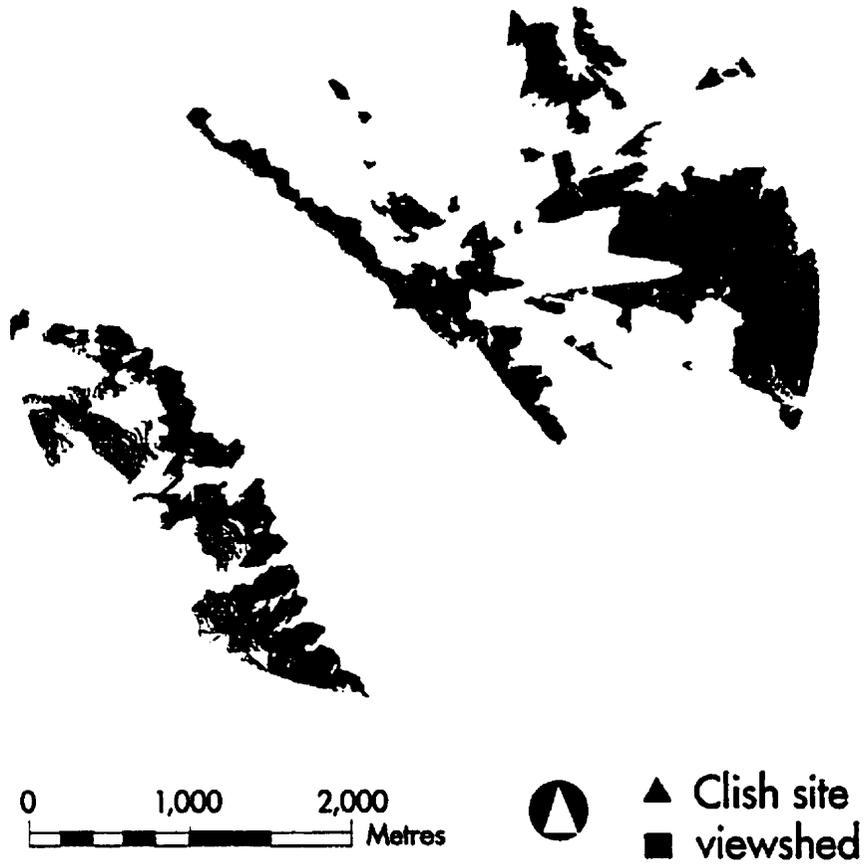


Figure A1-42: Glen Meyer Wentworth cluster: Clish.

