BETHLEHEM AUTHORITY IMPROVED FOREST MANAGEMENT PROJECT

Document Prepared by Anew Climate LLC

Project Title	Bethlehem Authority Improved Forest Management Project
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Date of Issue	22-December-2022
Project ID	1060
Monitoring Period	01-01-2021 to 31-12-2021
Prepared By	Anew Climate LLC
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The Bethlehem Authority Improved Forest Management Project Area ("Project Area") is a 17,527 acre split-parcel situated in Monroe County and Carbon County, Pennsylvania. The Project Area has been put under a 60-year term conservation easement with The Nature Conservancy (TNC) with the intention of conserving the property and managing its forest resources sustainably into perpetuity. The Project Area has ecological, scientific, educational and aesthetic value in its present state as a natural area that has not been subject to development or severe exploitation. A total of 35,959 tCO2e emissions/reductions were generated during the 10th monitoring period dating from January 1st to December 31st, 2021, resulting in 31,464 positive removals during the monitoring period.

The Project Area is comprised of primarily native forest types characteristic of the region and surrounds the headwaters of Tunkhannock Creek and Wild Creek that flow into the Delaware Basin. Interspersed with the hardwood forests are significant stands of mixed conifers and special habitat types including wetlands that provided habitat for a multitude of rare species and natural communities.

The project extends the rotation age of the timber resource on the property by approximately 70 years compared to Common Practice, thereby reducing carbon emissions and increasing carbon sequestration. The project activity employs a sustainable level of harvesting, as specified in the FSC compliant management plan required by the conservation easement and facilitates improvement in the overall health of the forest.

While executing this carbon stock enhancing harvest strategy, management practices vary to some degree based on the unique ecological features of the Wild Creek and Tunkhannock tracts.

Within the Wild Creek Tract, management is tailored for species diversity with primary target species of red oak, white oak, chestnut oak, red maple and white pine. The age structure, which is currently over-weighted in the two main age classes (90-120 and 60-75 years), will be better distributed through regeneration in appropriate areas to create vigorous young stands of early successional habitat while other stands are thinned and allowed to mature. The tract's plantations are being managed to optimal stocking for improved health, better growth and extended rotations. The deer herd is being controlled via increased hunting to allow the slow establishment of advanced oak regeneration, creating conditions where shelterwood management will successfully regenerate the oak forests. As healthy stands are allowed to mature and overstocked stands are thinned to control species and spacing, the property should experience forest stocking of increasing volume and value. Once these management goals are achieved, the Authority intends to continue to manage the forest under a long rotation harvest regime designed to sustain the forest's health and promote the ecosystem services it provides.

The Tunkhannock tract is being managed to promote healthy and expanding populations of rare, threatened, and endangered species, while encouraging increased carbon stocks. Black cherry, red maple, sugar maple, red oak, white oak, white pine and red spruce are targeted species in the upland areas for value growth and regeneration and the percent stocking of beech will be reduced over time. The future forest will have a more diverse age class and species mix where portions of the current northern hardwood forest of 100-120-year-old stands will be successfully regenerated. Forest growth in terms of timber value and carbon capture are both being accelerated through (1) thinnings to control species and spacing, and (2) successful regeneration to overcome pressure from deer browse and competing vegetation which currently preclude new age classes of seedling establishment. The minor component of conifer plantations is being managed for growth and carbon capture where they remain healthy, any plantation acres that fail to flourish will be considered for conversion to native forest.

1.2 Sectoral Scope and Project Type

The Project is within sectoral scope 14; Agriculture, Forestry and Other Land Use (AFOLU). The AFOLU project category is Improved Forest Management, Extended Rotation Age (IFM ERA) and the methodology applied is VM0003 v1.1. The Project is an individual project.

1.3 Project Proponent

Organization name	Bethlehem Authority ("the Authority")
Contact person	Stephen Repasch
Title	Executive Director
Address	10 East Church St., Bethlehem PA 18018
Telephone	610-865-7090
Email	srepasch@bethlehem-pa.gov

1.4 Other Entities Involved in the Project

Organization name	Anew
Role in the Project	Project Developer
Contact person	Liz Lott
Title	Vice President – Natural Climate Solutions

Address	582 Market Street, Suite 1505, San Francisco, CA 94104
Telephone	(415) 434-4165
Email	llott@anewclimate.com

Organization name	The Nature Conservancy (TNC), Pennsylvania
Role in the Project	Easement Holder/Forest Management Advisor
Contact person	Josh Parrish
Title	Director of Land Conservation
Address	2101 North Front Street, Building #1, Suite 200, Harrisburg, PA 17110
Telephone	717-232-6001 ext.110
Email	Josh_parrish@tnc.org

Organization name	Woodlands Management Services LLC (WMS)
Role in the Project	Forest Advisor: WMS designed the forest inventory process utilized for the *Bethlehem Authority IFM project* and conducted onsite forest measurements. Throughout the crediting period WMS, in conjunction with TNC, supervised, or directly carried out, all forest management, inventory, and monitoring activities within the project area. WMS also established the network of permanent inventory plots throughout the project area in order to facilitate future project inventory updates.
Contact person	Robin Wildermuth
Title	Proprietor and Lead Forester
Address	308 Egypt Road, Tafton, PA 18464
Telephone	570-470-7441
Email	wms1@hughes.net

1.5 Project Start Date

The Project Start Date is represented by the conveyance of the term conservation easement on the Project Area. This action occurred on April 14, 2011.

[The conservation easement is provided separately for verification purposes.]

1.6 Project Crediting Period

The project has a 100-year crediting period. This time horizon coincides with both the completion of a full timber rotation under the IFM ERA forest management plan. The crediting period start date took place on May 29, 2012 in conjunction with the official issuance of Forest Stewardship Council (FSC) certification. The Project crediting period end date is May 28, 2112.

