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The Greatest Advancement Since the Shovel: Remote Sensing on Three Historical Case Studies

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THE GREATEST ADVANCEMENT SINCE THE SHOVEL: REMOTE SENSING ON THREE HISTORICAL CASE STUDIES

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Introduction

Archaeology as a discipline has changed greatly in the past two hundred years. Although the same methods of excavation, the trowel and shovel still dominate most archaeologists' methodology the ways in which artifacts and strata are interpreted has undergone great transformation. Part of the reason for this encompassing transformative nature of the disciple is the ways in which data can be interpreted. The greatest single example of this aspect that is slowly making its way into archaeology; is the onset of a myriad of new technologically-advanced machines and tools that have opened up new avenues, and methodologies for both researchers and archeologists. Perhaps the biggest technological advancement to be integrated into to the field of archaeology has been the introduction of the geophysical element; more specifically the geophysical subfield of remote sensing.

My thesis, as both a research and exploratory-driven investigation, seeks to investigate the effectiveness of using remote sensing technology on historical case studies. If the technology reveals itself to be beneficial in understanding historical landscapes, then I will prognosticate on future archaeological excavations on those locations, based on the inferences and conclusions, gained from the remote sensing images.

I used the technology on three case studies where prominent geo-spatial and archaeological questions already existed. For the first case study, I choose to explore the area where the William Beach Lawrence estate manor house was thought to have been built. My second case study follows the same trend as the first and explores another area

where the William Beach Lawrence dependencies were built. Lastly, I choose to attempt to locate the Edgewater estate house using remote sensing.

Remote Sensing

In order to see why the technology of remote sensing creates an opportunity for locating the William Beach Lawrence and Edgewater estates, some definition and explanation of what remote sensing allows us to do is necessary. Remote sensing abstractly can be defined as the study of something without making actual contact with the object of study. More precisely, remote sensing is the: "The acquisition and measurement of data/information on some property(ies) of a phenomenon, object, or material by a recording device not in physical, intimate contact with the feature(s) under surveillance" (CGIS at Towson University).

When thinking about remote sensing, it is paramount to remember that whatever working definition you use to describe remote sensing, the key concept is that the process involves seeing information, data and images without actually physically seeing them. It is this phenomenon, the remote nature of the technology, that makes it so uniquely well suited to potential archeological resources. By allowing the researcher to make observations, take measurements, and produce images of phenomena that are beyond the limits of our own senses, potential archaeological sites can be drawn up, mapped out and planned (see Figure A-2 in appendix).

Remote sensing can be performed via several different machines. This thesis will employ the RM-15 apparatus, which is a device that uses electro-magnitivity to map out potential archaeological sites (Figure A-1). In RM-15 information is transferred by use

of electromagnetic radiation (EMR). EMR is a form of energy that reveals its presence by the observable effects it produces when it strikes the matter (Conolly & Lake, 2006).

The RM-15 survey

The survey equipment that my group and I used to remote sense the three case studies is a relatively simple tool, consisting of a resistance meter and a probe array. (Figure A-1). The basic principle of the RM-15 is the injection of an electric current into the ground. The machine then measures the electrical resistance at that point on the site. The current is conveyed to the ground by means of a metal (current) probe and the resistance is measured by a meter connected to an adjacent (voltage) probe. Both probes are mounted on a horizontal beam and the beam/probe combination is called a probe array. The distance between the current and voltage probes determines the approximate depth of survey and, along with data sample density, is one of the survey design parameters (Conyers, 1997).

Based on the fact that the RM-15 takes measurements of the resistance level present in the ground at the point of entry, setting up a grid or a point of entry in which to work is essential. Part of setting up the grid parameters is determined by how large an amount of time you have to survey. The time factor is perhaps the most important factor to consider when setting up and utilizing the RM-15 machine. Possible grid sizes vary depending on time constraints. Setting up a 100 by 100 meter grid is wonderful in that you receive tons of accurate data without having to stop and move around your equipment. A grid that large, however, would take an immense number of hours, perhaps thirty. As a result it is nearly impossible to complete in a short amount of time. Because

my sites were part of a university campus, where there were both going to be visitors and a need to manicure the lawns relatively frequently, we had a significant time constraint. In addition, our team had only 3 members. Thus, we could not complete a large (over 30 meters) survey in one day, nor could we leave our stakes and tape on the lawn for more than one day. Instead we chose to allot our time and effort to the task of tackling readings on one twenty-meter grid per day for our case studies. Subsequent case studies enlarged the grid size to 30 meters by 30 meters; those grids will be discussed in more detail in those case study sections. Setting up a grid consists of measuring twenty meters from a known hard point and through the process of triangulation locating the point lying directly diagonal from the first hard point. From the second point a second triangular line is drawn and a third stake placed in that location. Finally, measuring twenty meters from that last reading completes your rectangular grid. This process of calculation allows a perfect square to be established by eliminating human error and irregularities on the surface of the ground that may throw human measurements awry (Geoscan Research, (2001).

After setting up the grid, the process of taking readings then progresses. Readings are stored in a non-volatile memory, which is partitioned into grid sizes of 10m, 20m or 30m square. The reading intervals are then placed at every 1m or every .5m. Logging the information is a fairly simple procedure. All you do is simply inserting the probes into the ground. The RM15 determines when the reading has been settled, logs it and then beeps. At this beep the operator simply moves onto the next reading. Typically 400 readings may be taken in just over 30 minutes (Farley, Limp, & Lockhart, 1990). After taking 40 readings starting always on one side of the square, you simply go back down a similar

line one meter away. Thus, you end up with 800 readings for each 20 by 20 meter grid. By reducing the transect spacing from 1 meter (the default setting) to .5 meters, my group gathered a fairly high number of data entries, thus increasing our likelihood of detecting archaeological deposits. Indeed, when minimum cost or time is essential, it is important to focus on the feature type requiring the lowest data sample density, while remaining aware that this may mean that smaller feature types may not be detected or mapped reliably. When this it is not acceptable, one can use the more rigorous (higher data density) survey design, and reduce the area to be surveyed. With the foundation and understanding of both what a remote sensing survey entails and how to set one up, my group proceeded to survey and hopefully locate the William Beach Lawrence estate.

William Beach Lawrence Case Study

The William Beach Lawrence estate is a puzzling case study. Exactly where the 1835 main manor house stood has been a question of contention for many years in Newport and amongst the students of Salve Regina University. Once a bustling 60 acre villa replete with six full time staff members, the estate now lies solely in the past, the land long since divided. Scant information exists on the estate; besides having a general idea of the boundaries of the estate, researchers have little to go on as far as what to expect in the sub terrain.

Historical map work has been utilized, aerial photographs pored over, even several test pits dug; all were unsuccessful in pinpointing any structural evidence of the home's foundation. Based on map work, the basic assumption has been that the William Beach Lawrence main estate was located somewhere around McAuley and the

Boathouse. Geophysical surveying has not however been utilized on the area. Thus, the William Beach Lawrence estate provided an ideal chance to test the effectiveness of remote sensing technology on a site steeped in mystery, while hopefully being able to hypothesize, based on our findings, on future archaeological work.

Before we could survey the lawn, a contextual analysis and timeline of who and what was on the area of the boathouse lawn had to be established. This analysis came to incorporate all the levels of activity on the premise and a discussion of the major parties involved. The majority of this analysis was done via historical map work. For easy reference the grassy area surrounding the current Boathouse structure will be referenced as the Boathouse lawn.

Layers of Activity

First my group[1] and I had to acknowledge that the boathouse lawn and area surrounding it have been the center of much activity since the 1830s. As a result, the landscape we see today is a conglomeration of different historical and contextual layers. That has little resemblance to the assemblage of structures that once dotted the Boathouse lawn. Although Vineland still exists, it has been changed substantially. It has been enlarged, renamed McAuley, and converted into an academic building. As far as the lawn goes, only the engine and furnace room of the 1881 Lorillard greenhouse complex still stand (Cook, 2005).

[1] My group consisted of Michelle Styger, Maria Pease, Cezanne Perez, Colleen McCarthy, and Kelly Mustone.

There has been some previous academic research on the Lawrence estate. In 2005, Meghan Cook, a Salve Regina University Cultural and Historic Preservation student, wrote a thesis on the Lawrence estate and its larger context of Gentleman farms. In her thesis, she described the social and economic consequences of landscape as a tool of power and subjugation. My thesis takes a tangential approach to the topic of gentleman farms, but I did use much of the same map work and historical documentation. William Beach Lawrence before starting to sell off much of his acreage in the late 1870s and before the Lorillard's purchased the last remaining parcel of land from William Beach Lawrence, the collection of Lawrence's estate was known as the Ochre Point Farm (Yarnall, 2005).

Ochre Point Farm

The entire history of the Ochre Point district is inherently tied to William Beach Lawrence, as he was the first to develop the area. William Beach Lawrence purchased sixty acres of land to the east of Bellevue Avenue in 1835 from John Wilbour (Figure 4-B). According to the deed, Lawrence's land was bounded as follows:

> Easterly and southerly on the sea, westerly partly on land of the heirs of James Phillips and partly on land of the heirs of Thomas Hazard, and northerly on land late of George Armstrong, now of David P. Hall, it being the same estate which was conveyed to myself [John Wilbour] and George Armstrong by the assignment of a mortgage, given by Nicholas Taylor to Elisha Coggeshall, which said assignment was made by Henry Y. Cranston, Administrator de bonis non, with the will annexed, of the said Elisha Coggeshall (Newport City Hall).

Lawrence's purchase was of considerable note to the city of Newport. Newport was expanding during this period and land speculation was running rampant. For some time,

the land of Ochre Point had been highly sought after because of its location near the ocean (Yarnall, 2005). After buying the land, Mr. Lawrence in 1835 built a home in the Greek Revival style in the middle of the his 60 acres, close to the ocean cliffs (Figure B-1). Maps pinpoint the estate's location, but its site has long been divided. Because nothing is around the manor house, transposing future maps with different scales is difficult. It can be said, however, that the approximate location of the main estate is near the Vineland estate. The main house indeed could very likely be located on the exact footprint that Vineland now occupies (Figure B-7).

