

**ANALYSIS OF
CONCEPTUAL HABITAT EVALUATION METHOD
FOR NORTHERN PINE SNAKES
APPLIED TO
BLOCK 505, LOTS 14 AND 15
TOWNSHIP OF TOMS RIVER
AND
BLOCK 44, LOTS 2, 3, 4 (PART), AND 5
TOWNSHIP OF MANCHESTER
AND
ASSOCIATED PROPOSED MITIGATION PARCELS**

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November 29, 2010

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Attachment A – Qualifications of Preparers

I. SUMMARY

EcolSciences (David Moskowitz and Daniel Brill) met with Dave Golden of the DEP Endangered and Nongame Species Program (ENSP) Friday, September 3 to review and compare our results of ENSP's draft Conceptual Habitat Evaluation Method (HEM) for Northern Pine Snakes applied to the proposed project site and mitigation parcels. This was followed by a discussion on how to offset the loss of pine snake habitat on the project site. Patrick Woerner, a GIS specialist with ENSP, also attended the meeting.

In brief, the total habitat values that EcolSciences and Dave Golden independently arrived at using the HEM combination of desktop analysis and field evaluation were remarkably similar for the project site and mitigation parcels, indicating in this early test that the draft HEM may be a reliable means to assess pine snake habitat. Our ensuing dialogue and recalculations concluded that with adequate enhancements, the habitat values of the mitigation parcels could be sufficiently raised to compensate for the lost value on the project site. However, it would require most of the recently proposed mitigation parcels noted below (Table 1) with enhancements to achieve no net loss. This assumes that a portion of the project site will retain some habitat value following construction and can also be enhanced.

Table 1: Summary of Habitat Value Lost/Gained

Project Site (Block 505, Lots 14 &15, Toms River Twp, Block 44, Lots 2, 3, part of 4 & 5, Manchester Twp)	Habitat value lost = -51.8
Proposed mitigation (all Manchester Twp)	Enhancement habitat value
Project Site	+4.3
Block 75.01, Lot 3	+12.5
Block 73, Lots 31 & 32	+2.0
Block 73, Lot 21	+6.0
Block 77, Lot 27	+5.6
Block 77, Lots 2, 4, 5 & 6	+24.2
	Habitat value gained = +54.6

A description of the HEM, our results together with a listing of discussed mitigation possibilities, and accompanying tables and figures follows.

II. HABITAT EVALUATION METHOD - DESCRIBED

The HEM is a guided qualitative assessment of pine snake habitat suitability that is divided into three sections: remote sensing interpretation, field-based habitat assessment, and threat assessment. Randomly generated sample points are used to evaluate a site. All sample points are located within 3-hectare (7.4-acre) grid cells that have 50% or greater pine snake habitat as determined through Division of Fish and Wildlife's Species-Based Patch (SBP) Pine Snake Habitat Model (NJDFW, 2009). This model values specific land covers that pine snakes are known to inhabit. EcoSciences re-created and evaluated the SBP model using NJDEP 2007 land use/land cover (LU/LC) mapping. We applied the SBP model to several sites where we have tracked pine snake in the past, including the project site. A majority of our radio tracking data coincides with the SBP pine snake habitat.

Remote sensing interpretation is a desktop exercise that evaluates sampling points in terms of habitat connectivity, distribution of suitable habitat and soils (Lakehurst, Woodmansie, and Lakewood sands), and proximity to documented pine snake records, preserved lands, and roads. The field-based habitat assessment relies on expert opinion of the area within 100 meters of these sample points, evaluating several characteristics with regards to pine snake habitat including soils, canopy closure, community type, and stand and understory density. The remote sensing interpretation and field-based assessment are each scored on a 0 (not habitat) to 10 (excellent habitat) scale. Threat assessment (scaled from no current threat to high threat) is both a desktop and field-based exercise that evaluates the sample points for various hazards including proposed development, off-road vehicle use, and predators. A collective point score (CPS) from 0 to 10 is determined for each sample point, but it is not intended to be an average of the remote sensing interpretation, field-based habitat assessment, and threat assessment scores. The total habitat value of a site is the mean collective point score of the sample points multiplied by the area (in hectares) of the on-site SBP habitat.

DEP selected a total of 21 sample points for the project site and five mitigation parcels. In addition, DEP provided a table indicating whether a sample point occurred within one mile of a documented pine snake record or 500-meter species occurrence area (SOA) as well as the area and percent cover of SBP habitat and Lakewood-Woodmansie-Lakehurst soils within 1,000 feet of the sample point. Dave Golden and EcoSciences personnel visited all 21 sample points on August 26 and 27.

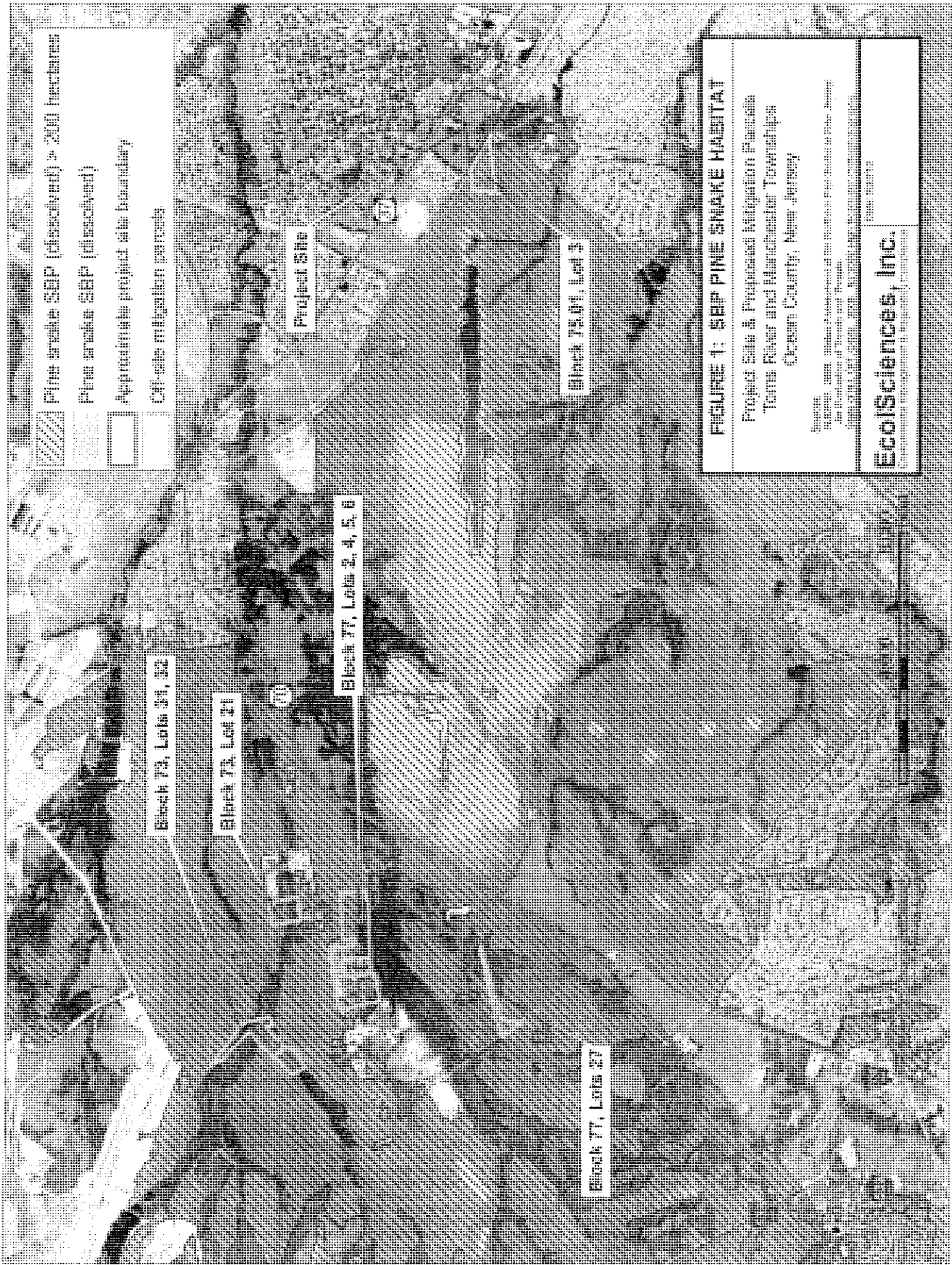
III. HABITAT EVALUATION METHOD - RESULTS