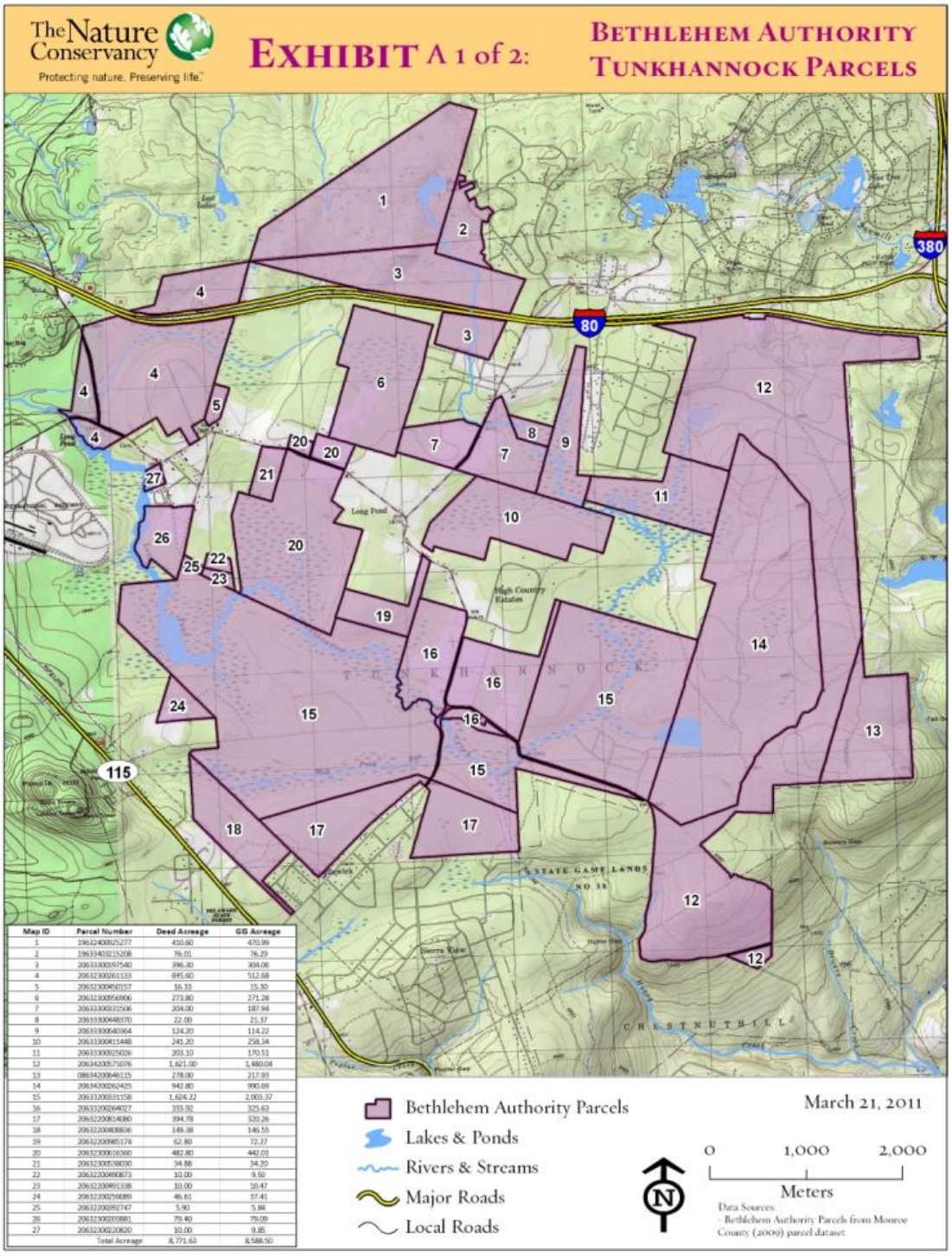
1.7 Project Location

The Project Area is located in Monroe and Carbon County, Pennsylvania and is comprised of two semi-contiguous areas of land parcels. The 'Tunkhannock Parcels' are situated in Monroe County, bordering Interstate 80. These are identified in Exhibit A 1 of 2 with Map ID's 1 through 27. The second is the 'Wild Creek Parcels' which straddle the Monroe and Carbon Country borders (See Exhibit A, 2 of 2), bordering Interstate 476. These land parcels are identified as with Map ID's 1 thru 44. Each individual land parcel also has a unique Parcel identification number (PIN).

The Tunkhannock Parcels in the Project area represent a total acreage of approximately 4,965 forested acres and are bisected by the Tunkhannock Creek. The Wild Creek Parcels in the Project area represent a total acreage of approximately 12,562 forested acres and are bisected by the Wild Creek.

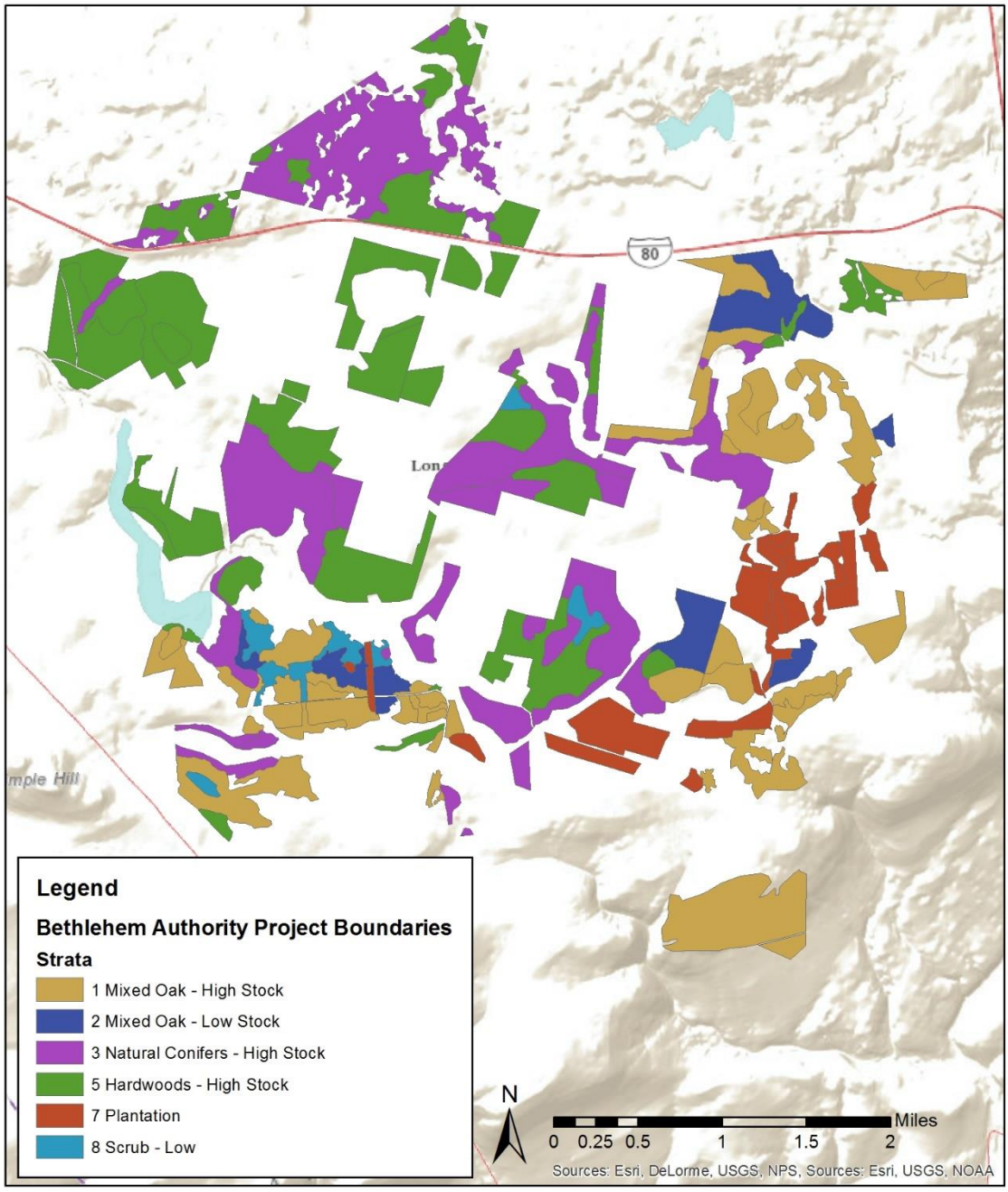
Exhibit B shows the proximity of the Tunkhannock and Wild Creek Parcels.

[KMZ files, with the associated KML component provided separately for verification purposes.]



Map ID	Parcel Number	Deed Acreage	GIS Acreage
1	19612400025277	450.60	470.99
2	19633403215208	76.01	76.29
3	20633300197540	296.30	304.06
4	20632300261133	695.60	512.68
5	20632300450157	16.35	15.30
6	20632300556906	273.80	271.28
7	20633300237506	204.00	187.94
8	20633300448570	22.00	21.37
9	20633300640864	124.20	114.22
10	20633300411448	241.20	258.34
11	20633300025026	203.10	170.51
12	20634200571076	1,621.00	1,480.04
13	08634200846115	278.00	217.93
14	20634200262425	942.80	990.69
15	20633200031158	1,624.22	2,003.37
16	20633200264027	355.92	325.63
17	20632200814080	394.78	320.28
18	20632300688636	149.38	146.55
19	20632200985174	62.80	72.27
20	20632300616560	482.80	442.01
21	20632300538030	34.88	34.20
22	20632200490873	10.00	9.59
23	20632200491338	10.00	10.47
24	20632200250089	46.61	57.41
25	20632200992747	5.90	5.84
26	20632300203881	79.40	79.09
27	20632300220820	10.00	9.85
	Total Acreage	8,771.63	9,588.50

Tunkhannock Stratification Map (4,964.9 acres)



