Appendix 2. Model Input Data

2.1 Simulated river network

A simulated topological network representing the river network was derived from a HydroSheds digital elevation model (Lehner et al. 2008) at a 45-arc second resolution following Fekete et al. (2001).

2.2 Contemporary climate data

Historical climate from NASA Modern Era-Retrospective Analysis for Research and Applications (MERRA) was used to drive the coupled model (PnET-FrAMES) for the period of 1980-2014. Key drivers in the coupled model include average, minimum, and maximum daily air temperature, total daily precipitation, average daily cloud cover and average daily wind speed. MERRA data are at a spatial resolution of 1/2 degree latitude by 2/3 degree longitude.

We adjusted MERRA air temperature to account for elevation effects, which varies from 49 m to 1416 m in the upper Merrimack R. watershed (UMRW). We assumed a lapse rate of 6.4 °C per km of altitude above ground level (NOAA et al. 1976). The elevation difference between the MERRA course scale datasets (1/2 by 2/3 degrees) and the 45-arc second river network grid was used to adjust MERRA air temperature data for altitude. To develop a map of high-resolution daily precipitation for the region we adjusted the gridded MERRA precipitation using data from between 52 and 132 stations (depending on year) in New England from the Global Historical Climatology Network (GHCN), assuming a 50% interpolation weighing factor.

2.3 Contemporary land cover data

Land cover for the contemporary period (1980-2019) is based on data described in Thorn et al. (this issue) at 30 meter spatial resolution for the period 1996-2010. We resampled land cover to develop percent cover in each 45 arc-second grid cell. PnET-CN distinguishes forest processes in deciduous, coniferous, and mixed categories, which were also acquired from Thorn et al. (this issue) which was estimated directly from the National Oceanic and Atmospheric Administration's Coastal Change Analysis Program data. A separate impervious cover data layer was derived from the National Land Cover Dataset (Xian et al. 2011). We disaggregated developed land cover to impervious and lawn covers by assigning all non-impervious developed land to a lawn land cover type. Finally, we used the spatially distributed population estimate of Thorn et al. (this issue), which is needed as both a model driver (e.g., waste water and domestic chloride inputs) and to develop indicators (see below).

2.4 Future climate scenarios

Future climate projections used statistically downscaled climate data derived from the Geophysical Fluid Dynamics Laboratory CM2.1 model. Statistical downscaling from a native $2° \times 2.5°$ resolution to $7.5' \times 7.5'$ was performed as described in Hayhoe et al. (2007). We used two scenarios bounding a range of potential future temperature and regional climate: lower CO_2 emission (B1, 550 ppm CO_2 by 2100) and higher CO_2 emission (A1FI, 970 ppm CO_2 by 2100). Air temperature were adjusted for elevation as described above, and precipitation was bilinearly interpolated. The downscaled global climate model simulations used for environmental indicators of climate used a different statistical downscaling technique (Stoner et al. 2013, Wake et al. 2014) these data were unavailable as gridded data for our model domain. However, a check of projections at the specific location indicate they are consistent.

2.5 Future land cover scenarios

To demonstrate the coupled model, and to develop indicators required for the ecosystem services valuation (Mavrommati et al. 2017), we focus on two land cover scenarios expected to show the largest range in changing ES, the "Backyard Amenities" (Backyard) and the "Small Community with Promotion of Local Food" (Small Community Food) (Thorn et al. this issue). Table 1 presents key differences between these land cover scenarios. The Backyard land cover scenario, which prioritizes large building lots and incurs increased transportation related energy consumption, was paired with higher greenhouse gas emission (A1Fi) scenario. Conversely, the Small Community Food scenario reduces transportation-related energy consumption and is more consistent with the lower greenhouse gas emission (B1) scenario. For subsequent analyses into the specific roles of climate and land cover change, we consider the responses of the suite of land cover (Thorn et al. this issue) and emission scenarios.

We simulate future drivers of terrestrial and aquatic ecosystems using projected impervious cover, population density, and land cover from Thorn et al. (this issue) for each future decade from 2020 to 2100. Land cover and population data was aggregated using the same methodology as for contemporary land cover. We assumed the proportion of each forest type remains constant in the future.

Table A2.1. Considered Indicators

Considered Indicators	Domain
	Land
Climate Regulation	
Biofuels	
Bioproducts	
Farmland	
Forest Biodiversity	
Forest Type	
Carbon Sequestration	
Timber Stock	
Forest Cover	
	Climate
Agricultural-Livestock	
Agricultural-Maple Syrup	
Heating + Cooling Degree Days	
Hot Days	
Snow Days	
Snowmaking Days	
Snow-clearing Impact	
Winter Road Closure Days	
Significant Precipitation Days	
Hemlock Wooly Adelgid Index	
Fall Foliage Days	
Summer Days	
Lyme Disease Risk Index	
Air Quality Impaired Days	
	Water
Water Provision	
Shallow Ground Water Supply	
Total Water Supply	
Surface Drinking Water (DW) Impairment	
Shallow Ground DW Impairment	
Total DWQ Impaired	
Flood Attenuation (100-Yr)	
Flood Attenuation (50-Yr)	
Power Plant Operation Threshold	
Fish Habitat Thermal Impairment	
Riverine Environmental Flow Impairment	
Fish Habitat Chloride Impairment	

Drinking Water Low Sodium Impairment
Drinking Water Trace Metals Impairment
Fish Habitat Nitrate Impairment
River Habitat
Fecal Coliform Impairment
Dissolved Oxygen Impairment
Coastal Health

Considered indicators are sized by the round when an indicator was eliminated from consideration (first, second, third, **final**).