Project Summary

This project will evaluate the land cover change between undeveloped land and urban development in rural Sacramento County in California. For the specified area, a supervised classification will be used for two different years to compare and quantify the different land cover types. After the classification is complete, the statistics for the area will be determined to quantify the change over the two years.

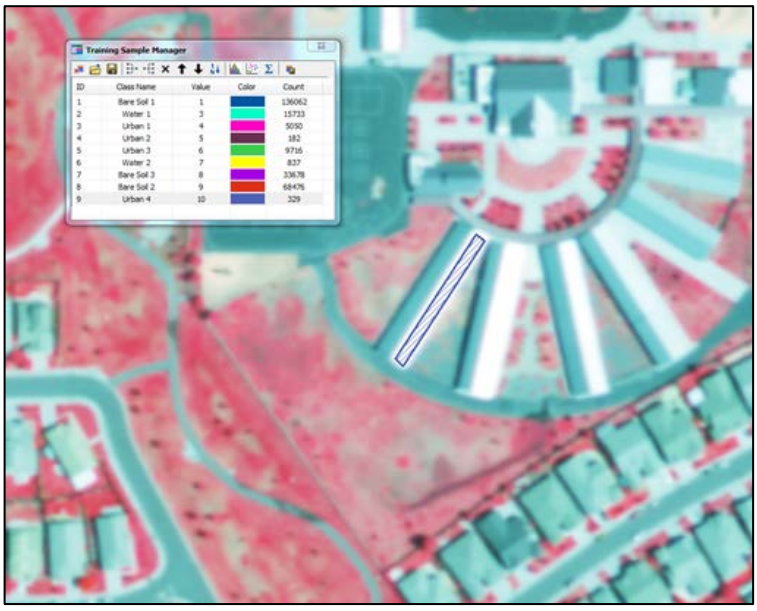
Parameters

The purpose of this project is to compare the land cover area in Natomas, California and determine the change between 2009 and 2014. To perform this analysis, National Agriculture Imagery Program (NAIP) imagery will be classified for each year and then compared to determine the land cover for each category. Once the land cover is calculated, it will be compared to determine the land cover change between 2009 and 2014.

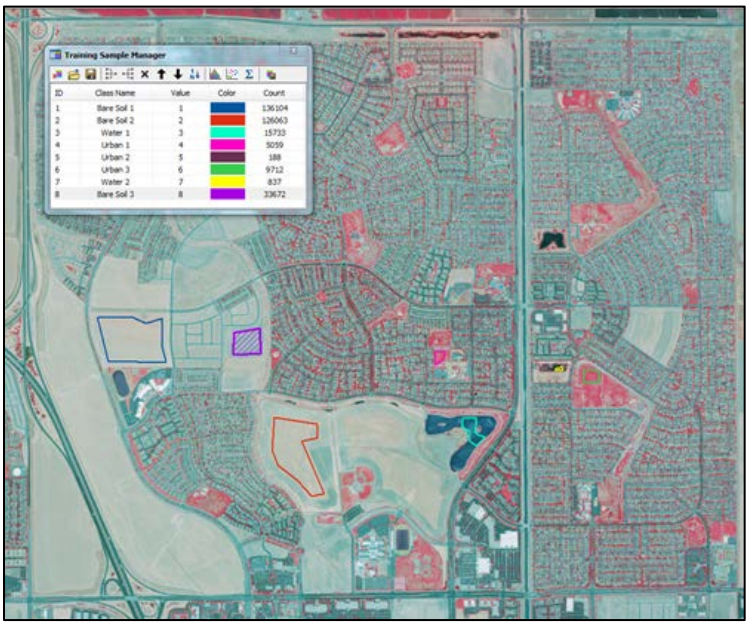
Methods and Analysis

The NAIP imagery for the Sacramento County area was downloaded and evaluated to determine the best area for this project. Initially, a rural area was the target; however the land cover change between 2009 and 2014 was not significant to determine the land cover change for this project. A location in North Natomas was selected due to the visual land cover change between 2009 and 2014. The image was clipped to the specified area for both images so the same areas could be compared. After the image area was determined, the color bands were arranged to show the land cover changes.

To perform the Supervised Classification on the area, training sites were needed for the baseline. After evaluating the area, it was determined that nine training sites would be used; for water, bare soil, and urban development. Each training site was selected for the uniqueness of color, size, and classification type.