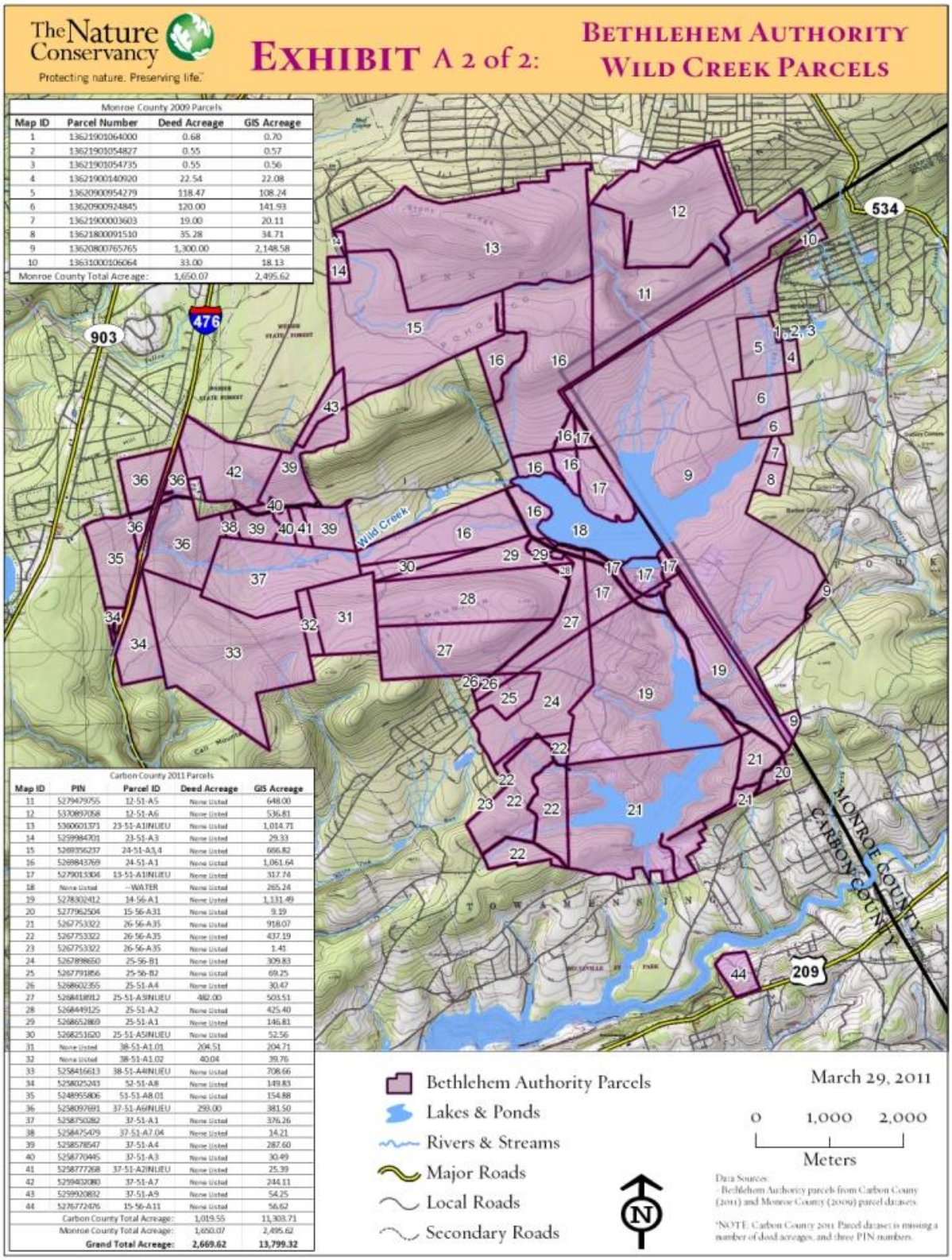

The Nature Conservancy
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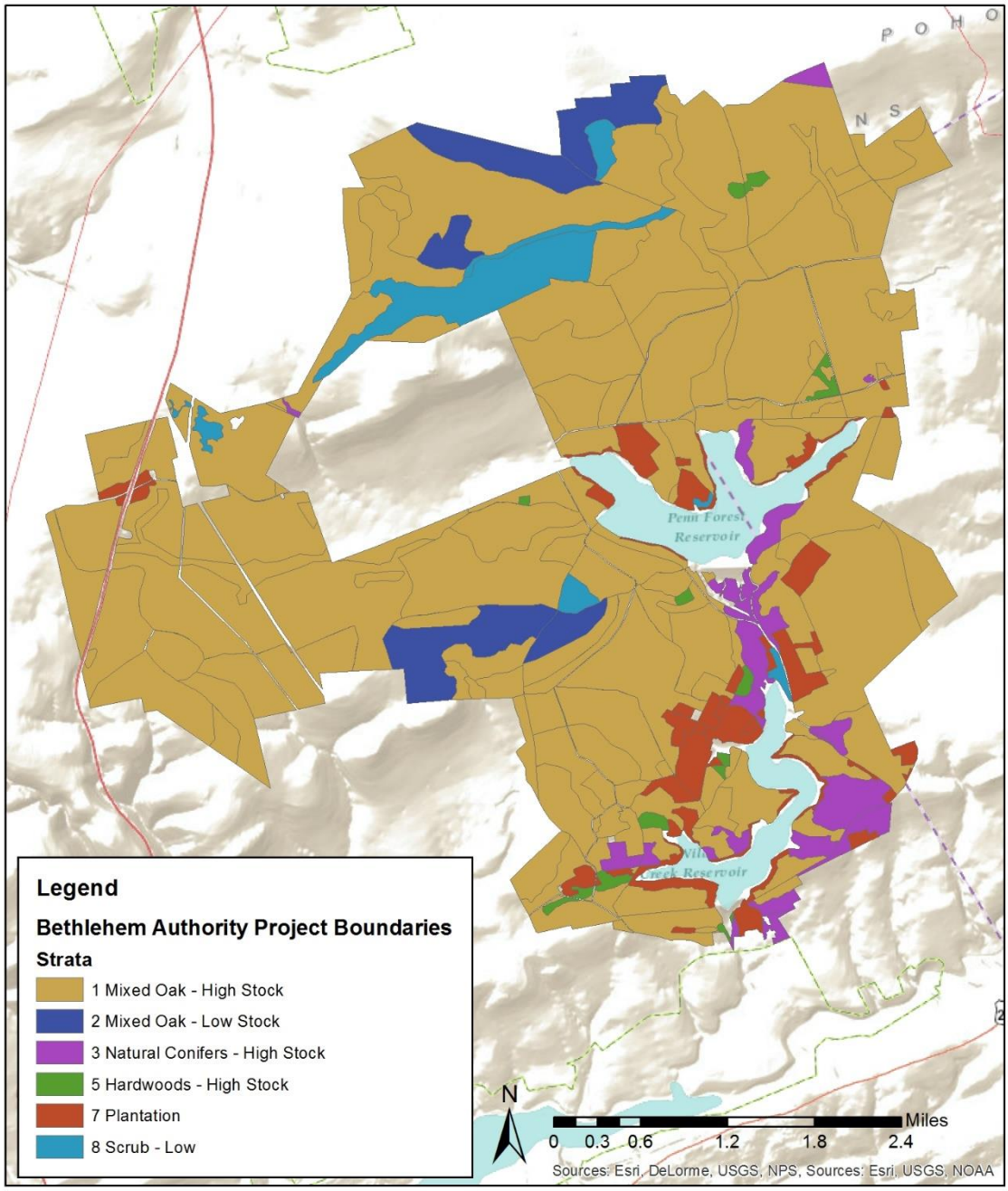
EXHIBIT A 2 of 2:
BETHLEHEM AUTHORITY WILD CREEK PARCELS
Monroe County 2009 Parcels
Map ID | Parcel Number | Deed Acreage | GIS Acreage
1 | 13621901064000 | 0.68 | 0.70
2 | 13621901054827 | 0.55 | 0.57
3 | 13621901054735 | 0.55 | 0.56
4 | 13621900140920 | 22.54 | 22.08
5 | 13620900954279 | 118.47 | 108.24
6 | 13620900924845 | 120.00 | 141.93
7 | 13621900003603 | 19.00 | 20.11
8 | 13621800091510 | 35.28 | 34.71
9 | 13620800765765 | 1,300.00 | 2,148.58
10 | 13631000106064 | 33.00 | 18.13
Monroe County Total Acreage: | | 1,650.07 | 2,495.62
Carbon County 2011 Parcels
Map ID | PIN | Parcel ID | Deed Acreage | GIS Acreage
11 | 5279479755 | 12-51-A5 | None Listed | 648.00
12 | 5370892058 | 12-51-A6 | None Listed | 536.81
13 | 5360601371 | 23-51-A1INUEU | None Listed | 1,014.71
14 | 5299984701 | 23-51-A3 | None Listed | 29.33
15 | 5269356237 | 24-51-A3,4 | None Listed | 666.82
16 | 5269843769 | 24-51-A1 | None Listed | 1,061.64
17 | 5279013304 | 13-51-A1INUEU | None Listed | 317.74
18 | None Listed | --WATER | None Listed | 265.24
19 | 5278302412 | 14-56-A1 | None Listed | 1,131.49
20 | 5277962504 | 15-56-A31 | None Listed | 9.19
21 | 5267753322 | 26-56-A35 | None Listed | 918.07
22 | 5267753322 | 26-56-A35 | None Listed | 437.19
23 | 5267753322 | 26-56-A35 | None Listed | 1.41
24 | 5267898850 | 25-56-B1 | None Listed | 309.83
25 | 5267791856 | 25-56-B2 | None Listed | 69.25
26 | 5268602355 | 25-51-A4 | None Listed | 30.47
27 | 5268418912 | 25-51-A3INUEU | 482.00 | 503.51
28 | 5268449125 | 25-51-A2 | None Listed | 425.40
29 | 5268652869 | 25-51-A1 | None Listed | 146.81
30 | 5268253620 | 25-51-A5INUEU | None Listed | 52.56
31 | None Listed | 38-51-A1.01 | 204.51 | 204.71
32 | None Listed | 38-51-A1.02 | 40.04 | 39.76
33 | 5258416613 | 38-51-A4INUEU | None Listed | 708.66
34 | 5258025243 | 52-51-A8 | None Listed | 149.83
35 | 5248955806 | 51-51-A8.01 | None Listed | 154.88
36 | 5258097691 | 37-51-A6INUEU | 293.00 | 381.50
37 | 5258750282 | 37-51-A1 | None Listed | 376.26
38 | 5258475479 | 37-51-A7.04 | None Listed | 14.21
39 | 5258578547 | 37-51-A4 | None Listed | 287.60
40 | 5258770445 | 37-51-A3 | None Listed | 30.49
41 | 5258777268 | 37-51-A2INUEU | None Listed | 25.39
42 | 5259820080 | 37-51-A7 | None Listed | 244.11
43 | 5259920832 | 37-51-A9 | None Listed | 54.25
44 | 5276772476 | 15-56-A11 | None Listed | 56.62
Carbon County Total Acreage: | | | 1,019.55 | 11,303.71
Monroe County Total Acreage: | | | 1,650.07 | 2,495.62
Grand Total Acreage: | | | 2,669.62 | 13,799.32
Wild Creek
Bethlehem Authority Parcels
Lakes & Ponds
Rivers & Streams
Major Roads
Local Roads
Secondary Roads
March 29, 2011
0 1,000 2,000
Meters
Data Sources:
- Bethlehem Authority parcels from Carbon County (2011) and Monroe County (2009) parcel datasets.
*NOTE: Carbon County 2011 Parcel dataset is missing a number of deed acreages, and three PIN numbers.
MONROE COUNTY
CARBON COUNTY
903
476
534
209