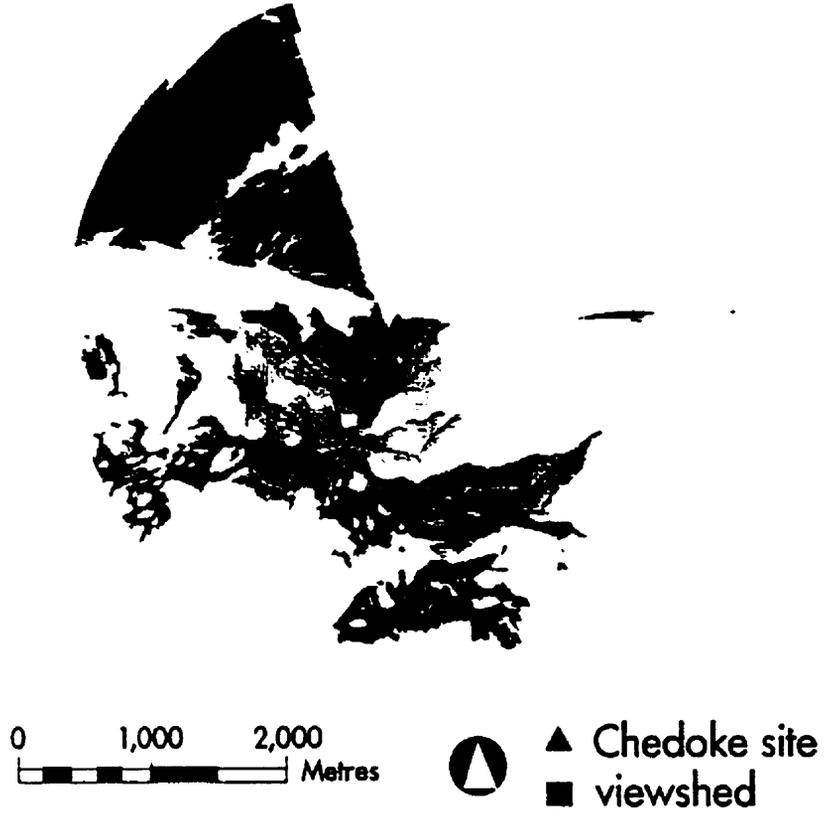


Figure A1-43: Glen Meyer Wentworth cluster: Chedoke Falls.