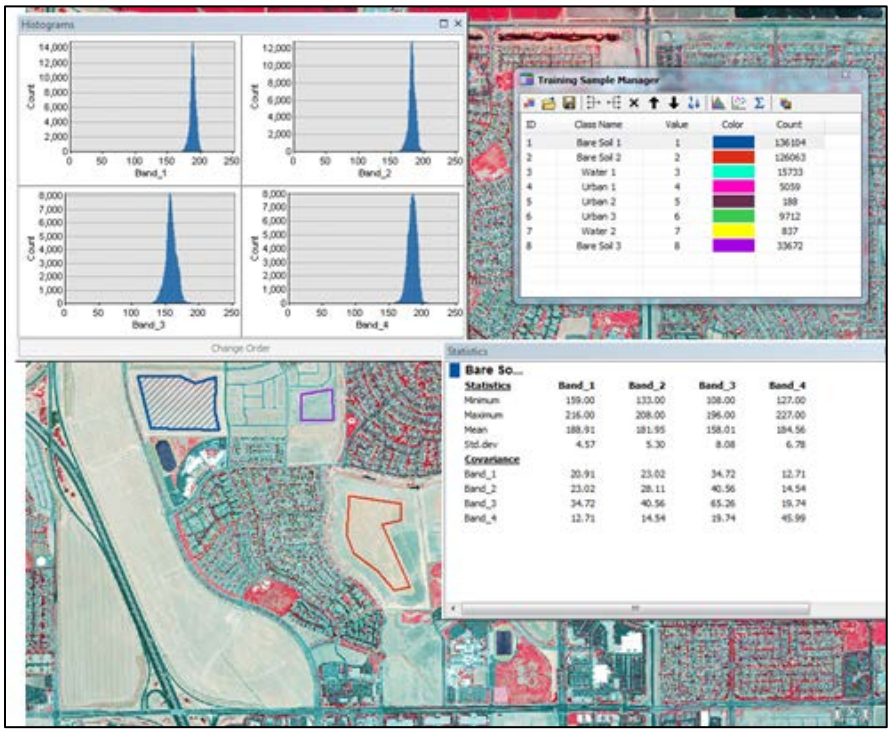


2009 Training Sites for Supervised Classification

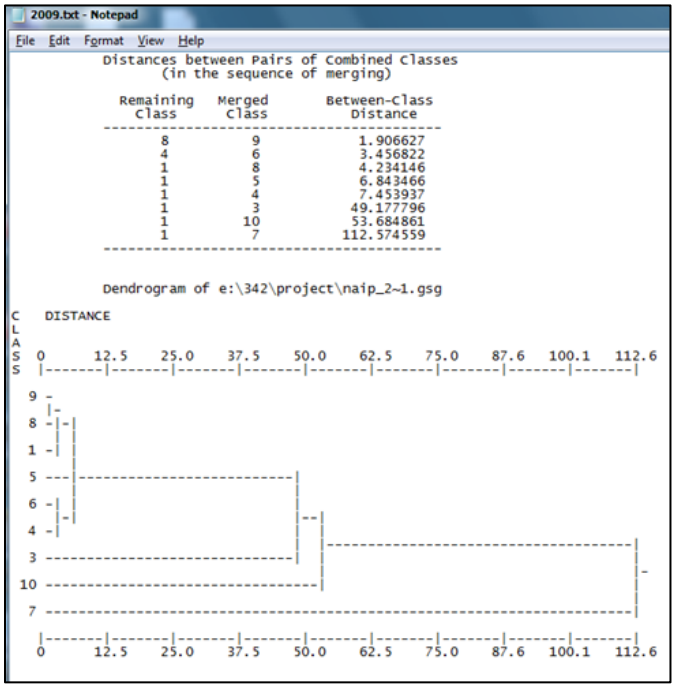


2014 Training Sites for Supervised Classification

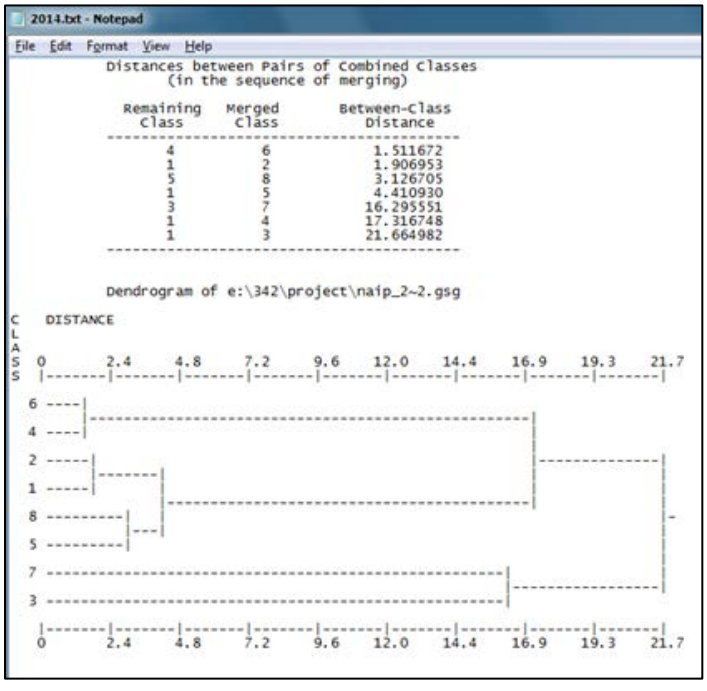
After the training sites were selected for each year, the sites were evaluated. Each training site was evaluated for the size, or count, to ensure the site was large enough for analysis. The histogram was evaluated to determine the sample site did not have any outliers. The statistics were evaluated for the standard deviation and covariance.



The dendrogram was also used to evaluate the uniqueness between the spectral signatures for each year.



2009 Dendrogram



2014 Dendrogram

Once the training sites were evaluated, the Maximum Likelihood Classification was performed for the image. This resulted in nine classifications for each image.