Wild Creek Stratification Map (12,562.4 acres)



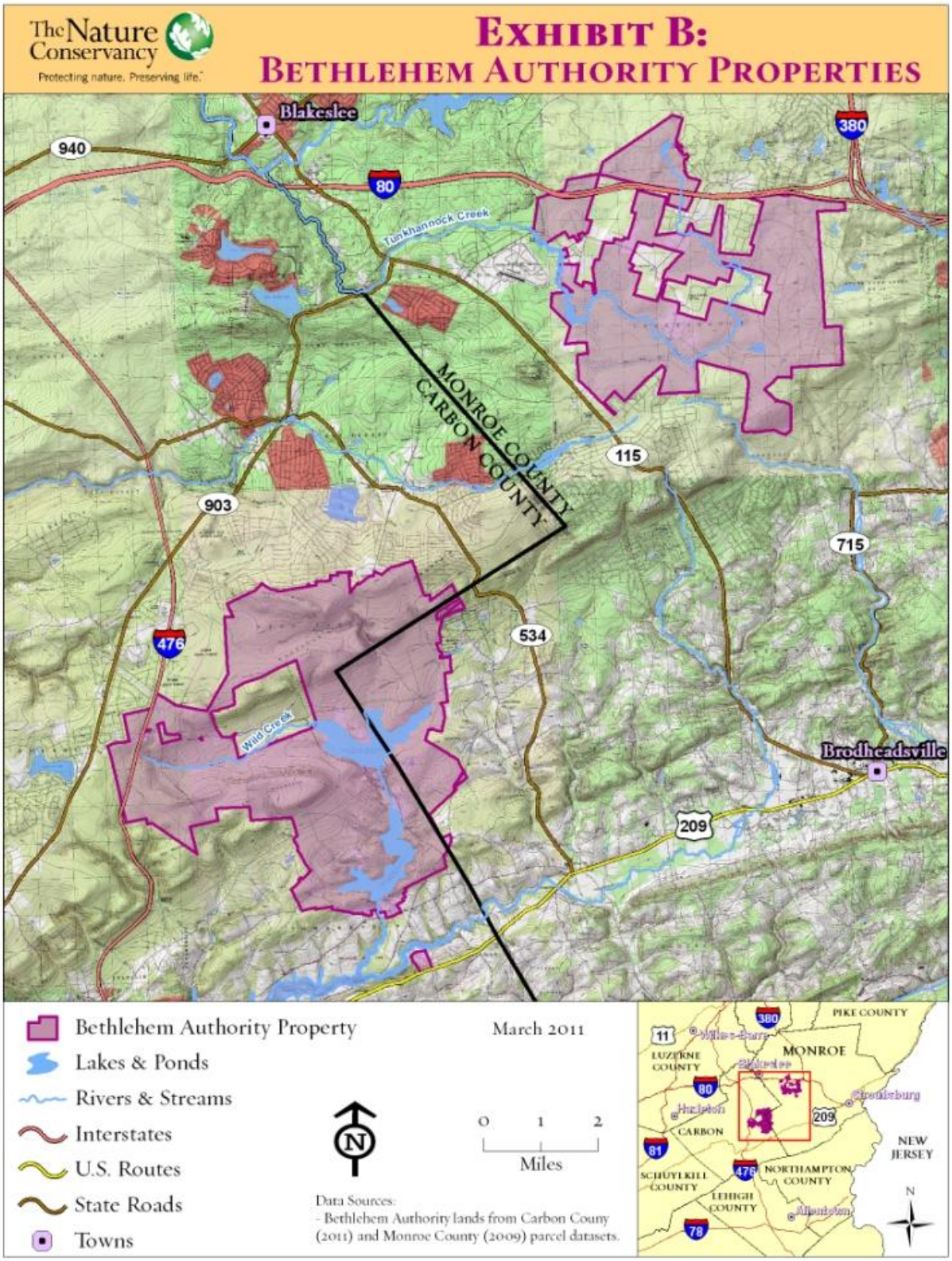

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EXHIBIT B:
BETHLEHEM AUTHORITY PROPERTIES
Blakeslee
940
80
380
Tunkhannock Creek
MONROE COUNTY
CARBON COUNTY
115
903
715
534
476
Wild Creek
Brodheadsville
209
Bethlehem Authority Property
Lakes & Ponds
Rivers & Streams
Interstates
U.S. Routes
State Roads
Towns
March 2011
N
0 1 2
Miles
Data Sources:
- Bethlehem Authority lands from Carbon County (2011) and Monroe County (2009) parcel datasets.
PIKE COUNTY
11
MONROE
LUZERNE COUNTY
Stroudsburg
Hazleton
CARBON
81
NEW JERSEY
SCHUYLKILL COUNTY
NORTHAMPTON COUNTY
LEHIGH COUNTY
Allentown
78
N