Figures 1 and 2 illustrate the SBP pine snake habitat and Lakehurst-Woodmansie-Lakewood soils, respectively, in relation to the project site and mitigation parcels and their associated sample points. A preponderance of the land area of all the parcels consists of pine snake habitat (Figure 1). It should be noted that one prerequisite of the HEM is that a site be part of a contiguous SBP patch 200 hectares or greater in order for it to be further evaluated. The habitat patch intersecting the project site is less than 200 hectares and is separated from the vast area of mapped habitat to the southwest by the adjacent railroad track. This is a limitation of LU/LC mapping, as it does not distinguish one rail line from multiple parallel rail lines or active rail lines from those that are abandoned or rarely used. In reality, the nearby rail line is not a significant barrier to pine snake movement. The proposed mitigation parcels all intersect habitat patches greater than 200 hectares in extent. Almost all of Block 75.01, Lot 3, located immediately southwest of the project site, is part of a contiguous 4,427-hectare (17.1-square mile) SBP patch bound by a Conrail ROW to the north, State Highway 70 to the west, County Route 530 to the south, and the Garden State Parkway to the east. Portions of the remaining mitigation parcels are all part of a 1,792-hectare (15.6-square mile) SBP patch bound by County Route 571 to the northeast, County Route 547 to the east, State Highway 70 to the south, and County Route 539 to the west. Much of the uplands on the project site and mitigation parcels have Lakehurst-Woodmansie-Lakewood soils (Figure 2).

Table 2: HEM Site Summary

Site	Site Area (ha)	Pine Snake Habitat Area (ha)	Mean Collective Point Score	Total Habitat Value of Site
Project Site	17.0	12.7	5.2	66.04
Block 75.01, Lot 3	8.6	8.3	8.1	67.23
Block 73, Lots 31 & 32	14.7	11.0	3.8	42.17
Block 73, Lot 21	6.3	4.9	3	14.70
Block 77, Lot 27	4.5	3.7	7.5	27.75
Block 77, Lots 2, 4, 5 & 6	35.7	19.6	4.75	93.10

Table 2 summarizes the HEM's mean CPS and total habitat value for the project site and mitigation parcels according to EcoSciences' calculations. Dave Golden's total habitat values were comparable for all sites. Block 75.01, Lot 3 has a high mean CPS and has nearly equal total habitat value with the project site, although the former is almost half the area of the latter. Block 77, Lot 27 also has a high mean CPS, while the project site and remaining mitigation parcels have a low to moderate mean CPS.







-  Pine snake SSP (dissolved) > 200 hectares
-  Pine snake SSP (proposed)
-  Approximate project site boundary
-  Off-site mitigation parcels

FIGURE 1: SSP PINE SNAKE HABITAT

Project Site & Proposed Mitigation Parcels
 Toms River and Manchester Townships
 Ocean County, New Jersey

Source: 2008 Wetland Assessment of the Toms River Project in Pine Snake
 and Block 77, Lots 27 and 28
 and Block 73, Lots 31 and 32
 by EcoSciences, Inc.

EcoSciences, Inc.
 1000 ...

