Chesapeake Bay Program Partner's Local Government Forum Proceedings

Hosted by the Local Government Advisory Committee to the Chesapeake Executive Council and the Chesapeake Bay Program's Land Use Workgroup

June 7, 2017
Annapolis, MD

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Chesapeake Bay Program Partner's Local Government Forum Proceedings

Edited by Peter Claggett, U.S. Geological Survey and Lindsey Gordon, Chesapeake Research Consortium

This forum was convened by the Alliance for the Chesapeake Bay (Alliance), in cooperation with the Local Government Advisory Committee to the Chesapeake Executive Council (LGAC), and the Chesapeake Bay Program's (CBP) Land Use Workgroup (LUWG).

Forum Synopsis

Background

A joint forum of the Local Government Advisory Committee to the Chesapeake Executive Council and the Land Use Workgroup was held on June 7, 2017 in Annapolis, Maryland at the Crowne Plaza Hotel. The theme of the forum was "Future Land Use Scenarios Relevant to Local Planning Decisions to Maintain Water Quality". A copy of the agenda may be found in Appendix B.

The purpose of the forum was to learn about the potential use of future scenarios to inform local restoration and conservation actions, explore possible scenario narratives and assumptions, and build consensus around a subset of scenarios to inform Phase III Watershed Implementation Plan (WIP) development. The Alliance's approach was to engage land use planning and policy experts to review historic trends, describe relevant current policies, and gain sufficient understanding of the methods used in developing these scenarios to enable them to review and build consensus around a set of proposed alternative future scenarios.

The Phase III Watershed Implementation Plans, which are due in April 2019, must account for anticipated increases in nutrient and sediment loads associated with population growth between 2019 and 2025, the end date for meeting the Chesapeake Bay TMDL goals. One way to account for changing conditions is to compare plausible scenarios of future land use with current conditions. The Chesapeake Bay Land Change Model (CBLCM), developed by the U.S. Geological Survey at the Chesapeake Bay Program (CBP) Office, is designed to simulate future land use conditions for the year 2025 based on county-level population and employment projections while accounting for local zoning, the suitability of land for development, slopes, housing and employment densities, and other factors. These forecasts can be directly used in the CBP Partnership's watershed model to estimate potential changes in nutrient and sediment loads that would result from changes in land use.

Under the direction of its Land Use Workgroup, the CBP Partnership plans to develop several future land use scenarios to bracket the range of potential changes in land use resulting from a continuation of historic trends and/or partial buildout of lands zoned for development. The CBP Partnership would like to get as much local input as possible for designing future land use scenarios so that they are locally relevant and useful for Phase III WIP development.

Forum Objectives

- Refine the Historic Trend scenario (aka "Business as Usual").
    - Do the forecasts appear plausible? If not, why?
    - What information is needed to improve the Historic Trend forecasts?

- Identify alternative future scenarios that are plausible and useful.
    - How might the future differ from historic trends?
    - What policies and actions support the realization of alternative scenarios?
    - Which scenarios are most plausible and useful to the Bay jurisdictions for informing the Phase III WIPs and other state and local decisions?

Participants

Over 60 participants were present at the forum on June 7, 2017, representing local, state, and nonprofit organizations from across the Chesapeake Bay watershed. The workshop was geared toward individuals who had knowledge and expertise related to land-use trends and policies in their jurisdiction. A complete list of participants can be viewed at the end of this report (in appendix A).

Format

The workshop began in the morning with presentations and a large group discussion soliciting feedback on the Historic Trends scenario, followed by individually moderated small group work sessions in the afternoon focusing on alternative future growth scenarios based mostly on current and/or potential policies for managing growth. The workshop concluded with a large session where collective priorities and metrics for alternative future scenarios were discussed and prioritized.

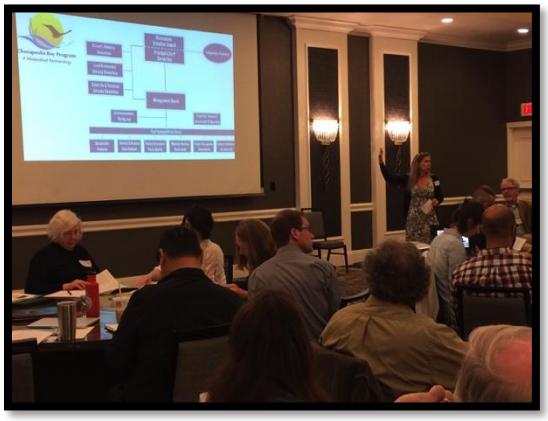
Preliminary Outcomes

The outcome of the forum was to develop a vetted set of future growth scenarios to simulate in the Chesapeake Bay watershed, with particular relevance for developing Phase III WIPs and assessing the magnitude of growth offsets that might be required. The top prioritized alternative future scenarios developed at the conclusion of the forum included the following alternative future growth scenarios (with significant additional detail in the body of the report):

1. **Utopia**: Combination of scenarios #2 – #5, discussed below.
2. **Current Policy and All Infrastructure**: Current growth management policies and zoning combined with planned transportation and other infrastructure (e.g., sewer and water) improvements and constraints.
3. **Conserving and Land and Preserving Rural Character scenarios:** Up-zoning suburban/urban areas and down-zoning rural areas combined with aggressive land conservation, with the goal of maintaining natural resources and rural open space.
4. **Infill and Redevelopment:** Added incentives to promote infill and redevelopment**.**
5. **Climate-Based:** Restricting development in areas prone to sea-level rise and storm surge.

Finally, forum participants discussed assumptions, policies, regulations, and other factors that pertain to each of these scenarios, which are described in detail in the small group discussion summaries below.

Forum Welcome and Introductions



At the beginning of the forum, Hon. Bruce Williams, Chair, Local Government Advisory Committee (LGAC), Karl Berger, Chair, Chesapeake Bay Program's Land Use Workgroup, Metropolitan Washington Council of Governments provided the welcome to the meeting. Then, Mary Gattis, Director of Local Government Programs, Alliance for the Chesapeake Bay, provided an overview of the meeting purpose and facilitated participant introductions, which involved sharing a one word hope for the Chesapeake Bay watershed, which included:

- Forests
- Results
- Commitment
- Awareness
- Planning
- Sustainability
- United
- Balanced
- Infill
- Buy-in
- Swimmable Anacostia
- Vibrant
- Engagement
- Inclusion
- Thriving
- Consistency
- Fisheries
- Thoughtful
- TMDL
- Crabs
- Ecosystems
- Public buy-in
- Recreation
- Funded
- Preservation
- Progress
- Clean
- Restoration
- Protected progress
- Fish
- Clear
- Coordination
- Data
- Healthy
- Viable agriculture
- Training
- Clarity
- Closure
- Science
- Conservation
- Accuracy
- Enhancement
- Smart development
- Patience
- Water quality
- Resilient
- Fact-based
- Connected
- Benthic community
- Research
- Cooperation
- Collaboration
- Engaged

After meeting introductions, Mary introduced meeting guidelines which included: acronym alert (spell out acronyms the first time they are used); don't let yourself get lost; have fun; all ideas are welcome (as well as brevity); and use "ditto" to voice support for an idea that has already been expressed.

Presentations and Feedback on Historic Trends

In preparation for three small group break out discussions later in the day focused on alternative future growth scenarios, two presentations were shared in the morning that focused on an introduction to Chesapeake Bay future scenarios as well as future scenario planning in the Delaware Basin. In addition, participants also shared questions, feedback and critique of the current scenarios during the morning.

Introduction to Chesapeake Bay Future Scenarios: Narratives, Assumptions, Evaluation Metrics; and Applications - Peter Claggett, U.S. Geological Survey

Mr. Claggett's presentation provided an introduction to the Chesapeake Bay future scenarios and discussed the reasons for forecasting growth in the Chesapeake Bay, how forecasting is conducted

and what data sources are used, as well as model capabilities and sensitivities. In addition, Mr. Claggett discussed the value of forecasting beyond 2025 and provided highlights of different maps and scenarios. A copy of the presentation, as well as handouts, are available in the Appendix C.

Feedback on Historic Trends

After Mr. Claggett's presentation, the meeting facilitator, Christine Gyovai of Dialogue + Design Associates, invited forum attendees to review the Historic Trends scenario as maps of forecasted growth by state, summarized by tract/municipality, and tables with statistics on county-level population projections and estimated infill/redevelopment rates. Forum attendees were asked to individually consider the following questions:

- **What do you see in the maps and tables that you agree with and why?**
- **What have we missed?**
    - *Such as development in areas experiencing net declines in population and/or jobs or subject to environmental limitations; Changes in socio-economic conditions and/or consumer preferences that might influence the location of growth; Existing transportation/Infrastructure projects; Existing policies and plans not reflected in trends; and other ideas.*

During a break, participants walked throughout the meeting space to view the maps highlighting the current trends, wrote responses to the questions above on individual sheets of paper, and discussed the Historic Trends scenario with model experts from the U.S. Geological Survey (USGS). The individual responses that were submitted at the end of the Forum are compiled and included in Appendix D.

After the break, forum participants joined in a large group discussion to share their feedback to the two questions above. The critique of historic trends focused on four core themes including "ground-truthing" (or testing assumptions on-the-ground in jurisdictions) the Historic Trends scenario findings, adding clarifying information on the maps such as a legend or additional key information, including parameters such as utility service areas and future land use considerations, and updating information for specific areas and jurisdictions. General questions about the Historic Trends scenario are included below, followed by feedback around display considerations, geographic considerations, additional parameters, and future land use considerations.

Questions Regarding the Chesapeake Bay Future Scenarios

- Regarding the grey areas on the maps – is that the model projecting no growth, or was there not data available?
    - Peter Claggett's response: That is where the population projection is essentially negative or zero, with the exception of D.C., where projections are forthcoming.
- What's the difference between a projection and a trend?
    - Response: Population projections are produced by demographic models and through cooperative negotiations among jurisdictions. Population trends are the result of linearly extrapolating population data through time.
- For the 2030-2040 time frames, how will climate change or sea level rise be included?

- Response: One way we anticipate incorporating sea-level rise is using maps of inundation based on the latest topography/bathymetry data. We would add that layer into our models as a constraint. Other aspects of climate change like changes in temperature and more frequent and/or severe storms are still being considered.

- What information was taken out of the domain of developable lands?
  - Response: The Chesapeake Bay Program (CBP) assessment of pervious lands available for new development excluded steep slopes, which were defined uniquely state-by-state, protected lands and easement areas, impervious surfaces, water, and tidal emergent wetlands.
- Did you consider growth zones? For example, Kent County, Delaware has a portion in the Chesapeake that's not as conducive to development.
  - Response: We didn't account for it in the Historic Trends scenario, but will account for it in the Current Policy scenario.

Historic Trends Scenario Feedback

What do you see in the maps that you agree with, and why?

- The Shenandoah Valley in Virginia appears accurate and is consistent with peoples' expectations. However, the Winchester, Virginia area may need further exploration.
- There was support for modeling new growth adjacent to existing growth, along with projections that follow major transportation corridors.

What have we missed?

Display considerations

- The intensity of development (i.e. infill) should be shown more clearly on the maps.
- A legend is needed on the maps, to show the percent of suitable land that is projected to be developed by 2030.
- Display additional base layers and reference layers, such as imagery and transportation networks, to provide more context for interpreting spatial patterns of growth and why specific counties have high projected growth on the maps.
- Subtleties of why growth exists in certain areas should be more contextualized in the maps to help readers interpret these results.
  - For example, a participant said, "If I were to show a map of PA to someone not in this room, I would have a hard time explaining why Bradford and Lancaster Counties look almost the same. I had a hard time understanding until someone else explained it to me."
- To further inform the historical trends, the creation of an outlier map to be compared to 2016 population estimates for cities and counties would be helpful.

Geographic considerations

- Growth in Washington D.C. should be visualized to identify data needs for the locality and the Chesapeake Bay Program.
- Zoning is not mandated in Virginia, which could impact both the Historic Trends and Current Policy scenarios. However, most localities have some type of zoning data.
- Question from participant: Regarding the sources for your projections in Virginia, can you use MWCOG (Metropolitan Washington Council of Governments) projections instead of statewide projections? They are more reflective of the jurisdictions' zoning and comprehensive plans.
    - Response: For the Washington COG area, and for the Baltimore area, we did use their forecasts and assumed that they were more accurate than the state forecasts.
- Question from participant: How is the model projecting sustainable growth? And to what degree does the model factor in millennial/generational trends? Walkability is a big factor for many, and some areas need to be vetted on the ground. For example, Salisbury on the eastern shore is currently showing little growth. However, substantial growth is taking place right now.
    - Response: In the Historic Trends scenario, we have current easements, but not anything about potential future preservation activity. We have the capacity to simulate conservation by land use. We're also aware of millennial trends, but won't be simulating those. With the high-rises in Salisbury – we rely on aggregate growth estimates (projected population and employment) for the whole county and then allocate that projected growth to locations our model tells us are likely to grow. Because future demand for land is seldom high enough to affect all eligible areas, and because our model produces 101 Monte Carlo simulations for each scenario, future growth will not be allocated to all areas eligible for growth. With better local information on the locations for planned new developments, we might be able to address this issue.
- It would be helpful to solicit jurisdictions' feedback or agreement on the population and employment projections.
- The available developable lands need to be ground-truthed in the jurisdictions to ensure those delineations are accurate.
- Consider the real limitations on land development in certain localities. For example, on the Virginia maps many of the areas that are shown as developable wouldn't be able to be developed due to limitations of steep slopes and soils, or in places like Charles City County, due to lack of public sewer and water. Noting the service areas for water and sewer would be useful.
- It would be helpful to represent information in terms of change in land use type, such as impervious surfaces, forest change, or changes in nutrient loading and to show the consequences of these projections in the maps.
- The maps showing the Delaware portion in the Bay look accurate, but the current amount of growth happening on the west side of the state does not appear to be accounted for in the maps.
- Northwest Virginia looks reasonable, but in Winchester or Frederick counties, the projections for population growth should be higher. Eastern Frederick doesn't look consistent with local projections.

Additional parameters

- Consider up-zoning and down-zoning.

- Consider the availability and capacity of all infrastructure including water availability, wastewater, sewer, soil capacity, and all utilities.
    - Noted that many wastewater treatment plants are serving multiple jurisdictions in the Historic Trends scenario.
- The projections should show the potential influence of heavy or commuter rail lines and their future increasing usage. Highway projects or bridge enhancements should be included that could change growth patterns. (ex: rail-line in Spotsylvania County and Stafford Bridge in Maryland).
- Existing or future utility service areas should be factored in to the Historic Trends scenario.
- Identify the major employers in growth areas to help ground-truth future economic trends and projections (and future viability of large-scale employers).
- Much of the population lives in urban service areas, but the majority of land loss is on septic (which generally covers 2-5 acre properties). Having information about percolation data for soils consistently across the watershed would be helpful.
- Federal facilities are important to consider.
- Add groundwater restrictions as a consideration for the scenarios.
- There is a need to talk with local planners to get a full picture for future scenarios; coordination with the American Planning Association could help.

Future Land Use considerations

- Consider the future ownership of land, particularly of lands that are now in agriculture and forestry use. Many areas are converting to second-home ownership and to vacation homes, particularly along the Virginia shore of forested lands near rivers.
- Note that not all growth is related to population. For example, in Hardy County, WV, there is a large second-home community, but the population growth isn't reflected in new development. Showing new and projected development would be helpful.
    - Response: There were issues in Charles County as well, but it wasn't an environmental constraint – it was the lack of forecasted population growth. There is data on soil building suitability, which is something that might be helpful to incorporate.
    - Response #2: Soil surveys are typically not accurate enough on the percolation level to determine building suitability, which means it results in scale issues for how growth is allocated. However, it is something that would be helpful to try to incorporate.
- Consider demographics carefully for the Historic Trends scenario as demographics will really dictate the manner in which locations develop. For example, in King George, VA, we were planning for schools, but now aren't expecting any increase in our school-age population.
- Take into account the remaining parkland after future growth projects are accounted for.
- Note that when you take out all of the land unavailable for development, there is not much room left to change.
- Consideration of how trends are projected is important, as they will be key for Watershed Implementation Plan (WIP) development.

Alternative Future Scenarios – Dr. Claire Jantz, Shippensburg University

After the discussion and feedback around the Historic Trends scenarios, Dr. Claire Jantz's presentation focused on why and how alternative future scenarios focus were created in the Delaware River Basin, lessons learns, information about the utility and practicality of alternative futures, as well as considerations around potential pairing with other models.

Questions from the group following the personation:

- Who was the client for this information?
  - The response was that local governments were the primary client, along with a variety of planning participants.
- Why 2070 was chosen as a particular time frame?
  - The response was that the client wanted to plan for the long term.

Alternative Futures Scenario Priorities and Considerations

Following the morning discussion and presentation, forum participants took a break for lunch and then reconvened for small group discussions in the afternoon. Participants divided into three small groups organized by geographic region. There was a facilitator, flip chart recorder, and computer recorder in each of the small groups. Mary Gattis facilitated the Virginia and West Virginia small group (VA + WV), Renee Thompson facilitated the Maryland, Delaware, and Washington, D.C. small group (MD, DE, + DC), and Antonia Price facilitated the Pennsylvania and New York small group (PA + NY).

The focus for the small group discussions was to develop a prioritized set of alternative future scenarios and to discuss policies, regulations, and other factors contributing to each theme (making them possible). Small group facilitators reviewed the alternative future scenarios that Peter Claggett shared during the morning presentation, and examples of policies, regulations, and infrastructure improvements. These included:

Alternative Future Scenarios

1. Historic Trends
2. Current Policies
3. Land Conservation
4. Rural Character
5. Infill and Redevelopment
6. Deregulated and less-managed growth
7. Distributed, amenity-driven growth: satellite cities and small towns
8. Concentrated growth along major transportation corridors

Examples of factors that may influence scenarios:

1. Policies & Regulations
   a. Property and income taxes
   b. Tax incentives (e.g., to encourage revitalization)
   c. Zoning
      i. Environmental protections (e.g., stream/ shoreline buffers)
      ii. Transfer of Development Rights

    d. Forest and farm conservation
2. Infrastructure Improvements
    a. Roads and bridges: outer beltway, 3rd Bay Bridge, Water supply and treatment, High-speed internet
3. Parking lot issues (important for narratives but not controllable)
    a. Technological innovations
        i. Driverless cars, Better batteries, Decentralized electricity generation
    b. Regional/National/Global economic policies and factors
        i. Commodity prices, Trade policies, Domestic and international migration

Below is a summary of each small group discussion, followed by a presentation of the prioritized scenarios by each small group when everyone reconvened as a large group. During the small groups, participants focused on the following questions:

- What themes/scenarios are missing from these lists?
- Which themes/scenarios would be most plausible and useful to simulate?
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?

Virginia & West Virginia Small Breakout Group Discussion

General feedback and questions

- Can a city use these scenarios outside of an MS4 to offset reductions they may not be making?
    - Response: At a local level, a jurisdiction could use this information to determine how much work will have to be done between now and 2025, with the recognition that the adoption of certain infill policies may reduce the workload for offsetting those loads.
- Will these scenarios consider that policies may affect change?
- Note that West Virginia is not a Dillon Rule state, but that Pennsylvania is; perhaps Virginia and Pennsylvania could work together to develop alternative future scenarios.
- Participants suggested how to produce results that distinguish between different types of growth: how much did commercial, residential, mixed use, and industrial land uses grow? A follow-up suggestion included considering agricultural intensification as a unique form of growth.
- Participants also suggested forecasting land use to a later date than 2025. This would help account for scenarios that operate on longer time-frames, such as a climate-based scenario, in which sea level rise impacts may not be realized until 2050 or later.

Mary Gattis, who was facilitating the small group, asked each participant to **record scenarios that they think are missing in the provided list**. Suggestions for scenarios are listed below:

- Recommendation to include a greater explicit focus on water quality. In other words, what would the landscape look like if it were designed to protect drinking water supply, reduce the largest sources of load, and meet the water quality goals under the TMDL? This would essentially work backwards from stated water quality goals to produce a best-case land use scenario.
- There was a suggestion to model fringe development around an urban center. This would include concentrating growth around urban areas, but would also consider infrastructure that may be able to absorb population growth without resulting in construction.

- Geologic scenario: Include datasets of geographic variables as limiting factors. For example, karst topography serves as a limiting factor to development.
- Climate-Based scenario: This would include data related to subsidence, accretion, and sea level rise. In this scenario, population growth would not occur near water bodies, but would shift inland. This scenario was suggested by multiple participants.
    - A few participants noted that a scenario in which growth is focused along coasts should not be recommended.
    - Another participant made the case that visualizing growth concentrated on water bodies would still be a useful scenario, and supported the idea of a climate-based scenario.
    - An attendee noted that this scenario would require forecasting land use to a later date than 2040 in order to see environmental changes.
- A Planned Infrastructure scenario was suggested: This would assume that all development that is planned or in the process of being planned would be fully executed in the near future. This scenario would help serve as a worst-case scenario for jurisdictions to visualize the extent of impervious surface growth if their current projects are implemented as-is.
    - Several participants made follow-up suggestions to consider transportation projects when projecting growth, with the recognition that in some instances, growth will deliberately not occur near transportation corridors based on policies in place.
- Vacant Housing Stock scenario: This scenario would account for existing housing capacity to absorb new population growth. If a community has a high capacity, population growth would not spur significant development compared to a situation in which the housing capacity is reached.
- Green-Technology Developments scenario: Assuming there are advancements in green-technology, how would this impact growth projections? Included in this scenario would be consideration for how expanding solar-power infrastructure will increase land development, specifically in relation to agricultural land.
- Mixed-Use Growth scenario: In this scenario, development and growth would be localized to minimize transportation. For example, future development would cluster resources such as grocery stores together with neighborhoods so that commercially zoned areas and residentially zoned areas would be blended.
    - There was a suggestion from participants that this scenario could constitute a combination of previously suggested scenarios.
- Political Landscape scenario: Recommendation to consider how federal and state policies may affect the ability of certain localities to develop.
- There was a suggestion to analyze how increasing median household income would affect where and how growth occurs.
- An attendee suggested a metric by which to evaluate the alternative future growth scenarios. They suggested conducting an analysis to look at the impact of green infrastructure development relative to past nutrient and sediment loads. This would help localities determine if their development interventions had an impact on nutrient and sediment loads to the Bay.
- Another participant raised a suggestion for a metric by which to evaluate the scenarios: to examine any co-benefits associated with the assumptions and practices informing the scenario. For example, jurisdictions should consider co-benefits associated with land conversion when evaluating a scenario.

Mary then asked participants to review the list of suggested scenarios, and **rank the top 2 scenarios** that would be most plausible and useful for jurisdictions. The aggregated results of this ranking are provided below, where 1 represents the highest priority scenario:

1. Combining Land Conservation & Rural Character into one scenario, which includes reducing farmland/forest fragmentation, was the **top priority**.
2. Infill & Redevelopment Scenario, including smart growth and green infrastructure.
3. Transportation Infrastructure and Corridors: this scenario would assume that all planned infrastructure projects are implemented, and that growth concentrates near transportation corridors (unless otherwise stated by policy and zoning information). This scenario also factors in infrastructure constraints, specifically related to sewer/septic areas.
4. Climate-Based: This scenario would include projected data for land subsidence, accretion, and sea level rise. Population growth would not occur near water bodies, and this scenario would best be represented when modeled past 2025.
5. Combination of Historic Trends and Land Conservation: this scenario would use conservation policy and implementation to offset impacts of projected population growth.

