Center for Land Use and Sustainability
SHIPPENSBURG UNIVERSITY

PKC2070 Version 2.1
Baseline and Alternative Scenarios

April 24, 2017

Lead developers:

Dr. Claire Jantz
CLUS Director
cajant@ship.edu
717-477-1399

Alfonso Yáñez Morillo
CLUS Research Analyst
ayanezmorillo@ship.edu
717-477-1517

Joshua Barth
CLUS Graduate Student Fellow
jb7337@ship.edu

Antonia Price
CLUS Project Coordinator
afprice@ship.edu
717-477-1519

Improvements over Version 2.0:

PKC2070 version 2.1 represents a baseline and two alternative forecasts of urban land use in the Poconos-Kittatinny Cluster (PKC) out to the year 2070. Based off feedback from the PKC focus area group, PKC2070 version 2.1 includes the following adjustments:

- Instead of treating the municipal ordinance layer as municipal-wide and with strong positive or negative weighting, we applied weights only to stream buffer areas. For municipalities with a strong ranking, stream buffer areas were treated with additional protection from development. In municipalities with a low ranking, buffers did not receive additional protection.
- In the sprawl scenario, we applied a strong positive weighting for development around the casino and transportation corridors, and increased attraction around major road intersections.
- For EV/HQ streams, we removed the trout and trout spawning streams from NY (classes "B" and "C").
- We will be developing an on-line viewer for PKC similar to the basin-wide viewer (http://www.drbproject.org/products/).
- We will be incorporating results from the PKC region into the basin-wide results in DRB 2.0 so that these data can be incorporated seamlessly into SRAT and other tools.

Product overview:

To develop these forecasts, we calibrated the SLEUTH urban growth model for the PKC region over the 2001-2006 time period, and validated the model for the 2006-2011 time period. We used the National Land Cover Database (NLCD) urban classes to represent urban land cover as developed or not developed (**Figure 1**).

The data provided to PKC is described in **Appendix 1**, and represents forecasts of urban land cover in 2030 and 2070, summarized by National Hydrography Dataset Plus (NHDPlus, version 2.0) catchments.

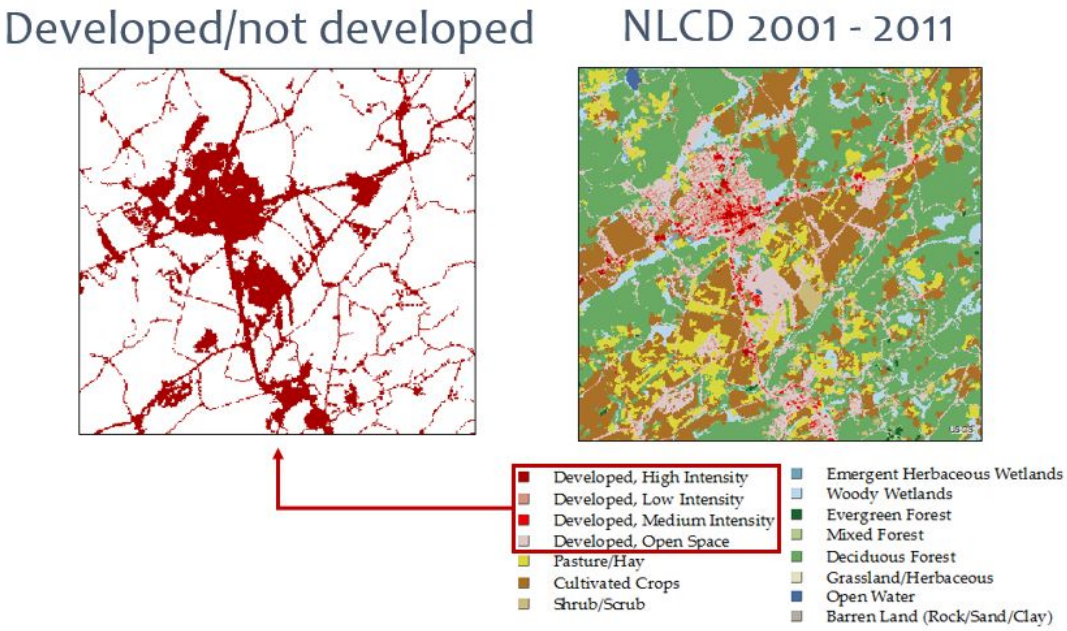

Figure 1: All four NLCD developed classes were consolidated into a single representation to designate developed/non developed as required for SLEUTH input.

The primary input layer to SLEUTH is the exclusion/attraction layer, a layer that describes areas that are more or less suitable for urban development. For the PKC region, we began with the exclusion/attraction layer that was developed for the Delaware River Basin modeling work (DRB2070 Version 1.0 can be found online: www.drbproject.org/products). This layer is the result of statistical and spatial modeling of accessibility, environmental suitability, employment and population spatial dynamics, and land protection.