Block 73, Lots 31, 32

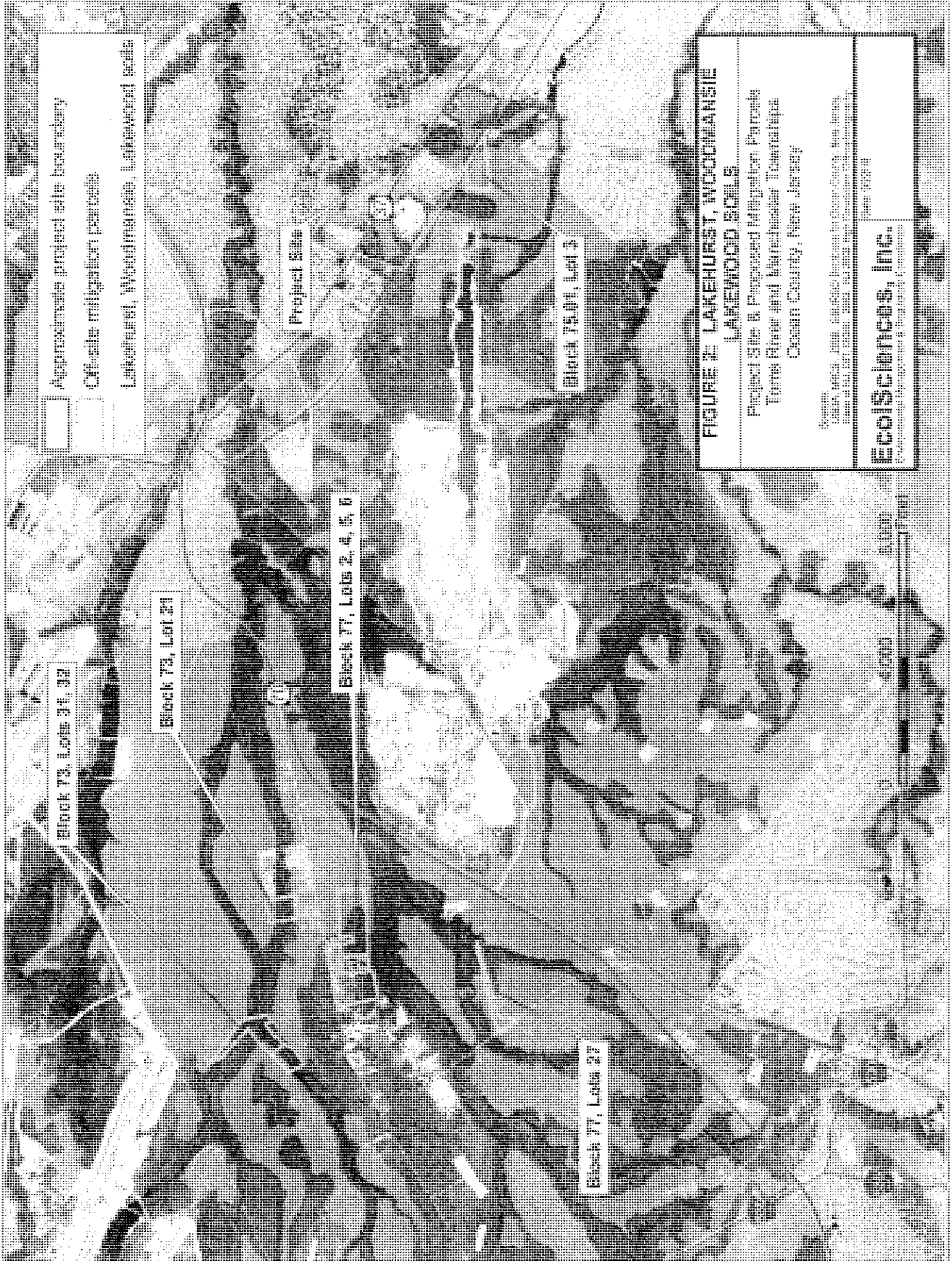
Block 73, Lot 31

Block 77, Lots 2, 4, 5, 6

Block 77, Lots 27

Project Site

Block 75.01, Lot 5



Approximate project site boundary
 Off-site mitigation parcels
 Lakewood, Woodmansie, Lakewood Soils

Block 73, Lots 31, 32

Block 73, Lot 21

Project Site

Block 77, Lots 2, 4, 5, 6

Block 7501, Lot 3

Block 77, Lot 27

**FIGURE 2: LAKEHURST, WOODMANISIE
 LAKEWOOD SOILS**

Project Site & Proposed Mitigation Parcels
 Toms River and Manchester Townships
 Ocean County, New Jersey

Scale: 1 inch = 100 feet
 Date: 10/10/01

EcoScience, Inc.
 Environmental Management & Remediation Professionals



The following pages provide EcolSciences' detailed HEM scoring of the project site and mitigation parcels. Proposed mitigative measures are listed and their potential locations are mapped.

A. Project Site HEM Results

Table 3 represents the habitat value of the project site in its present state. The bulk of the site is mapped with SBP pine snake habitat and suitable soils. Sample Point 14 is close to the pine snake winter den used in 2005 but was given a marginal CPS due to its proximity to roads and other impermeable surfaces. Potential threats were deemed moderate to high as the sample points either approach or are located on trails or roads.

Table 3: Project Site HEM Results

Sample Point	Remote Sensing Interpretation	Field-based Assessment	Threat Assessment	Collective Point Score
10	5.7	4	High	4.5
11	5.8	6.4	Moderate	6.0
12	5.7	6	Moderate	5.8
13	5.3	5.3	Moderate	5.3
14	4.2	4.5	Moderate	4.4
Mean Collective Point Score				5.2
Pine Snake Habitat Area (ha)				12.7
Total Habitat Value of Site				66.04

During our meeting with Dave Golden, we determined the amount of habitat value lost with construction on the site (Figure 3). Roughly 7.63 hectares of SBP pine snake habitat would be lost. Suppositions were made that a 2.90-hectare portion of the on-site habitat nearest the construction would have reduced value (60%), while the value of a 2.17-hectare portion of habitat farthest from construction would remain unchanged. The average of DEP's and EcolSciences' mean collective scores is 5.53 and is used here to determine lost pine snake habitat. Thus, as shown below, the total habitat value lost after construction is 51.8.

$$\begin{aligned} \text{Habitat lost: } 7.63 \times 5.53 &= 42.2 \\ \text{Habitat reduced in value: } (2.90 \times 5.53) \times 0.6 &= 9.6 \\ &\mathbf{51.8 \text{ total habitat value lost}} \end{aligned}$$

Blocked trail access and selective tree thinning are proposed in the 2.17-hectare portion of the site farthest from construction. Selective tree thinning would occur in uplands characterized by a dense canopy where pine snakes would benefit from the creation of small forest openings and

reduced canopy closure. These enhancements would result in an increase to the CPS by 2.0 points and offset the total habitat value lost by 4.3 points.