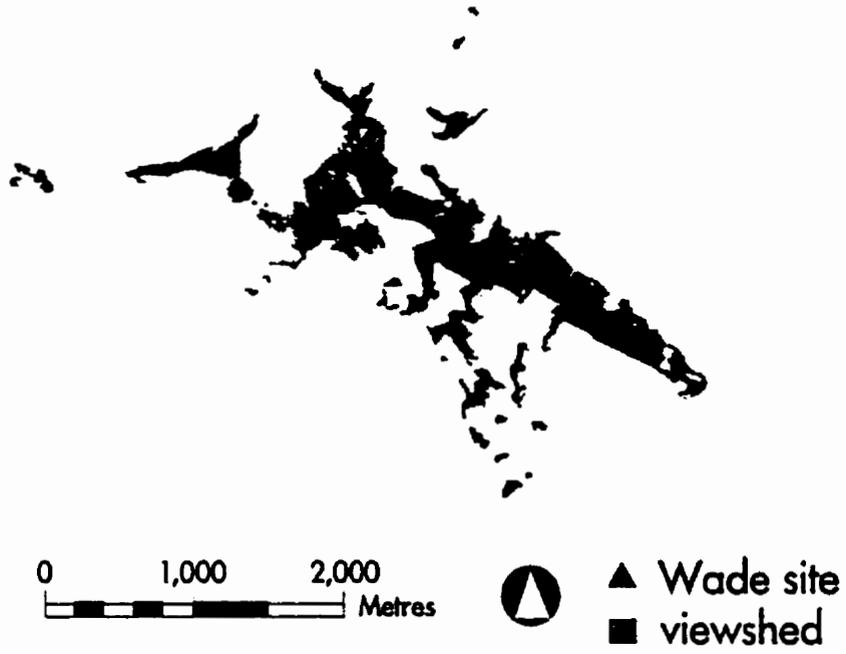
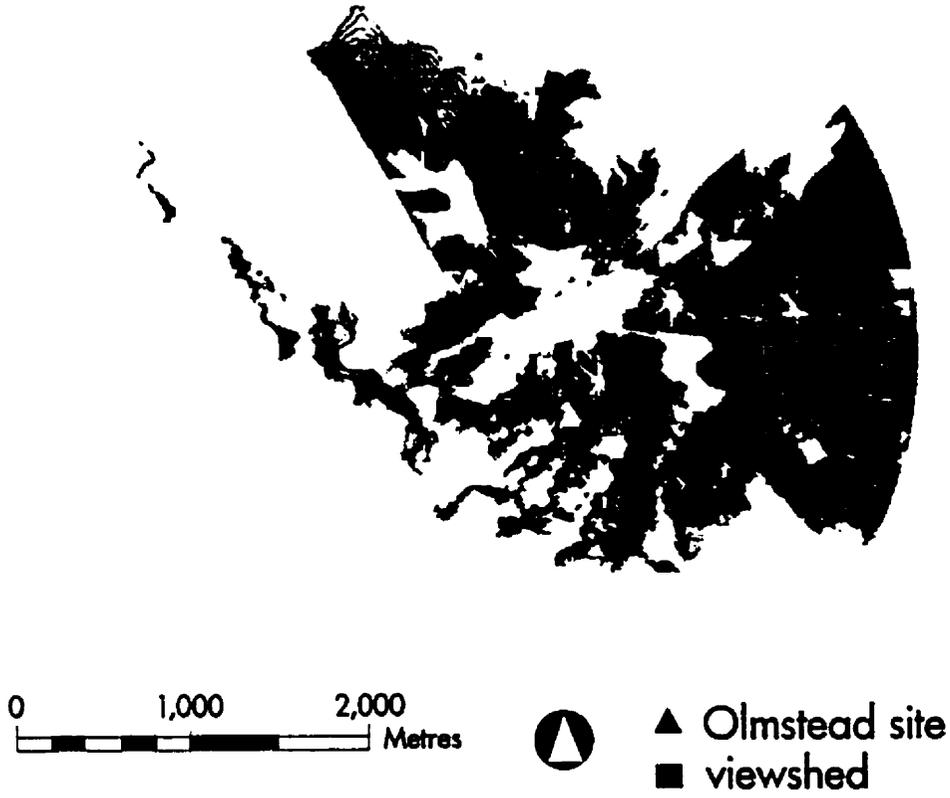