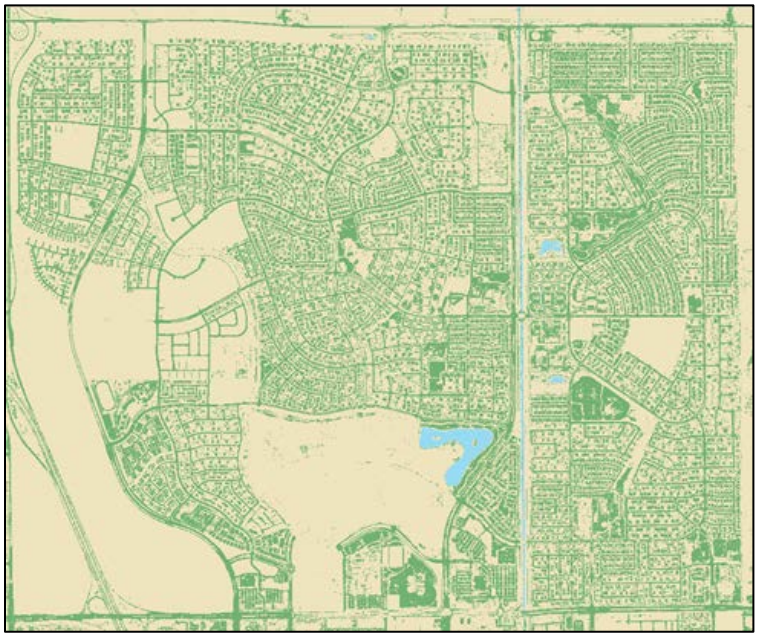
2009 Maximum Likelihood Classification

2014 Maximum Likelihood Classification

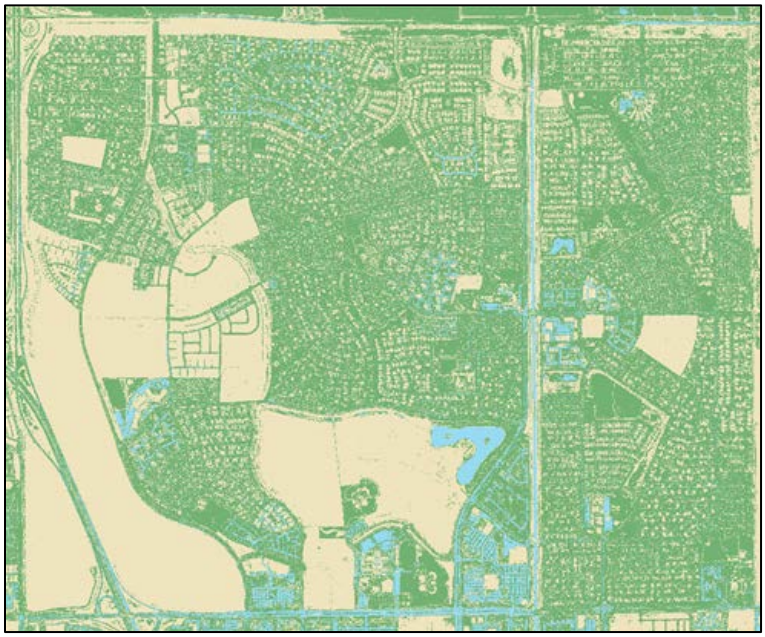
The results were then reclassified into three categories: water, urban development, and bare soil. Each year was evaluated to determine if the image analysis was complete or if there were errors. The 2014 image had “known” errors in the classification. The Interstate 5 roadway and several surface streets were incorrectly classified as water.

2014 Reclassified

After further investigation, the shadowing on the image appeared to have the water and roadway similarly categorized together. The training site was recaptured to show a different area and the Maximum Likelihood Classification was run again. The result still had some errors, but they were significantly reduced.



2009 Result



2014 Result

After the Maximum Likelihood Classification was performed, the categories were reclassified into three categories and the area was calculated. Since the raster was a NAIP 1 meter pixel, the area of each raster pixel was 1 m^2. Therefore, the count of each category was the area. The area was then converted into acres and the percentages of each were computed.

2009	Category	Meters Squared	Acres
1	Bare Soil	2,940,260	726.55
2	Water	145,534	35.96
3	Urban	48,419	11.96
4	Urban	6,006,460	1,484.23
5	Urban	1,539,950	380.53
6	Water	14,497	3.58
7	Bare Soil	12,528,500	3,095.85
8	Bare Soil	1,151,450	284.53
9	Urban	50,445	12.47

2014	Category	Meters Squared	Acres
1	Bare Soil	4,346,320	1,074.00
2	Bare Soil	975,900	241.15
3	Water	1,157,050	285.91
4	Urban	4,825,370	1,192.37
5	Urban	3,122,390	771.56
6	Urban	1,276,800	315.50
7	Water	98,373	24.31
8	Bare Soil	5,091,770	1,258.20
9	Urban	3,521,960	870.29

Results

The land cover change between 2009 and 2014 was a 25% increase in urban development and a 25% decrease in bare soil. Initially, the result displayed a 4% increase in water, however after further analysis it was determined to be an error because of the classification of some roadways as water due to the shadowing. Because there was no change in water, the 4% misclassification was added to the urban development number.