$$2.17 \times 2.0 = 4.3 \text{ total habitat value gained with enhancements}$$

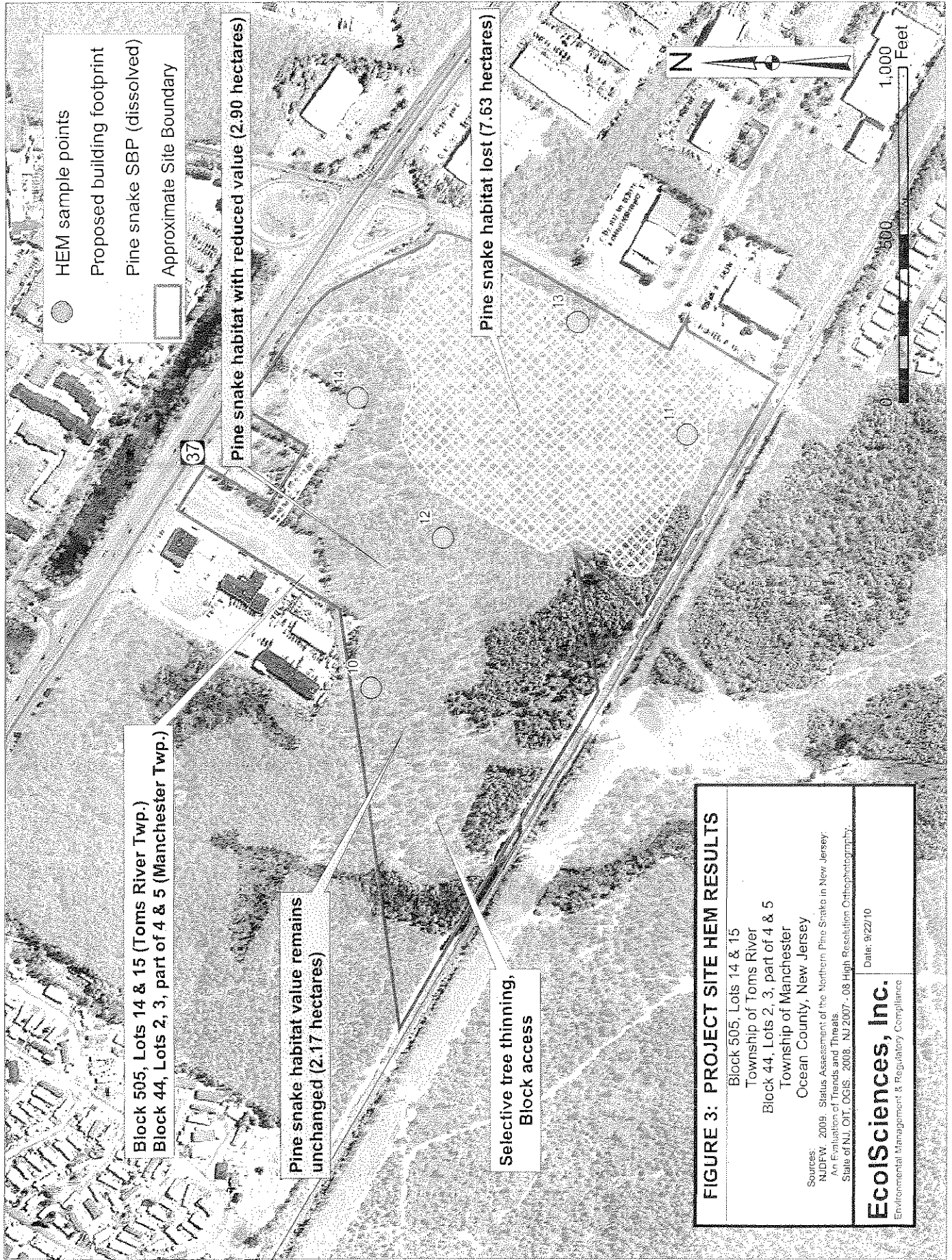


FIGURE 3: PROJECT SITE HEM RESULTS

Block 505, Lots 14 & 15
 Township of Toms River
 Block 44, Lots 2, 3, part of 4 & 5
 Township of Manchester
 Ocean County, New Jersey

Sources:
 NJDFW, 2009. Status Assessment of the Northern Pine Snake in New Jersey: An Evaluation of Trends and Threats.
 State of N.J. O.T., OGIS, 2008. NJ 2007-08 High Resolution Orthophotography.

Date: 9/22/10

EcolSciences, Inc.
 Environmental Management & Regulatory Compliance

B. Block 75.01, Lot 3 HEM Results

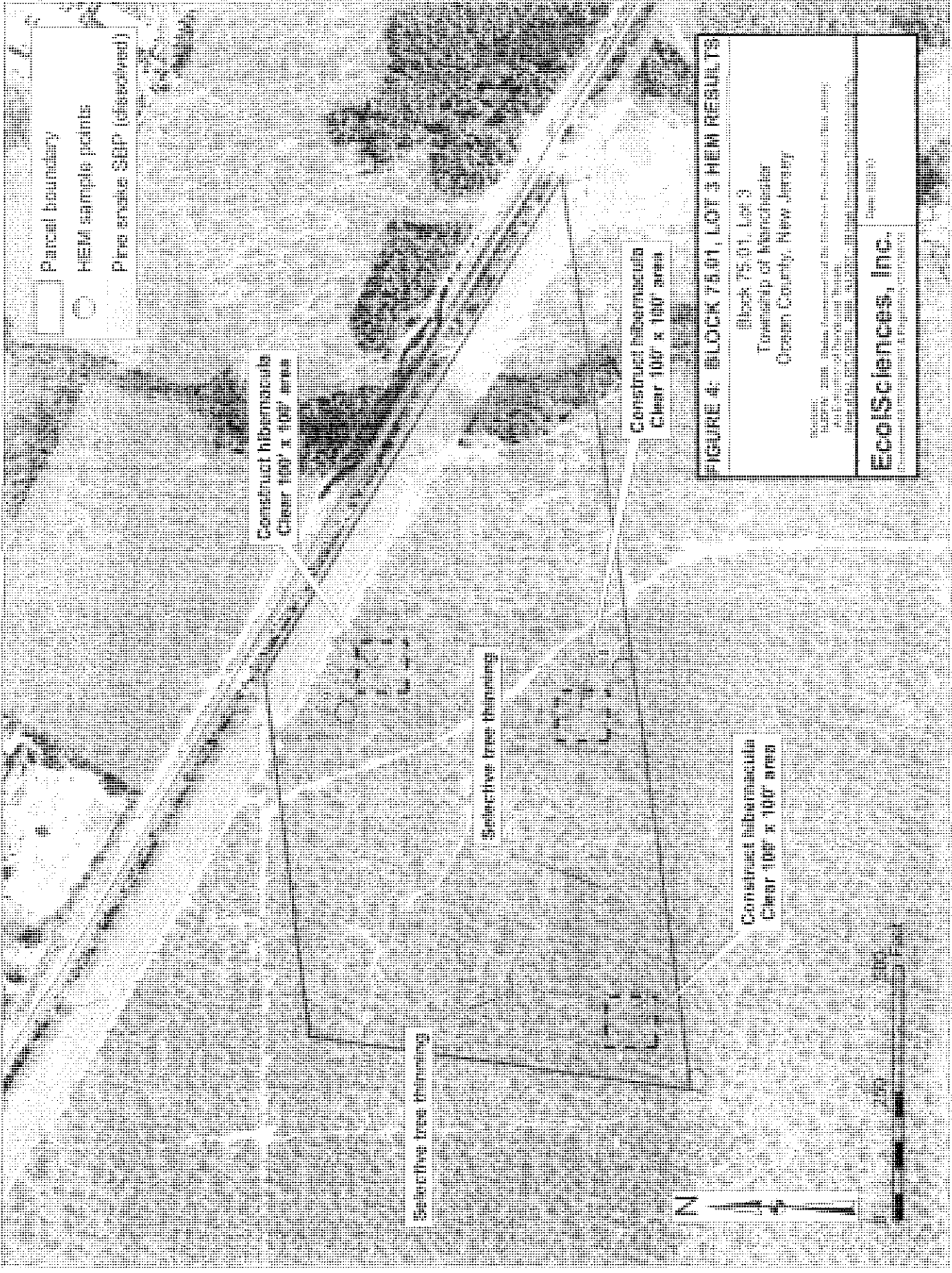
Based on our meeting with DEP, the recently proposed mitigation parcels with appropriate enhancements, in addition to those proposed on the project site, would more than compensate for the 51.8 habitat value lost at the project site. The nearest mitigation parcel, Block 75.01, Lot 3, also has the highest mean CPS (Table 4). All three sample points are characterized by open pitch-pine dominant woodland and sandy soils. Sample Point 9 approaches potential nesting habitat in the nearby overhead wire right-of-way, an area also characterized by high off-road vehicle use. Sample Points 7 and 8 are located near smaller trails. This lot is located adjacent to the preserved portion of the Heritage Minerals tract that in total is approximately 6,140 acres (2,485 hectares) in extent. The portion of the Heritage Minerals tract adjacent to this parcel is also contiguous to other extensive areas of open space including Whiting Wildlife Management Area and the Crossley Preserve.