We then customized this input layer for the PKC region to better reflect unique drivers of change, for example, urban land use change driven by recreational housing development. We also incorporated feedback from the PKC cluster to define baseline and alternative scenarios to better meet their needs. Alternative scenario 1 describes a sprawl with low conservation future, and alternative scenario 2 describes a smart growth with high conservation future. See **Figure 2** to compare the exclusion/attraction layers used for the three scenarios.

Please note: the exclusion/attraction layers displayed in PKC2070 version 1.0 and 2.0 documents showed all excluded areas in one layer. For improved visualization, the figures below show separate layers of excluded areas including road, 2011 urban development, slopes over 15%, secured areas, non-forested wetlands, active river area, 100ft stream buffer, and water bodies.

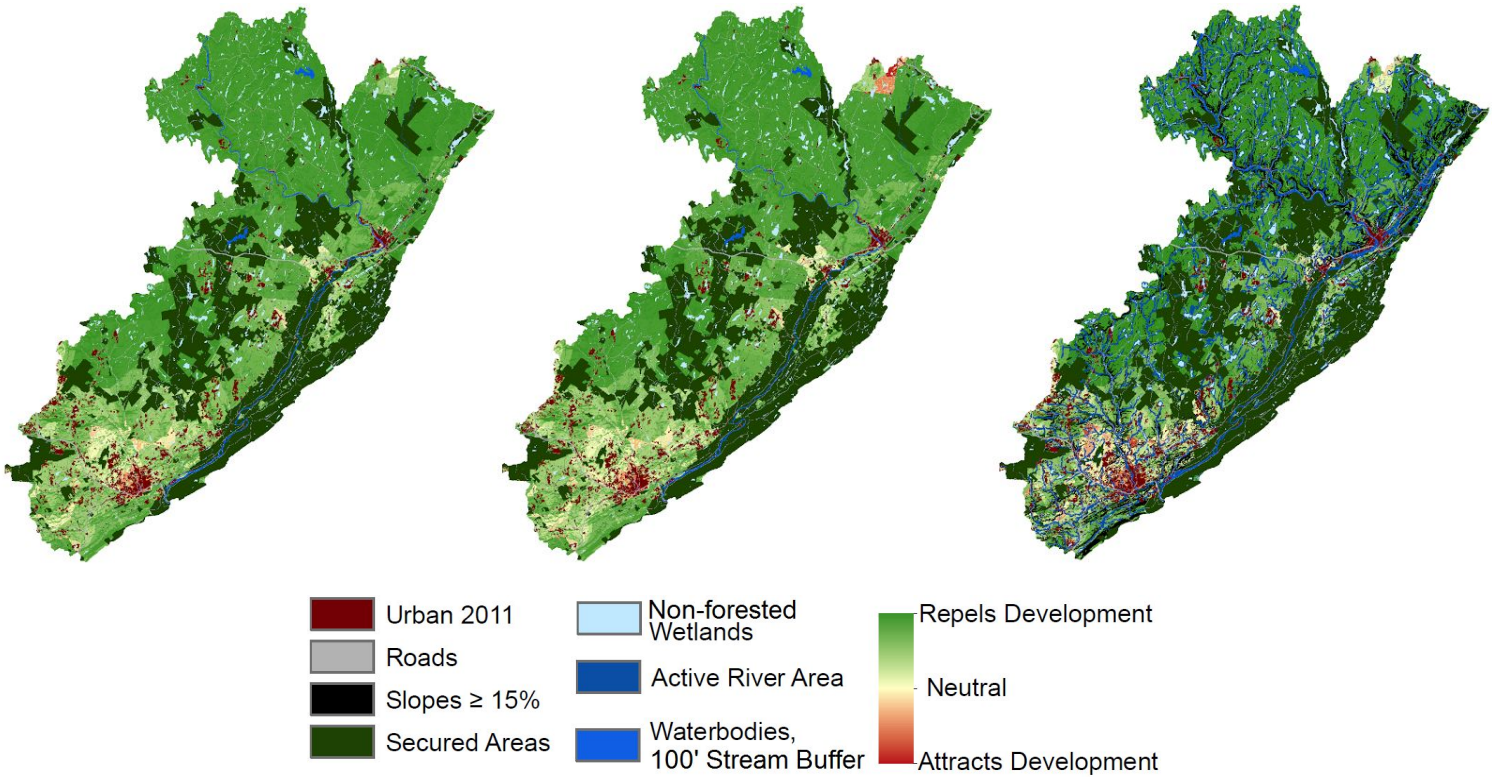

Figure 2: The exclusion/attraction layers used to drive the 2030 and 2070 baseline forecast (left), alternative scenario 1 (sprawl and low conservation) (middle), and alternative scenario 2 (smart growth and high conservation) (right).