2009 Imagery		
Category	Acres	Percent
Bare Soil	4106.94	68%
Water	39.54	1%
Urban	1889.19	31%
Total	6035.67	100%

2014 Imagery			
Category	Acres	Percentage	Adjusted
Bare Soil	2573.35	43%	43%
Water	310.22	5%*	1%
Urban	3149.73	52%	56%
TOTAL	6033.30	100%	100%

*Water increase was an error. This is actually urban.

Discussion

After performing the analysis for the project, it appears that the difficulties were with the NAIP imagery. The data was collected during the summer months and had significant shadowing and dark areas which were hard for classification. The darker areas seemed to be categorized as water rather than urban areas which make the maximum likelihood classification difficult. Other training sites were evaluated, but the same result appeared where the dark areas were too similar to water. Having knowledge of the area also proved helpful because misclassified areas were able to be solved rather than overlooked if it was an unfamiliar area. Overall, the analysis worked well and the NAIP imagery was sufficient rather than a full infrared image because vegetation analysis was not needed. It would be interesting to perform this on the same area with an infrared image and see if the results were the same.

Conclusion

The land cover change in the Natomas, California area was apparent in the images and confirmed through the Maximum Likelihood Classification analysis. In a true color image, the land cover change is noticeable, but with the image classification it is clear that a significant land cover change happened between 2009 and 2014. Accounting for errors in the classification, prior field knowledge, and patience to reproduce training sites as needed helped make this project a success.

References

Department of Fish and Game https://www.dfg.ca.gov/biogeodata/gis/map_services.asp