Table 4: Block 75.01, Lot 3 HEM Results

Sample Point	Remote Sensing Interpretation	Field-based Assessment	Threat Assessment	Collective Point Score
7	8.7	7	Moderate	8.0
8	8.7	8	Moderate	8.2
9	9.4	9	High	8.0
			Mean Collective Point Score	8.1
			Pine Snake Habitat Area (ha)	8.3
			Total Habitat Value of Site	67.23

Selective clearing and construction of hibernacula in the vicinity of all three sample points, and selective tree thinning throughout the site is proposed. Selective tree thinning would occur in uplands characterized by a dense canopy where pine snakes would benefit from the creation of small forest openings and reduced canopy closure. With these enhancements, Dave Golden concluded that the mean CPS could be augmented an additional 1.5 points (Figure 4). Multiplying this value with the area of SBP pine snake habitat (8.3 hectares) on this parcel results in a total habitat value increase of 12.5.

$$8.3 \times 1.5 = 12.5 \text{ total habitat value gained with enhancements}$$



Parcel boundary

HEM sample points

Pine snake SDP (observed)

Construct Hibernaculum
Clear 100' x 100' area

Selective tree thinning

Construct Hibernaculum
Clear 100' x 100' area

Construct Hibernaculum
Clear 100' x 100' area

FIGURE 4: BLOCK 75.01, LOT 3 HEM RESULTS

Block 75.01, Lot 3
Township of Manchester
Ocean County, New Jersey

Project: 2016 - 2018, Habitat Management and Conservation Plan, Projected at 2018, Jersey
At: Environmental Protection, Wildlife
Date: 11/11/2016, 11:11:51 AM, Project Manager: [unreadable]

Date: 11/11/16

EcoSciences, Inc.
Environmental Assessment & Remediation



C. Block 73, Lots 31 & 32 HEM Results

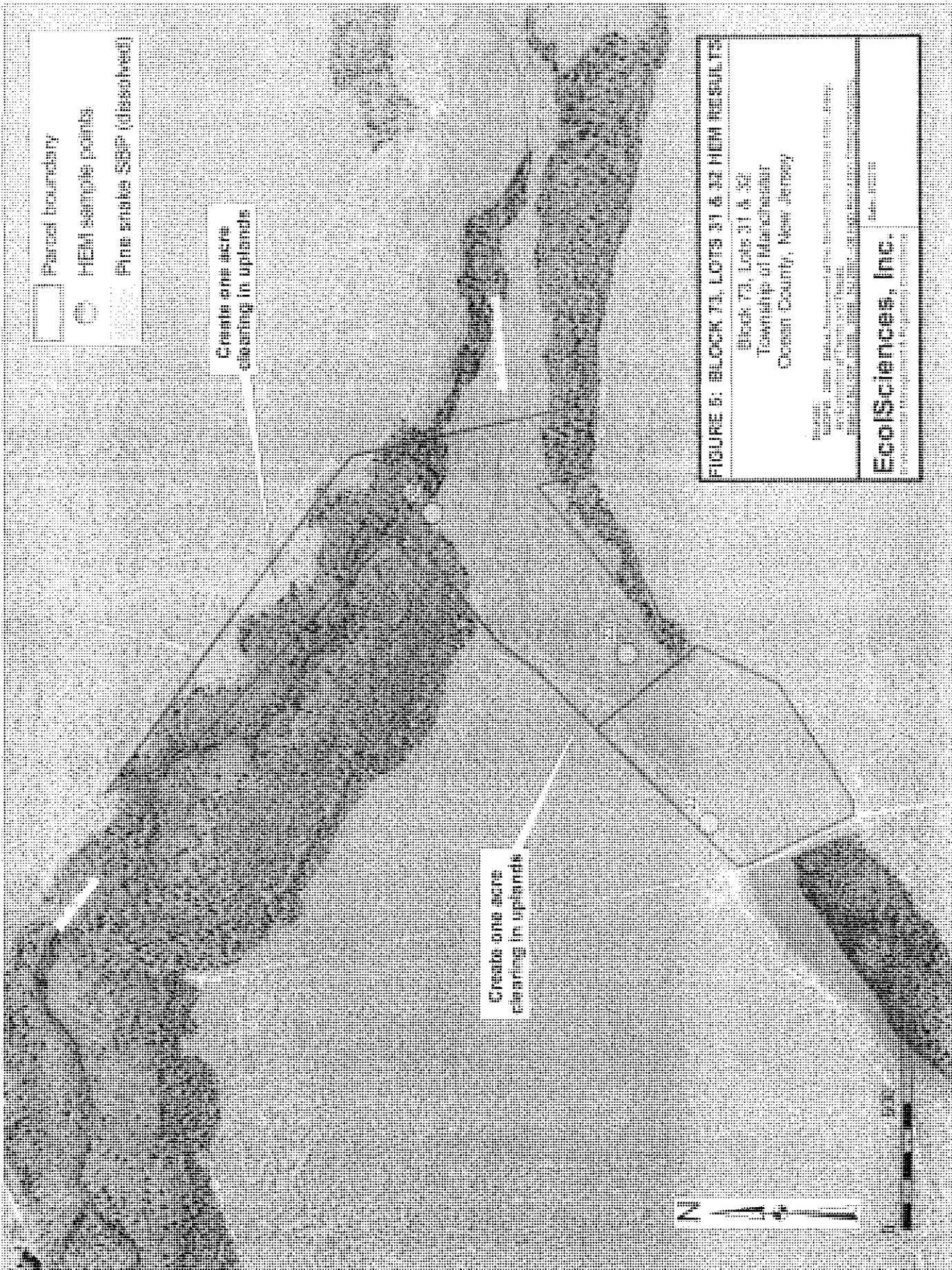
Block 73, Lots 31 and 32 (Table 5) are located between separated portions of the Manchester Wildlife Management Area. A portion of the Heritage Minerals open space is located adjacent to these lots to the north and south. Much of the area is characterized by forested wetlands associated with South Ruckels Branch and Blacks Branch. SBP pine snake habitat values certain wetland covers and, as such, we gave the three sample points moderate to moderately high scores according to remote sensing interpretation. However, all three points scored much lower during the field-based assessment, as two are located deep within forested wetlands, and the other is located at the wetland fringe. The vegetative communities at these points are more representative of transient habitat rather than breeding or foraging habitat. Threats to the habitat here are essentially nonexistent based on the extensive wetlands and the lack of established trails within property boundaries.

Table 5: Block 73, Lots 31 & 32 HEM Results

Sample Point	Remote Sensing Interpretation	Field-based Assessment	Threat Assessment	Collective Point Score
22	7.1	4.5	None	5.5
23	7.1	2	None	3
24	6.2	2	None	3
			Mean Collective Point Score	3.8
			Pine Snake Habitat Area (ha)	11.0
			Total Habitat Value of Site	42.17

There is no realistic means to enhance wetland habitats for pine snakes. Dave Golden pointed out that a lack of forest clearings (for nesting) in otherwise appropriate habitat is a major limiting factor for pine snake. Given the lack of forest openings on or near these parcels, Dave Golden believes that the creation of two one-acre clearings in the adjacent uplands would enhance the total habitat value here an additional two points (Figure 5).