After growth, regression

The Lawrence estate would not remain static for long. In 1853, Lawrence became acting Governor of Rhode Island and spend much of his time writing on international law. According to all area maps dating after 1859, Lawrence never again built in Newport. This is contrary to other documentation, in 1861; he officially announced plans to build a "large and expensive mansion house" at Ochre Point (Cook, 2005, p. 23). In, 1862, he began to sell off his lots. It is not clear why he sold the lots; it was not for money. As Lawrence aged, it seemed that he began to sell off his land from the outer edges inward, which suggest that Lawrence may no longer have been capable of running a 60-acre farm. Because Lawrence sold off his farmland first he remained living in his manor house until he sold the last of his acreage. After his death in 1881, Catherine Lorillard Wolfe purchased the remaining 13 acres for $192,000 from the executors of Lawrence's will (Cook, 2005). That purchase included Lawrence's main manor house and the area where the boathouse complex is now. Since this first case

study focus on the land involving the boathouse lawn the land around that area is clearly important.

Post- William Beach Lawrence

After Lawrence's death and the sale of his remaining land, Lawrence's main farmhouse was demolished by Ms. Lorillard Wolfe in 1881. She built a large mansion which she called Vineland (Figure B-6). Ms. Wolfe customized the landscape by adding four greenhouses and a boiler room. An image of the greenhouses can be found in the 1907 L.J Richards map (Figure B-7). By 1907, the construction of Ms. Lorillard's estate was completed. Currently, the four greenhouses no longer exist. According to the 1953 Sanborn map and other documentation in the Salve Regina archives, they were destroyed in 1959. Although of lesser importance to finding the boundaries of the William Beach Lawrence estate my group and I were eager to test the imaging abilities of the RM-15 in producing an image of the greenhouses since we knew of their exact location.

Use of Maps

Maps, although not one hundred percent accurate, are highly useful in that they describe in image form the approximate nature of the landscape surrounding the Lawrence estate. In particular, the Dripps map of 1850 shows the meticulously manicured landscape of the estate (Figure B-3). The western façade of the manor house would have faced Ochre Point Avenue. The Dripps map also shows a heavily landscaped lawn, with rows of trees and shrubbery planted along the western and northern sides of the estate. For privacy, on one can clearly see that Lawrence planted an especially high

number of trees near where his driveway intersected Ochre Point Avenue. The south and eastern portions of the estate were left open to create an unabated view of the Atlantic Ocean. This knowledge of how the landscape looked in 1850 proved instrumental in translating the remote sensing images of the boathouse lawn.

By employing maps and other records, we knew the rough area where the structures of the Lawrence estate had once stood. It was at this stage where the historical document has revealed all that it has to reveal; now the utilization of the remote sensing technology becomes crucial. What follows is a description of how my group and I set up the nine grids and remote-sensed the entire boathouse area.

Surveying: 101

Before surveying the area, my team and I compiled a large amount of data in order to generate a hypothesis on the kinds of artifacts that may lie beneath the surface and to determine where to set up the remote sensing grid. In discussing the Lawrence estate, we came to the conclusion that the majority of archaeology remains present in the ground were going to be of a variety of which had high resistance magnetic fields. All features have either strong (high contrast) or weak (low-contrast) magnetic fields. Strong fields are usually associated with iron/steel and basalt objects, and include many intact fired features like hearths, bricks, and other architectural ceramics. Weak magnetic fields are usually associated with disturbed or differentiated soil features like pits, middens lens, road, paths and un-burned house pits. Prehistoric sites are often dominated by low-contrast features and artifacts, while historic sites usually have both high and low-contrast features (Stine & Decker, 1990). Since my thesis utilizes historic sites, my

group and I were able to focus carefully on the high resistance magnetic content of the data from our surveys. Analyzing the images received using a high resistance context, was essential in our interpretation of the images we received.

The grid that we decided to utilize for this first case study was a simple 20 meter by 20 meter grid. A grid is constructed by placing two stakes twenty meters apart. By calculating where the other sides of the square should be placed using the square root of 400, a 20 by 20 meter square is constructed. Dividing your grid into one meter squares via spray-paints or a tape line is the next step. Every survey needs a traverse height which dictates how many readings the machine is to receive per line. We choose a .5 meter level, so for every twenty meters across we took 40 readings. This choice made sense for a number of reasons. For starters, taking a reading every half meter rather than the standard one meter gave us more readings to use, and more readings make a more detailed image. More readings as a general principle made the image more accurate, as basic probability rules dictate that a higher level of anything renders the margin of error less (Geoscan Research, 2001).

Secondly, we could afford to use the .5 sample interval, which was smaller than the default 1 meter, because we were working with a smaller grid. We needed to make doubly sure that our readings were as accurate as possible because our image would be smaller so even small levels of inaccuracies would appear quite large on the image.

After the RM-15 Survey

Physically taking the units measurements though does not produce a final image and results. Once the data has been dumped, the analysis of the resitivity images can

commence. After taking the readings, one takes the machine and, via a serial port, "dumps" the data on to a computer program. Only on such a program can you visually 'see' the image of the subsurface. The computer program further elucidates the image as it is able to recognize inaccurate readings and delete them, a process that significantly reduces bad data. Conversely "good" data, i.e., data characterized by a relatively high signal-to-noise ratio and few survey defects is then what appears on the computer screen. There are typically two principal stages in resistivity data processing. The first is concerned with large-area and high-contrast anomalies. The second is concerned with the small-area and low-contrast anomalies. The former generally does not require high-pass filtering of the data; the latter does (Geoscan Research, 2001).

Analysis of the Boathouse image

After compiling and uploading the data from the nine separate 20- by 20 meter grids, we performed an editing technique in which we edge matched and transposed the pieces to form a single fluent background image of the boathouse complex. At this point, we were finally able to 'see' the compiled boathouse image. Because the remote sensing imagery captures the sum total of history, the image of the boathouse represented a number of occupants and a number of years. The image of case study one clearly showed the greenhouses dating back to the 1880's and built by Ms. Catherine Lorillard Wolfe. A path was even shown on the image leading from the original driveway of Vineland to the greenhouse complex. What the image didn't show, however, was a clear depiction of any kind of foundation or structural boundary (Figure B-8).

The areas of the map that are darker symbolize deposits or remnants of artifacts or anything man oriented. By that I mean, humans created the darker areas, whether by putting down bricks, moving dirt there, building foundations, or even by dumping trash. Darker areas, like those labeled as #4 on the remote sensed image (Figure B-8), can also be the result of large root systems, or otherwise dense material that does not conduct resistivity levels well.

The lighter areas are places that are not significantly changed. They are highly uniform and level in what they are comprised of. Dirt floors, or simply the uninterrupted bottoms of greenhouses, are the white areas on the image. Thus, we can make out what would have been rectangular walls housing several greenhouses on the right hand side of the image, numbered 5 and labeled as the 'greenhouse complex.'

According to blueprints done by the facilities department at Salve Regina University, there were four greenhouses, an upper greenhouse, followed by a pond, and three final greenhouses. The pond was obviously used to water the surrounding four greenhouses and is labeled as #6 on the boathouse image. The four greenhouses, labeled as #5, were quite large. The campus facilities map shows each greenhouse to be approximately the same size as the boathouse structure, 60 by 12 feet. The greenhouses were oriented perpendicular to the boathouse with the longer side of the greenhouses running parallel to Ochre Point Ave. The darkened winding path that starts at the lower left-hand corner and winds up to the edge of the leftmost greenhouse wall would have been the driveway and path of choice for the gardens and workers of the Lorillard estate. This pathway was built after the William Beach Lawrence occupation by some 40 years.

The RM-15 image also clearly shows a brick wall that surrounds the greenhouse complex. Placed here for protection and security, this wall was the approximate length of the greenhouse and was made of a similarly dense element, perhaps rock or brick. The stone wall ran approximately five feet parallel along the road that now known as Ochre Point Ave. The stone wall also ran closely, within five feet, of the greenhouses in the Boathouse complex. The Boathouse building is labeled as #8 on the image. The boathouse is situated east of the pond and the second greenhouse down from Ochre Point Ave.

A closer inspection of the image clearly shows that there are several areas of the image that look incongruous to map as a whole. In particular, the rectangular areas of blue in the top left-hand corner and bottom right stand out (labeled in figure as #1). These readings are 'dummy' readings. Dummy readings are readings that are taken in areas or regions where conventional remote sensing, that is prodding the two points into the ground, is impossible. Impossible regions might include thick brush, stumps or paved parts of the survey area. The machine, unable to take an accurate reading, then takes a reading that is identical to the last accurately received reading on that axis. Therefore, the regions are mirror images of the region below and beside them. In the boathouse scenario, the upper left hand patch is actually an area of the lawn that is paved over near the gatehouse. The same goes for the lower right hand corner blue area, which is the pavement near the Angelus academic building (lower #1).

Conclusions and Future Work

Overall, the William Lawrence case study was a mixture of successes and failures. Firstly, the adaptation of the RM-15 technology to a historical setting was a success. Based on the later map work and corresponding pictorial evidence, my team and I were able to validate what was known to be buried beneath the surface of the boathouse lawn and thus validate the effectiveness of the remote sensing technology as a whole. Our failures came in one main form. My team and I were unable to locate the main estate house of the William Beach Lawrence estate. Based on the finding from the RM-15 images, my group and I can conclusively say that the estate lies somewhere either underneath the driveway to McAuley or below the beech tree that grows in front of the entrance to McAuley. My team used both historical maps to pinpoint a rough approximation of where the estate could lie and then proceeded to survey all we could of that area and found nothing to be consistent with the foundation of a building. In this case, remote sensing, due to its need to be done on a softer surface than pavement or tough roots cannot be used to complete any further surveys near the beech tree. Coupled with the fact that archaeology cannot easily or simply be done on pavement, no additional or future work can be easily done on this potential area where the William Beach Lawrence main estate house may rest.

Case Study 2: The William Beach Lawrence Dependencies

The success of the remote sensing, although proven to be quite high in identifying known features under the boathouse lawn, needed further use in order to better assess the usefulness of the technology in historical archaeology settings. Using a similar

methodology to the first two case studies my team relied on historical maps and images to map out the historical surroundings of the Wakehurst lawn dependences.

The RM-15 survey of the main manor house, however, did put to rest any questions on the William Beach Lawrence estate. Although remote sensing conclusively demonstrated that the main manor house of the Lawrence estate lay under pavement, Lawrence's estate did not simply consist of one large manor house. One of the maps my group used, the Newport City Hall Hopkins Map of 1876 (Figure C-1) clearly shows that a gardeners cottage was built on the opposite side of Ochre Point Avenue, far enough away from the main house as to ensure that Lawrence could have full privacy and the illusion that he was alone on the estate. Several other outbuildings, including an ice house and horse barn, were built at a 90 degree angle to the street (Cook, 2005). These dependences, the last remaining vestiges of the William Beach Lawrence estate, are the focal point of my second case study.