- Mary Gattis suggested considering a Transect Scenario: this would divide land use into six sectors, where each sector has a different scale of development. Then population would be distributed along each sector, such that the infill and redevelopment sector would have high population growth, and rural lands would have low population growth.

The group then prioritized their top recommendations to bring back to the larger group to present, as noted above.

Delaware, Maryland, and Washington D.C. Small Breakout Group Discussion

General feedback and questions

- Climate Change and Sea Level Rise scenarios are important for planning infrastructure, communities, health, etc. Saltwater intrusion was also raised as an issue as it will alter the soil composition.
  - Adaptation and resiliency to climate change should be considered as well. How do we count in resilience and adaptation measures?
  - Adaptation and mitigation are important, and both types of action should be represented in any Climate Change scenario.
- One participant asked the group to define "rural character."
  - Response: An area that has large lot zoning and is not as intensive in development. That scenario increases the potential for rural areas to absorb growth and development as urban centers become saturated.
  - Do we have the baseline that we can measure alternative futures by?
    - Renee Thompson clarified that the historical trends are our baseline for the past, and the alternative futures are options or pressures that could change from the historical trends.
- Infill and Redevelopment should be separated out into different factors, as they have different end results in land use/cover that have water quality impacts. Infill as defined in some areas is the "filling in" of greenfield near urban areas. Redevelopment is where existing development is changed to accommodate higher density. From a water quality

perspective, redevelopment is better than infill. The most impactful to water quality improvement is redevelopment, and infill tends to degrade water quality.
    - The land change model definition related to infill and redevelopment of those two things is slightly different; for the model it is the amount of housing that was absorbed into the existing urban footprint but was not seen as a change in land cover on the landscape. Definitions and clear explanations related to communicating these scenarios are important to bring in to this process.
- The model may need to adjust for different jurisdictions looking for water quality improvements, since there are different stormwater regulations from jurisdiction to jurisdiction.
- There is a need to further quantify what effect the Infill and Redevelopment scenario would convey (particularly around whether there would be a load reduction).
    - Note that there will be a shift in land use as mixed-use development becomes more prevalent (do the current scenarios take this into account? For example, with redeveloped strip malls?).
- Consider the likely coming change or possible impending collapse in brick and mortar retail, and the impact on land use and development (for strip malls but larger malls as well).
    - Note that with the lack of wifi coverage, rural areas may be very under-resourced in the future if these commercial areas collapse.
- Alternatively, how will the potential expansion of information infrastructure in rural areas change the landscape?
    - Is a whole scenario missing that needs to be added, or are these assumptions or add-ins to all the scenarios that need to be considered?
- Peter Claggett asked the group: How important is it to build in internet infrastructure in projecting land use and growth?
- There is a need to consider wastewater treatment plants (WWTPs) and their projected capacity changes to accommodate changing populations.
    - There is a further need to consider that there is a lot of new technology in wastewater treatment, so the net effect of that growth isn't linear to additional input loads. (Don't assume that a historic trend will equal a linear projection.)
        - Many areas (MD and DC) have already invested and got credit for WWTP upgrades. There will not be an incentive for some areas.
- There is a need to look at the amount of capacity and discharge levels of WWTPs as they are very important at the municipal level, and at every level, and should be considered in the scenarios.
- Renee asked the group: Should we have a standalone WWTP and internet scenario or add in to existing scenarios?
    - We need household development that will expand to WWTP vs. households that stay on septic as that will change water quality impacts significantly.
    - On the other hand, WWTPs add nutrients directly, and the other factors like internet or redevelopment are secondary/tertiary.
- How should increasing animal operations to feed future population growth be considered in the scenarios?
    - Note that this question won't necessarily lead to an increase in nutrients as the scenario needs to relate to water quality.
    - One participant noted that they are replacing chicken houses with larger areas of free-

range chickens, so the land footprint grows but the amount of chickens will stay the same.

- How are we setting aside land for agriculture and farms to feed growing populations?
  - There was a bit of a divide in the group on how important agricultural expansion is. Some felt the water quality impact was not enough to warrant a scenario, and others did not feel this way.
- A participant noted that there is a lot of international investment in chicken production in the watershed, and it might be worthwhile to look at international economic trends and how they might impact land use.
  - Another participant noted that international countries are buying land to produce food and ship it back to their countries too, so what does that mean for future land use in the watershed?
- A question was raised about preserved and conserved agricultural land.
  - Renee Thompson responded that currently only conservation easements are preserved in the model, but they might also add in agricultural zoning and preservation district information to inform future agricultural land in scenarios.
- Should Agricultural zones be included in a "policy" scenario?
- A question was raised is the scenario supposed to be universal as the results would differ substantial if it is created around a local concern versus a watershed wide scenario.
  - Renee responded that they will be running the scenarios by state, and will be taking statewide concerns into account. Renee also noted that for the small group discussion, standalone scenarios could be considered or they can be consolidated into whatever seems most plausible to the participant.
- There will be differences between local jurisdictions as well as what they will be interested in. There is hope to produce a range of scenarios in terms of water quality considerations from worst to best, with in-between scenarios having impacts on water quality.
  - A participant noted that a "Business-as-Usual" scenario should be considered at the very least.
- A participant noted that a lot of these suggestions are mechanisms that will give us growth and development patterns, and there is a need to make a distinction between those and the big themes in these scenarios.
- Is there a need to define what is a factor/policy/action that will support or influence the themes?
- Infrastructure in urban areas facilitates infill, but infrastructure in rural areas encourages other things, like sprawl.
- With historical trends, does that assume current policy? Does that make any distinction between policies that could continue or those that are unsustainable?
  - There is a possibility to do a combination of current trends and future factors.
- Peter Claggett noted that they can make zoning and policies a soft or a hard guideline in the model -- whichever is most helpful.
- One participant noted that in Maryland, they use historical trends as a projection and they use current policies and zoning to determine how that projection is distributed.
- It might be helpful to consider a "Business as Usual" scenario, unconstrained, and a "Business as Intended," constrained with policies put in place in the last 10 years. The distinction between business as usual and business as intended might be helpful.
  - It is important to consider historical trends vs. current policies and factors in place.

    - Renee noted that themes for consideration include redevelopment, a "Historical Trend-as-Future-Projections," and business as intended would be "Policies-in-Place-Last-Ten-Years."
- A participant noted that Delaware and Virginia don't have land use authority, which is delegated to counties.
- Peter Claggett noted that they have zoning by state, but the data comes in by county. In those counties that don't have zoning, they need proxies like infrastructure patterns. While there is variability within state, they need a consistent, narrative aggregated to the state level.
    - A participant noted that it is important not to assume that public policy will be the main driver of future growth and development as zoning is not the only factor to consider. In some places, drivers are local businesses, retiree destinations, other behavior changes, etc.
- Another participant noted that in the last year, the largest change in land use was renewable energy sprawl. So what happens to those large tracts of land in terms of land use projections? Or sprawl from increased highway usage due to self-driving cars?
    - Another participant asked if that may be a disruptive technology?
- Future annexation areas that should be included in the scenarios and determining water quality impacts in the model.
- Do all the scenarios have to be proposed now? There may be a need for some time to experiment with innovative scenarios after the forum to see what works and what else could be used.
    - Renee responded that the goal for the meeting is to talk to the experts and get a direction that everyone is comfortable with, and it may be that after the group revises the future scenarios, they make come back to participants for review.
- We need a current policy scenario that includes a lot of infrastructure that might be driving future growth.

Major Themes and Scenarios:

- Historical Trends: Highest priority
- Hybrid Current Policy (Business as Intended): Looks at historical trends but incorporates recent policies' effects on landscape. This scenario would also include infrastructure, natural resources, etc. Highest priority
- Rural Character combined with Conservation - Hybrid (Utopia scenario): Growth will be redirected to conserve most possible natural resources and rural areas: Highest priority
- Discussion around the top themes and scenarios included:
    - It would be very helpful to consider infrastructure like WWTPs and load caps in consideration in those scenarios.
        - Renee noted that they could run that scenario with and without WWTPs as an added component.
    - Another participant noted that the WWTP issue matters a lot because state practices have a lot of variability, future technology may be quite different, and the future terms of the waste local allocation (WLA) cap are currently unknown.
    - Another participant noted that Rural Character and Conservation seem similar, as purchasing the land and zoning it achieves the same end.
        - There's a difference in local control as well—conservation is usually up to the individual landowner, and zoning is a government entity.

        - Note that the scenarios are hypothetical extremes of any rule—these rules are applied to all of the possible land rather than the piecemeal reality you will actually get.
- Renee summarized the top scenarios that had been discussed thus far which included: combined Infill and Redevelopment, and Conservation and Rural Character also combined into one hybrid scenario.
- Another participant brought up the issue of trading and offsets programs and the related shift in money sources and implementers to companies rather than governments.
- The deregulation scenario is laissez faire and will contrast with regulated and conserved lands.
- Renee asked the group: What about climate change and sea level rise (SLR)?
    - SLR is an important factor to development and should be included in these scenarios.
    - A few participants noted that "Climate" could be an add-on to any future scenario.
- Renee summarized the following potential top scenarios from small group discussion:
    - Business as usual (BAU)
    - BAU + recent policies
    - Infrastructure
    - Climate change
    - Redevelopment— note that this could include retail changes and reusing collapsed retail, and non-traditional redevelopment. Redevelopment and infill need to be defined clearly as they mean different things in different jurisdictions.
        - A participant noted that this could be positive or negative--deliberate or left alone

What policies, actions or factors support the development of these three scenarios?

- Scenario/theme 1: Business as Usual (BAU), with only Historic Trends
    - One participant asked asked to clarify what "no constraints" means?
        - Renee replied noting that it means no future constraints of new policies or recent innovations.
- Scenario/theme 2: Hybrid of BAU and new policies implemented as intended, with new infrastructure
    - It could be possible to expand the services from the urban center outward, and encourage densification to attract growth to the urban areas.
    - Note that most of these policies we have are historic and have been around for decades in a fairly heavily regulated landscape. What are the primary differences between scenario 1 and 2?
    - Are policies taken into account with the future scenarios?
        - Renee replied that this introduces the intention of the policy as a constraint in the scenario that isn't currently present in historical trend growth.
    - Another participant noted that the current historical trends scenario is taking areas of current density and expanding new growth near to where growth has already occurred, without any input from policies or actions.
    - An example of policy-influenced growth is that growth would be constrained to priority funding areas and planned policies.
- Scenario/Theme 3: Hybrid of Land Conservation/Infill-Redevelopment/Rural Character ("Utopia" scenario)
    - A participant noted that this scenario needs to incorporate constraints on growth like WWTPs, and the need that when there is overflow of the existing capacity, a release

valve needed to be added.
    - Renee asked the group: What actions or policies would influence this scenario?
        - A participant noted that it would be possible to expand services from the urban center outward and encourage densification to attract growth.
- A participant noted that it might be helpful to identify policies or factors that you would like to see in any of these scenarios, such as new technology or infrastructure changes.
    - A participant noted that it is important to incentivize water quality improvement actions so any conservation scenario has to include federal-state assistance to municipalities.
    - It is important to allow flexibility around treatment facilities, either for building new plants or increasing capacity of existing plants.
- A participant stated that it would be helpful if we could better simulate the devolution of funds to municipalities to better simulate local control of land use changes (given that in some states the counties and municipalities have authority over that).
- Other factors to consider include the: Attitude of younger generations, business-friendly federal attitudes, availability and amount of block grants to local jurisdictions.

The group then prioritized their top recommendations to bring back to the larger group to present, as noted above.

Pennsylvania & New York Small Breakout Group Discussion

Themes/Scenarios not currently captured in projections:

- Antonia Price asked the group to brainstorm themes, scenarios, and considerations that are not currently captured in the eight scenarios provided.
    - Antonia reiterated the need to generate top three scenarios and policies necessary to make them a reality in the small group discussion.
    - The group recognized NY representatives were absent from the discussion and highlighted the need for watershed-wide focus and including NY in addition to PA.
- A participant noted that the impact of different types of land uses and how they are zoned by localities was cited as an important metric and impacts on water quality (including impacts on stormwater, TMDL, etc.).
- Utility Capacity and Restrictions need to be taken into account -- they must have capacity and resources for development to occur (reservoirs, tanks, etc.).
    - Examples include wastewater treatment plant capacity as a limiting factor for population growth, and high-speed internet as a catalyst for employment center development and growth in small communities. There is also a shift from current population centers to more rural areas.
    - A participant noted that included in this scenario should be sewer and septic system capacity (consider nutrient constraints in conjunction with population demands).
    - The substantial build out potential may not be currently captured in the scenarios. Note that once infrastructure is extended, these additional areas act as development catalysts that must be considered (at either end and between).
- Regarding Energy Policy and Development -- there are many shale communities in the watershed that generate significant amounts of revenue with small populations, so that may act as a confounding factor in growth projections. Pipelines may be next with

unknown influence due to low employment potential, but high revenue and impacts on forests (and therefore water).

- Antonia suggested that the group think of broad-scale themes in order to distill down to a more narrow set of scenarios.
- A participant noted that the distinction between development, land suitable for development, and agricultural areas are all important to consider. Many projections don't account for the capacity for agricultural land to act as a hub for development, particularly as it relates to animal agriculture and the construction of impervious agricultural surfaces, but also in terms of intensification.
    - Several participants suggested that the group may want to include definitions of agriculture with Concentrated Animal Farming Operations (CAFOs) versus crops, or rating intensification related to water impacts and the economics that drive agriculture.
- Regarding transportation and improvement programs, it would be important to account for planned infrastructure and how that may interplay with population growth. Looking at long-range transportation plans- Transportation Improvement Programs (TIPs) – would be helpful to consider as well.
    - As they are not taken into account in the scenarios, several participants were unsure where the large transportation plans were coming from in the scenarios.
- A participant noted that it would be helpful to consider automation in the workplace and how that will impact employment availability and resulting population change. Where growth will go and how much will happen?
- Climate Change: how will increased sea level rise impact growth? Climate-related factors should be taken into consideration as well.
    - Floodplain protection is key in PA, and could change how population and development grows on the landscape.
- Economic considerations should include how salary increases will impact population growth and rural vs. suburban.
- Considering green infrastructure (roofs, bio-swales, and green gutters): How effective are they and how will they perform over time? Regarding current best management practices (BMPs), how do they perform out to 2070?
- Healthcare, hospitals, public services, school quality all have an effect on where development occurs.
- Antonia then asked the group to identify themes and scenarios that would be most useful and plausible.

Themes/Scenarios that are most plausible and useful:

- Expanding the Land Conservation scenario to be more inclusive and include farms, forests, riparian areas, floodplains, wetlands and all areas that could be conserved would be helpful.
- Combine elements into a "Best Case" scenario with strong infill and redevelopment, smart growth, green infrastructure, along with land conservation and agricultural intensification/preservation.
- A participant recommended modeling decreasing effectiveness of BMPs and the impact that may have to future land use. (Note that this would not necessarily be considered a scenario, but rather a metric by which to evaluate.) The BMP longevity issue could be incorporated in multiple scenarios -- particularly related to Current Policies, Infill +

Redevelopment, and a Green Infrastructure approach.

- There was a suggestion to model Historic Trends with conservation zoning.
- It could be helpful to redefine Rural Character scenario to Agricultural Activity – High Intensity, including more fine-scale data than county-level agricultural census information, and factoring in agricultural activity and capacity.
    - There was a recommendation to consider agricultural activities, and how they impact water quality. A heatmap of densities or types of agricultural operations could be helpful.
    - As agriculture intensifies, there should be some water quality-protecting interventions commensurate with that in the scenarios.
    - A participant suggested to blend this scenario with Infill and Redevelopment, but to also include utility restraints.
- Current Policy could be combined with Infill and Redevelopment scenario to include negative impacts of agricultural activity, and/or shifts in eating habits and impacts on land.
- Transportation and New Development could include residential and industrial transportation and development, and this scenario would consider the far-reaching capacity for increased population that new and improved transportation networks produces (the build out that comes from new development).
- Focusing on Current Policies and Rural Character separately would be helpful (there is a bias in discussions related to agriculture and CAFOs). There is an economic reality that we perceive as "rural" vs. agriculture. Most of PA watershed is truly rural. There is also the economics of CAFO's close to urban centers to consider. Is it possible to take advantage of true rural area (through transportation) instead of letting economy drive concentrated farming? Foodshed planning should be included as well.
- Better and more reliable transportation should be included in the scenarios.
- Improved policies (especially environmental) in scenarios should be considered in the scenarios as well, particularly around how they apply to infill and redevelopment, as well as development.
- Utilities & Infrastructure: Combining roads, sewer, water, internet, transportation, and all other public services will help define where there is high population density, and where there is likely to be expanded growth.
- Discussion of policies that would support these themes:
    - The upzoning of rural areas.
    - Service-agreements: certain areas have agreements with utilities not to provide service outside of designated areas.
    - Polices to incentivize healthy activities for the Bay, especially related to transportation (e.g. Building out roads can have a negative effect). If there is improvement to include other types (like rail), that could be good, but there is a need to determine how to include and define that (and how to consider both sides of the coin, both good and bad).

Top Themes and Scenarios (group conversation to combine themes above):

- Infrastructure scenario- expand this scenario to include utilities, roads/transportation, sewer, water, internet, energy, green infrastructure, public and health services, etc. Impacts population and user density should be included as well.

- Agriculture scenario- is current missing the impacts of agricultural development on water quality (e.g. watershed plan shows too many animals, but we are still seeing growth. Agricultural development impacts surface water resources, but there is nothing is slowing it down). There is a need to look at high intensity agriculture and crops vs. animals/CAFOs, as well as the economy of agriculture including market dynamics/commodity price increases. There is a need to aggregate and integrate the land base and impacts.
    - As agriculture intensifies, there should be commensurate water quality or conservation to keep in step with the intensification including conserving wetlands, drainage areas to waterways on farms, keeping cattle out of streams. Mitigation is something to consider as well as the consideration that agricultural is a land use and business (including an economic driver).
    - Technological advancements/requirements/incentives to consider include manure digesters and vertical farming.
    - It is important to consider consumer preferences for a greater trend toward hormone free, free-range meats etc. to the animal intensification consideration only. Economic costs and land requirements are associated with free range should be considered as well potentially conducting a foodshed analysis with transportation and other impacts. There is a need to consider local level policies related to food sources.
    - There is a need for a separate and related effort to do agricultural census to 2030.
- BMP's could be included in the "Current Policies" scenario with a focus on water quality impacts in addition to stormwater management. Model the assumption that BMP effectiveness decreases as time goes on could be helpful and then see what happens to water quality. On the other hand, it might be helpful to model technology improving effectiveness of BMPs in the future, which may include improved municipal zoning.
- Automated workforce- large scale technological advances impacting population and employment dynamics should be considered. The private sector with markets moving toward automation (cars, retail, other industry) should be taken into account as well -- some estimates say 20% of malls will be closed in the future.

The group then prioritized their top recommendations to bring back to the larger group to present, as noted above.

Building Consensus around a set of plausible and useful scenarios

After the small group discussions, participants reconvened to share their top prioritized scenarios. Christine Gyovai facilitated a large group discussion that included clarifying prioritized scenarios for each small group, and then grouping and clarifying themes into a revised list for large group prioritizing.

Small group discussion prioritized scenarios

Virginia & West Virginia:

1. Combining Land Conservation & Rural Character, which includes reducing farmland/forest fragmentation, was the top priority scenario.
2. Infill & Redevelopment, including smart growth and green infrastructure.

3. Transportation Infrastructure and Corridors: this scenario would assume that all planned infrastructure projects are implemented, and that growth concentrates near transportation corridors (unless otherwise states by policy and zoning information). This scenario also factors in infrastructure constraints, specifically related to sewer/septic areas.
4. Climate-Based: This scenario would focus on climate resiliency, and include projected data for land subsidence, accretion, and sea level rise. Population growth would not occur near water bodies, and this scenario would best be represented when modeled past 2025. It should be focused for the long-range and on buildable areas, specifically the most important factor is the shift in population as a result of climate changes.
5. The group had significant discussion on how 2025 is short-term, and that forecasts for specific scenarios may be appropriate for time-scales longer than 2025.
6. Additional scenarios that were considered include changes to policy and development based on current political climate, and the adoption of policies at state or local level may preclude certain other scenarios to play out.

Maryland, Delaware, and Washington D.C.:

1. Renee Thompson summarized the top three major scenarios recommended by the breakout group. They include:
2. Historic plus policy – both intended and infrastructure
3. Baseline and Historical Trends - Hybrid current policy (Business as Intended)—looks at historical trends but takes recent policies' effects on landscape, would also include infrastructure, natural resources, etc.
4. Rural character combined with land conservation and infill/ redevelopment hybrid ("Utopia" scenario): growth will be redirected to conserve most possible natural resources and rural areas.
5. The group also noted that re-development is more important than infill for the MD/DE/D.C. area, with a suggestion to separate out those two policies.
6. Considering how elements of the built environment will be repurposed will be important. In other words, is there growth capacity in certain areas that would be able to absorb future population growth?
7. There was a suggestion to model the effects of broad infrastructure development and the expansion into rural areas, and to consider changes in wastewater treatment plants and their capacity.

Pennsylvania & New York:

1. Agriculture and agricultural intensity, including commodity prices, and different levels of intensity. Some policies that we considered include looking at food-sheds, where agricultural products are being shipped, land use impacts of free-range and organic production systems, and the policy implications of technology. In terms of land use scenarios, we would recommend considering the impact of utilities and infrastructure (such as road networks, rail lines, sewer systems, water resources), agricultural intensification as a depressant on agricultural growth but commensurate with population growth, and the effect of technological shifts. We recommend looking at the impact of stormwater and other water quality BMPs when evaluating these scenarios.
2. Build a scenario based on utilities and infrastructure including roads, internet, schools, sewer, power and rail. This would include looking at the impact of utilities on the watershed, long-range transportation plans (transportation corridors), and utility service areas' impacts on the

likelihood of development.

3. Employment shift due to technology and retail -- technology and employment factors in the forecasts. For example, how will automation might development and population growth in certain areas?
4. BMP's should be taken into account as well across all the scenarios, particularly to include stormwater, BMP effectiveness over time.

Large group questions and discussion included:

- One participant commented that land conservation could be combined with infill and redevelopment, which could be captured within the rural character scenario.
- Another participant asked about the impacts and consequences of agriculture in future land use?
  - Peter replied that the Agriculture Workgroup is tackling this issue.
- Another participant asked how 'rural' is defined?
  - Peter replied that it's partially defined based on distance to urbanized areas, incorporating data on Census Urbanized Areas.