Two 1 acre clearings = 2.0 total habitat value gained with enhancements



Parcel boundary

HEM sample points

Pine snake SOP (misspelled)

Create one acre clearing in uplands

Create one acre clearing in uplands

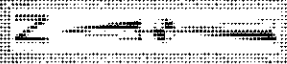
FIGURE 5: BLOCK 73, LOTS 31 & 32 HEM RESULTS

Block 73, Lots 31 & 32
 Township of Mendham
 Ocean County, New Jersey

Prepared by: EcoSciences, Inc.
 1000 Route 100, Suite 100, Mendham, NJ 08854
 Phone: 609.392.1000

Date: 10/20/10

EcoSciences, Inc.
 Environmental Assessment & Remediation Consultants



D. Block 73, Lot 21 HEM Results

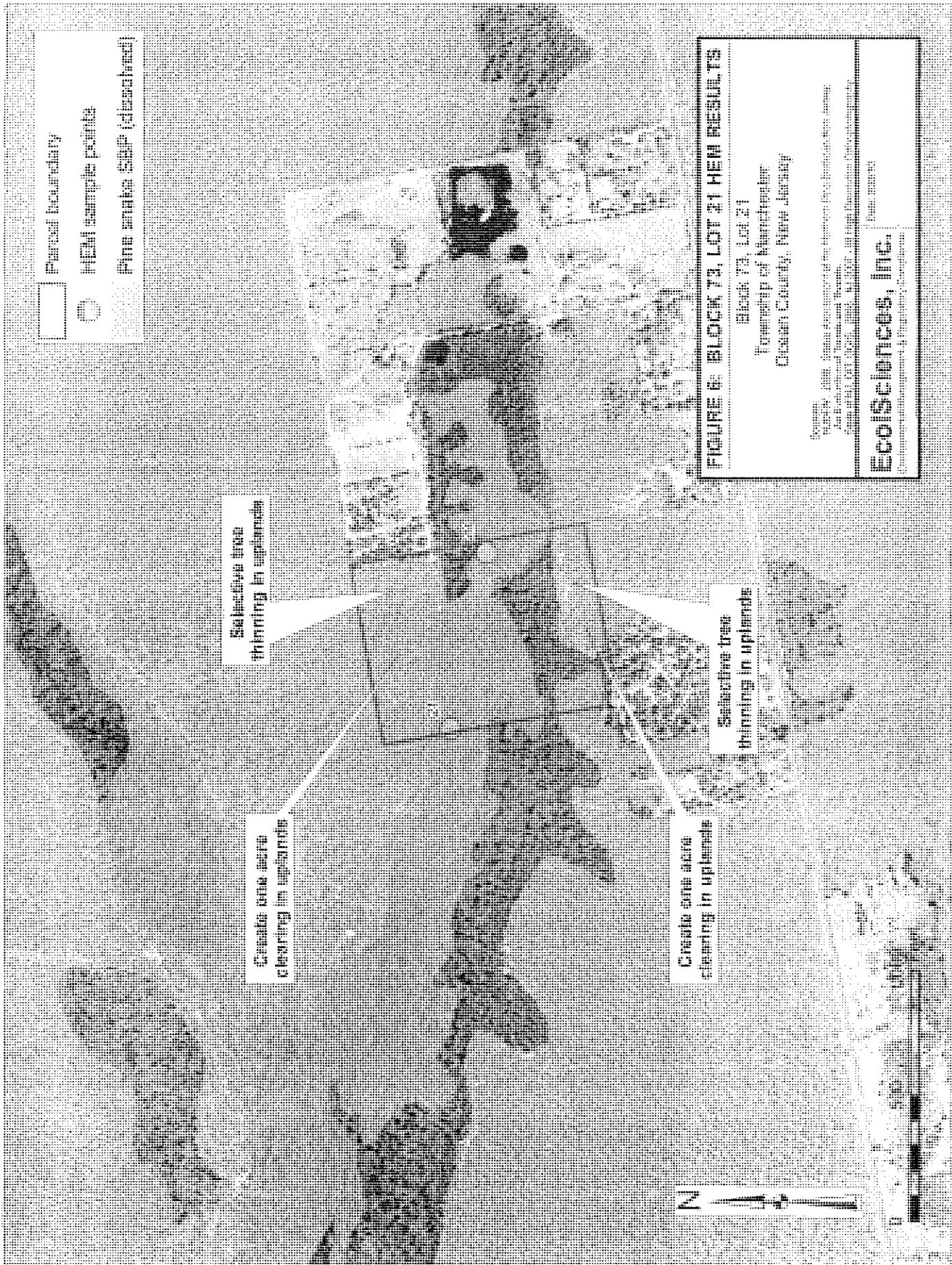
Block 73, Lot 21 (Table 6) has similar limitations as Block 73, Lots 31 ad 33. Much of the site is encumbered by wetlands associated with South Ruckels Branch. The two sample points are located in the wetlands and, in a consistent pattern, scored relatively high according to remote sensing interpretation and threat assessment, but lower during the field-based assessment. Heritage Minerals open space borders this parcel to the north and west.

Table 6: Block 73, Lot 21 HEM Results

Sample Point	Remote Sensing Interpretation	Field-based Assessment	Threat Assessment	Collective Point Score
21	6.2	2	None	3
29	5.8	2	None	3
			Mean Collective Point Score	3.0
			Pine Snake Habitat Area (ha)	4.9
			Total Habitat Value of Site	14.7

There are approximately three hectares of uplands on this parcel bracketing the wetlands, all of which are valued as pine snake habitat. Assuming enhancements in the uplands would increase the mean CPS 2.0 points, this would result in an additional 6.0 points in total habitat value (Figure 6). Such enhancements would include two one-acre clearings in the uplands north and south of South Ruckels Branch and selective tree thinning throughout the 3.0-hectares of uplands. Selective tree thinning would occur in uplands characterized by a dense canopy where pine snakes would benefit from the creation of small forest openings and reduced canopy closure.

$$3.0 \times 2.0 = 6.0 \text{ total habitat value gained with enhancements}$$



Parcel boundary

Hem sample points

Pino arnab SBP (disabvcd)

Selective tree thinning in uplands

Create one acre clearing in uplands

Create one acre clearing in uplands

Selective tree thinning in uplands

FIGURE 6: BLOCK 73, LOT 21 HEM RESULTS

Block 73, Lot 21
Township of Northover
Ocean County, New Jersey

Project: 1000 - Annual Assessment of the Impacts of a Residential Home on the
 2005-2006 Forest Land Inventory
 Date: 10/11/05
 Scale: 1:10000
 Author: [Name]

EcoSciences, Inc.
 Environmental Assessment & Engineering, Inc.