In keeping with the first case study, we selected a landscape devoid of obstacles and one fairly wide open. The area was also well documented and researched; therefore my team and I would have a fairly clear idea at the end of our map research of where the structures may lie and thus where to begin to lay out our grid. As with any remote sensing survey, research is crucial in helping narrow down where the most beneficial area to begin sensing is.

On the Van Alen property, the building known as Wakehurst was constructed on rectangle of preexisting William Beach Lawrence land between Lawrence Avenue, Lerory Avenue, Ochre Point Avenue and Shepherd Avenue between the years of 1884 and 1887. With this construction, the remaining outbuildings belonging to the William

Beach Lawrence estate were removed by the time the 1921 Sanborn map was published. The outbuildings probably were taken down in conjunction with the construction of Wakehurst (Styger et al., 2006).

Post William Beach Lawrence

With the death of William Beach Lawrence in 1881, the executors of his will, James N. Pratt and James G. K. Lawrence, sold the remaining property to wealthy New Yorkers who were looking for beautiful locations for their summer homes. In this same year, a particular parcel was sold to former Union Army General, James H. Van Alen (1819-1886) for a sum of $98,942 (Newport Land Evidence [NPTLE] 52:396). Ten acres of that lot is currently owned by Salve Regina University and is bounded by the following: north by Leroy Avenue; east by Ochre Point Avenue; south by Shepard Avenue; and west by Lawrence Avenue. Those 10 acres of came to include what is now the Wakehurst estate (Styger et al., 2006).

The Dependencies

After purchasing a plot of land from the executors of Lawrence's will, General James H. Van Alen constructed "The Grange," in a Flemish Revival style. The house erected with a half-circle drive extending off Lawrence Avenue in the southwest corner of Van Alen's property (Styger et al., 2006). According to the 1883 Hopkins map, some of the preexisting out-buildings of the Lawrence estate still stood after the Grange was built (Figure C-2). The historical maps show in particular two outbuildings, located on the western portion of the Lawrence estates now the Wakehurst property. One of the

outbuildings was a greenhouse, constructed on the western portion of the grounds near the present day footprint of Wakehurst. The other structure, according to maps, was the approximate size and shape of what might have been an ice house. A pathway runs from east to west between these outbuildings. By 1883, the former Lawrence estate had been subdivided and Ochre Point was laid out in its present grid (Styger et al., 2006).

Previous Survey Work

My case study is firmly rooted in pre-existing work. In this case, the land of the Van Alen Estate was researched by a 2005 Salve Regina University campus archaeology class. The class found some indications of formations and irregularities within the present day Wakehurst landscape. These discoveries led them to hypothesize on the location of a previous fountain and several of the William Beech Lawrence's outbuildings. One was a greenhouse, which is visible in a photograph of the Grange. The other, however, is believed to have been a series of stables (Elliot, Zawalich, & Kronenburg, 2006). The area in which these buildings were located contains soil that is very soft and easily saturated by the rain year round. Since this area was prone to a marsh-like existence, Salve Regina installed a drainage system to reduce the wetness. After comparing Sanborn maps to more recent aerial photographs, the class took GPS coordinates of three corners of the outbuildings.[2]

[2] These coordinates are: N 0307820, E 4593723; N 0307818, E 4593700; N 03078591, E 4593695.

Previous GPR Survey

In addition to using the historical maps and synthesizing a previous class' work, we were able to narrow down where to remote sense based on the fact that the area in front of Wakehurst had already had another form of geophysical survey completed on the landscape. In 2005, SPECTRA Environmental group undertook ground penetrating radar on the landscape directly east of Wakehurst.

Ground penetrating radar is a noninvasive survey which, depending on soil conditions, can provide data on "subsurface geology and underground features to depths of 10 or more feet" (Spectra Environmental Group). The GPR, conducted on October 7, 2005, by the Spectra Environmental Group, probed to depths of approximately 8-9 feet below the ground surface. The goal of the project was to find the locations of potential buried buildings, structures, or other features by creating a "rectilinear" survey grid with two-foot spacing on the Wakehurst lawn (SPECTRA, 2005).

The SPECTRA group's grid on the Wakehurst lawn was a box measuring 100' south to north and 50' east to west. The GRP machinery was then dragged systematically over the grid. The results and image compiled by the GRP differ from those collected from RM-15 surveys but are similar enough to compare. The image complied by the GRP showed an area containing significant high amplitude reflectors in the northeastern portion of the study area (Figure C-3). Present within this area, as seen in the depths slices, is a northwest-southeast trending linear feature that seems to terminate in a circular feature approximately 60-70 feet north from the southern boundary of the survey area" (Spectra Environmental Group). They determined that these features could indicate the site of a former building's foundation or another significant feature (SPECTRA, 2005).

The feature is approximately 50 feet east of the western boundary and is located towards the back corner, some 30 meters close to the iron wrought gate and Ochre Point Ave.

The disturbance readings on the GPR radar instruments could very well signify the location of one of the greenhouses found exclusively on the 1876 Hopkins's map of Newport. Based on these findings my team and I decided to lay a 30 meter by 30 meter grid on top of the already completed GPR survey with special regards to the area of note in the GPR survey. The 30 meters north to south, and east to west measures when converted from metrics 98.4 feet, very close to the 100 feet used by the GPR survey. Placing our own grid on this existing grid was beneficial in that my group and I could confirm or negate the results of the GRP while comparing and contrasting the area with corresponding RM-15 images.

RM- 15 Survey

The actual setup of the remote sensing grid for case study 2 was a bit different in contrast to the 20-meter by 20 meter grids we utilized on the first case study, we used a larger 30-meter by 30 meter grid. In keeping with the first case study, my group and I set up the triangular coordinates in the same manner, drawing out a known point and measuring 30 meters diagonally from it. Because my group and I felt confident that we would come upon existing structures, due to the wealth of previous evidence and GRP survey, we decided to perform a more rigorous, more intense survey using both a traverse interval and a sample interval of .5m. This doubled the number of readings, thus creating a more fine-tuned and detailed image. A fine-tuned image was necessary because dependences due to their singular need and purpose were not built as structurally strong

and sound as buildings that would have been inhabited year round. Therefore, the foundations of such structures would be harder to pick up on the image because they were constructed as impermanent buildings.

After setting up the machine and programming the interval lengths, we proceeded to remote sense starting in the southeast corner and working west. Due to the fact that there was no obstructions, this area, was by far the most ideal of the case studies that we had completed. The results of the RM-15 sensing, based on the ideal conditions, previous research and scholarship, and the wealth of readings we received, were quite good and revealing. The finished image was revealing in that it clearly outlined both paths and the remaining foundations of the dependencies.

The RM-15 image confirmed the presence of the feature captured in the GRP survey. The feature, captured in our image as a semi-circular patch of high resistance readings just north of the dummy readings, was most likely the gardener's cottage (Figure C-5). My group and I believed that it was the gardener's cottage because it was significantly larger and had more high resistance readings than the other rectangular readings which were most likely smaller, less solid, dependencies, like ice houses. Furthermore, the majority of smaller rectangular features line up in rows. Therefore it is likely, that each dependency had one singular role and that they were sited close by to be accessible quickly and efficiently during the morning's chores and responsibilities.

In addition the larger gardener's cottage, several other dependencies showed up quite clearly on the RM-15 image (Figure C-5). Diagonally southwest (up and left) of the gardener's cottage, one can make out two, partially rectangular features. These could be the location of smaller sheds. The second shed to the south (left) has a circular feature

residing in the middle of it. This circle could be the remains of a hole dug for a well or a hole used as an icebox (Figure C-5). To the south (right and down) on the same linear axis, are the remains of perhaps two more dependencies. These last rectangular features are less apparent and more nebulous; they are difficult to decipher. They may be smaller sheds or storage areas or simply patches of high resistance readings.

Above the line of dependencies, lies a narrow horizontal line (Figure C-5). This procession of low-to-middle resistance readings may be a path made out of shell or small pebbles, objects that are not as hard and as dense as the brick and wood used in the construction of the sheds. The streak of readings is far too regular to simply be the result of random activity on the landscape. This idea of regularity is perhaps one of the most telling aspects of RM-15 imaging. The machine allows the researcher to clearly distinguish between lines of randomness and lines of intention, straight lines or features which are tell-tall signs of human intervention on the site.

Surveying the second proposed area of William Beach Lawrence structures was a success in that my group and I were able to take away from the survey a plethora of information. The images produced by the RM-15 survey were clear and understandable, allowing us to create a proposal for future archaeological excavation there.

Potential Archaeology for Dependencies

There are many challenges to be met when proposing the excavating of an archaeological landscape now longer in use. Much of the difficulty comes from in interpreting the ephemeral data. That difficulty is magnified on the William Beach

Lawrence case study 2 because in the process of excavation, one will encounter distinct layers that may or may not be the features displayed and identified on the RM-15 images.

By combining the technology of the RM-15 with primary source documents on the second William Beach Lawrence second case study, a richer picture of the William Beach Lawrence landscape came to focus. The RM-15 images suggested locations where archeological investigation could fill in the remaining historical gaps. Choosing the method of archaeological excavation is essential, as that helps determine the likeliness of finding substantial artifacts on a given site. Taking into consideration the fact that the William Beach Lawrence estate case studies are fairly small sites, less than 1,000 square meters, and are historical sites with relative ages dating back to the mid 19^{th} century, I would recommend performing a systematic sampling strategy (Barker, 1977).

A systematic sampling strategy is one in which a meter grid is the basis of excavation. Test pits are spaced equally on a linear pattern, which are placed on sections of the proposed site that are thought to be potentially rich sites for artifacts (Barker, 1977). The William Beach Lawrence dependency case study located the approximate location of the dependences and thus provided the archaeologists with a clear direction of where to place the test pits. A grid which included the five potential areas of dependencies would be a simple yet effective way of testing for structures. After laying out the grid, 5 test pits measuring 1 meter by 1 meter should be placed at the approximate center of the dependences. In the case that numerous artifacts are excavated from these smaller test pits, I would argue for doubling the 1 meter by 1 meter test pits to allow a far larger picture of the estate to arise

Case study three: Edgewater

After completing the surveys on the two William Beach Lawrence sites, my group turned to our final case study on the Salve Regina Campus. Having three case studies would provide a broad enough base of information in which to draw conclusions on the effectiveness of the technology. My group and I sought to test the technology by locating the foundation or remains of Edgewater, a structure built on the ocean side of Salve's Ochre Court. This case study, unlike the previous two, had been researched far less; no hypotheses on what lay beneath the landscape of Ochre Court had been made. Although the landscape of Ochre Cliffs is now dominated by the opulent Ochre Court mansion, it was not as such during Edgewater's time.