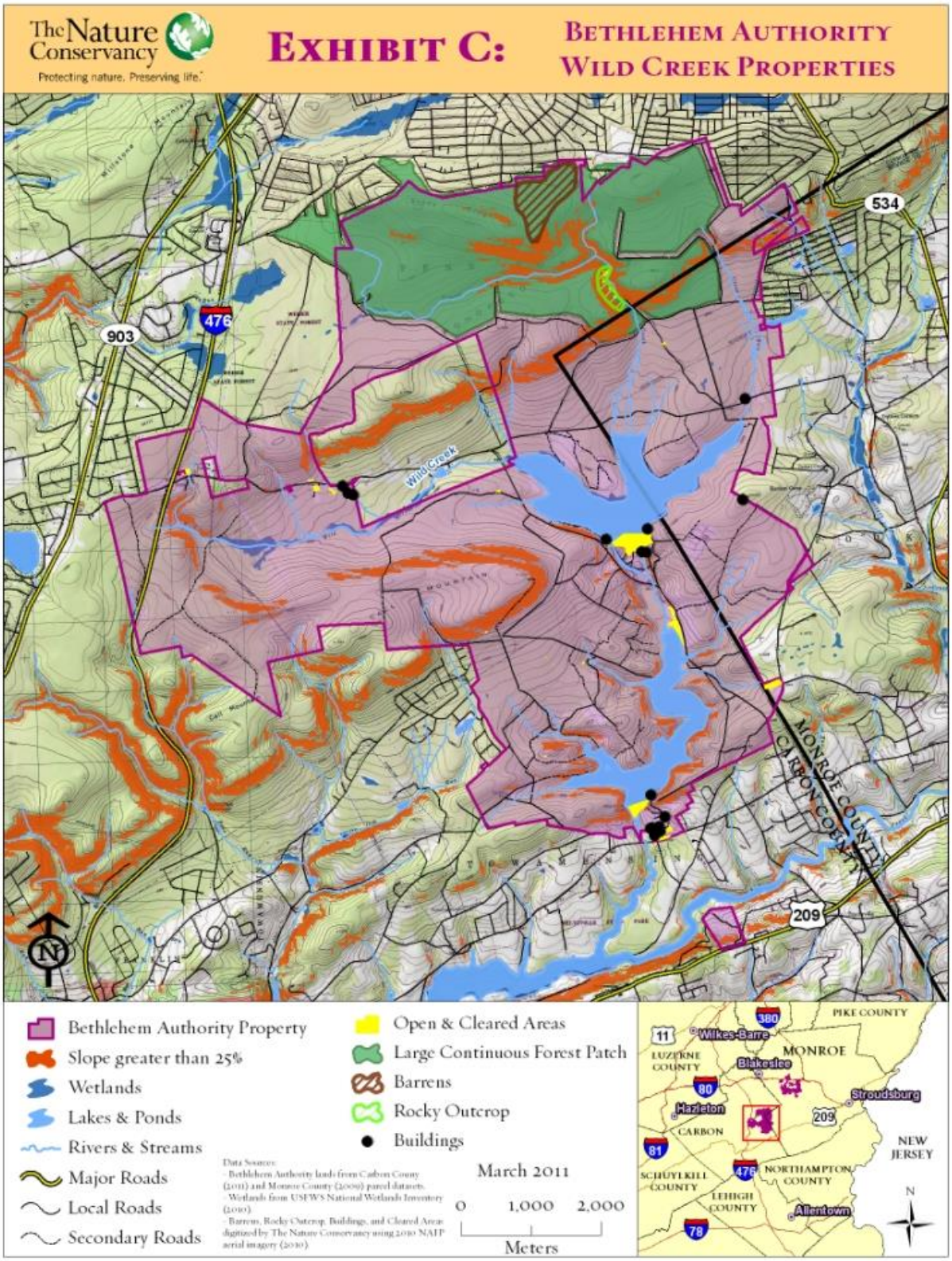
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EXHIBIT C:
BETHLEHEM AUTHORITY
WILD CREEK PROPERTIES
534
903
476
Wild Creek
MONROE COUNTY
CARBON COUNTY
209
Bethlehem Authority Property
Slope greater than 25%
Wetlands
Lakes & Ponds
Rivers & Streams
Major Roads
Local Roads
Secondary Roads
Open & Cleared Areas
Large Continuous Forest Patch
Barrens
Rocky Outcrop
Buildings
Data Sources:
- Bethlehem Authority lands from Carbon County (2011) and Monroe County (2009) parcel datasets.
- Wetlands from USFWS National Wetlands Inventory (2010).
- Barrens, Rocky Outcrop, Buildings, and Cleared Areas digitized by The Nature Conservancy using 2010 NAIP aerial imagery (2010).
March 2011
0 1,000 2,000
Meters
PIKE COUNTY
380
11
Wilkes-Barre
LUZERNE COUNTY
MONROE
Blakeslee
80
Stroudsburg
Hazleton
209
CARBON
81
NEW JERSEY
SCHUYLKILL COUNTY
476
NORTHAMPTON COUNTY
LEHIGH COUNTY
Allentown
78
N

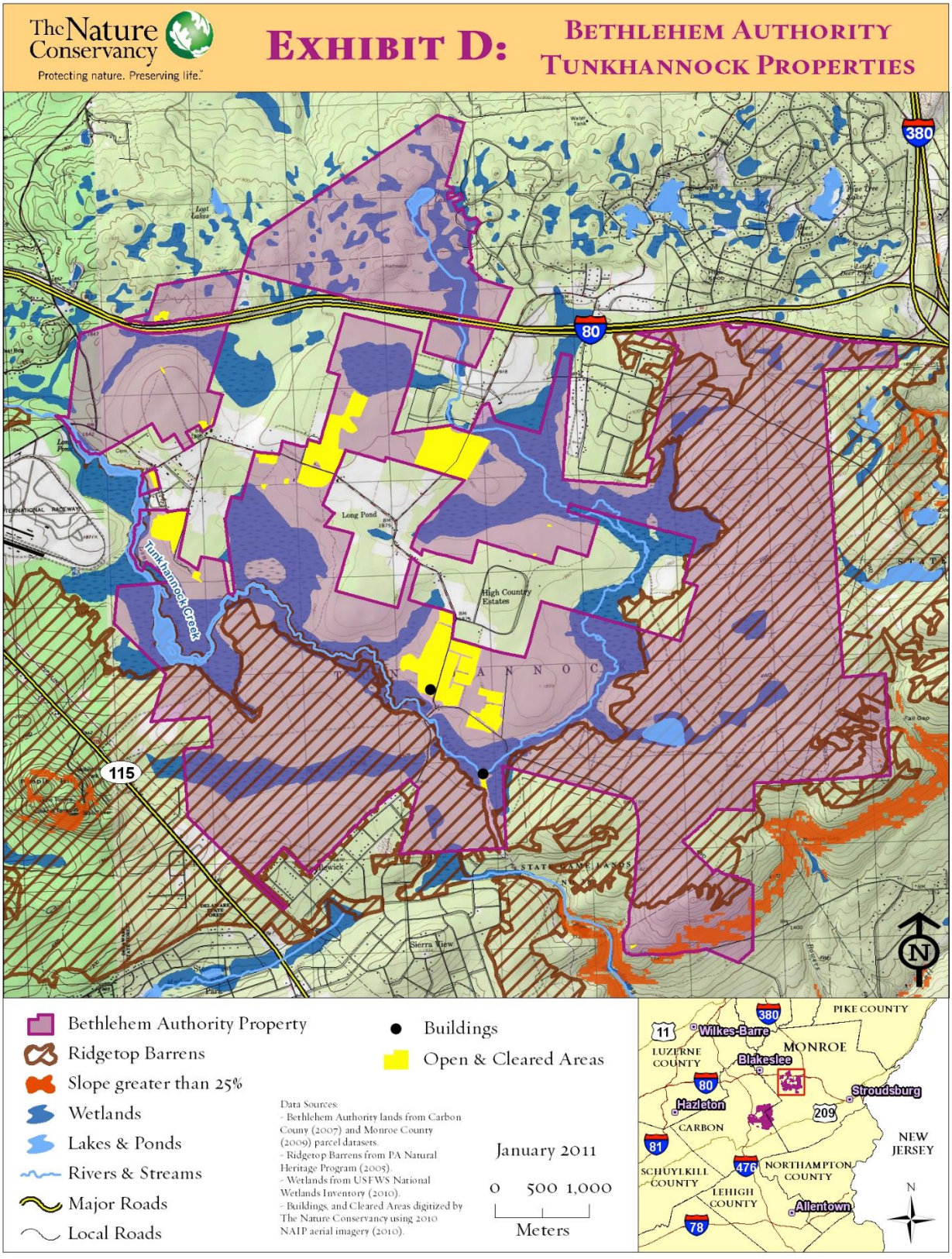
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EXHIBIT D:
BETHLEHEM AUTHORITY TUNKHANNOCK PROPERTIES
380
80
115
Long Pond
Tunkhannock Creek
High Country Estates
Sierra View
Bethlehem Authority Property
Ridgetop Barrens
Slope greater than 25%
Wetlands
Lakes & Ponds
Rivers & Streams
Major Roads
Local Roads
Buildings
Open & Cleared Areas
Data Sources:
- Bethlehem Authority lands from Carbon County (2007) and Monroe County (2009) parcel datasets.
- Ridgetop Barrens from PA Natural Heritage Program (2005).
- Wetlands from USFWS National Wetlands Inventory (2010).
- Buildings, and Cleared Areas digitized by The Nature Conservancy using 2010 NAIP aerial imagery (2010).
January 2011
0 500 1,000
Meters
PIKE COUNTY
Wilkes-Barre
LUZERNE COUNTY
MONROE
Blakeslee
Stroudsburg
Hazleton
209
CARBON
NEW JERSEY
SCHUYLKILL COUNTY
NORTHAMPTON COUNTY
LEHIGH COUNTY
Allentown
11
81
476
78
N

1.8 Title and Reference of Methodology

VCS methodology:

- VM0003 Methodology for Improved Forest Management through Extension of Rotation Age

Version 1.1, Sectoral Scope 14

And its associated sources and tools:

- AR-ACM0001 Afforestation and reforestation of degraded land
- The Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities
- The CDM Additionality Tests v5.2
- The UNFCCC Tool for testing significance of GHG emissions in A/R project activities v1.0
- The UNFCCC tool for the Calculation of the number of sample plots for measurements within A/R CDM project activities v2.0
- Risk Tool v4.0

1.9 Participation under other GHG Programs

Bethlehem is not registered under any other GHG programs. As such, this section is not applicable for the Bethlehem project.