E. Block 77, Lot 27 HEM Results

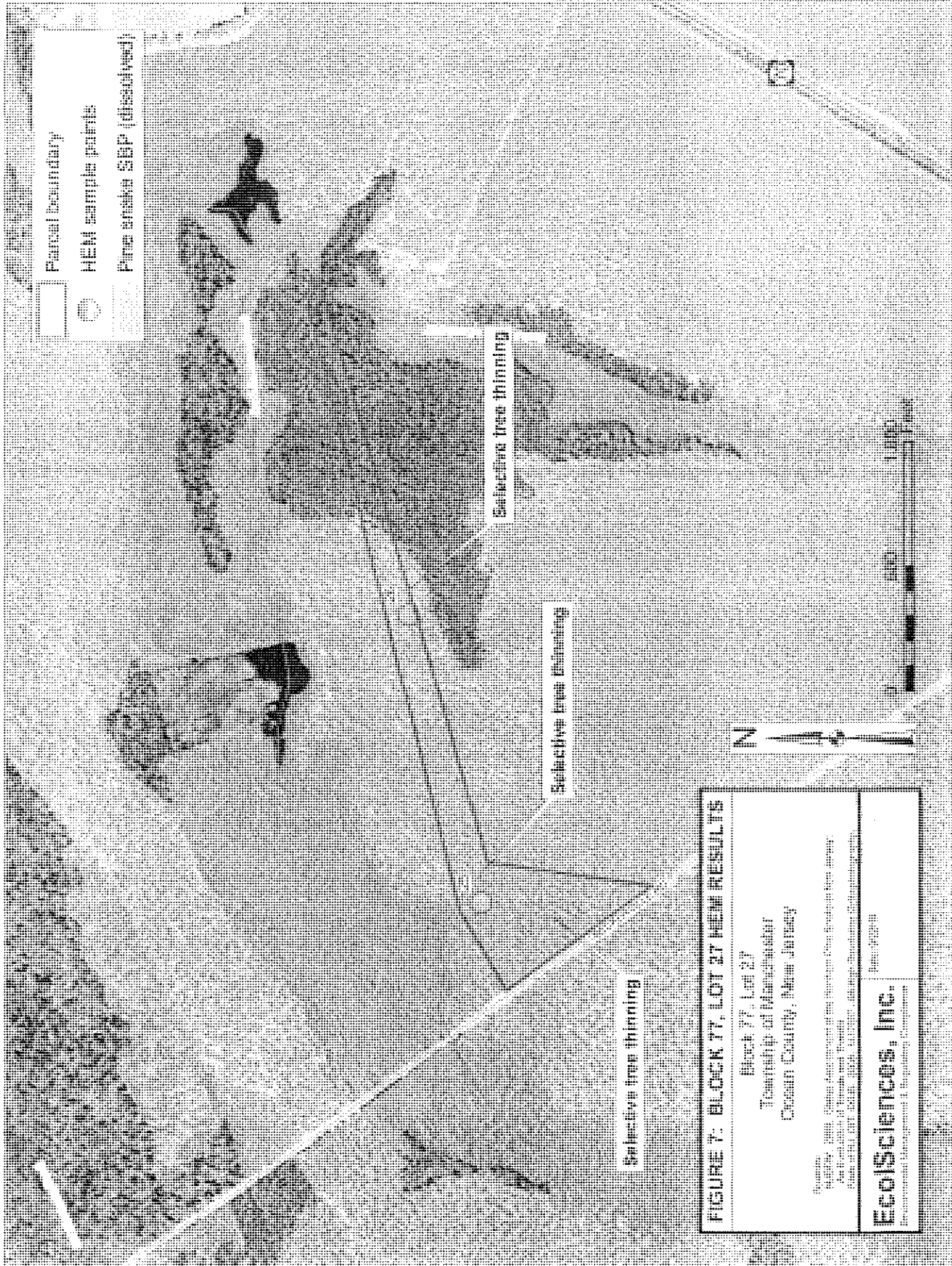
Block 77, Lot 27 (Table 7) had the second highest mean CPS of the proposed mitigation parcels. The two sample points are characterized by pine-dominant forest and sandy soils. Both scored higher in the field than at the desktop. The sample points do not approach trails or roads, and as such threats are absent. Portions of Manchester Wildlife Management Area and Heritage Minerals open space border this parcel to the north and south, respectively.

Table 7: Block 77, Lot 27 HEM Results

Sample Point	Remote Sensing Interpretation	Field-based Assessment	Threat Assessment	Collective Point Score
25	6.8	7	None	7
26	6.4	9	None	8
Mean Collective Point Score				7.5
Pine Snake Habitat Area (ha)				3.7
Total Habitat Value of Site				27.75

Selective tree thinning throughout the 3.7-hectares of mapped pine snake habitat would increase the potential of this parcel as a nest site. Selective tree thinning would occur in uplands characterized by a dense canopy where pine snakes would benefit from the creation of small forest openings and reduced canopy closure. An increase of the mean CPS by 1.5 would result in a gain of 5.6 in total habitat value.

$$3.7 \times 1.5 = 5.6 \text{ total habitat value gained with enhancements}$$



Parcel boundary
 HEM sample points
 Pineshake SBP (dissolved)

Selective tree thinning

Selective tree thinning

Selective tree thinning

FIGURE 7: BLOCK 77, LOT 27 HEM RESULTS

Block 77, Lot 27
 Township of Manasquan
 Ocean County, New Jersey

Prepared by:
 Ecology, Inc. - a subsidiary of the Heritage Group, Inc. in New Jersey
 For the benefit of the Township of Manasquan
 Date of Report: 04/26/2010

ECO/SCIENCES, Inc.
 Environmental Management & Regulatory Compliance
 P.O. Box 1000

F. Block 77, Lots 2, 4, 5 & 6 HEM Results

This largest of the proposed mitigation parcels also has the greatest total habitat value, though it has a relatively marginal mean CPS. The highest scored habitat is located in the easternmost portion of this parcel where pine-dominated forest coincides with sandy soils (Sample Point 6). Sample Points 3, 4, and 5 are all located in wetlands and scored lower in the field than at the desktop. Sample Points 1 and 2 scored higher in the field than at the desktop. Sample Point 1 consists of pine-dominant forest, while Sample Point 2 consists of mixed upland forest adjacent to successional field with several low, overgrown piles (potential hibernacula). Potential threats were characterized as low to none as off-road vehicle use and dumping appear to be infrequent. Heritage Minerals open space lies adjacent to this parcel to the south and east.