Ochre Court was not the first structure to be built on plot of land bordering the Atlantic Ocean and the Cliff walk. A far more subdued manor house perched on those very same cliffs for some 18 years before being torn down to make way for Ochre Court (Yarnall, 2005). That manor house, aptly named Edgewater, was constructed somewhere on the existing landscape of Ochre Court. Where it stood on the site, however, remains a mystery. With the aid of historical maps, pictorial evidence, and the RM-15 technology, my group and I were determined to figure out Edgewater's location.

As with all case studies, determining where to remote sense is crucial. The Ochre Court property contains well over 3 acres with the basic perimeter being hundreds of meters long. My group and I were looking for a manor house roughly ¼th the size of Ochre Court with no known landscaped features. A detailed record of where the Edgewater estate lay, its boundaries and a rough idea of the physical layout of the estate

needed to be established prior to remote sensing. I began by creating a timeline for Edgewater in order to determine where to lay out the remote sensing grids.

The Edgewater estate was designed by George Champlin Mason Sr. Mason was truly an eclectic character; he was a devotee of the "French roof" many years before it became popular. Mason also was something of an entrepreneur, buying in 1851 the *Newport Mercury*. While managing the paper, Mason became interested in architecture. His interest in architecture grew so strong that in 1858, he resigned as head of the local paper. In 1860, he opened the first professional architecture firm in Newport (Yarnall, 2005).

Before Ochre Court, the land was owned by William Beach Lawrence who sold the land to Mr. James P. Kernochan. In 1869 Mr. James P. Kernochan of New York contracted local Newport architect George Champlin Mason for the immediate erection of what was to be, according to Kernochan, a "65,000 stone villa to be built on the lot between Marine, Wetmore and Ruggles Avenues and the sea and opposite the elegant summer residence on Marine Avenue" (Yarnall, 2005, p. 69). The estate was to measure 721 by 121 feet on the ground with the entire first story to be made of local Rocky Farm stone with granite trimmings (Yarnall, 2005). The second story, at Kernochan's request, was to be faced not with stone, but would instead with studded with diamond-shaped tiles. Kernochan had also instructed that the roofing should be done in black slate. The interior was decadently designed as well, with hard wood furnishings throughout. Kernochan's plan was to create a villa and estate that would be in his words, "one of the finest villas on Ochre Point" (Yarnall, 2005, 70).

Using these stipulations Mason built Edgewater, a splendidly ornate Italianate home, for J. Fredrick Kernochan in 1870. The home had a steep French mansard roof, topped with an iron crest. The walls of the home were layered in polychrome wooden shingling. Kernochan's house was also unique in that it was rumored to have been perched quite literally on the cliffs near the Cliff Walk. Edgewater remained in the hands of J. Fredrich Kernochan until only 1881, when Kernochan sold the estate for the highly prized fee of $90,000 to Odgen Goelet (Yarnall, 2005).

Goelet was a sharp man who possessed a strong intuition. He realized that although Kernochan's asking price was high, the land would eventually be worth far more. Furthermore he had no intention of actually living in Edgewater; he bought the land with architectural plans for his own estate already in hand (Salve Regina Archives). By purchasing the land with Kernochan's house on it, Goelet had a place to stay while he constructed his own prized luxurious manor. Edgewater would stand until 1888, when Ogden Goelet, after living in the property for six summers, began in earnest to transform the land into his own vision. He took the first step in 1888 by demolishing Kernochan's vision after the construction of Ochre Court (Yarnall, 2005)**.**

Several years passed, after Goelet purchased the property, with little news on the future mansion. Two newspaper articles, both from the *Newport Mercury* paper dated, December 31, 1887, discuss in passing that Mr. Goelet is to have his present cottage, Edgewater, on Ochre Point removed and a much larger more expensive villa erected. The articles also mention that Mr. Goelet plans to have stables placed on land he recently

purchased from Governor Wetmore (Salve Archives)[3]. Interestingly, these articles contain no mention of the physical plans for Ochre Court nor the location or status of Edgewater.

A *Newport Mercury* 1889 article entitled "Improvement Notes" which detailed on the additions, remodeling and condition of the manors and mansions mentioned that among the many new projects one was a design for a new construction on Ochre Cliff, financed by a Mr. Ogden Goelet. In 1889 the same *Newport Mercury's* "Improvement Notes" predicted on the mid-summer arrival of the Goelet family. This article pointed out that the Ochre Court mansion was still being built in 1889 (Salve Archives). Subsequent articles in June 28, 1890, mention that Ochre Court is not yet completed but that it will be the "grandest of all the Newport manors, complete with a splendid garden and a great square portico" (Salve Archives). The last "Improvement Article" to mention the construction of Ochre Court was printed in the May 2, 1891, issue of the *Newport Mercury.* This article states that the construction of the manor is "going well". All these newspaper articles, however enlightening, don't highlight the location of Edgewater.

Map Evidence

Another piece of the puzzle of where Edgewater might have been located was solved using historical maps. My group and I hoped that since the location of Edgewater since was not explicitly outlined in any newspaper article, that maps, and pictorial evidence would provide that missing link. Using several historic maps, chiefly the

[3] Later sources indicate that these stables, were later constructed between 1888 and 1889 and are now owned by Salve Regina University and called Mercy Hall (Salve Archives).

Hopkins maps of 1883 (Figure D-2), which clearly shows the Edgewater estate under the words Ogden Goelet[4], and then transposing them to a present-day map my group and I determined that Edgewater had to have been built between the end of the landscaped terrace of Ochre Court and the Cliff Walk. Earlier Newport maps dating back to the 1890s, when transposed upon each other, showed that Edgewater was on the same axis as Ochre Court. This meant that Edgewater was not built on the sides of Ochre Court but instead, according to our best estimation of the maps, some 200 meters in front of Ochre Court towards the Atlantic Ocean. Both structures then stood during the duration of construction concurrently together. Based on this fact, the idea that Edgewater was literally torn down and Ochre Court being built on top of its remains could be ruled out.

More Modern Happenings

The next traceable event on the property occurred almost 100 years later. The Rhode Island Historic Preservation Commission, on November 28, 1979 authorized the expensive of $86,000 on fixing the backyard terrace/level at Ochre Court. The winning bid for the restoration of the terrace came from Robinson/Green Beretta Corporation. The company's plan was to "restore the central terrace platform projecting from the east side of the main terrace and to fix the adjacent wall and balustrade north of the east platform" (Salve Archives). The company also found that it was necessary to remove the present brick foundation and concrete support slabs in order to install a new concrete foundation and concrete support slabs. The ground then would be excavated to a depth of 3' 6". The target date for completion is May 13, 1980 (Salve Archives).

[4] Goelet had purchased the land by that date, but had not started construction

The projects' progress reports shared that the ground level and subsurface had been interfered with greatly. This upper level soil interference was of great importance as the remote sensing equipment only takes depths up to a meter. A progress report from January 31, 1980, states that the crew dug an "exploratory pit at the front of the foundation which appeared to be containing brick and stone, at a depth was at 40" (Salve Archives). Another progress report from April 8, 1980 states that by this time they had "reset the steps at the south end, reconstructed the brick foundation at the north end and, among other things, had placed pebbles for drains under front of terrace" (Salve Archives).

Expectations for Survey

Based on deeds, map work and documents from the Salve Archives we know that Ochre Court co-existed with the former Edgewater estate. Construction records from the Salve Regina archives indicate that Edgewater was still standing when Ochre Court was completed. Edgewater was demolished soon after Ochre Court was completed as the home disappeared from all maps after 1888 (Salve Archives). Thus Edgewater, by nature of its destruction, provides itself as an ideal case study for the usage of the remote sensing technology.

The area surrounding Ochre Point has a high potential for findings since at least part of the structure, a basement or structural foundation, lies somewhere under its expansion sea-bordering lawn. Remote sensing provided us with the missing link, allowing my group to "see" and "find" more clearly than maps the final resting place of the manor. Remote sensing also clarified the map research, which on older, more obtuse

maps were difficult to interpret. The ramifications of the 1979 beautification process on how my group and I analyzed our results cannot be overstated. The information was invaluable because it helped my group and I analyze the data supplied by remote sensing. Rocks, bricks and other sizable chunks of debris showed up in different levels than they might have originally because of the use of backhoe in the beatification process. Indeed the entire landscape of Ochre Court was churned up considerably making my remote sensing results all the harder to interpret.

In addition to creating a mess of the lower soil levels, the beautification process most likely took the line of bricks used in the foundation of Edgewater and removed them or smoothed them out completely. Due to the fact that the soil was interfered with, my team's results would have to speculative at best as the original soil containing the original foundation and or other artifacts might not have any relevance to the location of where it appeared on our remote sensing images.

Onto the Survey

My group and I decided to pursue remote sensing on the lower terrace of the Ochre Court Lawn, as this area provided a clear delineation between where Ochre Court stands and where Edgewater most practically would have stood. Surveying close to the Cliff walk was also keeping with the reports that stated that Edgewater was placed close to the water's edge. Based on the map work, my group and I had roughly a 50 meter by 60 meter rectangular in which we felt confident that Edgewater lay. Therefore, due to the size of the potential resting place of Edgewater, two 30 meter by 30 meter grids would

need to be constructed and remote sensed. Somewhere along those grids a line of foundation would surface, detailing the area where Edgewater once stood.

The setup of the remote sensing grid was constructed in a similar manner to the William Beach Lawrence case study. The first two grids ran perpendicular to the end of the landscaped area of the bottom Ochre Court terrace. The two grids, one 20 meters by 20 meters west to east and the other 13 meters by 20 west to east, extended the whole horizontal length of the potential construction area of Edgewater north to south. The sample interval was once again .5m. Our traverse interval, the distance one travels down before completing our next line, was set at 1 meter. We received 20 lines of data with 40 readings per line for a grand total of 800 data readings.

My group and I placed the first series of grids in the middle of the second partition on the Ochre Court lawn for a number of reasons. Previous scholarship ruled out the upper lawn of Ochre Court as early construction reports stated that Edgewater stood while Ochre Court was being built. Similar reports found in the Salve Regina archives describe the creation of a rear garden in the back of Ochre Court in concurrence with the construction of the mansion. Therefore it is highly improbable that Edgewater stood any further south, above where we began remote sensing because that would have been an area where the garden was being landscaped as Ochre Court was being built.

In addition, the land north of the stone terrace facing Ochre Court is higher than the surrounding land. It can be hypothesized that in constructing Ochre Court, the workers filled the area to create a berm, surrounding the basement or foundation of the house with fill. Our remote sensing corresponded to this decrease in maybe occupied

elevation in that our first 20-by 20 meter grid had its baseline on that change in elevation. The relative size of Edgewater would have fit in this area of lower elevation.