Figure A1-44: Glen Meyer Wentworth cluster: Wade.



**Figure A1-45: Glen Meyer Wentworth cluster: Olmstead.**

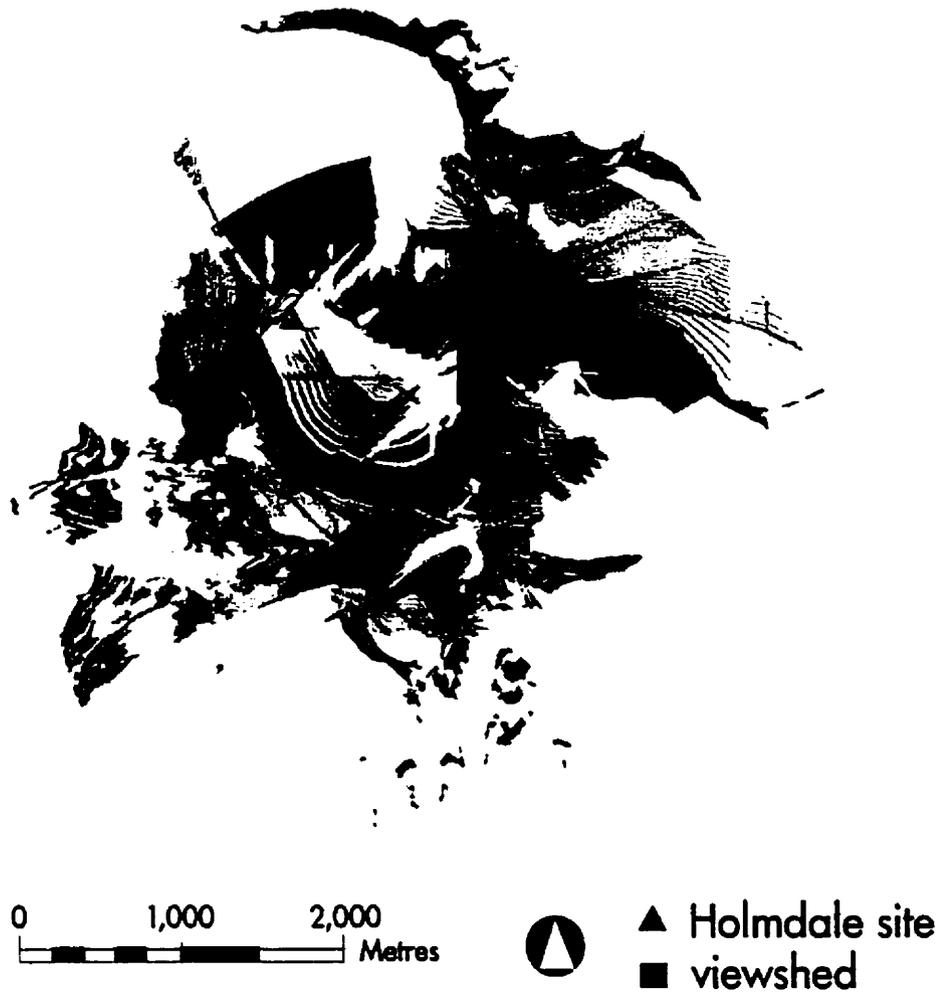


Figure A1-46: Grey sites: Holmdale.



Figure A1-47: Grey sites: Lone Pine.

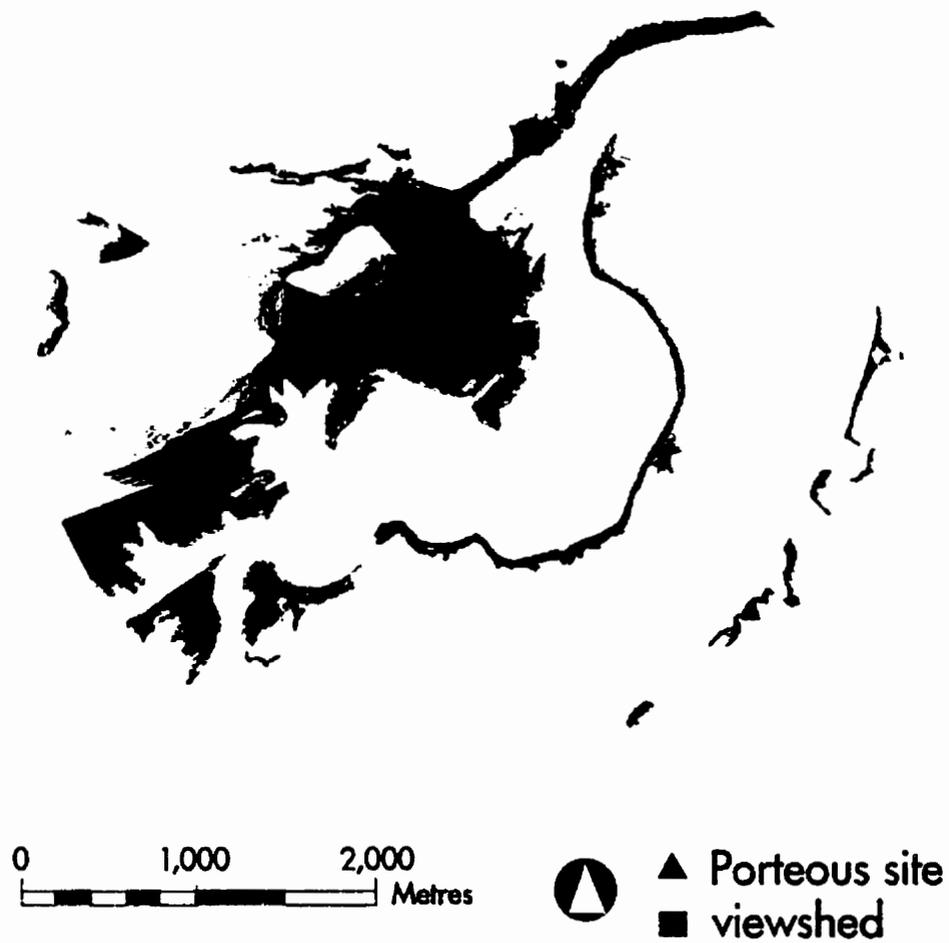


Figure A1-48: Grey sites: Porteous.

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