Table 8: Block 77, Lots 2, 4, 5 & 6 HEM Results

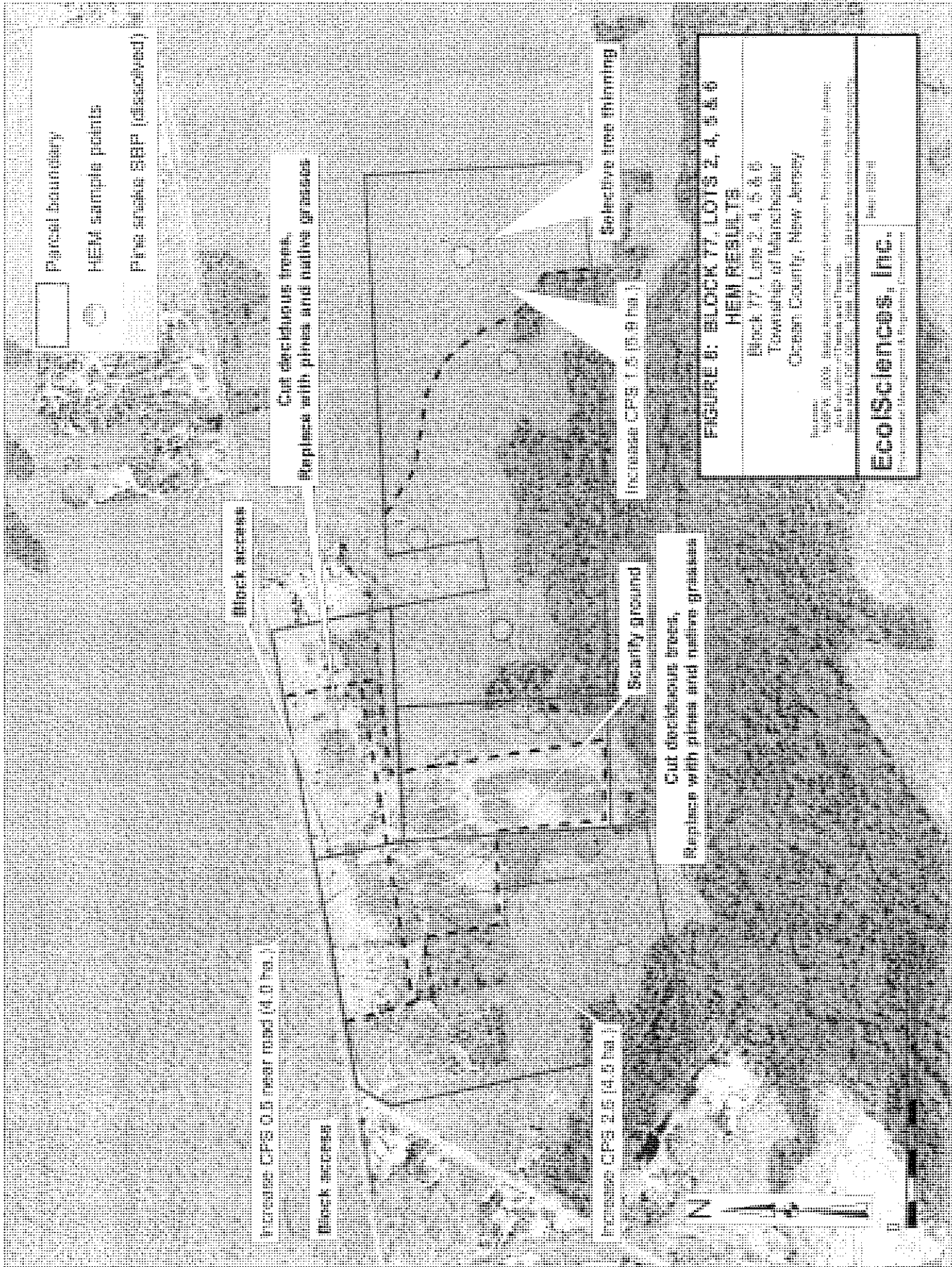
Sample Point	Remote Sensing Interpretation	Field-based Assessment	Threat Assessment	Collective Point Score
1	3.7	6	Low	5
2	4.3	6	Low	5
3	4.5	3	None	3.5
4	6.0	2.5	None	4
5	5.8	3	None	4
6	6.3	7.5	None	7
Mean Collective Point Score				4.75
Pine Snake Habitat Area (ha)				19.6
Total Habitat Value of Site				93.10

The fields and former orchards on this parcel present various mitigation opportunities. This area in its present state is not valued as SBP pine snake habitat. Proposed improvements include blocking access to keep out off-road vehicles, removing glass piles, cutting down deciduous trees and replacing with pines and native grasses, scarifying the ground, and introducing 100 cubic yards of sand. The fields and orchards are approximately 8.5 hectares in extent with about 4.0 hectares within 100 meters of Beckerville Road. Assuming the improved area approaching the road augments the CPS by 1.0 while the remaining area enhances the CPS by 2.5, this results in an increase of total habitat value by 13.3 points.

A 5.9-hectare portion of the highest rated habitat can add a 1.5 boost to the CPS with selective tree thinning. The 5.9 hectares represents the eastern portion of the site where SBP pine snake habitat intersects Lakehurst sand. Selective tree thinning would occur here in uplands characterized by a dense canopy where pine snakes would benefit from the creation of small forest openings and reduced canopy closure. A hypothetical 1.5 increase to the CPS would result in an

additional gain of 8.9 points towards the total habitat value of this parcel. All proposed improvements combined increase the total habitat value 24.2 points as shown below and illustrated in Figure 8.

- 4.0 x 1.0 = 4.0 **habitat value gained with enhancements nearest road (field/orchard)**
- 4.5 x 2.5 = 11.3 **habitat value gained with enhancements away from road (field /orchard)**
- 5.9 x 1.5 = 8.9 **habitat value gained with enhancements in SBP habitat over Lakehurst sand**
- 24.2 total habitat value gained with enhancements**



Parcel boundary

HEM sample points

Pine stands SFP (deciduous)

Block access

Increase CFS 0.8 near road (4.0 ha.)

Block access

Cut deciduous trees,
Replace with pines and native grasses

Increase CFS 2.6 (4.5 ha.)

Cut deciduous trees,
Replace with pines and native grasses

Scanty ground

Increase CFS 1.5 (0.8 ha.)

Selective tree thinning



FIGURE 6: BLOCK 77, LOTS 2, 4, 5 & 6

HEM RESULTS

Block 77, Lots 2, 4, 5 & 6
Township of Manchester
Ocean County, New Jersey

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EcoSciences, Inc.
Professional Management & Engineering Consultants

IV. CONCLUSION

Both NJDEP and EcolSciences applied the Endangered and Nongame Species Program's draft Conceptual Habitat Evaluation Method (HEM) for Northern Pine Snake to the project site and proposed mitigation parcels. The habitat values NJDEP and EcolSciences arrived at were notably close, indicating the HEM can accurately appraise a site's potential usage by pine snakes as well as quantify the amount of habitat lost through construction or gained through enhancements, such as the addition of artificial hibernacula. Each of the mitigation parcels is part of a vast area of pine snake habitat according to the Species-Based Patch Pine Snake Habitat Model, and all are located adjacent to extensive areas of open space. The habitat value gained via the proposed enhancements to the mitigation parcels and the preserved portion of the project site will exceed the value lost on the project site post-construction.

V. REFERENCES

New Jersey Division of Fish and Wildlife. 2009. Status Assessment of the Northern Pine Snake (*Pituophis m. melanoleucus*) in New Jersey: An Evaluation of Trends and Threats. New Jersey Department of Environmental Protection, Trenton, NJ. 53 pp.

New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered & Nongame Species Program. 2010. Conceptual Habitat Evaluation Method for Northern Pine Snakes (Draft). Dated August 25, 2010.