The two grids, for easier reference, stretched from the last stone terrace wall to the prominent statue of Jesus in the middle of the lower landscaped tier. Running the RM-15 much in the same way as done for the William Beach Lawrence estate, my group and I surveyed both of the grids in the first section we had mapped out. However, the results of the first 20-by 20 meter grid did not support our initial hypothesis (Figure D-4). A hodgepodge of darkened smudges and gray areas was all my group and I could initially make of the image. After running several diagnostic image filters, we were still unable to delineate any clear lines of foundations. My team then decided that we should progress to the next surveying grid we had set up before arriving at any conclusions. Due to the narrowness of the plateau of land, it was only 13 more meters to the edge of land where the Cliff Walk started. Thus, to finish up that section of lawn we needed only a 13 by 20 meter grid. We surveyed in the same manner as for the first grid and then edge-matched the data. Our newly updated image, however, did little to elucidate the situation. After further analysis, we concluded that we were probably either too far south of Edgewater, or and more likely, the work of 1979 had so damaged the integrity of the soil that we were looking at the foundation of Edgewater and not even realizing it.

Due to the mixture and clutter of high and low resistance readings, we concluded that this image probably depicted the remains of the construction of the Ochre Court terrace. The interspersions of high and low resistance levels and the lack of uniformity in lines of resistance ruled out that the area could contain Edgewater's foundation. The first composite of Edgewater then confirmed what my group and I had feared, that the 1979

re-construction of the terrace substantially moved and probably removed most of the dirt surrounding what was the Edgewater foundation.

After the first survey, my group and I still had the smaller northern second survey to initiate. This was our last chance to come upon the structure is this northern area as it delineates the line of the property's boundary. Using the statue of Jesus as our reference point, my group and I determined that we would survey the remaining 20-by 20 meter grid on a later date. The landscaped rear of Ochre Court tapers and narrows as the land gets closer to the Cliff walk. This tapering ended at the point that we were next going to a survey, a point of land nearly 30 meters across. The same traverse and interval spacing were used for the second section of remote sensing.

My group had hoped that since the bottom right-hand corner of our previous survey had resulted in a somewhat uniform darker area that we might come upon some uniformity in our readings. Pictorial evidence in the form of aerial images dating from 1963 (Figure D-3), showed a dark patch of grass measuring 20 meters by 33 meters on the lower half of the Ochre Court lawn. Dark irregularities in the grass are often caused by low lying changes in soil composition, and/or by a strong presence of rocks in the ground or metal. The darker lower patch of high resistance readings in the first image matched within three meters of this darker patch of grass on the aerial image. My group thought that if the second survey confirmed this patch of high readings that we would be looking at the footprint of Edgewater manor.

The results of that second round of remote sensing did not bring the clarity to the geographical and spatial paradox that had confounded my group after the first day of remote sensing. The results of the second phase of surveying showed only marginally

more uniformity (Figure D-5). The image of the second survey did exhibit patches of high resistance readings that could very well correspond to the edge of the Edgewater estate. In particular, the darkened path that runs into the lower right hand patch of dummy readings due to the line's straightness looks very similar to a line of deposited foundation material. In addition the high, dense collection of high readings demonstrates that a great deal of thick debris, rocks, metals, etc. was placed with some purpose in mind in that general vicinity. Such a pile clearly indicates that some form of structure, whether it was a piece of the landscaped lawn in a stone terrace or even in a structure, stood starting at about 10 meters down on our second 20 meter grid. The issue however was a lack of real uniformity. Although the images hinted at a structure, the lack of consistency throughout made it impossible to say with any certainty that we were looking at a stone or brick foundation.

Findings

Overall, the Edgewater case study demonstrates an important quality of remote sensing, the ability for the technology to save researchers and archaeologists a great deal of time and money. By using maps and pictorial evidence, two strong research tools and ones used often by archaeologists for planning larger scale excavations, an archaeologist would be confident that he or she had a fairly high chance of finding the structure of Edgewater running down the lower portion of the Ochre Court lawn. Therefore a team of archeologists might have begun a large scale excavation, a time-consuming and expensive proposition.

This is where remotes sensing technology comes in. The remote sensing imaging system is a perfect checks and balance system. The remote sensing equipment used before the excavation would have shown archaeologists that since the soil had been so tampered with that the majority of findings could easily be circa 1979 Styrofoam cups, left over from the reconstruction phase on the lawn. Furthermore it is possible that the proposed excavation, because the ground has been chopped up, may not reach material from the 19th century for quite a few meters if at all. Remote sensing however, in this case saved in this case saved a great deal of time and money and thwarted what would have been a potentially useless archaeology excavation.

Conclusion

Since my thesis was largely a test of technology never before utilized on historical New England sites, my critique of the technology and its adaptability to historical settings cannot be simply a positive or negative reaction (Somers, 2007). As with any new technology, there are bound to be ups and downs positives and negatives in the quality of responses and ease of usage. The RM-15 remote sensing tool was no different. Geophysical tools only date to the early 1970s; they are a relatively recent phenomenon and have been used primarily in the western portion of the United States by large scale groups like the Army Core of Engineers (Conyers, 2004).

Since the adaptation of the RM-15 on our case studies were among the first ever done using a New England historical archaeology context our images were difficult to place in what has been a historically, western, flat, arid RM-15 context. This was a challenge in that my group and I had few other RM-15 images and findings to compare

our images to. In order to assess the quality of our results and the adaptability of remote sensing to our case studies a re-examination of each of the case studies is necessary.

Quality of Case Studies

My first case study, the William Beach Lawrence Gentleman farm complex, worked wonderfully in conjunction with the RM-15 sensing equipment. The area of interest was wide open, grassy and free of intervening obstacles such as trees. The final image garnered from the machine was clear and far less ambiguous than the other two case study images. The image, although it did not conclusively show the William Beach Lawrence estate, demonstrated the clarity in images that such a survey is supposed to create. The issue of clarity is highly important and relevant because the image and its subsequent interpretation lead archaeologists to conjecture on potential archaeological sites. Without a clear image, no such interpretation can be made, and the project loses direction and purpose as a result. Case study one was a success in that my group and I could very clearly articulate that the image of the boathouse showed Wolfe-era occupations on the site but no Lawrence-era features. Based on this clarity, an inexpensive and highly specific archaeological excavation centered on those greenhouses would certainly find a plethora of artifacts and evidence of the 1882 constructions.

My second case study, attempting to locate the William Beach Lawrence dependencies on the Wakehurst lawn, was also highly successful in that I was able to suggest future archaeological excavations. The landscape of the second case study was also conducive to RM-15 activity. The area contained enough wide open spaces for a

large interrupted grid, a flat topography and an area without regions that I would have to 'dummy' read. My group and I were able to hypothesize on what we felt was a highly specific, relatively low risk and expense archaeological sound excavation based on the clarity of the RM-15 image. The technology also worked well for Edgewater; but in a different way than the previous two case studies. The technology on this historical landscape produced images that clearly showed that archaeological excavation on the site would be frivolous.

Assessment of Technology

Overall, the RM-15 as a technology is rigorously typecast; it can only be used in certain areas, among those grassy areas without much vegetation, and areas without too many large stumps or rocks (Somers, 2007). For an archaeologist, this is a serious downside to the technology because there is no rhyme or reasons to where artifacts lie; artifacts may just as easily lie in a rocky field as in grassy knoll. Having to work around areas with inconvenient natural settings that may house potentially rich artifacts is not practical. From that perspective, the archeology takes a back seat role to the qualities and characteristics of the site.

The RM-15 also produces images and interpretations of varying qualities. An image of a site can be very richly detailed, presenting a strong contrast in colors and values, or an image can literally be a washout, presenting a uniform image of one color or hue. As a general rule, the least amount of guesswork that has to go into a site's analysis, the better. The images that a RM-15 produces are very much open to speculation. A darkened line can be read as a path or as the edge of a foundation. The image of the

subsoil, no matter how careful you took the readings is not often clear. Besides interpretation, another area of concern is that the reality of what you see on the image and what actually lies in the ground can differ considerably (Somers, 2007). Even if all researchers agree that that an area of high resistance is the remains of a privy, when excavated that high resistance reading can be no more than a collection of c. 1980 beer bottles. In other words, remote sensing an area is never enough; archaeology must be employed to solidly check and affirm the RM-15 image.

Another negative factor of the technology is the time aspect. RM-15 remote sensing is a slow process; it takes a steady time frame and an even steadier hand. A 20-by 20 meter site takes between 2-3 hours to finish, a tough time frame in which to work if you have to take up all your equipment, stakes and tape included, in the same day in which you remote sensed. Working in groups was the only way to avoid such a prolonged time requirement. Another aspect of the technology that spawned several extra-long survey days is that once a RM-15 survey is underway, it must be finished. You cannot stop half-way through the survey, remove your probes and expect to be able to resume the next day because removing your hard points makes recreating your grid very challenging. Furthermore, even the slightest inaccuracy in where you resume surveying has dire effects on the finished image. Because of this fact, my team and I had to have a plan of action that detailed approximately how the survey would take while factoring in hours of daylight and the need to accommodate breaks and schedules. In the future, I would plan even more in advance, perhaps setting up the grid the day before surveying in order to save time whenever that is possible.

Despite these problems there are many positive aspects of the technology. The RM-15 is generally a very easy machine to set up and use. The simplicity of the machine allows for archaeologists to use the technology on a variety of areas. One simply has to place the probes of the RM-15 in the ground, wait for a beep and then move over to the next allotted space and repeat. Although time consuming and tedious, analyzing the data is also a comparatively easy process. The tutorials built into both the machine and the accompanying computer program allow for easy manipulation of the corresponding RM-15 produced images. The RM-15 is also compatible with all forms of weather. Wind and rain have no effect on the machine. The ruggedness of the machine is noteworthy especially in such a windy climate such as Newport.

Finally, the most beneficial aspect to remote sensing is that the process involves making observations remotely, or without physical contact with the object under investigation. Remote sensing performs archaeology without even picking up a trowel. For sites like the first William Beach Lawrence case study, the implications are huge. Spending time and money to open up a massive number of test pits can be avoided since the findings of the RM-15 demonstrated that nothing remains from the William Beach Lawrence context. Similarly, on my second case study, the survey allowed future archaeological teams to bypass the areas of low resitivity that did not render hope for any concrete William Beach Lawrence dependencies findings. Remote sensing, then, has been proven to be especially useful for sites that are precarious in either their physical or financial settings.