1.10 Other Forms of Credit

Bethlehem does not participate in any other Emissions Trading Programs or environmental credit mechanisms. As such, this section is not applicable for the Bethlehem project.

1.11 Sustainable Development Contributions

Bethlehem was validated before the Program Update was introduced requiring calculation of sustainable development contributions. As such, this section is not applicable for the Bethlehem project.

2 SAFEGUARDS

2.1 No Net Harm

Bethlehem was validated before the Program Update was introduced requiring Safeguards statements on No Net Harm. As such, this section is not required for the Bethlehem project.

2.2 Local Stakeholder Consultation

Bethlehem was validated before the Program Update was introduced requiring local stakeholder consultation prior to validation and the establishment of ongoing communication mechanisms. As such, this is not required for the Bethlehem project.

2.3 AFOLU-Specific Safeguards

Bethlehem was validated before the Program Update was introduced requiring AFOLU-Specific Safeguards. As such, this section is not required for the Bethlehem project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

Following the validated schedule of activities, this Monitoring Report is for Monitoring Period 10 of the project monitoring cycle.

Approximately 43 acres were harvested during the current monitoring period (1-1-2021 through 12-31-2021). The harvesting undertaken was a hardwood thin. This treatment was budgeted and included in the FSC Plan. Greater detail on this harvest can be found in the harvest reports provided separately for verification purposes.

Future harvesting activities depicted in the modeled Project Scenario will be carried out in accordance with the Bethlehem Authority Forest Management Plan.

Management staff consistently monitor the general health and condition of the forest throughout the course of normal forest management activities (e.g. road maintenance, timber harvesting, boundary marking, etc.), reducing the risk of reversal by disease, pest invasion, and unauthorized timber removal.

The non-permanence risk factors are reassessed during the monitoring period with the latest Risk Tool version. This assessment includes all internal, external, and natural risk factors listed in the Risk tool.

The applicability conditions of VM0003 and the VCS standard prohibit any activity shifting leakage as result of the implementation of an IFM project. As the Bethlehem project area is the only forestland owned/managed by BA, this requirement is automatically met.

Under the applicability conditions of VM0003 and the VCS standard, the only type of leakage emissions calculated for the project are GHG emissions due to market effects resulting from a shift in harvests through time.

Per VM0003 market effects leakage is defined as: Total GHG emissions due to impacts of project on timber supply and demand.

The impact of the project on timber supply was calculated using equation 42.

LKMarketEffects = LFME * (ΔCACTUAL – ΔCBSL)

Where:

LKMarketEffects Total GHG emissions due to market-effects leakage through decreased timber harvest; tCO2-e

LFME Leakage factor market-effects calculations; dimensionless

ΔCACTUAL Actual net greenhouse gas removals by sinks; tCO2-e

ΔCBSL Baseline net greenhouse gas removals by sinks; tCO2-e

As rotations within the project were extended by more than 10 years in comparison to the baseline scenario, the methodology requires that the LFME be determined by calculating the proportion of total biomass in commercial species that is merchantable (PMPi) within each project stratum and comparing that figure to the mean proportion of total biomass that is merchantable for each associated Forest Service FIA forest type group (PMLFT).

PMPi was established based on FVS total and merchantable biomass calculations.

PMLFT is a percent figure based on default forest type group values provided by VCS in the following table:

Forest Type Group	Merchantable Biomass as Proportion of Total Biomass
White Red Jack Pine	77%
Spruce Fir	58%
Longleaf Slash Pine	73%
Loblolly Shortleaf Pine	73%
Ponderosa Pine	64%
Oak Pine	71%
Oak Hickory	73%
Oak Gum Cypress	72%
Elm Ash Cottonwood	73%
Maple Beech Birch	76%
Aspen Birch	61%
Douglas Fir	70%
Western White Pine	62%
Fir-Spruce/Mountain Hemlock	62%
Lodgepole Pine	64%
Hemlock/Sitka Spruce	67%
Western Larch	66%
Redwood	43%
Western Oak	69%

A representative forest type group was selected for each of the five currently forested project strata (Mixed Oak High, Mixed Oak Low, Natural Conifer High, Hardwoods High, Plantation, and Scrub) based on the predominant tree species present in each stratum.

The following table depicts the percentage of merchantable biomass in each stratum and the percentage of merchantable biomass in each stratum's associated forest group type. The cumulative weighted average percentages were calculated based on the proportion of the total project acres represented in each stratum.

Strata name	Merchantable biomass in each stratum (PMP_i)	Associated forest type group	Merchantable biomass in associated forest type group (PML_FT)	Forested Acres
Mixed Oak (high stock)	61%	Oak Hickory	73%	11,443
Mixed Oak (low stock)	58%	Oak Hickory	73%	944
Natural Conifer (high stock)	62%	Hemlock/Sitka Spruce	67%	1,911
Hardwoods (high stock)	62%	Maple Beech Birch	76%	1,635
Plantation	64%	White Red Jack Pine	77%	1,007

Scrub	60%	Oak Hickory	73%	586
Weighted average	61%	Weighted average	73%	

The table illustrates that PMLFT (73%) is 16.4% greater than PMPi (61%). This means a higher proportion of total commercial species biomass is merchantable in the displacement forest (i.e. the area that will be harvested to satisfy market demand for wood products that would have been harvested on the project area in the baseline scenario) than in the project area forest. Therefore, a smaller area will have to be harvested in the displacement forest to provide the same quantity of wood that would have been produced on the project area in the baseline scenario.

Per VM0003:

$$PML_{FT} \text{ is} > 15\% \text{ greater than } PMP_i,\ LF_{ME} = 0.2$$

Therefore, the project's leakage factor for market effects (LFME) is 0.2.

Market effects leakage will continue to be reassessed at each verification but does not require additional specific leakage management activities.

3.2 Deviations

2.1.1 Methodology Deviations

Measuring Stumps:

The procedures for measuring standing dead wood in the project's forest inventory slightly deviate from those prescribed in the VM0003 methodology as stumps were not included in the project's field measurements. The exclusion of stumps increased both model accuracy and ensured conservatism in the projects carbon calculations and is therefore in conformance with the VCS Standard's requirement that the deviation "not negatively impact the conservativeness of the quantification of GHG emission reductions or removals."

Excluding stumps for the project model is conservative because stumps are excluded from the dead pool in the Forest Vegetation Simulator (FVS, the VM0003 approved model utilized for the Bethlehem project) and, therefore, cannot be tracked, and the FVS-NE variant (associated with the project location) excludes stumps in the wood product volume equations. The result of these FVS exclusions is that stumps are essentially a "lost" pool and are considered immediate GHG emissions in the model. The implication of this is that if stumps were included in the project carbon inventory, they would only contribute to the standing dead pool in the project scenario.

Clearly, accounting for stumps as stores of carbon in the project scenario, and as immediate sources of emissions in the baseline scenario would lead to an over crediting of VCUs.

Decomposition Classes:

A five-class system was initially used to identify level of decay in standing dead trees, based on the inventory designer's familiarity with the five class Harmon et al. 2011 system. However, after data was recorded, classes 4 and 5 were merged to represent one class of dead trees with only the bole and no branches remaining. This left four total classes conforming to the descriptions of each class laid out in VM0003 v1.1.