Ranking and Prioritization of Proposed Alternative Future Scenarios

After the small group presentation of top ideas, Christine asked participants to rank the suggested scenarios using consensus decision-making. The ranking was determined by the observed level of support by participants using a test for consensus decision-making based on the number of fingers participants held up to support ideas (three fingers indicate full support for the proposal or scenario, two fingers indicated support but with some questions or concerns, and one finger indicates too many questions or concerns to be able to support the proposal or scenario).

Results from these rankings of the top scenarios of the small group break outs, which were clarified and refined with the large group before the test for consensus, are below. Scoring metrics include High +, High, High -, Medium +, Medium, Medium -, Low +, and Low.

1. Combination of Land Conservation & Rural Character: High
2. Infill & Redevelopment: Medium +
3. Future Transportation Corridors & Infrastructure: Medium
4. Climate-Based (change and resilience, considering sea-level rise, long-range planning and buildable areas, and factoring in future shift in population and impacts: Medium +
5. Agriculture/Agricultural Intensity (including foodsheds, shipping of agricultural products, free range and organic food, technology): Medium –
6. Technology and Employment changes: Low +
7. Current Policy + Transportation Corridors + Future Infrastructure: High +
   a. Note that this scenario accounts for **all** infrastructure, including planned infrastructure, transportation corridors, infrastructure capacity, and infrastructure constraints.
8. Historic plus policy as intended (including infrastructure, planned roads, planned energy development, information (rural broadband), and service areas: High +
9. Rural Character + Land Conservation + Infill and Redevelopment ("**Utopia**" Scenario suggested by DE/MD/D.C. breakout group): High +
   a. Rural character combined with conservation hybrid ("Utopia" scenario): growth will

be redirected to conserve most possible natural resources and rural areas.

Christine reviewed and synthesized the top five prioritized scenarios from the full-group rankings, listed below:

1. Utopia: Combination of #2 – #5 discussed below.
2. Current Policy and All Infrastructure: Current growth management policies and zoning combined with planned transportation and other infrastructure (e.g., sewer and water) improvements and constraints.
3. Conserving and Land and Preserving Rural Character scenarios: Up-zoning suburban/urban areas and down-zoning rural areas combined with aggressive land conservation with the goal of maintaining natural resources and rural open space.
4. Infill and Redevelopment: Added incentives to promote infill and redevelopment.
5. Climate-Based: Restricting development in areas prone to sea-level rise and storm surge.

Suggested metrics to consider when evaluating scenarios

Christine then asked participants to suggest metrics by which to compare or contrast prioritized the future growth scenarios. Suggestions included:

- Results summarizing the acres of forest loss and acres of added impervious land.
- Percent of impervious cover that is developed (with a focus on water quality impact) by small watersheds
- Small watershed outputs
- Wastewater Sector considerations, including infrastructure
- Change in use of BMP's for redevelopment for sites (for example, for many sites, when they were first developed there were no BMPs)
- Suggestion to potentially use MS4 areas as a metric
- Incentives for watershed coordination that result from certain scenarios
- Per-capita pollutant load considerations: how many acres of impervious land were added per capita, by state?
- Considering forest and farmland fragmentation, as well as large forest patches conversion. This metric would be particularly useful for smaller counties in the watershed.
- Concentration or excess of manure/animal densities is important to consider.
- Recommendation to consider the age of infrastructure for infill/redevelopment scenarios.

Peter then asked participants what spatial scale would be useful to analyze the results.

- One participant noted that results by government/federal/state-owned lands would be useful for jurisdictions to assess what land they have control over.
- The small-watershed scale was also cited as a useful scale.

At the end of the workshop, the large group spent a few minutes discussing the dynamic versus static TMDL decision-making model that is currently under consideration. Then, Mary Gattis and Karl Berger thanked participants for their participation and closed the meeting.

Next Steps and Timeline

Based on feedback from this forum, the Chesapeake Bay Program Office will revise the Historic Trends scenario and simulate a Current Policy scenario that accounts for local zoning data in three ways: excluding areas from growth that are zoned for "conservation", "open space", or similar designations; limiting the locations of forecasted residential and commercial growth to areas zoned for these land uses; and weighting the probability surface to favor areas zoned for "planned growth/development". The Historic Trends scenario will be used in the Current Policy scenario for jurisdictions that did not provide zoning data to the Chesapeake Bay Program Office or provided insufficient data (e.g., over generalized or lacking attribute descriptions). The revised Historic Trends scenario will be available for review in early August and the draft Current Policy scenario will be available for review in mid-August. The forecasts will be available for viewing and download through the Phase 6 Land Use Viewer website. Additional scenarios accounting for more aggressive land conservation, existing and planned infrastructure, upzoning and downzoning, and climate change will be simulated in the fall of 2017 and disseminated through the Phase 6 Land Use Viewer website.

Appendix A – Participant List

First	Last Name	State	Affiliation
Rod	Altenberg	PA	Penn Future
Stephanie	Armpriester	PA	Brandywine Conservancy
Richard	Baugh	VA	Local Government Advisory Committee
Jamie	Baxter	CB	CB Funders Network
Karl	Berger	CB	WashCOG
Ruby	Brabo	VA	Local Government Advisory Committee
Darold	Burdick	VA	Fairfax City
Ed	Bustin	PA	Local Government Advisory Committee
Kevin	Byrnes	VA	Regional Decision Systems, LLC
Daniel	Chao	DC	Local Government Advisory Committee
Peter	Claggett	CB	USGS CPBO
Jacob	Czawlytko	CB	CBPO - GIS staff
Sebastian	Donner	WV	WVDEP
Justin	Evans	PA	Mount Joy Township
Greg	Evans	VA	VA Dept of Forestry
KC	Fillippino	VA	HRPDC
Mary	Gattis	CB	Local Government Advisory Committee
Patricia	Gleason	CB	EPA
Lindsey	Gordon	CB	CBPO
Joe	Gorney	VA	Fairfax County Dept of Planning & Zoning
Normand	Goulet	VA	Northern VA Regional Commission
Penelope	Gross	VA	Local Government Advisory Committee
Christine	Gyovai		Dialogue + Design Associates
Josh	Hastings	MD	Eastern Shore Land Conservancy
Tara	Hitchen	PA	East Lampeter Township
Gina	Hunt	MD	MD
Claire	Jantz	PA	Shippensburg University
Charlotte	Katzenmoyer	PA	Local Government Advisory Committee
Bill	Keeling	VA	VA DEQ
Larry	Land	VA	Local Government Advisory Committee
Roy	Livergood	PA	York County Planning Commission
Leo	Lutz	PA	Local Government Advisory Committee
Stephanie	Martins	MD	MDP
Shannon	McKenrick	MD	Maryland Department of the Environment
Jennifer	Miller Herzog	MD	Land Trust Alliance
Philip	Morefield	CB	EPA
Brianne	Nadeau	DC	Local Government Advisory Committee
David	Newburn	MD	UMD

David	Nunnally	VA	Caroline County Planning
Matthew	Pennington	WV	WV Region 9 Planning Development Council
Don	Phillips	DE	Local Government Advisory Committee
Kelly	Porter	MD	Local Government Advisory Committee
Lucinda	Power	CB	EPA
Antonia	Price	PA	Shippensburg University
Jake	Reilly	CB	NFWF
Melissa	Scott	WV	Hardy County (WV) Planning Dept.
Ann	Simonetti	PA	Local Government Advisory Committee
Indrani	Sistla	VA	Fairfax County Department of Planning & Zoning
Tanya	Spano	DC	WashCOG
Taylor	Stark	CB	Alliance/CBP
Jennifer	Starr	CB	Local Government Advisory Committee
Steve	Stewart	MD	Baltimore
Jeff	Sweeney	CB	EPA/CBPO Staff
John	Thomas	PA	Local Government Advisory Committee
Renee	Thompson	CB	USGS-Chesapeake Bay Program
James	Wheeler	PA	Local Government Advisory Committee
Bob	Willey	MD	Local Government Advisory Committee
Bruce	Williams	MD	Local Government Advisory Committee

Appendix B -- Agenda

Future Land Use Growth Scenarios
AGENDA
June 7, 2017

Location: Crowne Plaza, 173 Jennifer Road, Annapolis, MD 21401

Problem Statement: Phase III Watershed Implementation Plans (due in April 2019) must account for anticipated increases in nutrient and sediment loads associated with population growth between 2019 and 2025, the end date for meeting the Chesapeake Bay TMDL goals. One way to account for changing conditions is to compare plausible scenarios of future land uses with current conditions. The Chesapeake Bay Land Change Model (CBLCM) developed by the U.S. Geological Survey at the Chesapeake Bay Program Office is designed to simulate future land use conditions for the year 2025 based on county-level population and employment projections while accounting for local zoning, the suitability of land for development, slopes, housing and employment densities, and other factors. These forecasts can be fed through the Bay Program's watershed model to estimate potential changes in nutrient and sediment loads that would result from changes in land use.

Under the direction of its Land Use Workgroup, the CBP plans to develop several future land use scenarios to bracket potential changes in land use resulting from a continuation of historic trends and/or partial buildout of lands zoned for development. The CBP would like to get as much local input as possible for designing future land use scenarios that are locally relevant and useful for Phase III WIP development.

Meeting Goal: Refine the Historic Trend scenario (aka "Business As Usual") and Identify alternative future scenarios that are plausible and useful.

10:00 AM **Welcome**
Hon. Bruce Williams, Chair, Local Government Advisory Committee
Karl Berger, Chair, Chesapeake Bay Program's Land Use Workgroup

10:15 AM **Workshop Overview/Purpose**
Mary Gattis, AICP, Director of Local Government Programs, Alliance for the Chesapeake Bay

10:30 AM **Introduction to Chesapeake Bay Future Scenarios: Narratives, Assumptions, Evaluation Metrics; and Applications**
Peter Claggett, U.S. Geological Survey

11:00 AM **Critique Current Trends**
Christine Gyovai, Dialogue + Design Associates

12:00 PM **Alternative Future Scenarios**
Claire Jantz and Antonia Price, Shippensburg University

12:20 PM **Lunch (provided)**

1:00 PM **Brainstorm alternative futures (facilitated sessions in three state breakouts)**

2:30 PM **Break**

2:45 PM **Building Consensus around a set of plausible and useful scenarios**
Christine Gyovai

3:45 PM **Summarize Recommendations & Next Steps**
Mary Gattis and Peter Claggett

4:00 PM **Adjourn**

Appendix C -- Presentations and Handouts

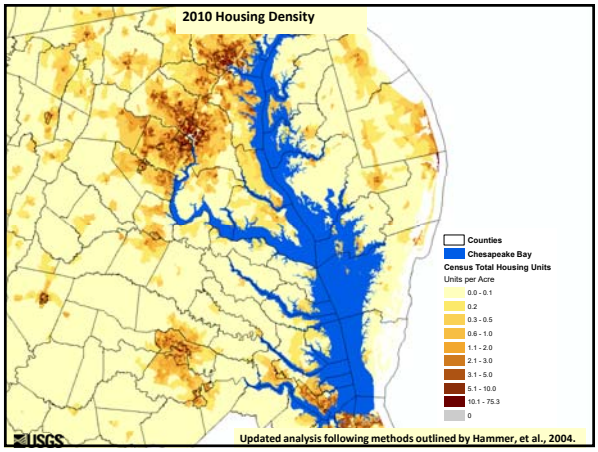
USGS
science for a changing world

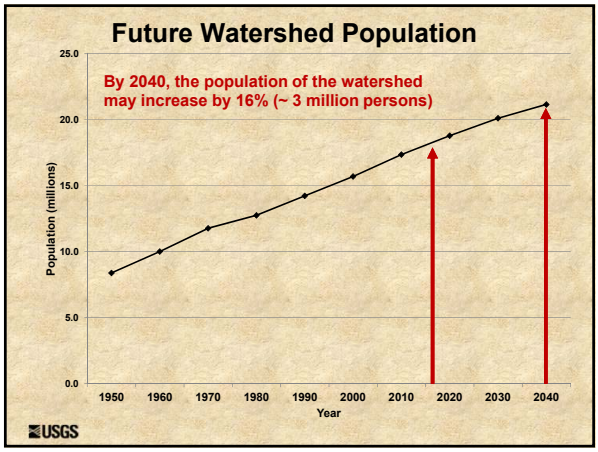
Future Urbanization in the Chesapeake Bay Watershed

Peter Claggett, Labeeb Ahmed, Jacob Czawlytko, David Donato, Fred Irani, Quentin Stubbs, and Renee Thompson

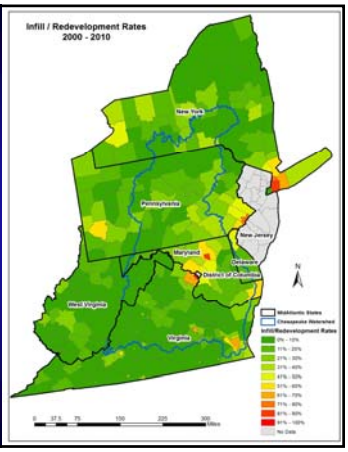
Chesapeake Bay Program's Local Government Forum
June 7, 2017

U.S. Department of the Interior
U.S. Geological Survey



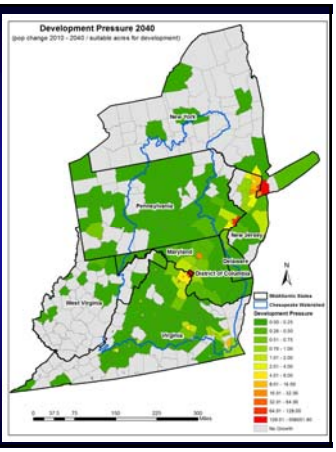


Estimated proportion of housing change (2000 – 2010) that did not result in an expected amount of land use change.



Example:

Montgomery County, MD
Population Change (2010-2040): 225,354
Suitable Land for Growth: 138,000
Development Pressure: 1.63

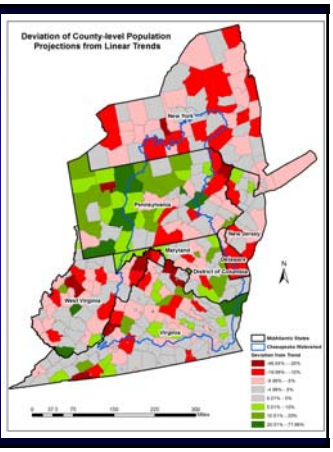


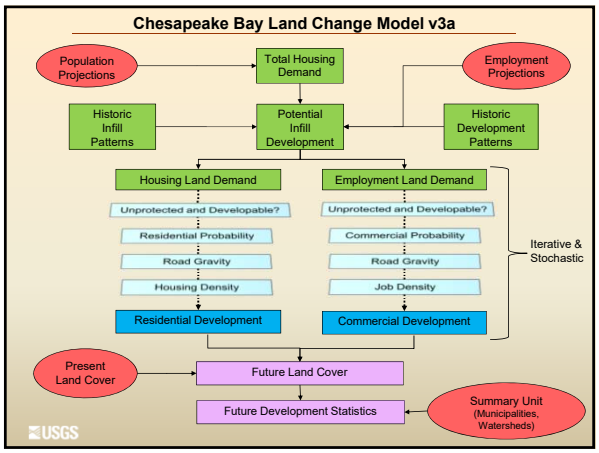
Example #1: Growing slower than expected

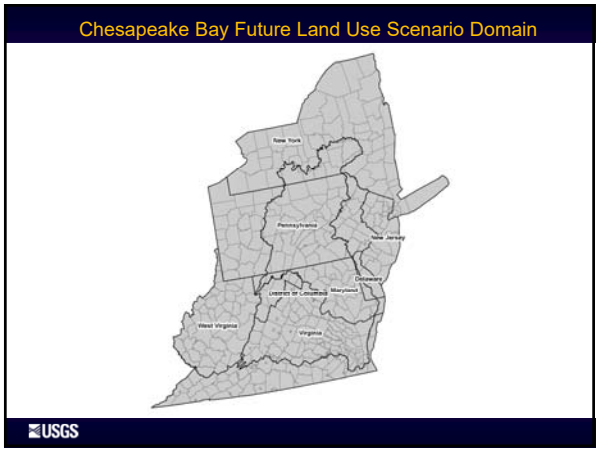
Loudoun County, VA
2040 Projected Population: 492,517
2040 Trends (2000 – 2015): 715,459

Example #2: Growing faster than expected

District of Columbia
2040 Projected Population: 940,687
2040 Trends (2000 – 2015): 811,060



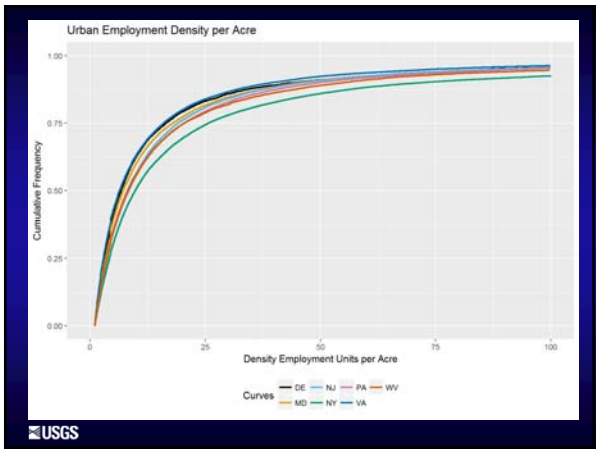


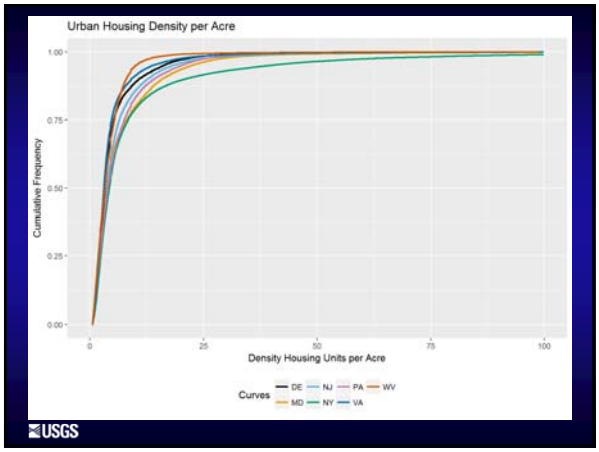


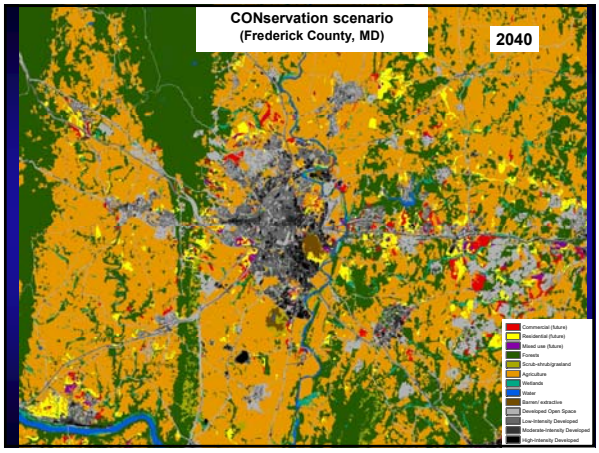
R^2 Values for Logistic Regressions

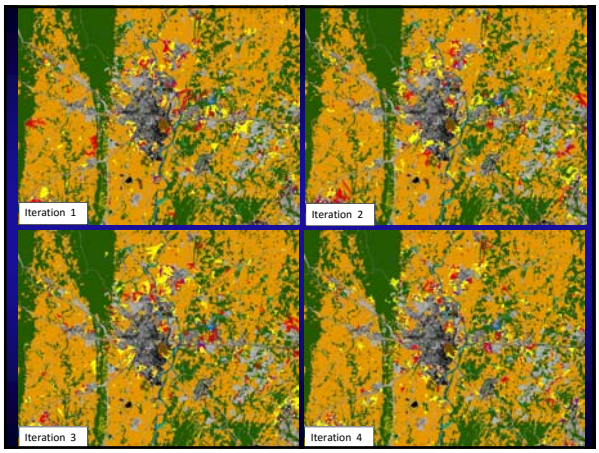
State	Residential	Commercial
Delaware	0.766	0.555
District of Columbia	n/a	n/a
Maryland	0.778	0.718
New York	0.871	0.867
Pennsylvania	0.835	0.821
Virginia	0.901	0.869
West Virginia	0.908	0.921

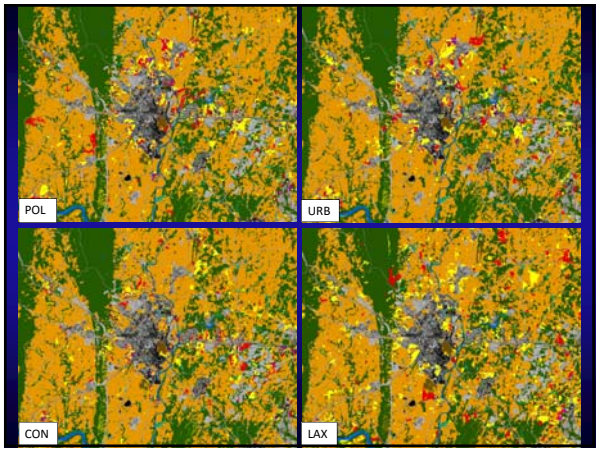
USGS

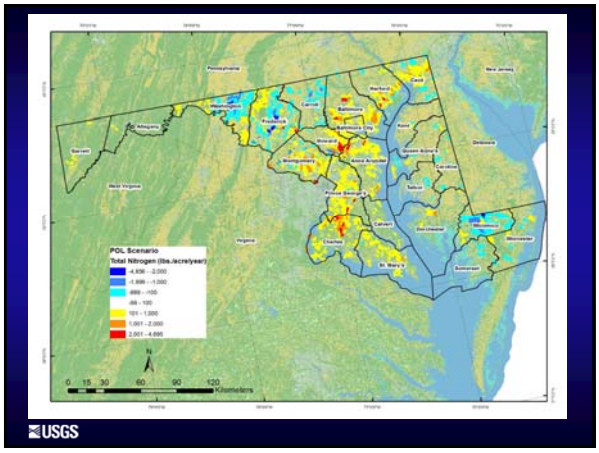

Urban Employment Density per Acre
Cumulative Frequency
1.00
0.75
0.50
0.25
0.00
0
25
50
75
100
Density Employment Units per Acre
Curves
DE
NJ
PA
WV
MD
NY
VA
USGS


Urban Housing Density per Acre
Cumulative Frequency
1.00
0.75
0.50
0.25
0.00
0
25
50
75
100
Density Housing Units per Acre
Curves
DE
NJ
PA
WV
MD
NY
VA
USGS


CONservation scenario
(Frederick County, MD)
2040
Commercial (future)
Residential (future)
Mixed use (future)
Forests
Scrub-shrub/grassland
Agriculture
Wetlands
Water
Barren/ extractive
Developed Open Space
Low-Intensity Developed
Moderate-Intensity Developed
High-Intensity Developed


Iteration 1
Iteration 2
Iteration 3
Iteration 4


POL
URB
CON
LAX


POL Scenario
Total Nitrogen (lbs./acre/year)
USGS

What can be changed in the model?