For each scenario, trajectories were determined for population growth, regional build-out, regional infrastructure, and conservation efforts.

***Baseline Land Use Scenario*:**

The baseline land use scenario represents recent trends in the PKC cluster.

- *Population Growth Trajectory*: We based the population trajectory on the EPA Integrated Climate and Land-Use Scenarios (ICLUS) B1 population forecast. The resulting urban land cover change trajectory is shown in **Figure 3** and summary statistics are presented in **Table 1**.
- *Regional Build-Out Trajectory*:
    - We incorporated the Natural Lands Trust (NLT) municipality ordinance review map to * *weight stream buffer areas based on their conservation orientation. (Note: we used the NLT ordinance review from March 2017). For municipalities with a strong ranking, stream buffer areas will be treated with additional protection from*

development. In municipalities with a low ranking, buffers will not receive additional protection.
    - Areas with a high density of recreation resource access (e.g. trailheads, parking facilities, boat launches, etc.) and areas closer to water features were given a positive weighting to make them more attractive for housing development.
- *Regional Infrastructure Trajectory*: We included an upgrade to Route 17 as identified in the PKC threats and stressors assessment. Transportation access (represented by road density) is important for second home location, so this was included as an attractor for development.
- *Conservation Efforts*: As in the region-wide model, non-forested wetlands are fully protected, forested or shrub wetlands have moderate to weak protection and we include protected lands as indicated in the PAD-US data. We also incorporated:
    - The Nature Conservancy (TNC) secured areas inventory, as fully protected.
    - Catchments with EV/HQ streams, as partially resistant to development. (We adapted the approach defined by DRBC to normalize the state stream data sets) **Streams in NY with "A" or "AA" classification were considered EV/HQ*
    - The FEMA 100-year floodplain as partially resistant to development.

Alternative Scenario 1 (sprawl with low conservation):

Alternative scenario 1 explores a future with low conservation focus and high sprawl.

- *Population Growth Trajectory*: We based the population trajectory on the ICLUS basecase population forecast, which assumes higher population pressure than in the PKC baseline future land use scenario. See **Figure 3** for the resulting urban land cover change trajectory; summary statistics are presented in **Table 1**.
- *Regional Build-Out Trajectory*: We focused growth along designated corridors (I-84, I-80, Delaware Water Gap) and included planned service stations for the Lackawanna cutoff
- *Regional Infrastructure Trajectory*: We started with the baseline regional infrastructure and considered buildout of a north-south limited access road following 209, and included additional infrastructure projects around casinos. * *We applied a strong positive weighting for development around the casino and transportation corridors, and increased attraction around major road intersections.*
- *Conservation Efforts*: We included the same conservation efforts as in the baseline future land use scenario.

Alternative Scenario 2 (smart-growth and high conservation):

Alternative scenario 2 explores a future with a high conservation focus and smart growth.

- *Population Growth Trajectory*: We based the population trajectory on the ICLUS basecase population forecast, which assumes higher population pressure than in the PKC baseline

future land use scenario. The resulting urban land cover change trajectory is shown in **Figure 3** and summary statistics are presented in **Table 1**.

- *Regional Build-Out Trajectory*: deemphasized growth around roads and corridors and emphasized growth around existing/historic urban centers
- *Regional Infrastructure Trajectory*: This was the same as alternative scenario 1.
- *Conservation Efforts*: We included the same conservation efforts as in the baseline future land use scenario, but included a minor resistance to development on forested and agricultural lands, added complete protection of 100ft buffer around all streams and wetlands, added complete protection of all slopes >15%, and added complete protection of contribution zones and flat zones as delineated in TNC's active river layer .

***Comparing the Baseline and Alternative Future Scenarios*:**

Urban land trajectories for each of the three scenarios are summarized in **Figure 3**. Note that as expected, alternative scenario 1 (sprawl with low conservation) predicts the highest levels of development, while the baseline scenario has the lowest.