2.1.2 Project Description Deviations

Note – All of the following deviations occurred in previous monitoring periods. No new deviations have taken place in the current monitoring period.

Decomposition Classes:

The original PD only used three decay classes. This was modified to a four-class approach in the updated project inventory to better align with the methods described in VM0003 v1.1.

Roads:

During the course of the forest inventory update, it was discovered that a minor roads component that was erroneously omitted from the original forested project area. The 63.4 acres occupied by these roads are no longer included as "forested acres" in the project scenario. Quantitative evidence was provided to the verification body demonstrating that the reduction of project acres did not have a material effect on the number of VCUs issued to the project.

Correction of Baseline Emissions for 2013:

The PD erroneously showed -15,897 tCO2e as the baseline emissions for 2013. The -15,897 value was calculated by subtracting the to-date GHG emission reductions and removals at year t1 (2012) from t2 (2013). However, the removals for year t2 (2013) in the original VCU calculations were incorrect. In the original calculations, year t2 (2013) was computed as two full years of baseline emissions (-12,086 x 2), but the first reporting period (2012) was 7 months, not 12 months. Therefore, the 2nd reporting period should be calculated as -12,086 x 1.58 for onsite stocks plus the sequestration from baseline wood products. The edit to baseline stocks results in baseline emissions of -10,821 tCO2e for 2013 instead of -15,897 tCO2e. This edit does not affect the number of credits issued for 2012, and only conservatively impacts the 2013 calculations. The table below illustrates the updated projected baseline emissions in each year of the first project decade following the calculation correction.

Years	Cumulative Baseline emissions or removals (tCO2e)	Annual Baseline emissions or removals (tCO2e)

2012	-5,112	-5,112
2013	-15,933	-10,821
2014	-28,234	-12,301
2015	-40,535	-12,301
2016	-52,836	-12,301
2017	-65,137	-12,301
2018	-77,438	-12,301
2019	-89,738	-12,301
2020	-102,039	-12,301
2021	-114,340	-12,301

3.3 Grouped Projects

Not Applicable, as Bethlehem is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	ABSL,1
Data unit	Acre
Description	Area of baseline stratum, 1
Source of data	GPS coordinates
Value applied	11,443.4
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,2
Data unit	Acre
Description	Area of baseline stratum, 2
Source of data	GPS coordinates

Value applied	944.3
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,3
Data unit	Acre
Description	Area of baseline stratum, 3
Source of data	GPS coordinates
Value applied	1.911.3
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,4
Data unit	Acre
Description	Area of baseline stratum, 4
Source of data	GPS coordinates
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,5
Data unit	Acre

Description	Area of baseline stratum, 5
Source of data	GPS coordinates
Value applied	1,635.1
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,6
Data unit	Acre
Description	Area of baseline stratum, 6
Source of data	GPS coordinates
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,7
Data unit	Acre
Description	Area of baseline stratum, 7
Source of data	GPS coordinates
Value applied	1,007.1
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	ABSL,8
Data unit	Acre
Description	Area of baseline stratum, 8
Source of data	GPS coordinates
Value applied	586.2
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	CF
Data unit	t C t^{-1} d.m.
Description	Carbon fraction of dry matter
Source of data	VM0003
Value applied	Default value 0.5 t C t^{-1} d.m.
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	D
Data unit	t d.m. m^{-3}
Description	Basic wood density
Source of data	National and species-specific data from US Forest Service Forest Vegetation Simulator (FVS)
Value applied	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003

Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	D_{DW}
Data unit	t d.m. m^{-3}
Description	Basic wood density of dead wood in the density class – soft snag (6), hard snag (9)
Source of data	FVS
Value applied	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	fj(DBH,H)
Data unit	t d.m. $tree^{-3}$
Description	Allometric equation for species j linking diameter at breast height (DBH) and possibly height (H) to above-ground biomass of living trees
Source of data	Jenkins et al. (2003) allometric equations within the FVS' Fire and Fuels Extension Carbon Submodel
Value applied	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	WW
Data unit	kg kg^{-1}.

Description	WW = Fraction of extracted biomass effectively emitted to the atmosphere during production
Source of data	The source of data is the published paper of Winjum et al. 1998
Value applied	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied	Prescribed in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	PML_{FT}
Data unit	%
Description	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type
Source of data	Official Government data and statistics within FVS
Value applied	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of Leakage
Comments	

Data / Parameter	R
Data unit	kg kg^{-1}.
Description	Root-shoot ratio appropriate for biomass increment of forest type / biome
Source of data	Jenkins et al. (2003) allometric equations within the FVS' Fire and Fuels Extension Carbon Submodel
Value applied	Provided in carbon inventory model

Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	SLF
Data unit	unitless
Description	Short lived fraction - proportion of wood products that oxidize immediately in the first three years after harvesting
Source of data	The Forestry Appendix of US Department of Energy's Technical Guidelines for The Voluntary Reporting of Greenhouse Gas Program (Section 1605b) http://www.eia.doe.gov/oiaf/1605/Forestryappendix[1].pdf Also available as a US Forest Service General Technical Report at: http://www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf Winjum et al., 1998
Value applied	Provided in carbon inventory model.
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	MLF
Data unit	unitless
Description	Medium lived fraction - Proportion of wood products that decay over a 20 year period after harvest
Source of data	The Forestry Appendix of US Department of Energy's Technical Guidelines for The Voluntary Reporting of Greenhouse Gas Program (Section 1605b)

	http://www.eia.doe.gov/oiaf/1605/Forestryappendix[1].pdf Also available as a US Forest Service General Technical Report at: http://www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf
Value applied	Provided in carbon inventory model.
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	LLF
Data unit	unitless
Description	Long lived fraction - proportion of wood products that remain stored for 100 years after harvest
Source of data	The Forestry Appendix of US Department of Energy's Technical Guidelines for The Voluntary Reporting of Greenhouse Gas Program (Section 1605b) http://www.eia.doe.gov/oiaf/1605/Forestryappendix[1].pdf Also available as a US Forest Service General Technical Report at: http://www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf
Value applied	Provided in carbon inventory model.
Justification of choice of data or description of measurement methods and procedures applied	Recommended in VM0003
Purpose of Data	Calculation of baseline emissions
Comments	

4.2 Data and Parameters Monitored

Data / Parameter	A_1
Data unit	Acres
Description	Area of stratum 1
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	11,443.4
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Meta data is kept current and uncorrupted
Purpose of the data	Calculation of project emissions
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A2
Data unit	Acres
Description	Area of stratum 2
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	944.3
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted

Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A3
Data unit	Acres
Description	Area of stratum 3
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	1,911.3
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A4
Data unit	Acres
Description	Area of stratum 4
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	0
Monitoring equipment	Hand held GPS unit, GIS software

QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A5
Data unit	Acres
Description	Area of stratum 5
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	1,635.1
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A6
Data unit	Acres
Description	Area of stratum 6
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates

Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	0
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A7
Data unit	Acres
Description	Area of stratum 7
Source of data	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	1,007.1
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	A8
Data unit	Acres
Description	Area of stratum 8
Source of data	GIS shape file derived from GPS coordinates

Description of measurement methods and procedures to be applied	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording	Decadal, following with inventory update
Value monitored	586.2
Monitoring equipment	Hand held GPS unit, GIS software
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Meta data is kept current and uncorrupted
Calculation method	Calculated in Arc GIS
Comments	

Data / Parameter	Ap
Data unit	Acres
Description	Area of sample plot
Source of data	
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	
Value monitored	N/A
Monitoring equipment	10 factor prism
QA/QC procedures to be applied	
Purpose of the data	
Calculation method	
Comments	Variable radius plot design using BAF 10 prism

Data / Parameter	DBH

Data unit	in
Description	Diameter at breast height of tree
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Tree diameter measured 4.5ft. above the ground
Frequency of monitoring/recording	Derived from field measurements during periodic inventories, and updated annually with growth modeling
Value monitored	
Monitoring equipment	Measured with Logger Tape or calipers
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	Equipment will be maintained in excellent condition. Breast height marked with permanent paint on all recorded trees >5in in diameter
Calculation method	
Comments	

Data / Parameter	Index
Data unit	Dimensionless
Description	Site Index
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Tree cores taken 4.5ft. above the ground (breast height)
Frequency of monitoring/recording	Updated during annual inventory process
Value monitored	
Monitoring equipment	Increment borer
QA/QC procedures to be applied	Calculation of project emissions