1. Demand for greenfield development
   - population and employment projections, infill/ redevelopment rates
2. Land available for development
   - zoning, easements, comprehensive plans, environmental constraints
3. Development capacity and density
   - zoning, subdivision ordinances, Transfer of Development Rights, Impact fees, urban service areas
4. Factors influencing the likelihood of development
   - proximity to recent development and/or employment centers, current land use (farms or forests), accessibility, amenities and dis-amenities, slope and other environmental constraints
5. Other
   - urban/rural boundaries; summary units (e.g., municipalities, watersheds), demand units (e.g., counties, metro areas, commuter sheds), densification rates; attractiveness of new development to roads and to areas of recent growth

USGS

Scenario Results For Review
Scales: P6 Land-River Segments & Counties

1. New development acres
2. Future population on sewer and septic
3. Residential land consumption rate (acres / household)
4. Commercial land consumption rate (acres/ job)
4. Forest acres converted to development
5. Farmland acres converted to development
6. Δ Total Nitrogen (# / acre / yr.)
7. Δ Total Phosphorus (# / acre / yr.)
8. Δ Total Sediment (tons / acre / yr.)

USGS

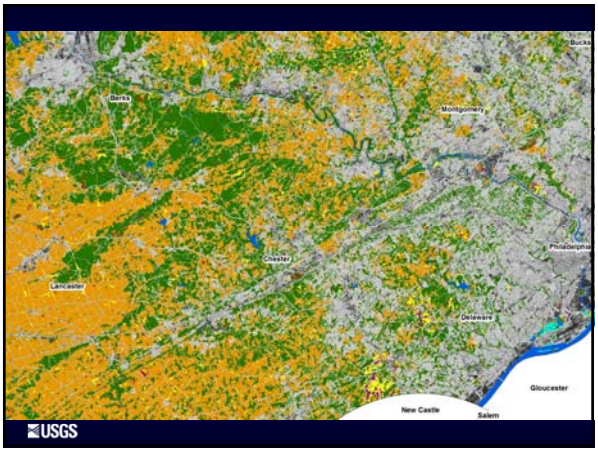
Optional Evaluation Metrics
Scale: P6 Land-River Segments & Counties

1. New impervious per capita
2. Large forest patches converted / total forest converted
3. Prime soils converted / total farmland converted
4. Forest and farmland fragmentation
5. Concentration or excess of manure
6. Loss of BMPs (due to the conversion of farmland)

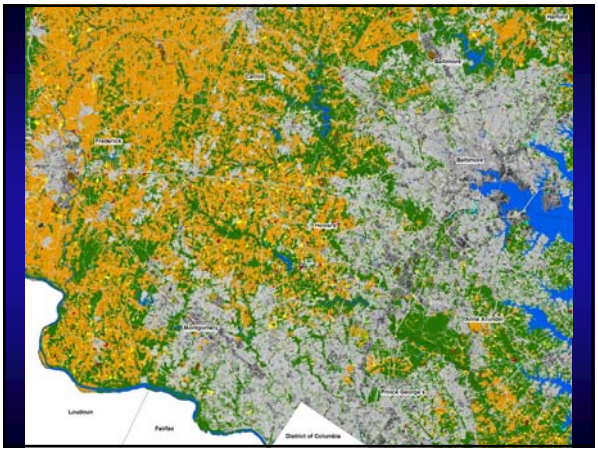
USGS

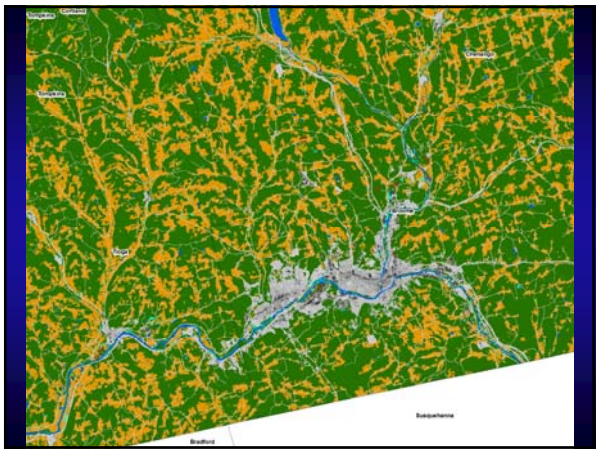
Chesapeake Bay Future Land Use Scenario Domain

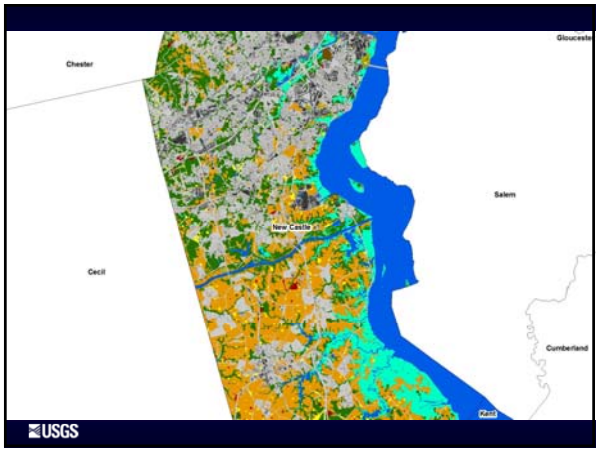
USGS

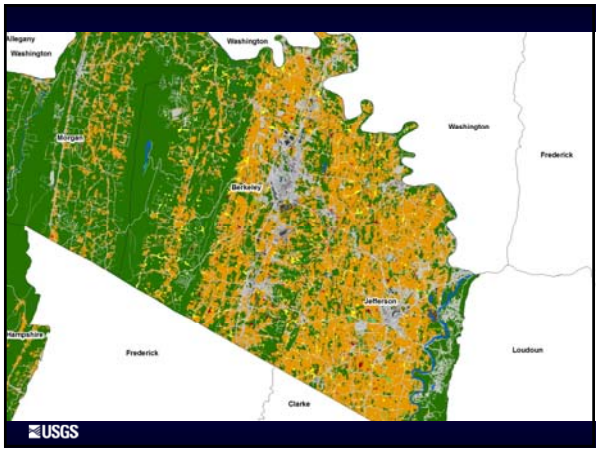


USGS

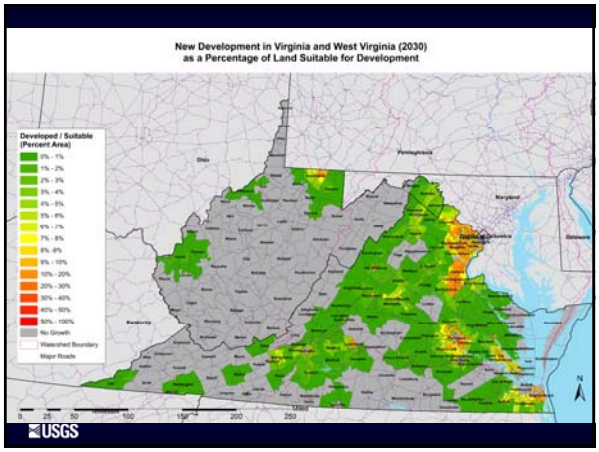


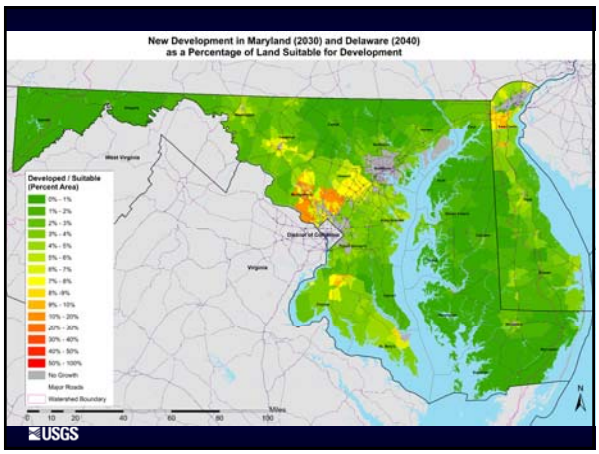


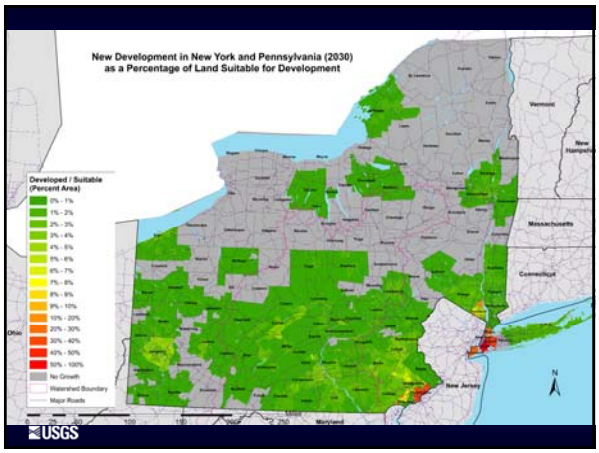

Chester
Salem
New Castle
Cecil
Cumberland
USGS


Washington
Washington
Morgan
Berkeley
Washington
Frederick
Jefferson
Frederick
Loudoun
Clarke
USGS


Caroline
Hanover
King William
King and Queen
Lancaster
Middlesex
Mathews
Gloucester
New Kent
Richmond
Henrico
James City
York
Williamsburg
Chesterfield
Hopewell
Colonial Heights
Prince George
Petersburg
Surry
Newport News
Amelia
Dinwiddie
Isle of Wight
Sussex
Southampton
USGS


New Development in Virginia and West Virginia (2030)
as a Percentage of Land Suitable for Development
Developed / Suitable
(Percent Area)
0% - 1%
1% - 2%
2% - 3%
3% - 4%
4% - 5%
5% - 6%
6% - 7%
7% - 8%
8% - 9%
9% - 10%
10% - 20%
20% - 30%
30% - 40%
40% - 50%
50% - 100%
No Growth
Watershed Boundary
Major Roads
Ohio
Pennsylvania
Maryland
Delaware
USGS


New Development in Maryland (2030) and Delaware (2040)
as a Percentage of Land Suitable for Development
Developed / Suitable
(Percent Area)
0% - 1%
1% - 2%
2% - 3%
3% - 4%
4% - 5%
5% - 6%
6% - 7%
7% - 8%
8% - 9%
9% - 10%
10% - 20%
20% - 30%
30% - 40%
40% - 50%
50% - 100%
No Growth
Major Roads
Watershed Boundary
West Virginia
Virginia
USGS



Future Land Use Scenarios:

Logically-coherent storylines and assumptions of factors influencing land use change that represent a full range of plausible futures.

Why?

To help jurisdictions account for potential future growth in pollutant loads as required by the Chesapeake Bay TMDL.

To inform long-range development, restoration, and conservation plans.

USGS

Potential Alternative Future Scenarios

"Historical Trends": patterns over previous decade(s) prevail.

"Current Policy": growth focused in areas with infrastructure and capacity.

"Land Conservation": more aggressive conservation of forests and farms.

"Rural Character": up-zone urban areas and down-zone rural areas.

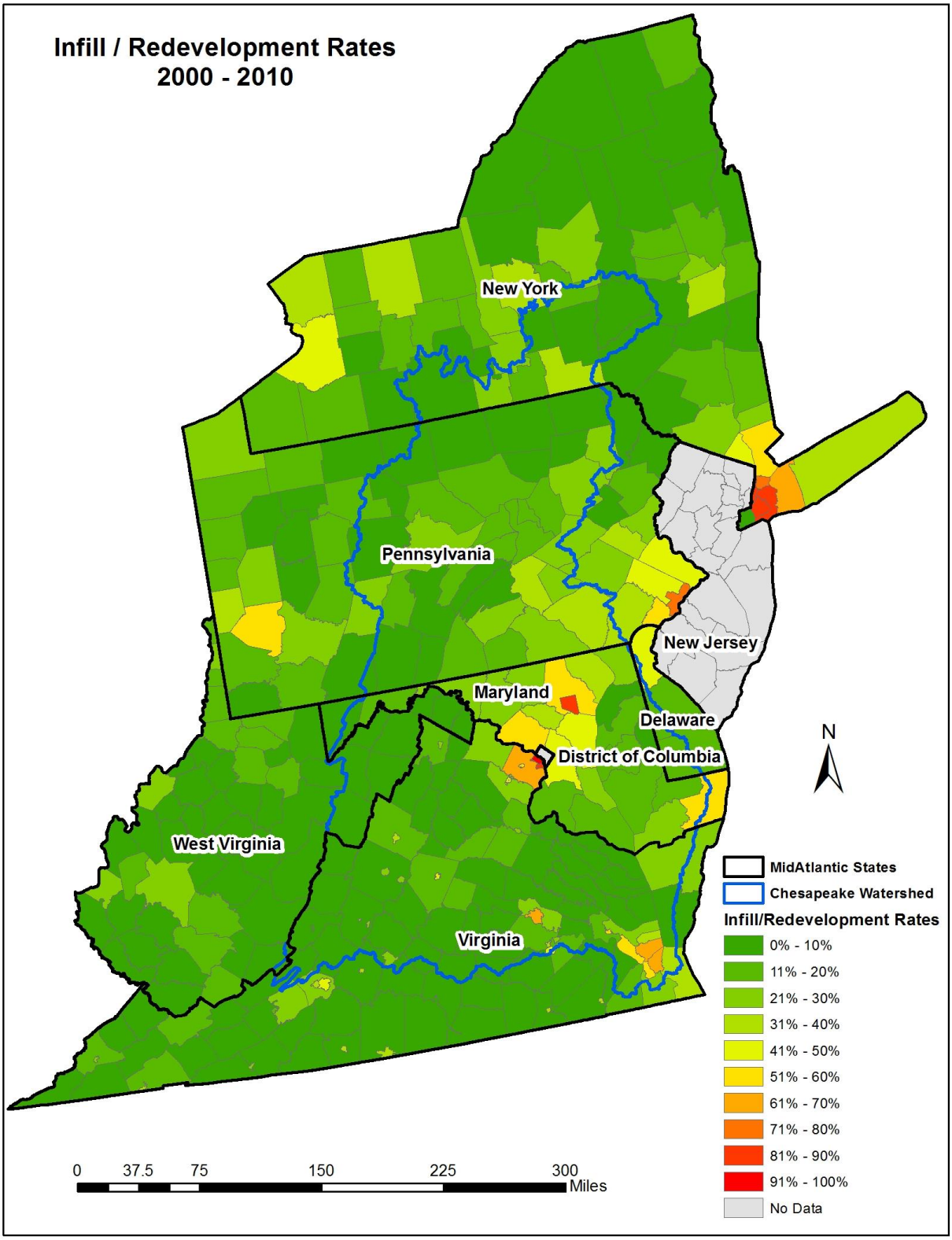
"Infill and Redevelopment": direct more growth into urban areas.

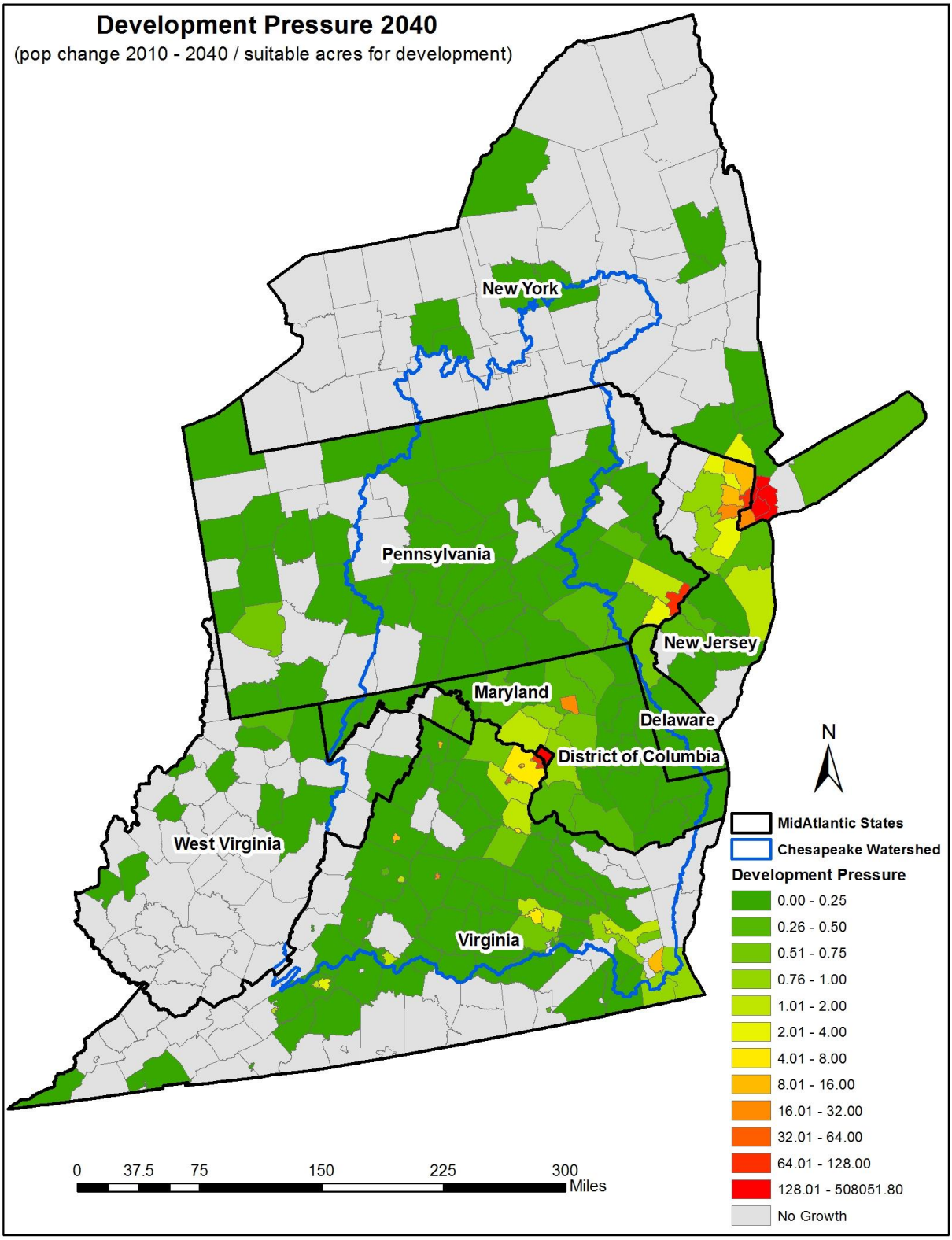
"Transportation Corridors": growth focused along major transportation corridors.

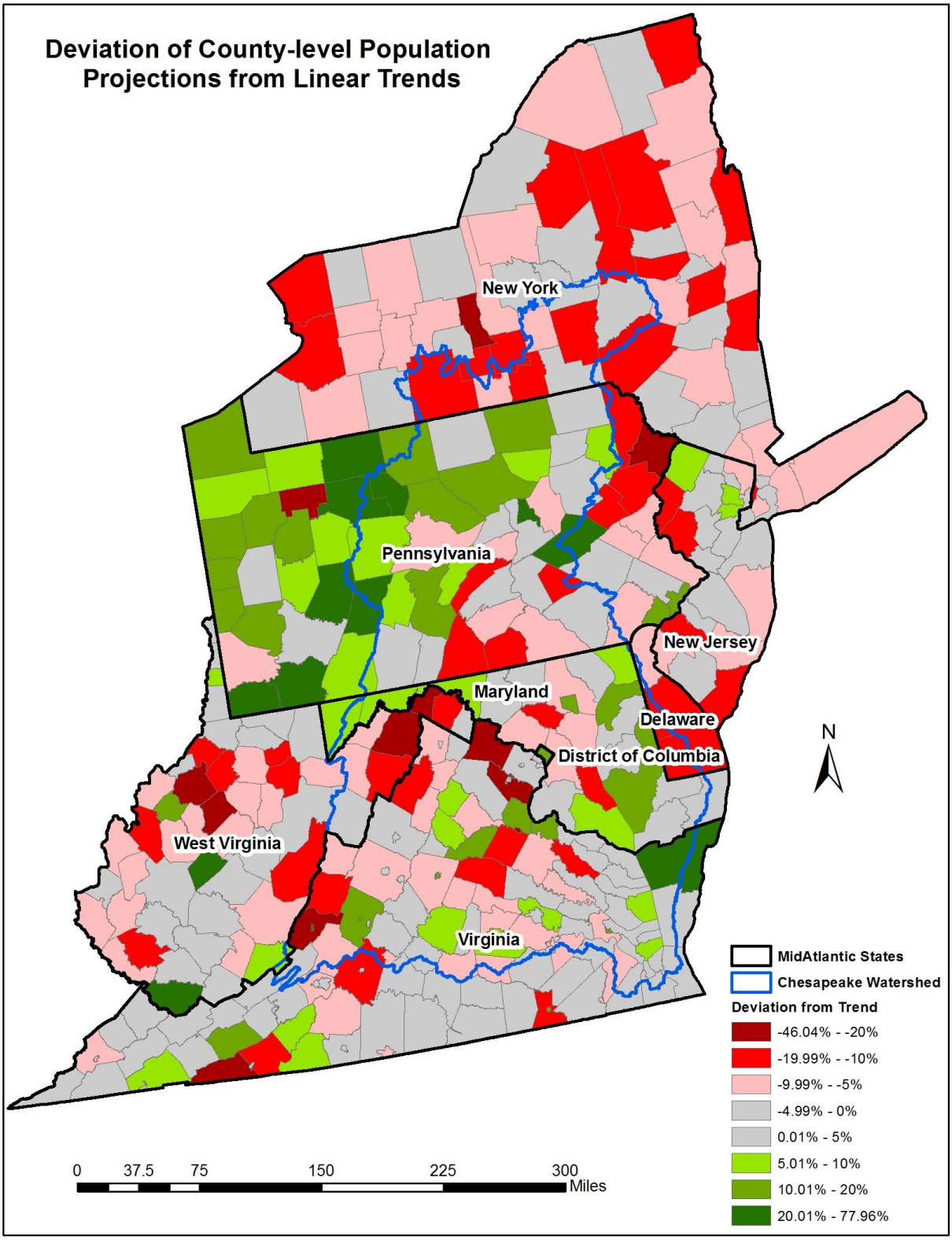
"Deregulated and Less Managed": patterns driven by private sector and free market.

"Amenity based": growth focused along coasts and adjacent to public lands.