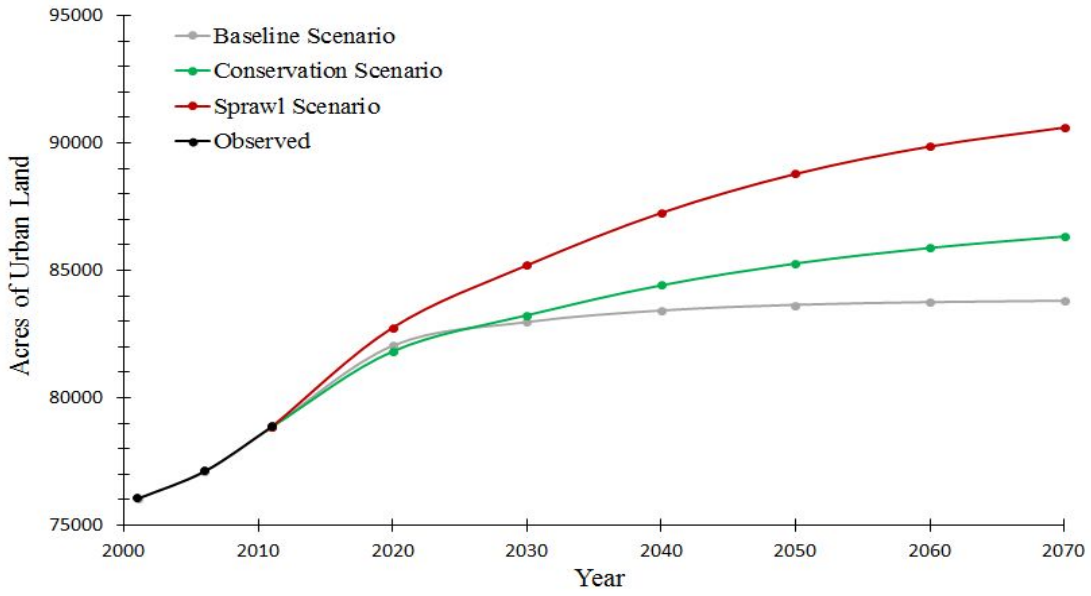

Figure 3: Urban land cover change trajectory for the PKC region from 2001 - 2011 (observed from NLCD) and from 2011 - 2070 (PKC2070 Version 2.1 forecast) for the baseline and alternative scenarios 1 and 2.

Between 2001 and 2011, developed land cover increased 2,805 acres from 76,056 to 78,861 acres, an increase of 3.7% (**Table 1**).

In the baseline scenario:

- We project a 5.2% increase by 2030, adding an additional 4,099 acres of urban land for a total estimate of 82,960 acres.
- By 2070, we project a 6.3% increase over 2011, adding an additional 4,930 acres for a total estimate of 83,791 acres.

In the sprawl with low conservation scenario:

- We project a 8.1% increase by 2030, adding an additional 6,350 acres of urban land for a total estimate of 85,211 acres.
- By 2070, we project a 14.9% increase over 2011, adding an additional 11,764 acres for a total estimate of 90,625 acres.

In the smart growth and high conservation scenario:

- We project a 5.6% increase by 2030, adding an additional 4,383 acres of urban land for a total estimate of 83,244 acres.
- By 2070, we project a 9.5% increase over 2011, adding an additional 7,475 acres for a total estimate of 86,336 acres.

Scenario	**Year**	**Developed land (ac)**	**Increase from 2001 (ac)**	**Percent (%) Increase from 2001**
Observed	2001 2011	76,056 78,861	- 2,805	- 3.7
			Increase from 2011 (ac)	**Percent (%) Increase from 2011**
Baseline *Alternative 1* *Alternative 2*	2030	82,960 85,211 83,244	4,099 6,350 4,383	5.2 8.1 5.6
Baseline *Alternative 1* *Alternative 2*	2070	83,791 90,625 86,336	4,930 11,764 7,475	6.3 14.9 9.5

Table 1: Developed acres and percent increase for the observational time period (2001-2011) and for forecasts of urban development under each scenario for 2030 and 2070.

Appendix 1. Data Available in the ArcMap Document

To visualize the results of the 2070 forecasts, we are providing a zip file that includes an ArcMap document and these data sets:

- Municipal boundaries (for reference)
- PKC boundary (for reference)
- 2011 urban land (30m raster, derived from the four NLCD developed classes, our starting point for the forecast)
- For each of the three scenarios (baseline and two alternatives)
    - Cumulative urban development for 2070 (30m raster, compiled from the 100 Monte Carlo trials), which represents the probability of development by 2070. We note that this layer does *not* represent the percent impervious surface.
    - Exclusion/attraction layer (30m raster), a SLEUTH model input that indicates areas that are expected to attract or repel development in the future.
    - National Hydrography Dataset Plus (NHDPlus, version 2.0) catchments symbolized based on the proportion of the catchment that is occupied by developed land cover in 2006, 2011, 2030, and 2070 (e.g. catchments in the <1% category have less than 1% of developed land cover in any given time period). These are the same catchments that are used in SRAT.
    - NHDPlus catchments symbolized based on the change in proportion developed between 2011 and 2070. This was calculated by subtracting the percent of developed land for catchments in 2011 from the percent of developed land in 2070. We note that this layer can be used to identify "hotspots" of change, or areas where the most change has occurred. It should be used in conjunction with the previous layers because this layer alone does not indicate the starting point. For example, a catchment that has the value of 5 could be a catchment that increased from 45% to 50% developed or from 5% to 10% developed.

We have saved the ArcMap document as version 10.4, 10.3, and 10.0 to ensure compatibility with your version. These are identical except for the version. All data sets include an item description that can be referred to for additional information.