Overall, because of the quality of the images taken by the remote sensing surveys, my team and I were able to conclusively put to rest many of the questions surrounding

the William Beach Lawrence estate. In the first case study, my team surveyed the entire area that was able to be both remote sensed and archaeologically excavated and demonstrated that the William Beach Lawrence estate simply is not accessible. This demonstration closes the case as to where the William Beach Lawrence estate house is once and for all. In addition, the survey in case study 2 established areas to avoid archaeologically while highlighting areas where high resistance readings may verify foundations. As with any survey, however only time and archeological excavation will tell us if our hypotheses are correct. The Edgewater case study demonstrated the fact that the RM-15 can be a huge time and money saver as it allows potentially poor areas to avoid been excavated.

The RM-15 technology performed better than I expected overall. Based on the high level of adaptability further usage of the machine will surely commence on many of the richer, historical and well researched sites of New England. As the scope of the technology increases and is fine-tuned to handle the rough, rocky New England historical environments, new archaeological projects will certainly begin in earnest as the images from the RM-15 pinpoint potentially rich area in which to excavate historical sites.

As with any research however my team and I created even more questions than answers. Among them, just where the William Beach Lawrence estate house is, what archaeology will find on the designated sites and if the Edgewater foundation can ever be found with so little imaging information to go on? Many of these questions may be answered if the proposed archaeology excavation on the William Beach Lawrence dependencies picks up artifacts and other evidence of the foundations of those dependencies.

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Assorted photographs: Courtesy of Newport Historical Society

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Appendix A:

Geophysical and

Remote Sensing technology

Figure A-1: The RM-15 basic probe array

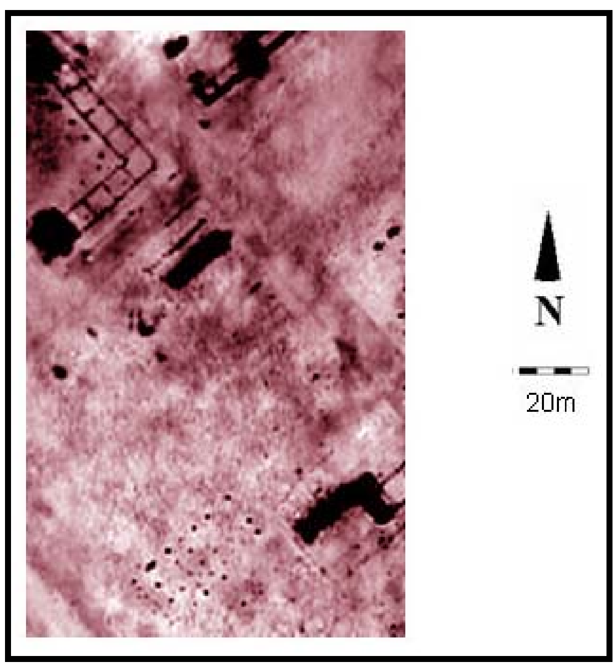

Figure A-2: Example of RM-15 image

Appendix B:

CASE STUDY 1

William Beach Lawrence maps

and remote sensed images

Figure B-1: Main estate house of William Beach Lawrence
Courtesy of Newport Historical Society

Figure B-2: Beers Map of 1870
Courtesy of Newport Historical Society

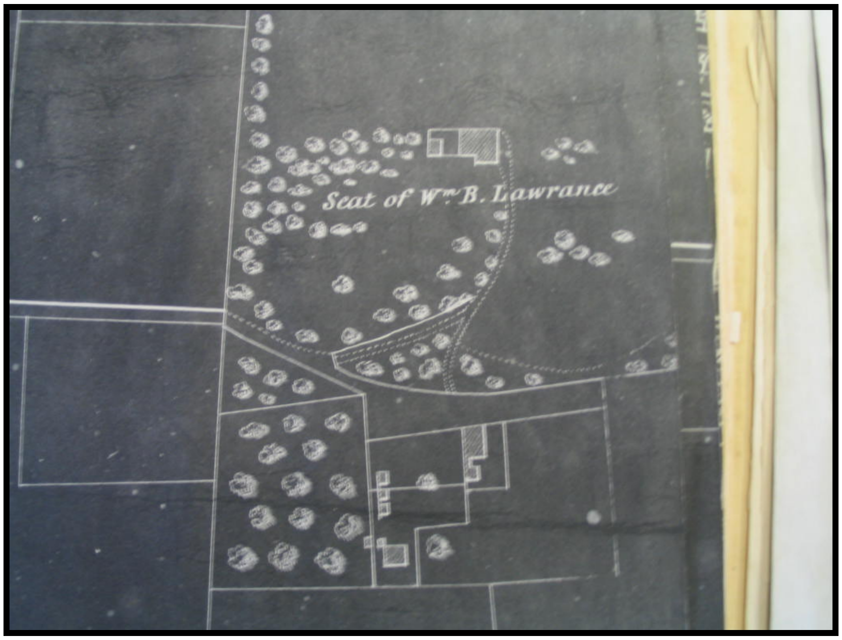

Figure B-3: 1850 Dripps Map
Courtesy of Newport Historical Society

Figure B-4: Hopkins map of 1836
Courtesy of Newport Historical Society

Figure B-5: Dripps Map of 1859 Courtesy of Newport Historical Society
Courtesy of Newport Historical Society