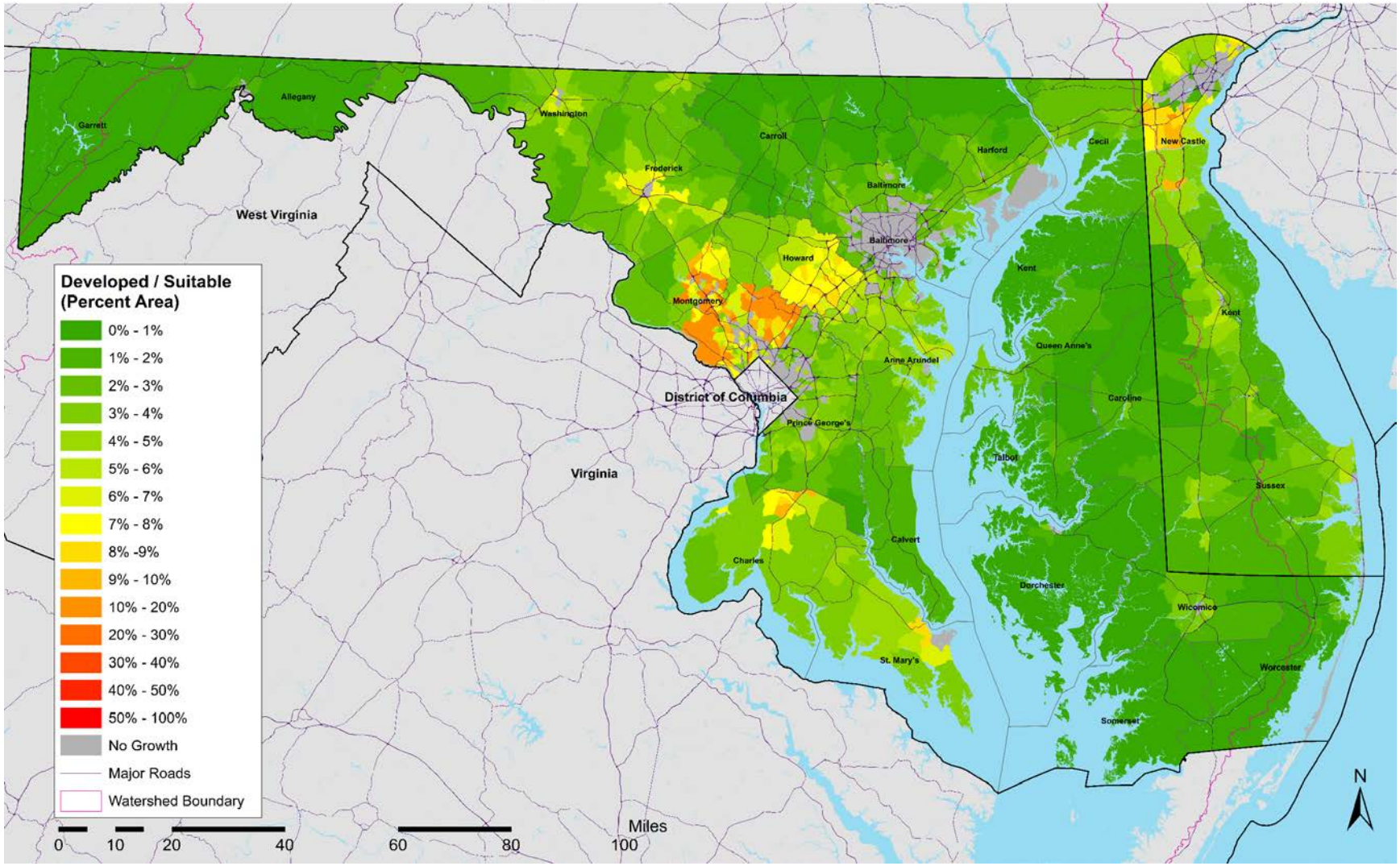
USGS

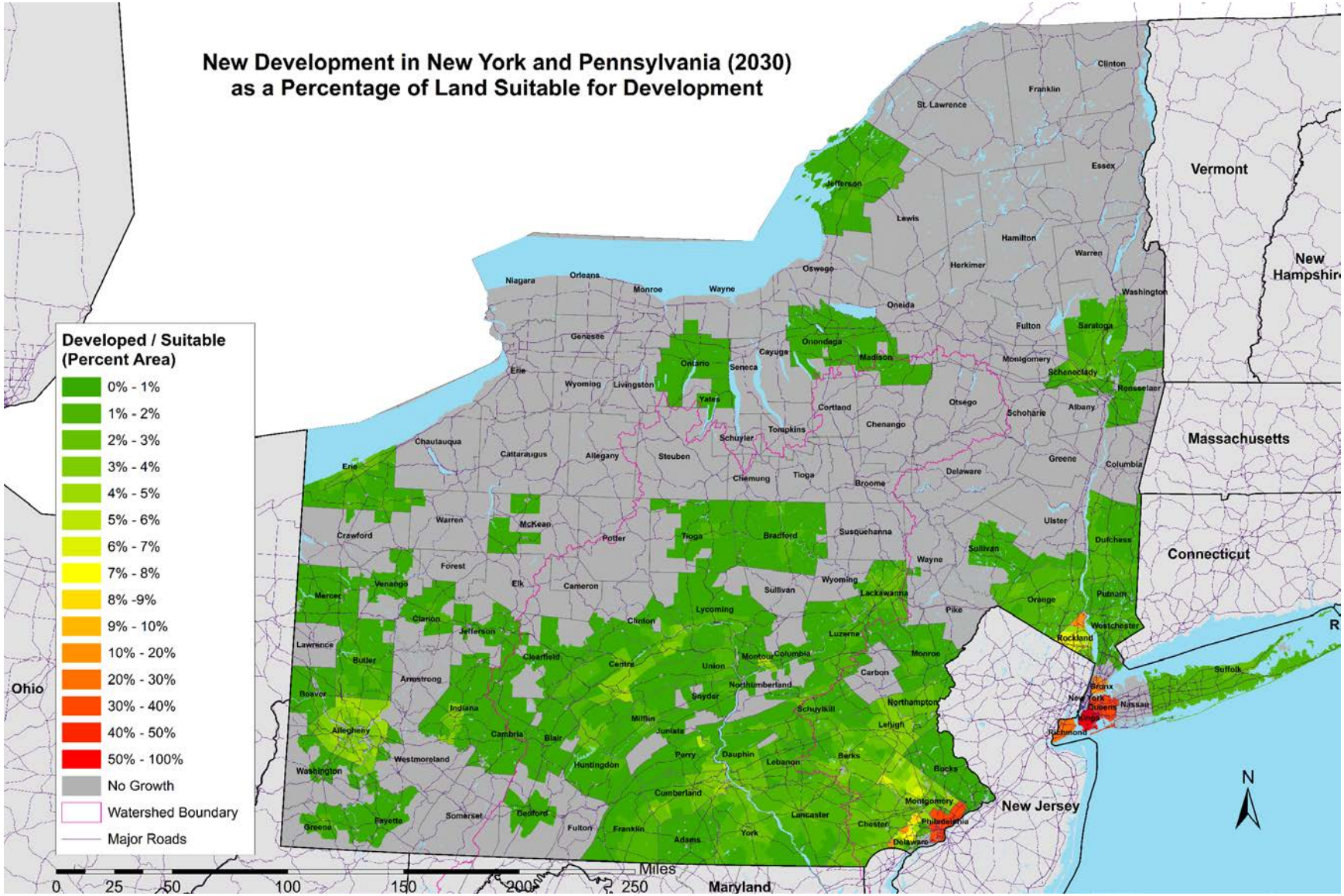

Infill / Redevelopment Rates
2000 - 2010
New York
Pennsylvania
New Jersey
Maryland
Delaware
District of Columbia
West Virginia
Virginia
N
0 37.5 75 150 225 300
Miles
MidAtlantic States
Chesapeake Watershed
Infill/Redevelopment Rates
0% - 10%
11% - 20%
21% - 30%
31% - 40%
41% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90%
91% - 100%
No Data


Development Pressure 2040
(pop change 2010 - 2040 / suitable acres for development)
New York
Pennsylvania
New Jersey
Maryland
Delaware
District of Columbia
West Virginia
Virginia
N
MidAtlantic States
Chesapeake Watershed
Development Pressure
0.00 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 2.00
2.01 - 4.00
4.01 - 8.00
8.01 - 16.00
16.01 - 32.00
32.01 - 64.00
64.01 - 128.00
128.01 - 508051.80
No Growth
0
37.5
75
150
225
300
Miles

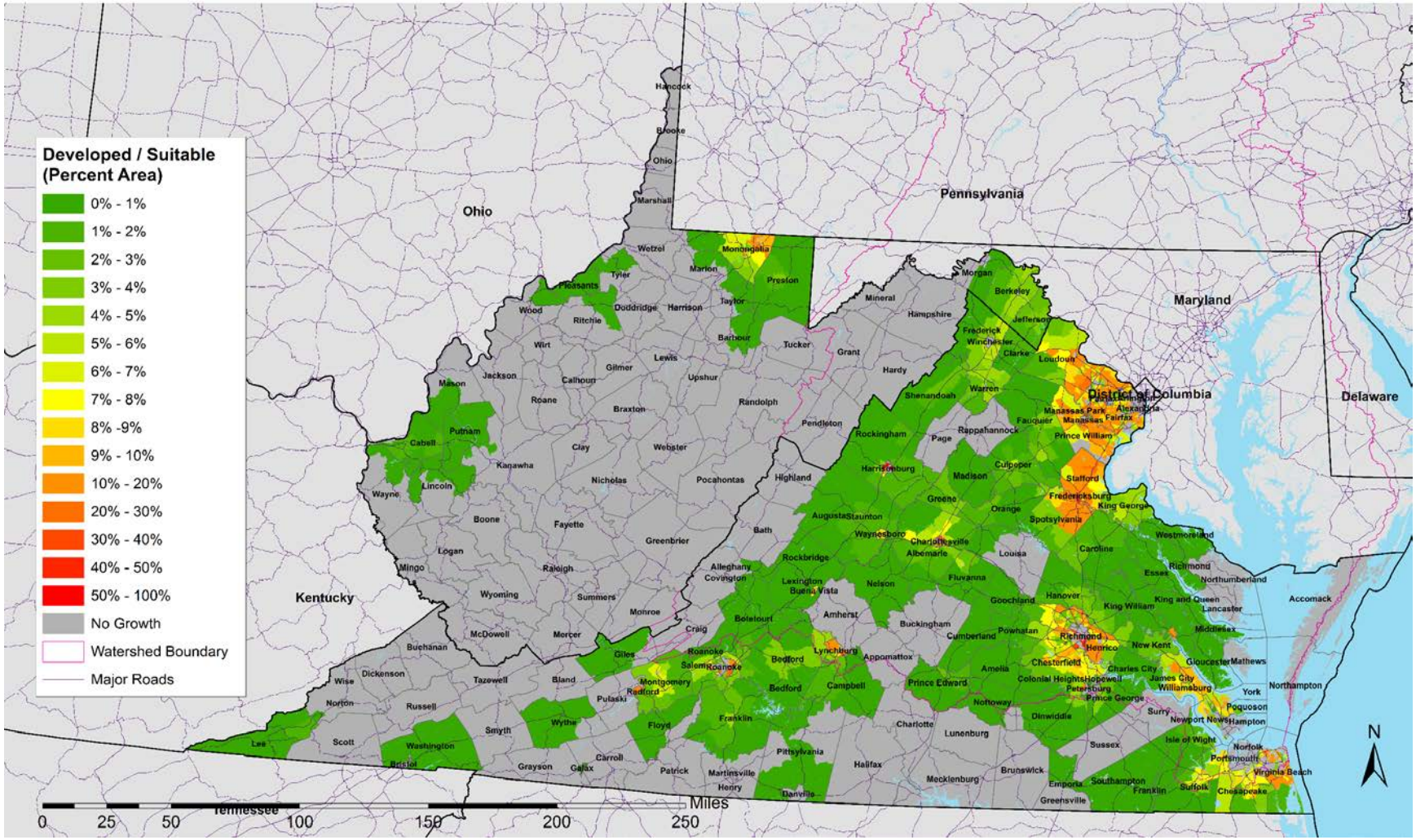

Deviation of County-level Population Projections from Linear Trends
New York
Pennsylvania
New Jersey
Maryland
Delaware
District of Columbia
West Virginia
Virginia
N
0
37.5
75
150
225
300
Miles
MidAtlantic States
Chesapeake Watershed
Deviation from Trend
-46.04% - -20%
-19.99% - -10%
-9.99% - -5%
-4.99% - 0%
0.01% - 5%
5.01% - 10%
10.01% - 20%
20.01% - 77.96%

New Development in Maryland (2030) and Delaware (2040) as a Percentage of Land Suitable for Development




New Development in New York and Pennsylvania (2030)
as a Percentage of Land Suitable for Development
Developed / Suitable
(Percent Area)
0% - 1%
1% - 2%
2% - 3%
3% - 4%
4% - 5%
5% - 6%
6% - 7%
7% - 8%
8% -9%
9% - 10%
10% - 20%
20% - 30%
30% - 40%
40% - 50%
50% - 100%
No Growth
Watershed Boundary
Major Roads
0
25
50
100
150
200
250
Miles
Vermont
New Hampshir
Massachusetts
Connecticut
New Jersey
Ohio
Maryland
N

New Development in Virginia and West Virginia (2030) as a Percentage of Land Suitable for Development



Housing and Employment Project Data for CBLCM v3a

Data provided by the US Census Bureau, Bureau of Economic Analysis, Bureau of Labor Statistics, and State agencies/consultants

FIPS	ST	CNTY	pINFILL	EMP_URB	THU_URB	THH10	EMP10	THH13	THH25	THH40	THH13_25	THH25_40	EMP13_25	EMP25_40
10001	10	Kent	18.4%	57.2%	85.7%	60,278	81,946	62,930	69,098	75,397	5,032	5,139	6,840	6,986
10003	10	NewCastle	43.4%	74.1%	90.8%	202,651	342,133	206,748	218,492	227,122	6,642	4,881	11,213	8,240
10005	10	Sussex	19.4%	43.9%	78.3%	79,368	99,034	83,406	94,784	106,927	9,170	9,786	11,442	12,210
24001	24	Allegany	19.9%	72.7%	75.8%	29,177	37,982	29,061	29,625	30,159	451	428	587	557
24003	24	AnneArundel	44.3%	84.8%	92.6%	199,378	345,913	204,487	217,896	232,098	7,474	7,915	12,967	13,732
24005	24	Baltimore	54.8%	85.3%	84.0%	316,715	488,147	323,347	333,614	343,601	4,640	4,514	7,151	6,957
24009	24	Calvert	23.6%	55.1%	75.4%	30,873	33,501	31,495	33,926	35,090	1,856	889	2,013	964
24011	24	Caroline	5.1%	35.4%	32.9%	12,158	13,332	12,345	13,963	16,436	1,535	2,346	1,683	2,572
24013	24	Carroll	26.4%	53.2%	74.4%	59,786	77,386	60,540	63,858	67,777	2,440	2,882	3,158	3,730
24015	24	Cecil	20.6%	51.3%	68.3%	36,867	40,431	37,429	42,663	51,486	4,156	7,005	4,557	7,682
24017	24	Charles	18.0%	34.6%	54.4%	51,214	59,301	52,133	62,311	78,142	8,344	12,979	9,661	15,028
24019	24	Dorchester	10.2%	24.2%	33.2%	13,522	15,926	13,684	15,114	16,650	1,283	1,378	1,511	1,622
24021	24	Frederick	26.1%	51.1%	69.5%	84,800	127,219	87,741	103,686	120,531	11,777	12,442	17,668	18,665
24023	24	Garrett	1.1%	5.0%	7.1%	12,057	16,717	12,058	12,541	12,798	477	254	661	352
24025	24	Harford	32.5%	64.7%	79.8%	90,218	114,756	91,849	96,913	107,459	3,418	7,119	4,347	9,055
24027	24	Howard	37.2%	83.7%	90.6%	104,749	200,591	109,595	123,367	130,645	8,642	4,567	16,549	8,745
24029	24	Kent	7.0%	6.0%	16.3%	8,165	12,515	8,274	8,972	9,662	648	642	993	984
24031	24	Montgomery	56.4%	83.8%	90.8%	357,086	652,369	366,743	393,228	433,137	11,550	17,404	21,100	31,795
24033	24	PrinceGeorge's	49.2%	80.8%	95.3%	304,042	427,155	312,930	325,043	340,971	6,148	8,084	8,637	11,357
24035	24	QueenAnne's	12.0%	28.2%	50.8%	18,016	21,603	18,559	21,351	24,672	2,458	2,923	2,947	3,504
24037	24	St.Mary's	16.6%	62.0%	52.6%	37,604	57,661	39,579	48,535	59,040	7,467	8,759	11,449	13,430
24039	24	Somerset	24.4%	60.5%	86.8%	8,788	9,432	8,899	9,600	10,077	529	360	567	386
24041	24	Talbot	11.0%	29.3%	41.2%	16,157	27,412	16,502	17,802	18,680	1,156	781	1,961	1,325
24043	24	Washington	23.6%	65.2%	73.6%	55,687	81,895	56,603	64,233	73,911	5,828	7,392	8,570	10,870
24045	24	Wicomico	19.9%	60.9%	81.7%	37,220	56,121	38,224	42,786	48,120	3,655	4,273	5,511	6,442
24047	24	Worcester	55.4%	24.6%	56.6%	22,229	32,753	22,617	25,301	27,408	1,198	940	1,765	1,385
24510	24	Baltimore	81.2%	100.0%	100.0%	249,903	397,797	250,920	259,379	266,531	1,593	1,347	2,535	2,144
36001	36	Albany	39.2%	77.0%	69.3%	126,251	260,107	126,501	126,522	122,400	12	0	24	0
36003	36	Allegany	2.1%	11.4%	1.5%	18,208	19,501	17,991	17,247	15,914	0	0	0	0
36005	36	Bronx	79.3%	100.0%	100.0%	483,449	356,384	490,877	512,797	537,400	4,543	5,098	3,348	3,758
36007	36	Broome	34.6%	62.1%	41.1%	82,167	114,068	82,053	81,365	78,521	0	0	0	0
36009	36	Cattaraugus	12.2%	24.5%	3.7%	32,263	39,425	31,712	29,498	24,845	0	0	0	0
36011	36	Cayuga	26.3%	20.1%	31.4%	31,445	34,548	31,050	29,338	25,192	0	0	0	0

Housing and Employment Project Data for CBLCM v3a

Data provided by the US Census Bureau, Bureau of Economic Analysis, Bureau of Labor Statistics, and State agencies/consultants

FIPS	ST	CNTY	pINFILL	EMP_URB	THU_URB	THH10	EMP10	THH13	THH25	THH40	THH13_25	THH25_40	EMP13_25	EMP25_40
36013	36	Chautauqua	11.9%	37.4%	21.4%	54,244	67,301	53,488	50,606	44,646	0	0	0	0
36015	36	Chemung	29.4%	59.3%	48.8%	35,462	46,029	35,033	33,446	30,243	0	0	0	0
36017	36	Chenango	2.2%	10.2%	1.7%	20,436	22,636	20,142	18,833	15,718	0	0	0	0
36019	36	Clinton	12.8%	34.8%	19.3%	31,582	42,237	31,278	29,856	26,179	0	0	0	0
36021	36	Columbia	5.9%	31.1%	10.5%	25,906	29,522	25,603	24,103	20,106	0	0	0	0
36023	36	Cortland	8.5%	20.6%	26.0%	18,671	22,726	18,630	18,351	17,261	0	0	0	0
36025	36	Delaware	2.0%	7.2%	2.5%	19,898	22,682	19,727	18,609	15,210	0	0	0	0
36027	36	Dutchess	19.7%	54.9%	63.2%	107,965	148,687	109,440	114,089	118,661	3,733	3,671	5,141	5,055
36029	36	Erie	43.0%	65.7%	80.1%	383,164	547,036	377,779	357,629	316,856	0	0	0	0
36031	36	Essex	4.2%	0.0%	0.0%	16,262	19,653	16,213	15,897	14,827	0	0	0	0
36033	36	Franklin	2.3%	10.6%	11.8%	19,054	24,625	19,094	19,020	18,096	0	0	0	0
36035	36	Fulton	15.1%	63.3%	36.0%	22,554	22,611	22,567	22,384	21,215	0	0	0	0
36037	36	Genesee	19.0%	41.4%	34.1%	23,728	29,517	23,609	22,974	21,053	0	0	0	0
36039	36	Greene	5.5%	39.3%	25.2%	19,823	20,929	19,870	19,861	19,125	0	0	0	0
36041	36	Hamilton	0.0%	0.0%	0.0%	2,262	2,584	2,176	1,855	1,309	0	0	0	0
36043	36	Herkimer	8.4%	36.2%	15.8%	26,324	23,316	26,035	24,633	20,906	0	0	0	0
36045	36	Jefferson	7.3%	22.0%	27.6%	43,451	72,546	44,218	46,484	49,086	2,100	2,411	3,506	4,025
36047	36	Kings	89.6%	100.0%	100.0%	916,856	799,183	923,796	940,142	947,773	1,693	790	1,475	688
36049	36	Lewis	0.4%	16.2%	10.0%	10,514	9,996	10,407	9,937	8,803	0	0	0	0
36051	36	Livingston	17.4%	51.6%	46.4%	24,409	27,324	24,307	23,958	23,084	0	0	0	0
36053	36	Madison	18.2%	28.1%	36.6%	27,754	30,373	28,075	28,973	29,374	735	327	804	357
36055	36	Monroe	35.7%	86.9%	89.9%	300,422	463,844	300,338	297,878	284,128	0	0	0	0
36057	36	Montgomery	16.4%	54.3%	26.4%	20,272	24,931	20,175	19,602	17,727	0	0	0	0
36059	36	Nassau	61.2%	94.5%	99.1%	448,528	815,474	446,879	440,915	424,504	0	0	0	0
36061	36	NewYork	83.1%	100.0%	100.0%	763,846	2,796,588	767,621	774,596	767,894	1,180	0	4,320	0
36063	36	Niagara	32.4%	55.3%	71.1%	90,556	88,342	89,521	85,127	74,644	0	0	0	0
36065	36	Oneida	20.9%	34.6%	48.1%	93,028	133,979	92,658	90,889	85,442	0	0	0	0
36067	36	Onondaga	33.2%	69.7%	77.5%	187,686	299,582	188,368	190,013	188,298	1,098	0	1,752	0
36069	36	Ontario	17.4%	57.3%	61.9%	43,019	62,964	43,468	44,862	46,132	1,152	1,049	1,686	1,535
36071	36	Orange	23.2%	65.6%	68.4%	125,925	175,609	128,808	137,993	149,266	7,052	8,656	9,834	12,071
36073	36	Orleans	11.0%	46.4%	13.0%	16,119	16,877	15,977	15,235	13,245	0	0	0	0
36075	36	Oswego	9.4%	45.9%	28.3%	46,400	44,503	45,992	44,098	39,315	0	0	0	0
36077	36	Otsego	6.8%	27.4%	7.5%	24,620	33,240	24,598	24,385	23,353	0	0	0	0

Housing and Employment Project Data for CBLCM v3a

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36079	36	Putnam	28.2%	70.5%	85.6%	35,041	39,201	35,344	36,243	36,756	644	368	720	411
36081	36	Queens	84.0%	100.0%	100.0%	780,117	753,656	790,942	821,992	851,870	4,954	4,767	4,785	4,605
36083	36	Rensselaer	18.6%	34.4%	53.5%	64,702	69,898	65,006	65,527	64,100	424	0	458	0
36085	36	Richmond	0.0%	100.0%	100.0%	165,516	142,694	168,266	176,561	185,086	8,295	8,524	7,151	7,348
36087	36	Rockland	40.1%	95.5%	99.6%	99,242	153,098	100,961	106,298	112,388	3,194	3,645	4,927	5,623
36089	36	St.Lawrence	7.1%	35.8%	0.0%	41,605	47,046	41,262	39,792	36,256	0	0	0	0
36091	36	Saratoga	19.3%	71.6%	72.4%	88,296	106,151	89,837	94,373	98,033	3,661	2,954	4,401	3,551
36093	36	Schenectady	29.9%	74.1%	74.6%	62,886	80,800	63,859	66,931	70,138	2,152	2,247	2,765	2,887
36095	36	Schoharie	4.2%	35.3%	9.7%	13,166	12,679	13,162	12,926	11,738	0	0	0	0
36097	36	Schuyler	6.4%	40.1%	7.6%	7,530	7,136	7,399	6,859	5,708	0	0	0	0
36099	36	Seneca	12.6%	9.8%	14.6%	13,393	15,037	13,255	12,624	10,971	0	0	0	0
36101	36	Steuben	9.4%	27.5%	13.8%	40,344	48,472	39,987	38,357	34,181	0	0	0	0
36103	36	Suffolk	37.5%	85.7%	88.2%	499,922	808,868	503,779	513,409	511,594	6,019	0	9,738	0
36105	36	Sullivan	8.7%	15.8%	15.4%	30,139	34,228	30,361	30,684	29,756	295	0	335	0
36107	36	Tioga	14.8%	43.8%	15.6%	20,350	19,346	20,004	18,591	15,595	0	0	0	0
36109	36	Tompkins	20.6%	86.8%	36.9%	38,967	67,683	38,990	38,831	37,485	0	0	0	0
36111	36	Ulster	16.8%	47.5%	48.3%	71,049	86,666	70,969	69,989	65,399	0	0	0	0
36113	36	Warren	9.2%	82.5%	96.7%	27,990	47,586	28,054	27,977	26,644	0	0	0	0
36115	36	Washington	5.9%	19.4%	32.0%	24,142	22,738	24,134	23,750	21,821	0	0	0	0
36117	36	Wayne	19.3%	40.4%	59.5%	36,585	39,048	36,424	35,499	32,667	0	0	0	0
36119	36	Westchester	59.0%	86.7%	86.6%	347,232	572,367	348,576	352,642	353,192	1,667	225	2,747	370
36121	36	Wyoming	9.2%	30.3%	20.3%	15,501	18,117	15,279	14,304	12,015	0	0	0	0
36123	36	Yates	2.9%	20.1%	17.7%	9,517	11,391	9,576	9,711	9,649	130	0	155	0
42001	42	Adams	14.0%	32.9%	55.4%	38,013	45,090	38,311	39,397	39,739	934	293	1,107	347
42003	42	Allegheny	56.2%	87.5%	96.5%	533,960	845,247	539,834	559,808	587,709	8,745	12,216	13,843	19,337
42005	42	Armstrong	9.8%	10.4%	54.9%	28,713	25,200	28,391	27,602	25,981	0	0	0	0
42007	42	Beaver	32.4%	64.9%	91.7%	71,383	72,957	71,579	72,588	72,477	681	0	696	0
42009	42	Bedford	1.4%	13.1%	33.9%	20,233	22,878	20,271	20,373	19,722	100	0	113	0
42011	42	Berks	29.2%	62.7%	75.1%	154,356	211,834	157,589	169,404	184,419	8,369	10,637	11,485	14,597
42013	42	Blair	19.5%	60.6%	78.3%	52,159	73,688	52,361	53,180	53,317	658	109	929	153
42015	42	Bradford	7.8%	8.6%	8.0%	25,321	32,416	25,484	26,225	27,186	683	885	874	1,132
42017	42	Bucks	41.8%	90.2%	89.0%	234,849	348,829	235,124	238,116	238,366	1,741	145	2,585	215
42019	42	Butler	20.5%	51.7%	67.4%	72,835	106,394	73,625	76,834	78,785	2,550	1,550	3,724	2,264

Housing and Employment Project Data for CBLCM v3a

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42021	42	Cambria	22.5%	45.4%	3.5%	58,950	72,467	59,266	60,095	60,510	642	321	789	394
42023	42	Cameron	0.0%	63.6%	100.0%	2,273	2,696	2,226	2,077	1,768	0	0	0	0
42025	42	Carbon	6.1%	33.1%	36.5%	26,684	23,309	26,487	25,814	24,745	0	0	0	0
42027	42	Centre	27.6%	46.2%	51.0%	57,573	108,993	59,479	65,244	71,750	4,172	4,708	7,898	8,912
42029	42	Chester	31.9%	79.0%	95.8%	182,900	323,776	186,799	201,242	220,671	9,841	13,239	17,420	23,436
42031	42	Clarion	1.0%	3.4%	37.3%	16,128	20,420	16,191	16,650	16,587	454	0	574	0
42033	42	Clearfield	9.0%	44.7%	34.9%	32,288	40,269	32,480	32,974	31,804	449	0	559	0
42035	42	Clinton	18.6%	42.0%	46.9%	15,151	17,523	15,475	16,715	18,852	1,009	1,740	1,166	2,012
42037	42	Columbia	18.8%	38.8%	57.9%	26,479	33,584	26,538	26,726	26,317	152	0	192	0
42039	42	Crawford	13.4%	20.1%	22.9%	35,028	42,872	34,943	34,854	34,483	0	0	0	0
42041	42	Cumberland	24.3%	79.0%	70.3%	93,943	158,707	96,171	103,193	112,620	5,313	7,132	8,975	12,048
42043	42	Dauphin	32.7%	78.1%	69.4%	110,435	214,462	111,930	116,550	121,977	3,108	3,650	6,035	7,088
42045	42	Delaware	54.6%	95.2%	99.8%	208,700	283,855	211,994	225,043	242,418	5,917	7,879	8,047	10,716
42047	42	Elk	15.9%	17.2%	100.0%	13,693	18,286	13,518	13,132	12,276	0	0	0	0
42049	42	Erie	28.2%	45.2%	60.5%	110,413	156,401	112,204	117,843	123,496	4,049	4,058	5,735	5,748
42051	42	Fayette	15.9%	36.9%	100.0%	55,997	55,003	56,073	56,998	57,642	778	542	764	532
42053	42	Forest	0.0%	0.0%	0.0%	2,511	3,261	2,502	2,332	1,963	0	0	0	0
42055	42	Franklin	16.8%	47.0%	67.0%	58,389	73,886	59,285	62,379	67,775	2,573	4,487	3,255	5,677
42057	42	Fulton	0.0%	0.0%	0.0%	6,014	6,804	6,022	6,085	6,268	62	183	70	207
42059	42	Greene	8.7%	18.5%	100.0%	14,724	18,091	14,908	15,390	15,131	439	0	539	0
42061	42	Huntingdon	6.0%	43.8%	17.4%	17,280	18,692	17,737	19,109	20,791	1,289	1,580	1,394	1,709
42063	42	Indiana	15.0%	43.2%	55.5%	35,005	46,818	35,825	38,209	41,453	2,025	2,755	2,708	3,684
42065	42	Jefferson	14.2%	43.6%	41.9%	18,561	22,256	18,534	18,558	18,601	20	37	23	44
42067	42	Juniata	6.4%	21.6%	18.3%	9,476	10,021	9,462	9,568	9,670	99	95	104	100
42069	42	Lackawanna	26.3%	70.9%	51.2%	87,226	122,591	88,091	91,564	95,156	2,558	2,646	3,595	3,718
42071	42	Lancaster	38.5%	71.3%	83.1%	193,602	299,077	198,146	214,456	239,178	10,036	15,212	15,503	23,499
42073	42	Lawrence	17.1%	36.9%	44.6%	37,126	40,891	36,893	36,714	36,217	0	0	0	0
42075	42	Lebanon	23.0%	35.5%	81.9%	52,258	64,670	52,911	55,549	58,430	2,031	2,219	2,513	2,746
42077	42	Lehigh	32.7%	82.1%	86.4%	133,983	217,148	135,831	143,022	153,344	4,838	6,946	7,841	11,257
42079	42	Luzerne	28.8%	57.4%	54.6%	131,932	172,344	132,846	136,013	137,670	2,253	1,179	2,943	1,540
42081	42	Lycoming	16.6%	48.7%	25.8%	46,700	67,218	47,058	48,031	48,627	811	497	1,167	715
42083	42	McKean	7.9%	12.8%	0.0%	17,183	21,291	17,317	17,739	17,508	388	0	480	0
42085	42	Mercer	15.5%	43.6%	34.3%	46,442	60,543	46,637	47,711	49,133	907	1,200	1,182	1,564

Housing and Employment Project Data for CBLCM v3a

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42087	42	Mifflin	12.9%	47.5%	42.0%	18,743	21,051	18,902	19,563	20,357	575	691	645	776
42089	42	Monroe	15.8%	80.0%	70.0%	61,091	76,400	61,549	63,610	63,406	1,735	0	2,169	0
42091	42	Montgomery	49.7%	94.8%	98.0%	307,750	612,683	312,009	330,786	360,964	9,452	15,191	18,817	30,242
42093	42	Montour	17.4%	85.8%	44.0%	7,393	18,044	7,545	8,168	9,370	514	993	1,254	2,423
42095	42	Northampton	26.5%	71.5%	87.7%	113,565	135,046	114,915	119,922	124,443	3,678	3,321	4,373	3,949
42097	42	Northumberland	15.4%	44.9%	32.0%	39,242	38,400	39,403	39,595	38,380	162	0	158	0
42099	42	Perry	2.9%	9.1%	6.7%	17,903	14,273	18,226	19,234	19,433	978	193	779	153
42101	42	Philadelphia	77.5%	100.0%	100.0%	599,736	786,645	616,395	663,487	731,184	10,582	15,212	13,879	19,952
42103	42	Pike	3.5%	14.6%	37.5%	21,925	17,562	21,734	21,557	20,842	0	0	0	0
42105	42	Potter	0.0%	0.0%	0.0%	7,227	8,186	7,309	7,618	7,627	309	8	350	9
42107	42	Schuylkill	25.7%	33.1%	45.1%	60,192	63,945	61,003	64,048	67,657	2,263	2,682	2,404	2,849
42109	42	Snyder	10.7%	51.7%	36.4%	14,750	20,776	14,995	15,498	15,376	449	0	632	0
42111	42	Somerset	5.3%	23.1%	20.8%	31,090	35,603	30,936	30,629	29,966	0	0	0	0
42113	42	Sullivan	0.0%	0.0%	0.0%	2,777	2,858	2,846	2,793	2,754	0	0	0	0
42115	42	Susquehanna	4.5%	13.9%	0.2%	17,798	16,694	17,648	17,298	16,405	0	0	0	0
42117	42	Tioga	4.5%	10.7%	5.3%	16,727	19,623	16,879	17,410	17,667	506	245	593	287
42119	42	Union	17.5%	62.9%	50.4%	14,765	21,863	15,104	16,167	17,532	876	1,125	1,297	1,665
42121	42	Venango	7.5%	19.0%	14.8%	22,621	26,428	22,676	22,788	22,643	103	0	120	0
42123	42	Warren	12.9%	51.5%	29.0%	17,767	20,614	17,592	17,106	15,838	0	0	0	0
42125	42	Washington	18.2%	33.8%	84.8%	85,089	109,699	84,869	84,984	83,098	93	0	119	0
42127	42	Wayne	2.2%	15.3%	6.7%	20,625	23,158	20,704	20,921	18,994	212	0	238	0
42129	42	Westmoreland	25.7%	65.4%	84.8%	153,650	177,494	152,590	150,612	144,471	0	0	0	0
42131	42	Wyoming	3.3%	11.0%	25.5%	11,237	14,069	11,282	11,248	10,715	0	0	0	0
42133	42	York	26.2%	51.3%	78.4%	168,372	222,167	171,470	181,699	191,996	7,548	7,597	9,959	10,024
51001	51	Accomack	26.6%	0.0%	0.1%	13,798	18,061	13,876	13,272	10,858	0	0	0	0
51003	51	Albemarle	13.0%	60.9%	49.2%	38,157	48,526	39,630	45,630	55,617	5,221	8,691	6,639	11,052
51005	51	Alleghany	4.9%	17.2%	0.1%	6,891	4,272	6,704	6,091	5,095	0	0	0	0
51007	51	Amelia	0.0%	0.0%	0.2%	4,821	4,373	4,868	5,131	5,624	263	492	238	446
51009	51	Amherst	5.5%	53.4%	35.9%	12,560	12,480	12,475	12,301	12,002	0	0	0	0
51011	51	Appomattox	0.0%	0.0%	0.0%	6,033	5,104	6,145	6,562	7,163	416	601	351	508
51013	51	Arlington	91.1%	100.0%	100.0%	98,050	210,581	101,748	113,417	129,664	1,035	1,441	2,222	3,094
51015	51	Augusta	6.3%	56.6%	59.4%	28,516	24,592	28,766	30,382	33,600	1,514	3,015	1,305	2,600
51017	51	Bath	0.0%	0.0%	0.0%	2,162	2,880	2,160	2,094	1,882	0	0	0	0

Housing and Employment Project Data for CBLCM v3a

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51019	51	Bedford	4.2%	54.5%	34.5%	27,465	29,699	28,846	32,576	36,350	3,573	3,616	3,863	3,910
51021	51	Bland	0.0%	0.0%	0.0%	2,566	2,874	2,530	2,430	2,264	0	0	0	0
51023	51	Botetourt	4.4%	62.0%	49.8%	13,126	13,637	13,197	13,684	14,601	465	876	483	910
51025	51	Brunswick	4.4%	32.0%	10.6%	6,366	5,896	6,239	5,771	4,870	0	0	0	0
51027	51	Buchanan	0.0%	0.0%	100.0%	9,968	9,787	9,674	8,460	6,258	0	0	0	0
51029	51	Buckingham	0.0%	0.0%	0.1%	5,965	4,826	5,924	6,024	6,447	100	423	80	342
51031	51	Campbell	9.3%	30.6%	32.3%	22,441	16,005	22,753	23,944	25,620	1,079	1,519	769	1,083
51033	51	Caroline	0.0%	6.0%	46.3%	10,456	8,223	10,727	12,147	14,919	1,420	2,771	1,116	2,179
51035	51	Carroll	0.0%	4.4%	18.7%	12,831	6,153	12,634	12,258	11,939	0	0	0	0
51036	51	Charles	0.0%	0.0%	0.4%	2,955	2,081	2,972	3,051	3,158	79	106	55	74
51037	51	Charlotte	0.0%	0.0%	0.0%	5,109	4,870	5,074	4,993	4,841	0	0	0	0
51041	51	Chesterfield	18.5%	84.5%	91.5%	115,680	156,773	119,403	134,583	159,633	12,378	20,426	16,775	27,681
51043	51	Clarke	7.2%	46.9%	31.6%	5,509	7,045	5,633	6,032	6,595	369	522	471	667
51045	51	Craig	0.0%	0.0%	0.0%	2,183	1,385	2,182	2,188	2,175	5	0	3	0
51047	51	Culpeper	6.3%	15.7%	32.7%	16,231	21,802	16,695	19,191	24,005	2,338	4,512	3,140	6,060
51049	51	Cumberland	0.0%	7.0%	5.9%	3,980	2,201	3,963	4,058	4,383	94	325	51	179
51051	51	Dickenson	0.0%	0.0%	100.0%	6,590	5,023	6,445	6,004	5,317	0	0	0	0
51053	51	Dinwiddie	4.1%	11.7%	24.4%	10,504	7,742	10,671	11,488	12,955	783	1,407	577	1,037
51057	51	Essex	0.0%	11.4%	16.1%	4,517	5,483	4,458	4,475	4,773	17	297	20	360
51059	51	Fairfax	60.0%	94.3%	98.6%	391,627	573,551	401,223	433,430	488,414	12,870	21,972	18,848	32,178
51061	51	Fauquier	6.0%	30.2%	51.6%	23,658	32,339	24,654	28,095	33,797	3,236	5,362	4,423	7,329
51063	51	Floyd	0.0%	0.0%	0.0%	6,415	5,631	6,449	6,710	7,235	261	524	229	459
51065	51	Fluvanna	18.6%	19.1%	43.5%	9,449	7,427	9,551	10,508	12,751	779	1,826	612	1,435
51067	51	Franklin	0.4%	42.5%	11.3%	22,780	20,760	22,819	24,134	27,635	1,308	3,485	1,192	3,175
51069	51	Frederick	11.2%	48.4%	44.7%	28,864	22,933	29,805	34,255	42,377	3,952	7,215	3,139	5,732
51071	51	Giles	1.0%	66.5%	25.3%	7,215	6,896	7,185	7,184	7,227	0	43	0	41
51073	51	Gloucester	4.9%	68.0%	59.6%	14,293	14,029	14,334	14,661	15,231	311	541	305	531
51075	51	Goochland	1.6%	5.4%	10.0%	7,998	14,995	8,124	9,052	11,105	913	2,020	1,711	3,787
51077	51	Grayson	0.0%	1.3%	8.1%	6,846	4,722	6,990	6,914	5,830	0	0	0	0
51079	51	Greene	0.0%	69.0%	66.0%	6,780	5,628	7,093	8,163	9,672	1,069	1,509	887	1,252
51081	51	Greensville	0.0%	22.2%	19.0%	3,566	4,451	3,457	3,289	3,270	0	0	0	0
51083	51	Halifax	4.0%	54.7%	18.2%	15,085	16,458	14,957	14,431	13,246	0	0	0	0
51085	51	Hanover	8.7%	73.9%	52.8%	36,589	60,723	37,474	41,038	46,658	3,252	5,129	5,397	8,512

Housing and Employment Project Data for CBLCM v3a

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51087	51	Henrico	23.1%	95.3%	92.4%	124,601	219,097	127,820	140,578	160,245	9,810	15,125	17,249	26,595
51089	51	Henry	6.9%	66.2%	37.1%	23,151	13,545	22,803	21,322	18,252	0	0	0	0
51091	51	Highland	0.0%	0.0%	0.0%	1,081	1,306	1,068	1,000	847	0	0	0	0
51093	51	IsleofWight	3.3%	21.0%	77.8%	13,718	14,230	13,982	15,302	17,777	1,277	2,394	1,324	2,483
51095	51	James	14.7%	68.4%	90.1%	26,860	26,180	28,411	34,504	44,637	5,199	8,648	5,067	8,429
51097	51	KingandQueen	0.0%	0.0%	1.8%	2,882	1,840	2,941	3,116	3,292	174	176	111	112
51099	51	KingGeorge	0.0%	37.6%	54.7%	8,376	13,355	9,102	11,692	15,585	2,590	3,893	4,129	6,207
51101	51	KingWilliam	2.0%	0.2%	12.1%	5,979	5,404	6,046	6,545	7,634	489	1,066	441	963
51103	51	Lancaster	0.0%	0.0%	0.0%	5,265	7,124	5,236	5,123	4,858	0	0	0	0
51105	51	Lee	0.0%	0.0%	1.9%	10,159	8,075	10,051	10,073	10,540	21	467	16	371
51107	51	Loudoun	22.8%	85.7%	72.5%	104,583	184,044	114,843	143,489	156,435	22,122	9,997	38,930	17,592
51109	51	Louisa	0.0%	0.0%	0.1%	12,944	12,240	13,191	14,741	18,004	1,550	3,263	1,465	3,085
51111	51	Lunenburg	0.0%	0.0%	0.0%	4,957	3,848	4,836	4,504	4,029	0	0	0	0
51113	51	Madison	0.0%	0.0%	0.0%	5,083	5,299	5,032	5,008	5,120	0	111	0	115
51115	51	Mathews	0.0%	0.0%	2.0%	3,858	3,005	3,797	3,612	3,317	0	0	0	0
51117	51	Mecklenburg	1.6%	35.8%	19.3%	13,495	16,145	13,206	12,543	11,809	0	0	0	0
51119	51	Middlesex	0.0%	0.0%	0.0%	4,708	5,367	4,737	4,948	5,363	210	415	239	473
51121	51	Montgomery	20.8%	40.4%	63.3%	35,767	39,117	36,667	40,119	45,338	2,732	4,132	2,987	4,519
51125	51	Nelson	0.0%	0.0%	0.3%	6,396	6,339	6,385	6,428	6,513	42	84	41	83
51127	51	NewKent	0.0%	0.0%	7.7%	6,813	6,600	7,283	8,969	11,561	1,686	2,592	1,633	2,510
51131	51	Northampton	0.0%	0.0%	0.0%	5,323	6,998	5,265	5,004	4,420	0	0	0	0
51133	51	Northumberland	0.0%	0.0%	0.0%	5,540	4,410	5,508	5,429	5,268	0	0	0	0
51135	51	Nottoway	8.9%	41.7%	14.4%	5,706	7,280	5,800	6,009	6,061	190	47	242	59
51137	51	Orange	16.2%	65.3%	49.4%	12,895	13,107	13,011	14,267	17,280	1,052	2,526	1,069	2,567
51139	51	Page	4.8%	61.2%	21.0%	9,746	8,747	9,663	9,565	9,545	0	0	0	0
51141	51	Patrick	0.0%	0.0%	0.0%	8,081	7,695	8,066	7,858	7,177	0	0	0	0
51143	51	Pittsylvania	1.5%	11.1%	23.4%	26,183	11,193	26,106	26,102	26,072	0	0	0	0
51145	51	Powhatan	0.0%	0.1%	2.0%	9,494	10,353	9,574	10,444	12,525	870	2,080	948	2,268
51147	51	PrinceEdward	3.7%	62.4%	33.3%	7,916	11,744	7,975	8,612	10,119	612	1,450	907	2,151
51149	51	PrinceGeorge	12.1%	44.7%	36.9%	11,451	13,097	11,754	12,751	14,026	876	1,121	1,001	1,282
51153	51	PrinceWilliam	24.8%	83.2%	95.0%	130,785	103,877	136,583	158,207	178,677	16,255	15,388	12,910	12,222
51155	51	Pulaski	7.2%	57.0%	44.6%	14,821	14,671	14,804	14,674	14,121	0	0	0	0
51157	51	Rappahannock	0.0%	0.0%	0.0%	3,072	3,248	3,054	3,061	3,129	7	67	7	70