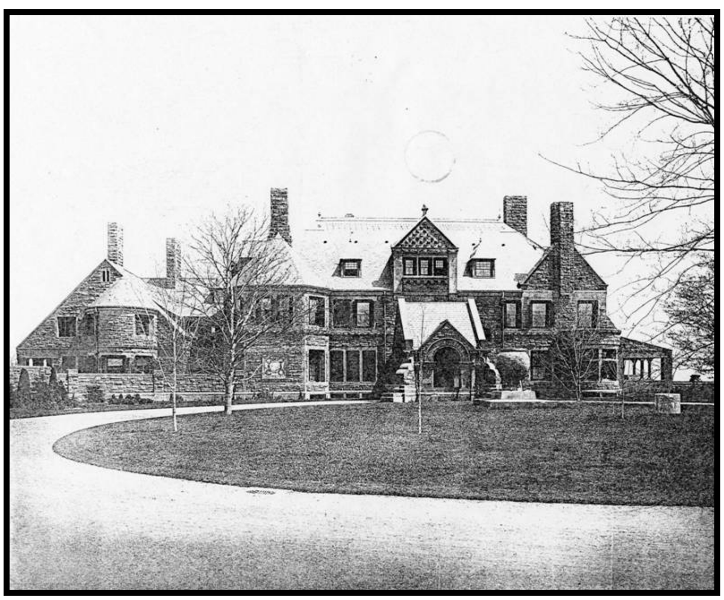

Figure B-6: Vineland circa 1884
Courtesy of Newport Historical Society

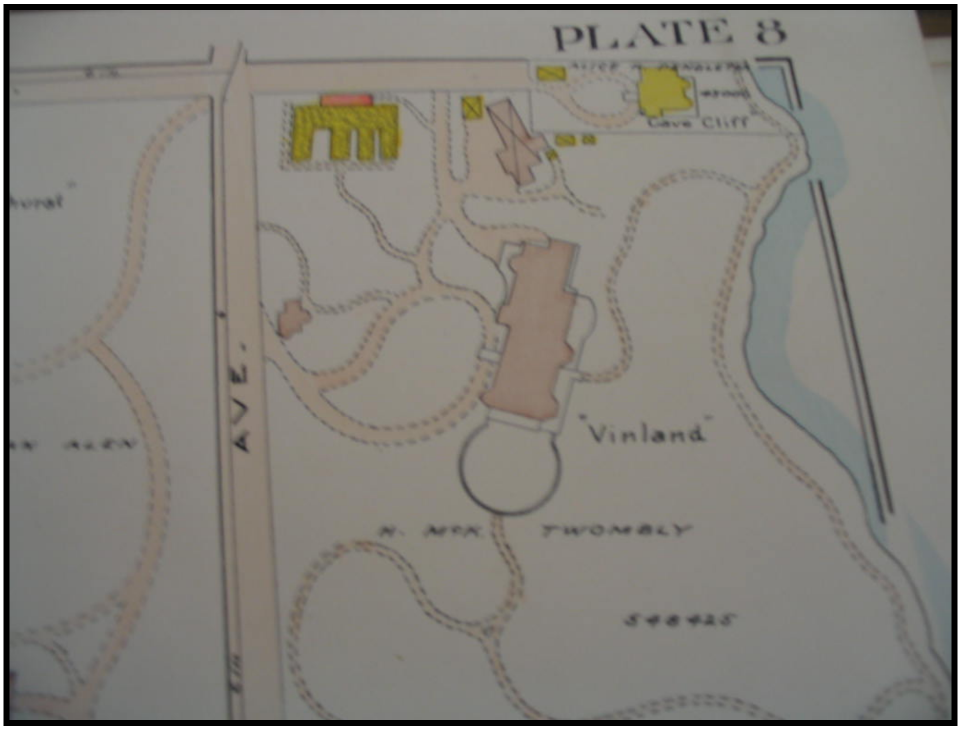

Figure B-7: L.J Richards map of 1907
Courtesy of Newport Historical Society

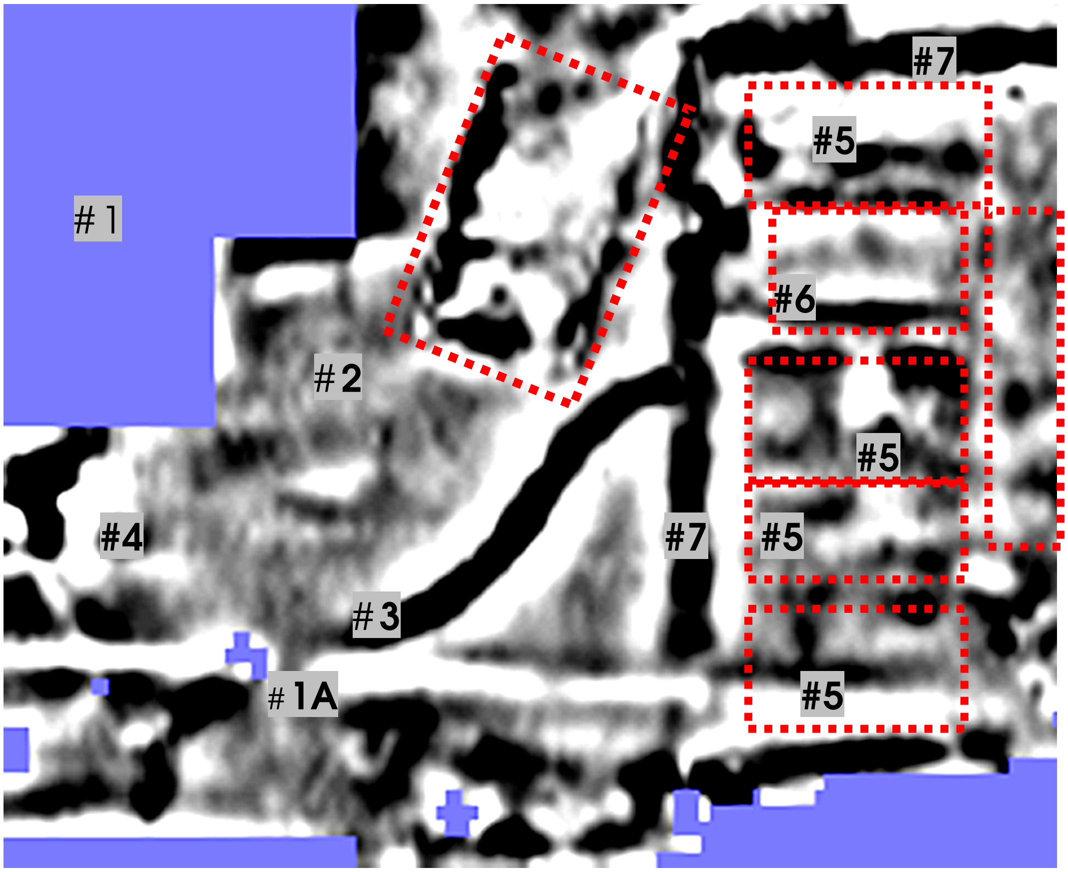

Figure B-8: Final composite of remote sense image of manor house

KEY

#1 = Dummy Readings of Gatehouse parking
#1A = Bush near Angelus Driveway
#1B = Angelus parking lot
#2 = SRU volleyball court
#3 = Catherine Lorillard era (1881-3) driveway (Brick, Gravel, or Stone)
#4 = Large stump complex near McAuley Hall
#5 = Greenhouse complex (Catherine Lorillard)
#6 = Pond
#7 = Wall around greenhouse complex
#8 = Beginnings of Boathouse building that currently stands

Appendix C:

CASE STUDY 2

William Beach Lawrence Dependencies

Remote sensed images

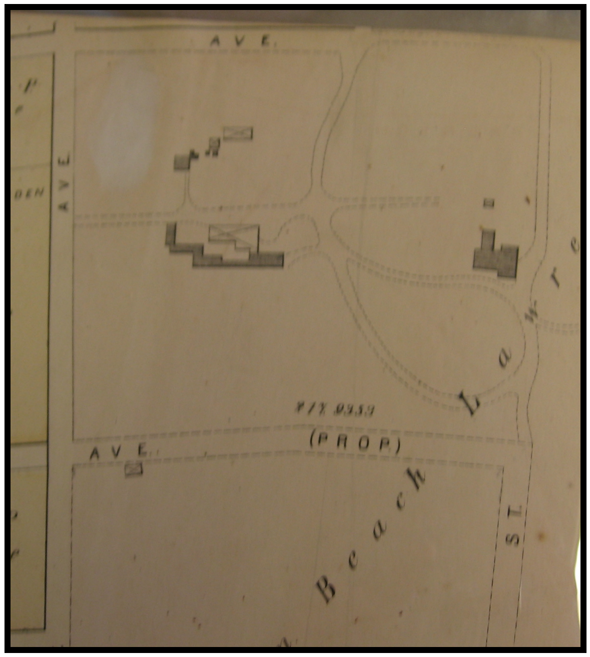

Figure C-1: Hopkins Map of 1876
Courtesy of Newport Historical Society

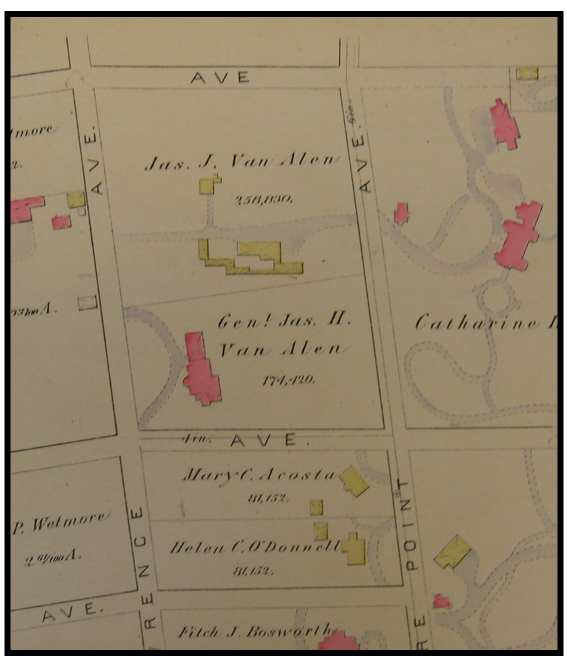

Figure C-2: Hopkins map of 1883
Courtesy of Newport Historical Society

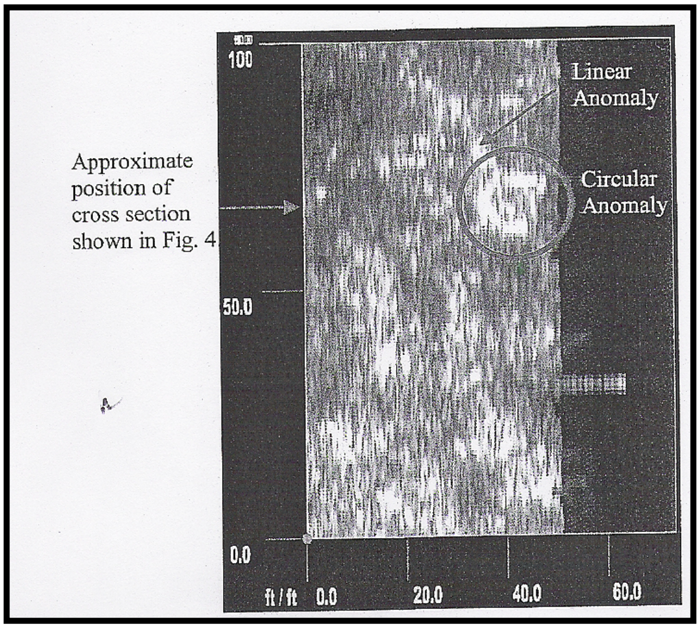

Figure C-3 SPECTRA's GRP image of Wakehurst Lawn

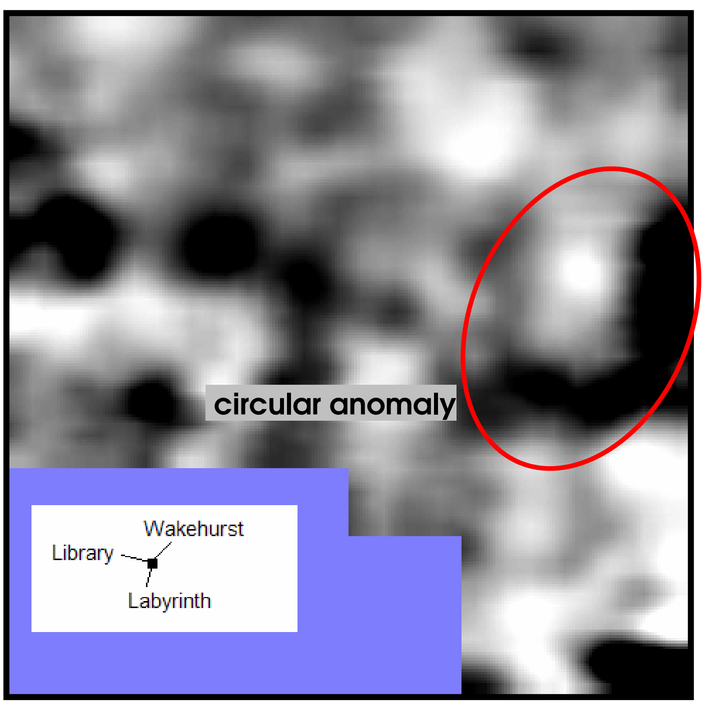

Figure C-4: Remote sensed image for William Beach Lawrence dependencies

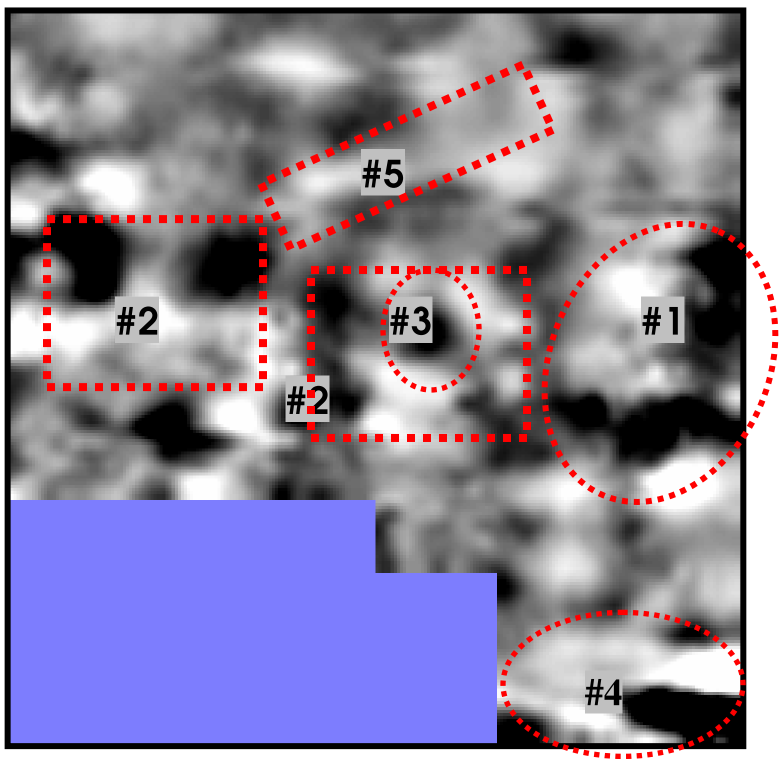

Figure C-5: Remote sensed image for William Beach Lawrence dependencies

Key

#1 = Gardeners Cottage
#2 = Dependencies
#3 = Ice-house
#4 = Unknown area
#5 = path

Appendix D:

CASE STUDY THREE

Edgewater and Ochre Court Estates

Remote sensed images

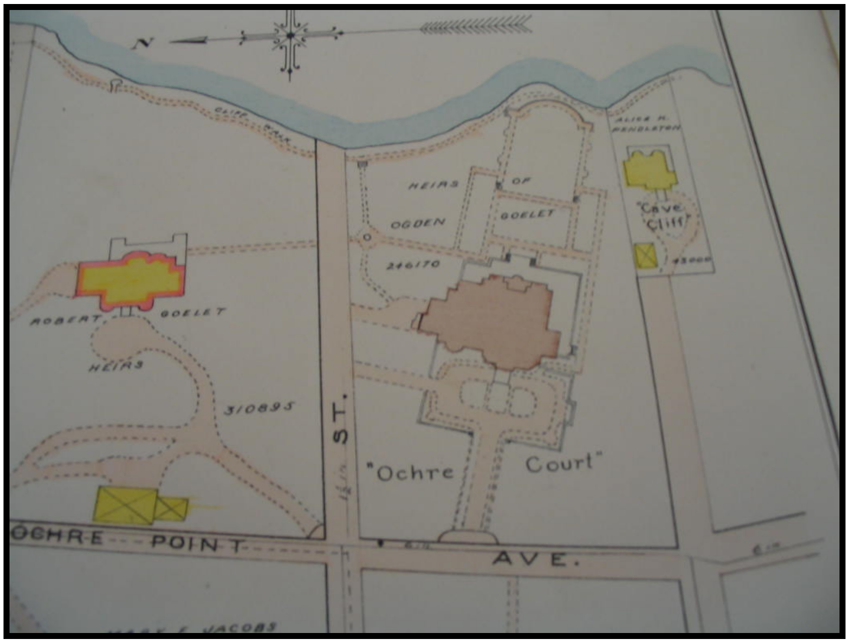

Figure D-1: L.J Richards map of 1893
Courtesy of Newport Historical Society

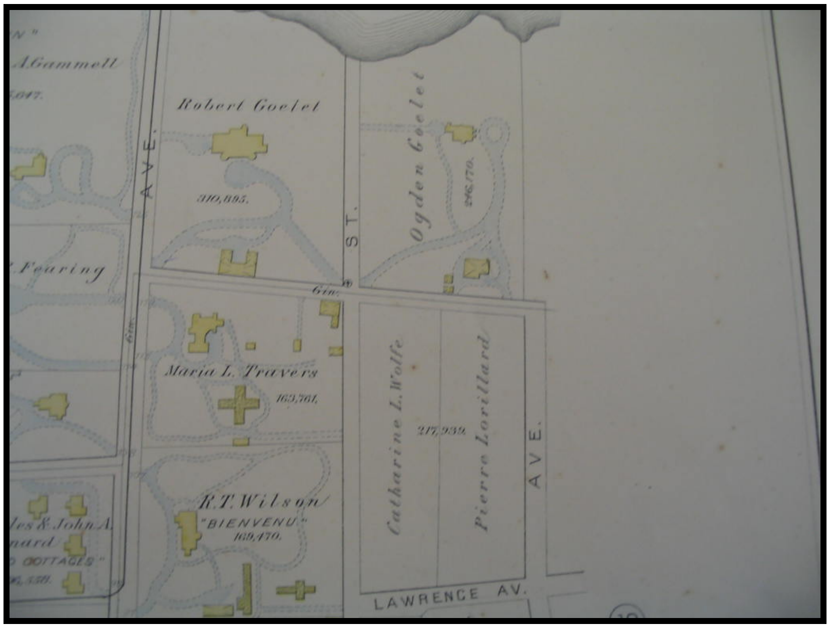

Figure D-2: Hopkins Map of 1883
Courtesy of Newport Historical Society

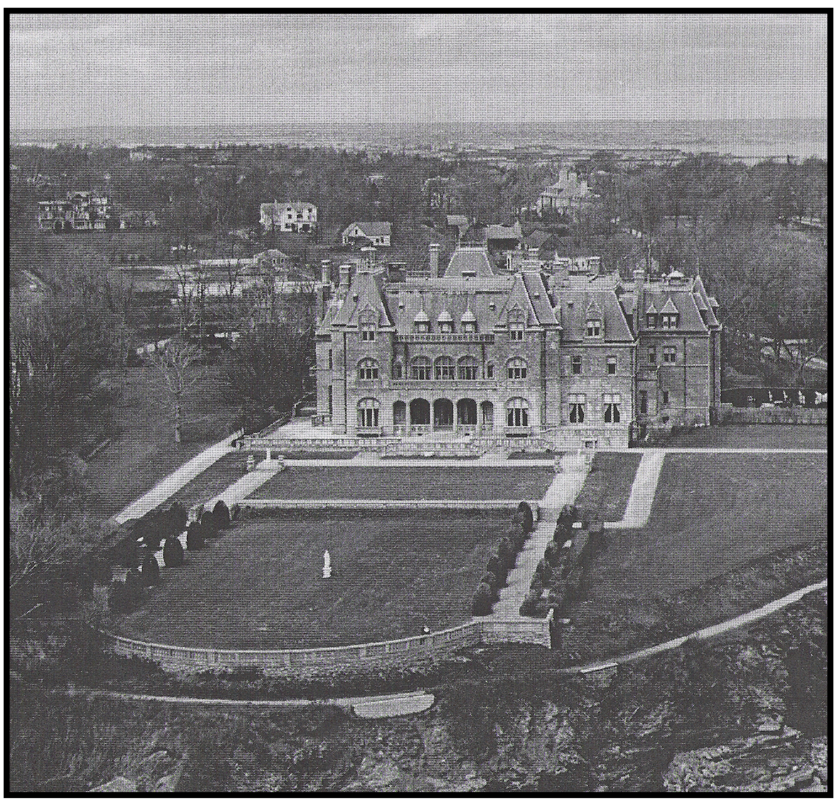

Figure D-3: 1963 Aerial image of Ochre Court and lawn

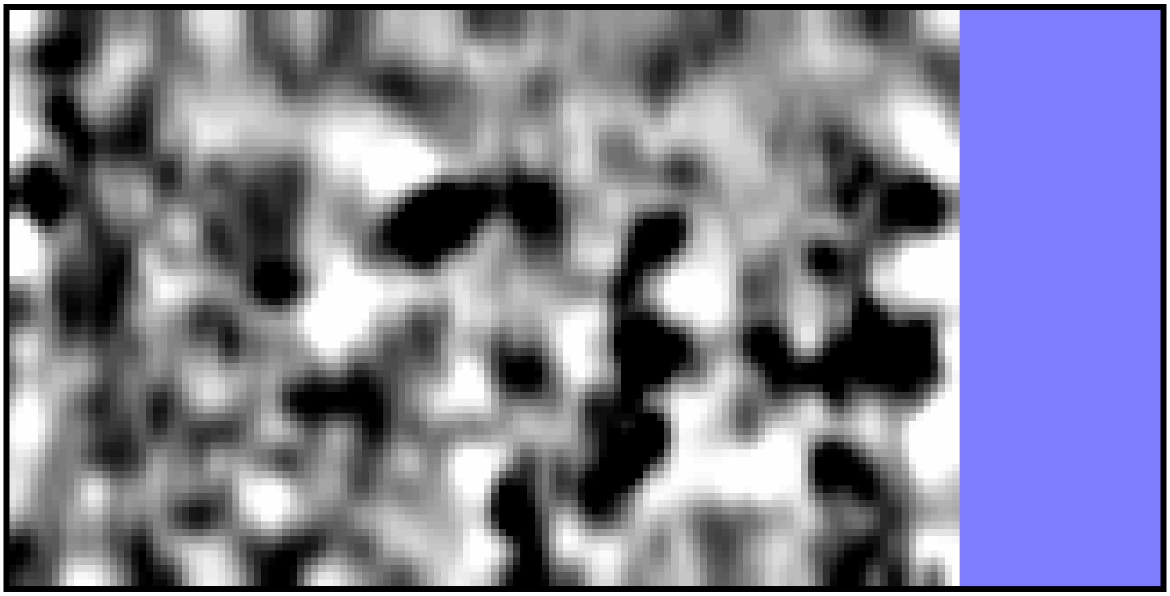

Figure D-4: Remote Sense image of Edgewater
1st (upper) grid

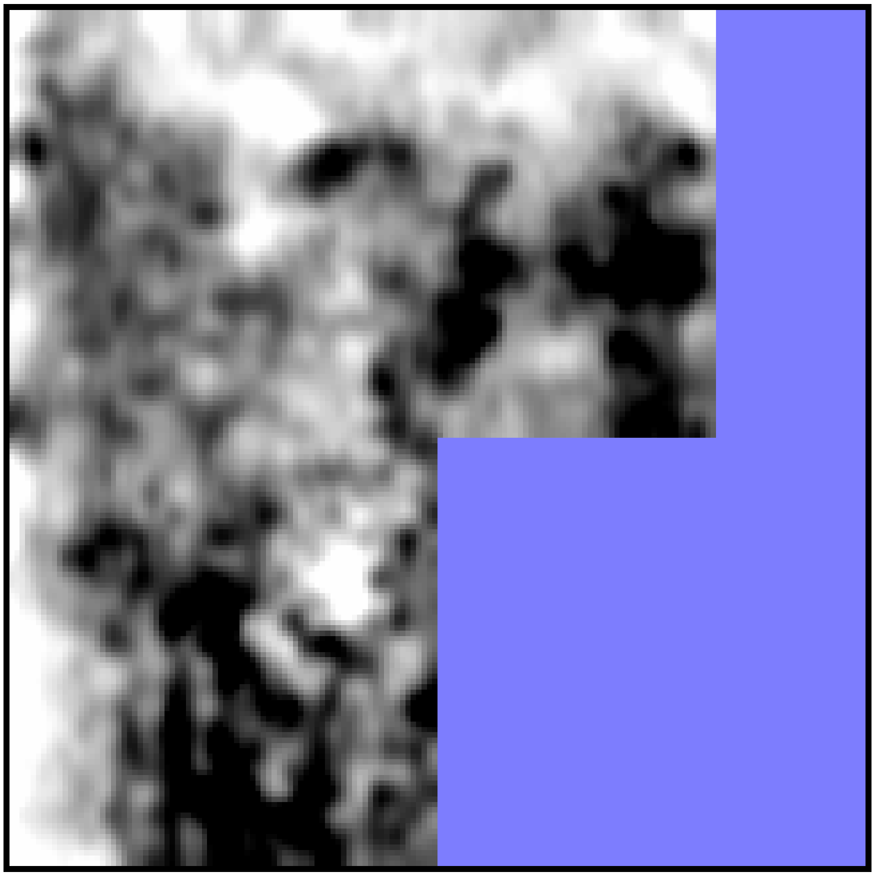

Figure D-5: Remote Sensed image of Edgewater
2nd (lower) grid