Housing and Employment Project Data for CBLCM v3a

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51159	51	Richmond	2.1%	0.0%	0.1%	3,159	3,825	3,123	3,095	3,136	0	39	0	47
51161	51	Roanoke	25.6%	83.2%	81.6%	37,608	34,284	37,929	39,492	42,004	1,162	1,869	1,059	1,703
51163	51	Rockbridge	1.3%	6.3%	27.5%	9,555	6,086	9,513	9,614	9,993	98	374	62	238
51165	51	Rockingham	11.6%	36.9%	58.4%	29,177	27,650	29,807	32,281	36,094	2,186	3,368	2,071	3,191
51167	51	Russell	1.0%	60.3%	26.7%	11,943	10,314	11,718	10,939	9,520	0	0	0	0
51169	51	Scott	1.7%	5.9%	0.0%	9,775	8,047	9,663	9,332	8,755	0	0	0	0
51171	51	Shenandoah	7.5%	34.5%	42.3%	17,076	19,769	17,122	18,136	20,681	937	2,354	1,084	2,725
51173	51	Smyth	6.3%	37.0%	63.0%	13,319	15,559	13,116	12,473	11,340	0	0	0	0
51175	51	Southampton	0.0%	0.1%	12.5%	6,719	3,762	6,710	6,817	7,074	106	257	59	143
51177	51	Spotsylvania	11.7%	45.5%	57.6%	41,942	30,072	46,077	60,326	81,750	12,588	18,928	9,025	13,571
51179	51	Stafford	11.8%	87.4%	80.1%	41,769	51,588	45,875	59,992	80,725	12,455	18,292	15,382	22,592
51181	51	Surry	0.0%	0.0%	1.6%	2,826	3,040	2,770	2,663	2,588	0	0	0	0
51183	51	Sussex	0.0%	0.0%	0.0%	3,994	4,536	3,941	3,738	3,304	0	0	0	0
51185	51	Tazewell	11.4%	57.0%	79.4%	18,449	21,585	18,182	17,571	16,796	0	0	0	0
51187	51	Warren	4.5%	17.8%	33.1%	14,085	16,617	14,356	15,672	17,990	1,257	2,214	1,482	2,612
51191	51	Washington	13.5%	48.5%	49.7%	22,843	19,417	22,642	22,678	23,485	31	697	26	592
51193	51	Westmoreland	8.7%	5.1%	21.0%	7,310	5,906	7,373	7,600	7,854	207	232	167	187
51195	51	Wise	10.6%	41.6%	87.9%	15,968	15,444	15,591	14,857	14,315	0	0	0	0
51197	51	Wythe	5.0%	31.5%	20.9%	12,472	15,261	12,341	12,248	12,458	0	199	0	243
51199	51	York	21.6%	60.2%	96.7%	24,006	20,971	24,909	28,045	32,579	2,458	3,553	2,147	3,103
51510	51	Alexandria	81.2%	100.0%	100.0%	68,082	123,715	70,346	80,163	91,751	1,845	2,178	3,352	3,957
51515	51	Bedford	39.1%	100.0%	100.0%	2,627	3,284	0	0	0	0	0	0	0
51520	51	Bristol	35.3%	55.3%	99.9%	7,879	12,083	7,819	7,730	7,646	0	0	0	0
51530	51	BuenaVista	24.0%	97.7%	93.6%	2,603	2,122	2,643	2,767	2,897	94	99	76	80
51540	51	Charlottesville	47.8%	100.0%	100.0%	17,778	34,673	19,022	21,496	22,315	1,290	427	2,515	832
51550	51	Chesapeake	29.8%	78.2%	94.0%	79,574	121,687	83,023	93,392	105,821	7,281	8,728	11,134	13,347
51570	51	ColonialHeights	37.8%	100.0%	100.0%	7,275	10,021	7,223	7,155	7,108	0	0	0	0
51580	51	Covington	0.0%	100.0%	100.0%	2,632	3,716	2,693	2,770	2,647	76	0	107	0
51590	51	Danville	38.7%	93.1%	100.0%	18,831	25,876	18,686	17,435	14,107	0	0	0	0
51595	51	Emporia	37.5%	100.0%	100.0%	2,316	3,816	2,352	2,460	2,569	67	67	110	110
51600	51	Fairfax	53.1%	100.0%	100.0%	8,347	19,877	8,825	9,482	10,014	308	249	733	592
51610	51	FallsChurch	81.9%	100.0%	100.0%	5,101	12,395	5,291	6,256	6,952	174	125	422	303
51620	51	Franklin	34.6%	100.0%	100.0%	3,530	4,033	3,516	3,508	3,498	0	0	0	0

Housing and Employment Project Data for CBLCM v3a

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51630	51	Fredericksburg	23.2%	45.1%	100.0%	9,505	25,137	9,892	11,286	13,353	1,070	1,587	2,829	4,196
51640	51	Galax	23.6%	79.5%	99.9%	2,922	6,254	2,921	2,938	2,951	12	10	25	21
51650	51	Hampton	60.1%	97.9%	100.0%	55,031	76,913	55,282	54,370	49,362	0	0	0	0
51660	51	Harrisonburg	32.1%	100.0%	100.0%	15,988	30,363	17,094	20,442	24,433	2,274	2,711	4,318	5,148
51670	51	Hopewell	28.6%	100.0%	100.0%	9,129	7,905	9,217	9,420	9,441	144	15	124	12
51678	51	Lexington	25.9%	100.0%	100.0%	2,237	4,904	2,342	2,595	2,765	186	126	407	276
51680	51	Lynchburg	28.1%	94.6%	100.0%	28,476	50,141	29,256	32,441	37,569	2,289	3,685	4,030	6,488
51683	51	Manassas	45.5%	100.0%	100.0%	12,527	23,743	13,447	14,431	16,004	536	858	1,015	1,626
51685	51	ManassasPark	28.0%	100.0%	100.0%	4,507	2,824	4,507	5,001	5,001	355	0	222	0
51690	51	Martinsville	37.1%	100.0%	100.0%	6,084	11,197	5,990	5,506	4,421	0	0	0	0
51700	51	NewportNews	53.7%	97.8%	100.0%	70,664	119,641	71,243	72,410	71,842	540	0	914	0
51710	51	Norfolk	63.2%	100.0%	100.0%	86,485	210,988	87,485	90,616	93,444	1,150	1,039	2,805	2,534
51720	51	Norton	23.7%	100.0%	100.0%	1,750	4,155	1,746	1,739	1,712	0	0	0	0
51730	51	Petersburg	42.6%	98.8%	100.0%	13,634	14,319	13,535	13,061	11,904	0	0	0	0
51735	51	Poquoson	34.2%	94.7%	100.0%	4,525	1,796	4,568	4,729	4,926	105	129	41	51
51740	51	Portsmouth	55.5%	100.0%	100.0%	37,324	57,413	37,619	37,455	34,810	0	0	0	0
51750	51	Radford	12.5%	74.6%	96.0%	5,990	5,954	6,255	6,918	7,446	580	462	576	459
51760	51	Richmond	68.8%	100.0%	100.0%	87,151	177,980	90,800	99,638	106,246	2,754	2,059	5,624	4,204
51770	51	Roanoke	49.6%	100.0%	100.0%	42,712	79,105	43,388	45,096	46,136	860	523	1,592	968
51775	51	Salem	34.6%	100.0%	100.0%	10,045	22,558	10,200	10,523	10,543	211	13	473	29
51790	51	Staunton	29.4%	100.0%	100.0%	10,480	11,132	10,692	11,121	11,152	302	22	320	23
51800	51	Suffolk	12.8%	84.6%	82.9%	30,868	34,747	32,138	37,506	46,678	4,678	7,994	5,265	8,998
51810	51	VirginiaBeach	39.5%	93.9%	88.2%	165,089	240,506	168,524	177,526	184,510	5,444	4,224	7,930	6,153
51820	51	Waynesboro	28.5%	98.0%	99.9%	8,903	9,139	9,097	9,718	10,463	443	532	454	546
51830	51	Williamsburg	56.3%	100.0%	100.0%	4,571	14,197	4,782	5,540	6,616	331	470	1,028	1,459
51840	51	Winchester	29.4%	100.0%	100.0%	10,607	25,494	10,923	11,945	13,215	720	896	1,730	2,153
54001	54	BARBOUR	10.4%	64.8%	47.9%	6,548	5,355	6,555	6,468	6,293	0	0	0	0
54003	54	BERKELEY	9.5%	71.2%	84.5%	39,855	39,906	41,755	47,968	57,308	5,624	8,455	5,631	8,465
54005	54	BOONE	2.0%	4.8%	100.0%	9,928	10,019	9,799	9,112	7,983	0	0	0	0
54007	54	BRAXTON	0.0%	0.0%	4.6%	6,000	5,448	5,962	5,670	5,170	0	0	0	0
54009	54	BROOKE	22.0%	73.6%	0.0%	10,020	9,825	9,813	9,156	8,051	0	0	0	0
54011	54	CABELL	26.4%	73.0%	72.1%	41,223	63,121	41,592	42,415	43,595	606	868	927	1,329
54013	54	CALHOUN	0.0%	0.0%	0.6%	3,268	2,876	3,256	3,153	2,993	0	0	0	0

Housing and Employment Project Data for CBLCM v3a

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54015	54	CLAY	0.0%	0.0%	100.0%	3,728	2,760	3,687	3,528	3,264	0	0	0	0
54017	54	DODDRIDGE	0.0%	0.0%	3.4%	3,099	2,054	3,149	3,313	3,541	164	227	108	150
54019	54	FAYETTE	14.3%	34.5%	100.0%	18,813	15,976	18,642	17,904	16,707	0	0	0	0
54021	54	GILMER	0.0%	75.3%	100.0%	2,753	3,418	2,734	2,680	2,526	0	0	0	0
54023	54	GRANT	6.3%	21.5%	63.4%	4,941	5,432	4,936	4,885	4,780	0	0	0	0
54025	54	GREENBRIER	6.8%	50.5%	70.0%	15,443	18,832	15,538	15,462	15,316	0	0	0	0
54027	54	HAMPSHIRE	0.0%	0.0%	1.1%	9,595	7,070	9,431	8,787	7,672	0	0	0	0
54029	54	HANCOCK	20.0%	37.3%	100.0%	13,297	14,244	13,077	12,276	10,978	0	0	0	0
54031	54	HARDY	0.0%	45.3%	26.7%	5,818	7,797	5,835	5,849	5,812	13	0	17	0
54033	54	HARRISON	16.0%	73.5%	62.5%	28,533	44,005	28,366	27,370	25,639	0	0	0	0
54035	54	JACKSON	3.7%	37.6%	48.8%	11,931	11,263	11,889	11,730	11,392	0	0	0	0
54037	54	JEFFERSON	3.4%	64.9%	97.1%	19,931	21,975	20,959	24,571	29,387	3,489	4,651	3,846	5,127
54039	54	KANAWHA	20.1%	48.4%	100.0%	84,201	131,260	83,824	81,181	76,973	0	0	0	0
54041	54	LEWIS	2.7%	20.8%	0.0%	6,863	9,219	6,805	6,432	5,812	0	0	0	0
54043	54	LINCOLN	0.0%	0.1%	100.0%	8,783	4,559	8,725	8,242	7,437	0	0	0	0
54045	54	LOGAN	8.5%	50.6%	100.0%	14,907	14,098	14,533	12,772	9,954	0	0	0	0
54047	54	McDOWELL	0.0%	2.3%	100.0%	9,176	6,897	8,786	7,329	5,027	0	0	0	0
54049	54	MARION	16.4%	74.9%	43.0%	23,786	27,446	23,929	23,943	23,908	11	0	12	0
54051	54	MARSHALL	11.7%	39.1%	36.3%	13,869	14,033	13,579	12,440	10,571	0	0	0	0
54053	54	MASON	3.6%	72.9%	33.8%	11,149	9,322	11,145	11,101	10,984	0	0	0	0
54055	54	MERCER	12.8%	49.9%	100.0%	26,603	28,312	26,441	25,868	24,794	0	0	0	0
54057	54	MINERAL	6.8%	34.5%	35.3%	11,550	10,750	11,477	11,306	10,937	0	0	0	0
54059	54	MINGO	3.9%	1.0%	100.0%	11,125	10,385	10,848	9,610	7,614	0	0	0	0
54061	54	MONONGALIA	18.9%	59.3%	89.1%	39,777	66,865	41,856	49,167	61,075	5,928	9,657	9,964	16,233
54063	54	MONROE	0.0%	0.7%	3.2%	5,655	4,157	5,649	5,463	5,096	0	0	0	0
54065	54	MORGAN	0.0%	0.0%	1.8%	7,303	4,847	7,313	7,322	7,278	8	0	5	0
54067	54	NICHOLAS	5.0%	22.0%	35.3%	10,938	10,769	10,922	10,526	9,830	0	0	0	0
54069	54	OHIO	19.0%	51.8%	63.2%	18,914	36,445	18,688	17,688	16,078	0	0	0	0
54071	54	PENDLETON	0.0%	0.0%	100.0%	3,285	3,184	3,203	2,831	2,239	0	0	0	0
54073	54	PLEASANTS	5.2%	47.0%	30.3%	2,861	3,540	2,848	2,937	2,985	84	45	103	55
54075	54	POCAHONTAS	0.0%	0.0%	0.3%	3,758	4,739	3,688	3,317	2,720	0	0	0	0
54077	54	PRESTON	2.5%	17.9%	15.0%	12,895	11,078	13,289	14,327	15,923	1,012	1,555	869	1,335
54079	54	PUTNAM	13.0%	51.3%	60.9%	21,981	25,947	22,333	22,738	23,391	352	567	415	669

Housing and Employment Project Data for CBLCM v3a

Data provided by the US Census Bureau, Bureau of Economic Analysis, Bureau of Labor Statistics, and State agencies/consultants

FIPS	ST	CNTY	pINFILL	EMP_URB	THU_URB	THH10	EMP10	THH13	THH25	THH40	THH13_25	THH25_40	EMP13_25	EMP25_40
54081	54	RALEIGH	14.3%	49.6%	100.0%	31,831	40,827	31,774	31,060	29,877	0	0	0	0
54083	54	RANDOLPH	4.4%	43.0%	65.9%	11,695	15,038	11,825	11,910	11,974	82	60	105	77
54085	54	RITCHIE	0.0%	0.0%	0.9%	4,367	4,941	4,270	3,881	3,163	0	0	0	0
54087	54	ROANE	3.3%	17.5%	100.0%	6,195	5,782	6,095	5,611	4,829	0	0	0	0
54089	54	SUMMERS	4.8%	2.5%	17.5%	5,572	3,720	5,560	5,396	5,126	0	0	0	0
54091	54	TAYLOR	4.5%	59.3%	74.6%	6,778	4,634	6,792	6,701	6,543	0	0	0	0
54093	54	TUCKER	0.0%	0.0%	0.0%	3,057	3,327	3,025	2,830	2,494	0	0	0	0
54095	54	TYLER	0.0%	0.0%	9.2%	3,858	3,180	3,786	3,473	2,960	0	0	0	0
54097	54	UPSHUR	5.3%	71.1%	54.5%	9,619	11,576	9,796	9,687	9,583	0	0	0	0
54099	54	WAYNE	9.8%	66.6%	72.9%	17,347	12,323	17,038	16,248	14,783	0	0	0	0
54101	54	WEBSTER	0.0%	0.0%	0.0%	3,792	2,883	3,734	3,417	2,904	0	0	0	0
54103	54	WETZEL	12.4%	12.1%	100.0%	6,968	5,896	6,820	6,158	5,068	0	0	0	0
54105	54	WIRT	0.0%	0.0%	52.1%	2,391	1,498	2,421	2,536	2,719	114	182	71	114
54107	54	WOOD	22.1%	74.1%	69.8%	36,571	48,640	36,327	35,197	33,194	0	0	0	0
54109	54	WYOMING	1.7%	0.0%	100.0%	9,687	6,638	9,481	8,482	6,895	0	0	0	0

A community-driven approach to developing future land use scenarios at the river basin scale:

An example from the Delaware River Basin

Dr. Claire A. Jantz
Project Lead

Ms. Antonia Price
Dr. Scott Drzyzga
Dr. Dorlisa Minnick
Mr. Alfonso Yáñez
Mr. Joshua Barth
Ms. Caitlin Lucas

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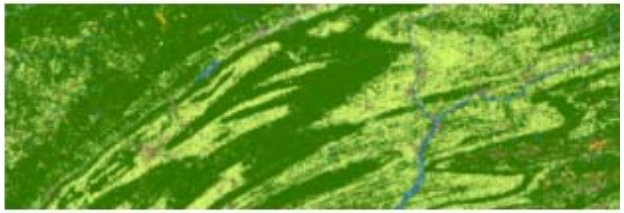
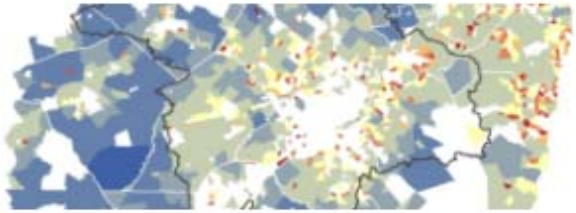
Mapping and modeling land use in the Delaware River Basin



MAPPING

High-resolution LiDAR-based land cover data for all 43 counties in the watershed



MODELING

Connecting models of land cover change, climate change, hydrology, and tree species to explore development and environmental impacts

MONITORING

Feasibility Analysis: establishing a long-term land cover monitoring program

www.drbproject.org

University of Vermont Spatial Analysis Lab

William Penn Foundation

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Delaware River Basin Land Use Dynamics
Shippensburg University

USGS science for a changing world

Grand Challenges

- Many waterways do not meet the "fishable and swimmable" Clean Water Act requirements
- Population growth and associated land cover change are a concern for water supply and quality
- Climate change and sea level rise

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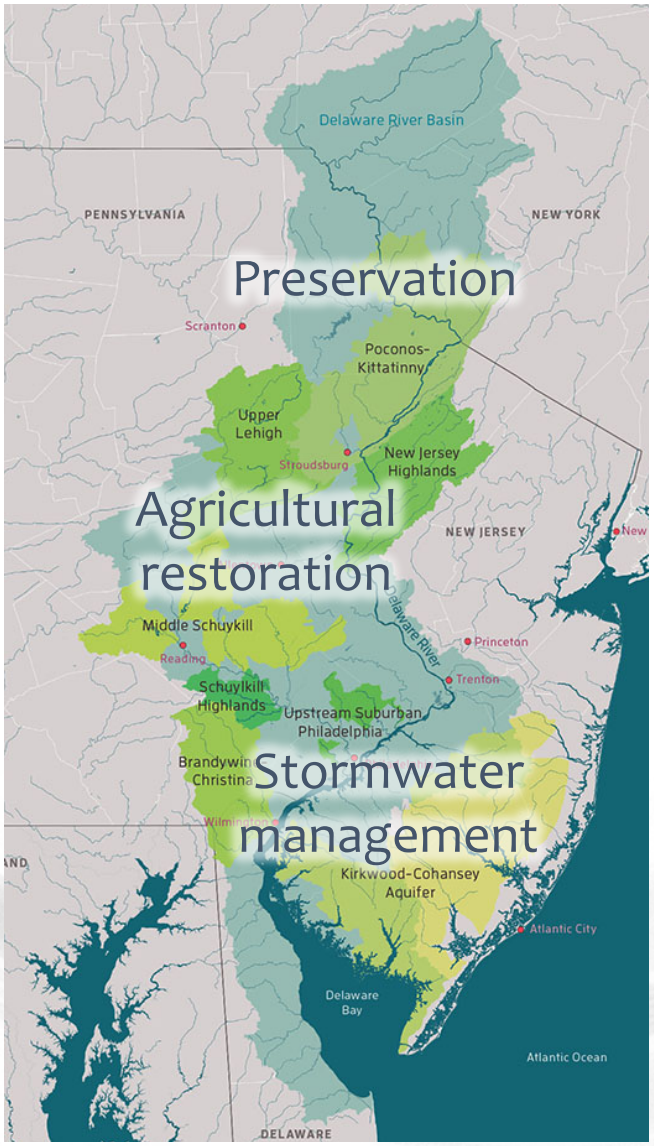
The Delaware River Watershed Initiative

WILLIAM PENN FOUNDATION

OPEN SPACE INSTITUTE

NATIONAL FISH AND WILDLIFE FOUNDATION



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The Delaware River Watershed Initiative

- Extensive monitoring program
- Watershed planning tools
  - Stream reach assessment tool
  - WikiWatershed
  - High resolution land use/land cover data
  - Forecasts of urban development
- Scientific research
  - Delaware Watershed Research Fund

THE ACADEMY OF NATURAL SCIENCES of DREXEL UNIVERSITY

STROUD™ WATER RESEARCH CENTER

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University of Vermont
Spatial Analysis Lab

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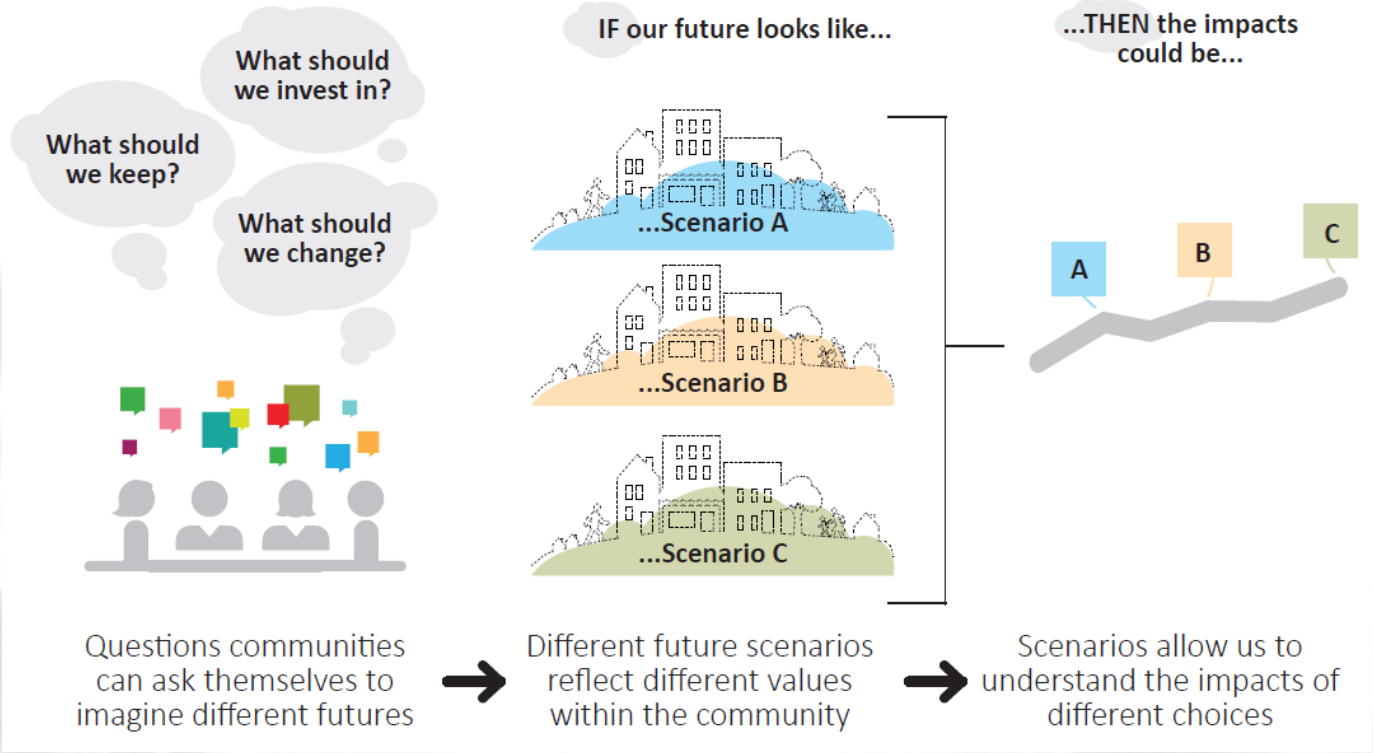
What will the watershed look like in 2070?

Delaware River Basin 2070

- **Scenarios** are plausible stories about the possible futures and range of changes that could occur



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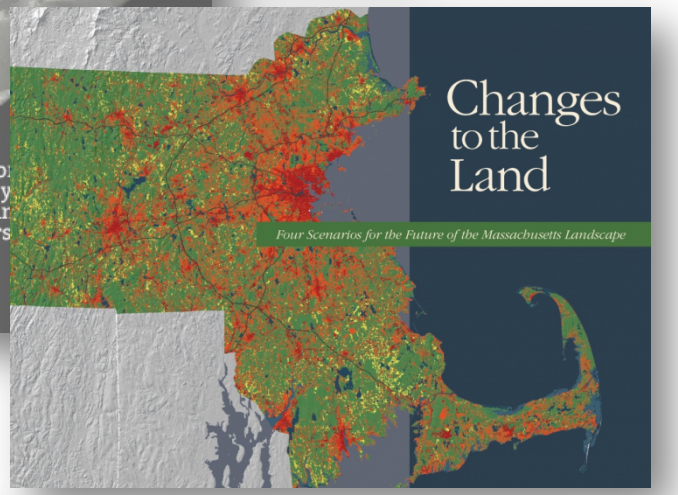
Related efforts



Why use scenarios?

- It is difficult to *predict* future land use

> **Prediction is very difficult, especially about the future.**
>
> *- Humorous Danish proverb*

- Scenarios can *guide decision making*
  - Evaluate effects or impacts of decisions or events

> **The future cannot be predicted, but futures can be invented.**
>
> *- Physicist Dennis Gabor, 1963*

Our iterative scenarios approach

Quantitative

- Collect best available ***population*** and ***employment*** projections
- Model ***socio-economic*** and ***environmental*** drivers of land change
- Integrate ***climate and sea level change*** projections

Qualitative

- Develop ***community feedback*** about the present and future
- Integrate feedback into ***storylines***
- Using data, translate storylines into ***future land use scenarios***

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DRB2070 scenarios

Baseline/business as usual

- *"Recent trends" with storm surge and sea level rise*

Alternative 1- growth along corridors

- "Sprawl" with greenfield development

Alternative 2- growth in historic centers

- "Conservation" with infill and land protection

www.drbproject.org/products

University of Vermont Spatial Analysis Lab

WILLIAM PENN FOUNDATION

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DELAWARE RIVER BASIN
Land Use Dynamics
SHIPPENSBURG UNIVERSITY

USGS
science for a changing world

Modeling Framework

Delaware River Basin 2070

Socio-economic

X

Accessibility Model

X

Physical Factors

X

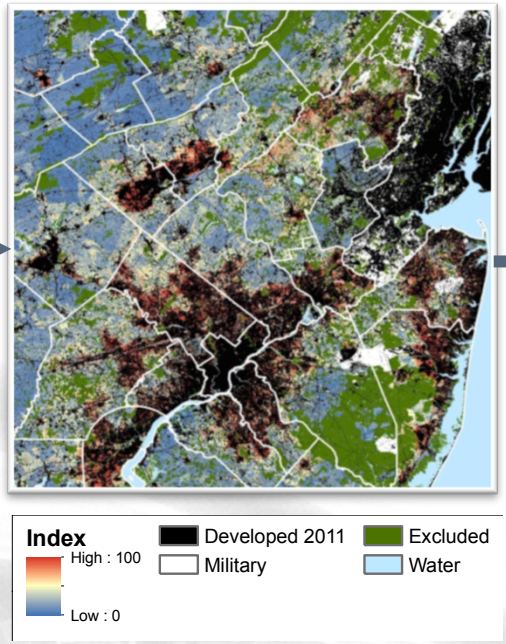
Restrictions or incentives

X

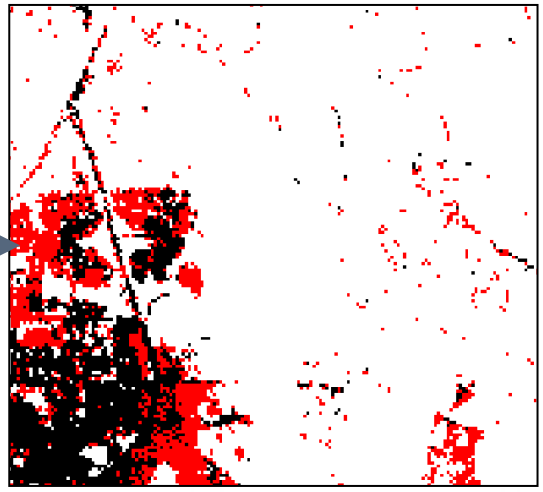
Exclusion / protection

Demand for new urban land

Suitability layer



Cellular automata



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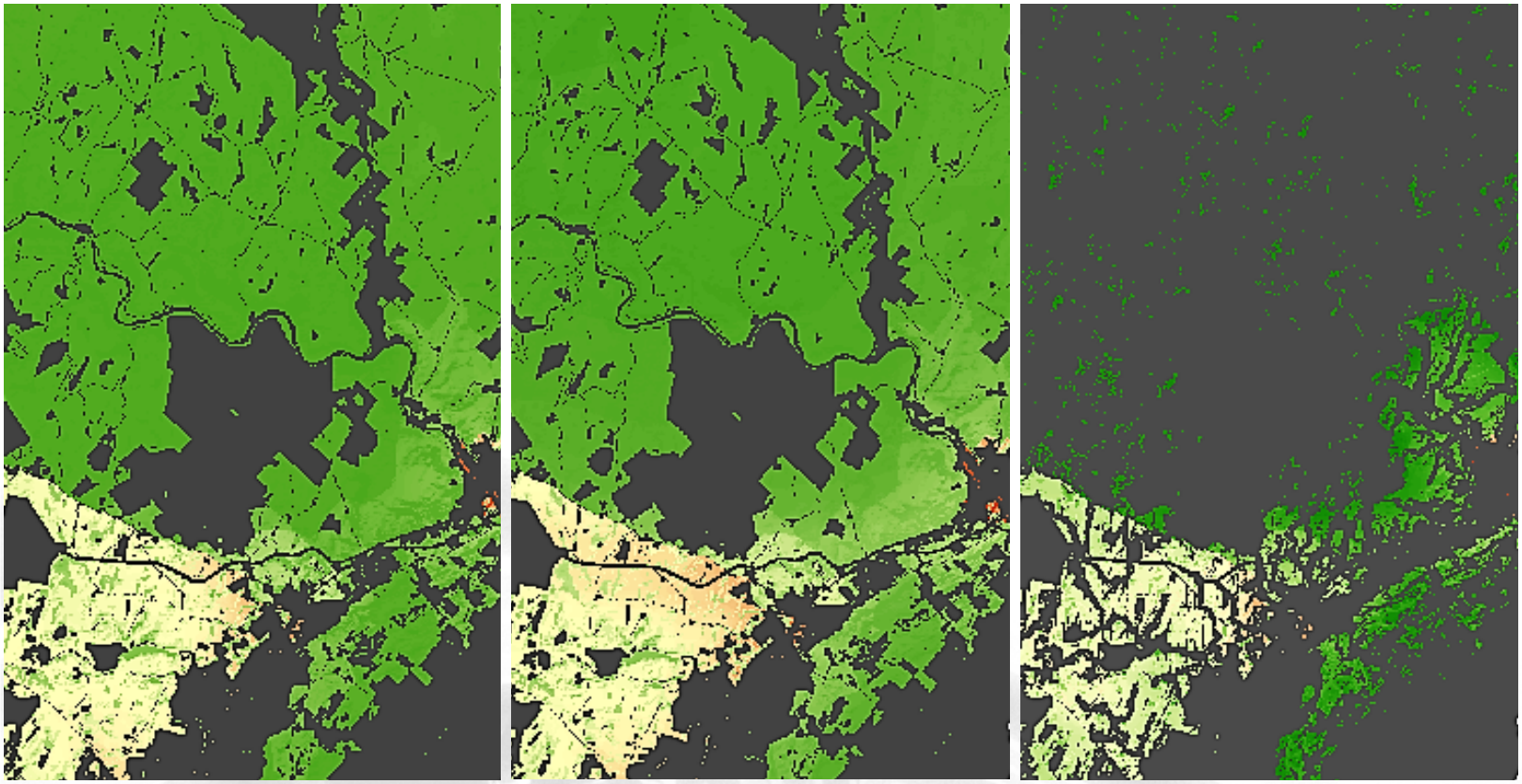
Exclusion/attraction layers



"Baseline" "Sprawl" "Conservation"

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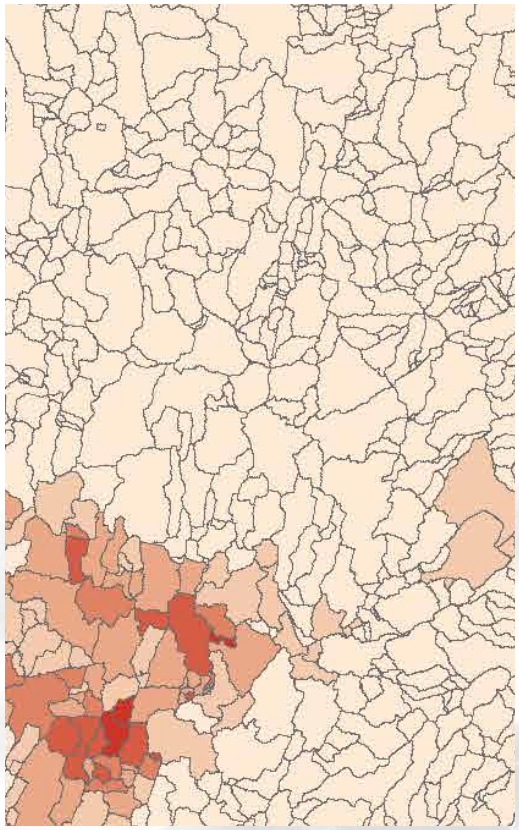
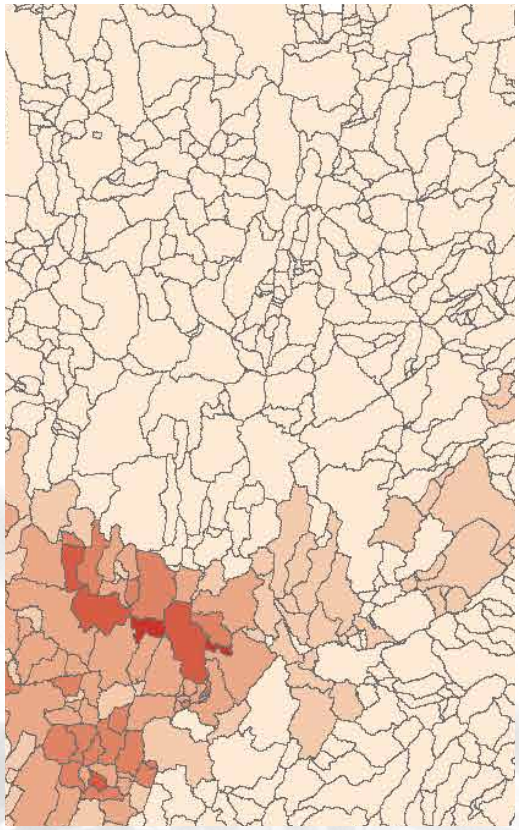
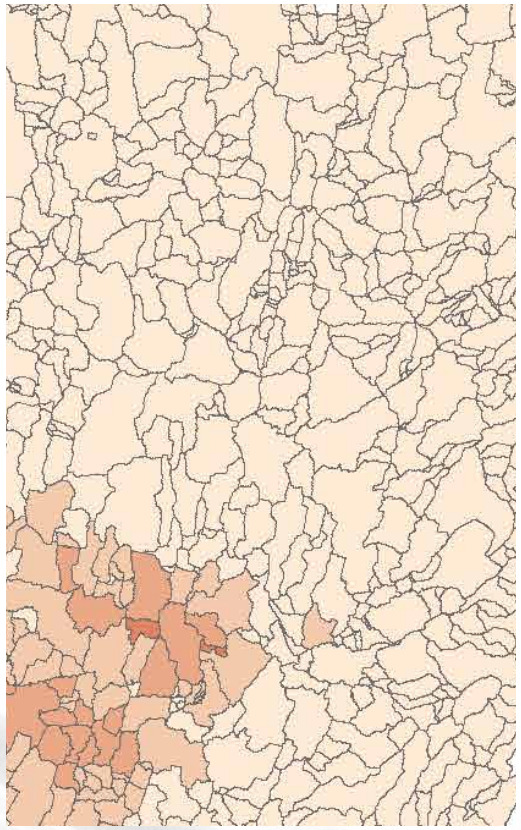
Modeled land use in 2070







% Urban
(difference 2011)

- ≤1%
- 1.01% - 5%
- 5.01% - 10%
- 10.01% - 15%
- 15.01% - 20%
- 20.01% - 25%
- >25%

"Baseline" "Sprawl" "Conservation"

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Applications

- Visually and quantitatively compare forecasted development across scenarios
- Identify/quantify potential impacts (i.e. on water quality, open space, etc.)
- Prioritize when/where to take action

Lesson learned: Imagining the future is difficult

Multimedia courtesy of Dr. Scott Drzyzga, Shippensburg University

Lesson learned: The process is as important as the products

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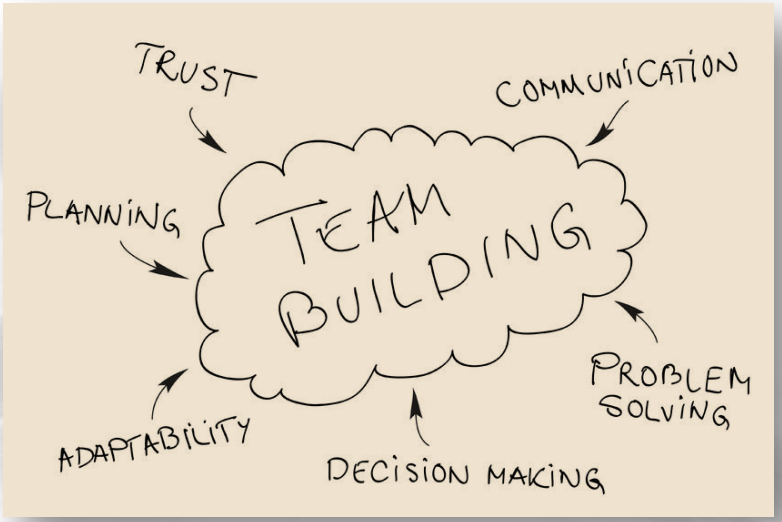
Engaging with stakeholders/end users/decision makers

- We all develop a deeper knowledge about the system we are modeling and the modeling tools
- You have a voice
- Networking and teambuilding



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Thank you!

Appendix D – Summary of Individually Written Sheets

Additional ideas from Meeting Participants

Meeting participants submitted ideas regarding the Historic Trends scenario during morning session, as well as some additional ideas regarding future scenarios on separate sheets of paper which were handed in at the conclusion of the meeting.

Historic Trends scenario feedback

- We need a cost-benefit analysis (at some point) for these "action plan items" before we try to "sell" this agenda to leaders and the public.
    - How can we judge projects vis-a-vis each other?
    - Leaders must work backwards. Costs → bang for the buck → benefit. What is the most/best we can get from our limited resources available?
- Factors include clean water shortage, technology development for electricity and clean water.
    - Decentralization of utilities in rural areas (off-grid settlement)
    - Growth of retirement communities
        - Contact for more review or ideas at: sebastian.donner@wv.gov
- Doesn't mapping by percent of suitable and distort the picture? You may have intensive development in portions of otherwise underdeveloped areas, but it will look like a very small percentage.
- Is it possible for you to share detailed (high resolution) maps for each of the jurisdictions for us to provide feedback on the model assumptions?
    - Indrani Sistla, Fairfax County Department of Planning and Zoning. Idriani.Sistla@fairfaxcounty.gov, 703–324–1380
- Regarding the Historic Trends scenarios, the East side of Sussex County Delaware should be yellow-orange.
    - The Center portion of Delaware should be more yellow-orange. Consider the Kent County growth zone.
    - Consider agricultural preservation districts in Delaware.
- The impact of natural gas development on land use restrictions (well pads, pipeline right-of-way, Northeast compression and electricity generation), which represent major development dollars with little employment.
    - Pennsylvania – clean and green as well as Farmland Preservation Act.
    - Ed Bustin, Bradford County PA LGAC, 570–886–1047
- Have the scenario results been compared to other growth projections? Such as highways and MPO's, school districts, utility districts, private capital?
    - Consider looking at available capacity at wastewater treatment plants.
    - Consider looking into local building permit history on local business permit trends.
    - Some planning offices publish annual activity reports, which document local development trends.
    - Was existing house in stock or available housing factored in to the scenarios?
        - Matthew Pennington
- Not a growth is related to population. Second homes and recreational properties have some impact (often rural with individual septic), but are not captured and trends (data). Additional data GIS layer such as subdivisions on record and easements could improve accuracy.

    - Hardy County West Virginia planner Melissa Scott.
- Retirement communities seem to be expanding much quicker than the surrounding municipalities. This is particularly true in Lancaster County. Yet that doesn't seem to have been taken into account. With aging population projections, that would seem to be the trend Bay wide. For example, Elizabethtown in Lancaster County has shown at 0 - 1%. Yet, it is growing faster due to Masonic Village, and another factor not taken into account, a very busy, newly upgraded train station. Entire route 283 corridor is growing faster than 0 - 1%.
- Population growth projections for Kent and Sussex counties in Delaware seem very low and compared with the county and state of Delaware modeling and long-term planning.
    - Don Phillips, LGAC, 443–359–1009
- Recreational smart park, low cost, environmentally cost-effective and partially savings income producing (wind and solar) apparatus inclusion.
    - Agri-growth.
    - Farming small scale.
    - Impervious surface construction.
    - Trails.
        - Councilmember Porter. keportinc@yahoo.com. 301– 655–1725.
- Historical trends need to incorporate sea level rise and nuisance flooding. This is a major driver for future development in coastal communities and flood prone localities
- Missing in the current trends: Not just climate change and impacts of sea level rise, but in Virginia land subsidence is a major issue as the water table of the aquifer has declined by three for feet per year for 30+ years; hence the groundwater restriction being implemented.
- Current trends maps or a combination of two layers, assumed growth and assumed available land.
    - It's difficult to critique the maps without knowing which side of the equation isn't reflecting ground truth.
- Agricultural "development" reflected?
    - Examples – more animal units/manure/large animal houses in Pennsylvania.
    - If agricultural development is not factored, is "developable lands" classification too broad? Agricultural easements, large blocks of restrictive agricultural zoning not available for housing/business growth.
- Please remember that agriculture encompasses both working forests and traditional farming.
- Historical Trends Comments:
    - Heavy commuter rail line impact in Virginia.
    - Highway enhancements to relieve traffic congestion on I-95.
    - Expansion of Nice Bridge between Maryland and Virginia and impact on King George county.
    - VDOT promotion of Route 31 as the new I-95 corridor.
    - Forest fragmentation from new development is impacting forest loss, which is projected as conserved.
    - Compare recent population estimates to population projection trends -- many communities have not sustained the growth project projected for them out to 2030 to 2040. How will they catch up?
        - Kevin Burns 804–270-1454

Alternative Future Scenarios Feedback (from small group session handout)

Sheet 1: from Kevin Byrnes

- What themes/scenarios are missing from these lists?
    a. Aggregation of local comprehensive plan scenarios.
    b. Market-based natural capital maximization scenario.
    c. Regional plan-based scenarios (like #a).
    d. Sea-rise impact scenario.
    e. Legacy development scenario.
- Which themes/scenarios would be most plausible and useful to simulate?
    a. Composite local plan scenario.
    b. Market-based natural capital max scenarios.
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?
    a. Private market transfer of development rights (TDR) to achieve rural downzoning.
    b. Adding natural capital valuations to incentivize forest retention on private lands.

Sheet 2

- What themes/scenarios are missing from these lists?
    a. Is there water quality-focused scenario that could be developed?
    b. We should have a scenario that projects to 2050 and 2070.
- Which themes/scenarios would be most plausible and useful to simulate?
    a. Historical Trends
    b. Current policy
    c. Land / conservation/ rural character (hybrid?)
    d. Deregulated and less managed
    e. Additional considerations:
        a. It would be nice to compare historical and current and have two that represent that spectrum.
        b. Maximum number of scenarios should be 5.
        c. All these scenarios will be run through the watershed model.
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?
    a. Can we look at the 2014 loads and the 2025 loads?
    b. Are wetlands with forest and farm conservation?
    c. Policies are driving local food production?

Sheet 3

- What themes/scenarios are missing from these lists?
    a. Hybrids of a few scenarios
    b. Geologic (i.e. Karst areas)
    c. Retirement demographics
    d. Fringe: History/ Transportation
    e. Built-out: Infill/ Policy
- Which themes/scenarios would be most plausible and useful to simulate?
    a. Infill and redevelopment (urban areas)
    b. Transportation corridors (rural)
    c. Current policy (urban)
- What policies, actions, and or other factors may happen over the next 10-30 years to support

the realization of the most plausible and useful scenarios?

a. Stormwater regulation for development - more stringent
b. Local TMDLs enforcement -more being added
c. Sea level rise

Sheet 4

- What themes/scenarios are missing from these lists?
    a. Additional infrastructure added (water, sewer)
    b. Transportation changes (more exits off of interstates) and corridor improvements – new roads
    c. Recreation (building along waterways)
- Which themes/scenarios would be most plausible and useful to simulate?
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?
    a. Note that the private sector and zoning changes are effecting the "Deregulated and less-managed growth" scenario

Sheet 5

- What themes/scenarios are missing from these lists?
    a. Climate change impacts – drought (water available), flood risk (inland and coastal), sea level rise, climate refugees
    b. Regionalization of economies
- Which themes/scenarios would be most plausible and useful to simulate?
    a. Energy development
    b. Change in transportation technology
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?
    a. Increased coastal flooding/ stronger hurricanes → more Sandys; in some areas or move away from the coast
    b. Increased fuel cost/ transportation costs

Sheet 6

- What themes/scenarios are missing from these lists?
    a. Transportation technology
    b. Distribution centers
    c. School quality (changes)
    d. Automation, job decreases
    e. Congestion
    f. Panama Canal expansion
    g. Increase in service jobs
    h. Economic downtown
    i. Drones
- Which themes/scenarios would be most plausible and useful to simulate?
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?

Sheet 7

- What themes/scenarios are missing from these lists?
    a. Resource constraints – grey infrastructure - utilities, natural – soils
    b. Changes in land ownership → Generational transfer
- Which themes/scenarios would be most plausible and useful to simulate?
    a. Land conservation and Rural Character
    b. Transportation Corridors
    c. Current policy blend with Historical Trend
- What policies, actions, and or other factors may happen over the next 10-30 years to support the realization of the most plausible and useful scenarios?
    a. Land conservation in Virginia
    b. Address the conflict between LUVT and Composite Index funding formula
    c. Create interbasin credit trading capability for TMDL and SWM – upstream and downstream
    d. Change to dynamic 2025 model baseline