Purpose of the data	Equipment will be maintained in excellent condition. If early rings are narrow in comparison to latter rings (signifying suppression) another core is taken from an alternate site tree
Calculation method	Calculation of project emissions
Comments	

Data / Parameter	H
Data unit	ft
Description	Height of tree
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Executed in accordance with standard forest mensuration practices
Frequency of monitoring/recording	Derived from field measurements during periodic inventories, and updated annually with growth modeling
Value monitored	
Monitoring equipment	Suunto Clinometer with percent and topographic scales
QA/QC procedures to be applied	Equipment will be maintained in excellent condition and all height entries will be double checked for reasonableness prior to submission for verification
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	PMPi
Data unit	%
Description	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data	
Description of measurement methods and procedures to be applied	Executed in accordance with standard forest mensuration practices

Frequency of monitoring/recording	Yearly
Value monitored	2021: 61%
Monitoring equipment	
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	All calculations double checked for accuracy prior to submission for verification
Calculation method	Divide the FVS merchantable biomass output for a given stratum by the total above ground live tree biomass in said stratum
Comments	

Data / Parameter	T
Data unit	yr
Description	Number of years between monitoring time t and t1 (T = t2 – t1)
Source of data	Monitoring reports
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Yearly
Value monitored	1
Monitoring equipment	Calendar
QA/QC procedures to be applied	Calculation of project emissions
Purpose of the data	All calculations double checked for accuracy prior to submission for verification
Calculation method	Subtraction
Comments	

4.3 Monitoring Plan

The following material outlines the monitoring plan to be followed during the first 10 years following project validation. It should be noted that modifications made to the measurement and monitoring techniques reviewed during the initial project field verification (e.g. permanent plot monumentation

and the recording of tree heights to the nearest foot) have been implemented to improve ease of plot location and increase carbon measurement precision.

Monitoring Method:

In the year of validation/verification (2013), a representative sample of 242 variable radius permanent inventory plots was established across the project area. 43 of these plots were integrated from a network of pre-existing continuous forest inventory (CFI) plots on the property dating back to 1991. GIS software was utilized to randomly distribute plot locations across the various project strata, in proportion to stratum acreage, while incorporating the 43 existing CFI plots. All 242 permanent plots will be re-inventoried at least one more time over the following decade to calibrate forest growth models and improve carbon sequestration projections.

Permanent inventory plot centers are logged using a professional grade GPS unit and monumented by a rebar pole buried in the ground and topped with a florescent plastic cap. Live trees qualifying as "in" using a BAF 10 prism are recorded for species, merchantable height to a 4" top, sawtimber height to a 10" top, % missing/rotten[1], and DBH (in 1/10th inches). Total height (in feet) is recorded for all "in" trees over 5" in DBH on every forth plot. Site index measurements are also recorded from a dominant tree on every fourth plot sampled. These site index figures are used to improve growth and yield model results. Standing dead trees qualifying as "in" using a BAF 10 prism are recorded for height as a tree originally stood (based on height of neighboring trees, in feet), height in current condition (in feet), DBH (in inches), % missing/rotten, and decay class[2] (1, 2, 3, 4, or 5). All height measurements are based on clinometer or laser range finder readings. All DBH measurements are taken using a logger's tape. All inventoried trees of 5" DBH or greater are marked with a permanent paint dot at breast height and numbered according to the order within the plot in which they were measured. At each plot a metal tag labeled with the inventory plot number and distance to plot center is driven at ground level into the inward facing base of a dominant/co-dominant tree to allow for location of plot center if permanent paint markings fade. This plot design gives forest managers the opportunity to consistently track the growth and development of specific trees over an extended timeline and allows for improved ease of plot location during field work and site verifications. It should be noted that harvest activities are not affected by permanent plot locations. This ensures that permanent plots accurately reflect the silvicultural treatments on the stands in which they reside.

In addition to inventory sampling, management staff consistently monitor the general health and condition of the forest throughout the course of normal forest management activities (e.g. road maintenance, timber harvesting, boundary marking, etc.), reducing the risk of reversal by disease, pest invasion, and unauthorized timber removal. Any scheduled forest treatments are documented

[1]If there are portions of the tree that are missing/rotten, percent defect should be estimated with by visually dividing the tree into thirds, estimating the percentage that is missing or rotten in each third, and then using these estimates to determine the total defect by assuming that 70% of biomass is in the bottom third, 25% is in the middle third, and 5% is in the top third.

[2]See Permanent Plot Network Inventory document, provided separately for verification purposes, for detail. After field data was collected, classes 4 and 5 were combined to represent a single class.

through pre- and post-treatment monitoring and all forest removals are tracked by product class. During pre-treatment monitoring, forest staff verify stand stocking and condition before marking stands to designate trees for removal, perimeter of sale, and protected areas. During the harvest forest staff periodically inspect the site to review forest treatment activities and ensure compliance with management standards. Inspection reports are generated documenting inspection findings. Post-harvest, a final inspection is carried out to assess conditions of the residual stand, quality of cleanup, and the retirement/stabilization of the landing and skid trails. Following natural disturbance events, affected project stands are assessed for damage by Bethlehem forestry staff. If damage is significant, the affected areas are re-inventoried and project scenario models are adjusted to reflect onsite carbon stocks. Any changes in strata boundaries necessitated by harvesting or natural disturbances (i.e. stands moving from high stocking to low stocking through mortality or harvest) are mapped and documented.

In years in which forest plots are not re-inventoried carbon stocks are monitored through forest growth and yield modeling using the US Forest Service's FVS software.

Leakage is consistently monitored throughout all project crediting periods. As the Bethlehem Project Area is the only working forestland owned/managed by BA, the project is automatically in compliance with VM0003's prohibition of *activity shifting leakage*. The project's *Market effects leakage* is re-assessed, prior to each project verification, based on a comparison of the percentage of merchantable timber per acre on the project site compared to other forests within the region (See section 3 for a detailed description of all leakage calculations).

In accordance with the VCS AFOLU Requirement document (v4.0 section 3.2.7), the project baseline will be updated every 10 years. All decadal inventories following the 2013 inventory update will be carried out in concurrence with the baseline update and the project scenario model and long term average will be calibrated/updated to reflect the most current state of the Bethlehem forest.

Organizational Structure, Responsibilities, and Competencies:

Anew Climate LLC (Anew) oversees the execution and reporting of all project reporting, modeling, and monitoring activities on behalf of the landowner, the Bethlehem Authority. The Nature Conservancy-Pennsylvania (TNC) and Woodlands Management Services LLC (WMS) are responsible for "on the ground" forest management activities on the project area, and conduct inventory measurements and data collection. After forest inventory data collection, both WMS and TNC report results to Anew for processing and updating of modeling projections. After processing is complete Anew houses all data and submits the necessary documentation for compliance with VCS standards. Anew then stores the project data in an online cloud storage account for at least two years after the conclusion of the project crediting period.

Anew is the leading climate change offset portfolio in the nation with more publicly registered third-party verified GHG offsets than any other company in North America. They have deep expertise in carbon project development and substantial experience working with forest carbon.

TNC is an internationally respected NGO that has been active in environmental management for over 60 years. TNC has a long history working with forest-based carbon projects dating back to the groundbreaking 1996 Noel Kempff climate action project. TNC's Pennsylvania chapter has a staff of

qualified natural resource managers and is responsible for Pennsylvania's Working Woodlands forest conservation program designed to protect the states forests while improving private forest management, providing revenue for forest landowners, and fighting climate change.

WMS is a consulting firm specializing in forest management, timberland investment, and land conservation services. WMS staff holds professional degrees in Forestry, Environmental Management, Biology, and Environmental Studies, and collectively bring 45 years of forest management experience to the organization. Founded in 1994, WMS currently manages over 50,000 acres of forestland.

Methods for Generating, Recording, Storing, Aggregating, Collating and Reporting Data:

All data is collected on hand-held Pocket PC data recorders incorporated with Pocket Dog data collection software, then downloaded and compiled on Office Dog. All equipment utilized throughout the course of the project is regularly calibrated to the equipment's specifications and/or the relevant national standards.

Field personnel use the following equipment for obtaining forest carbon data:

- 75' Logger Tape designed to measure in 10ths of inches
- Clinometer with percent and topographic scales
- 10 Basal Area Factor Prism
- Compass
- Increment borer
- Pocket PC equipped with PocketDog software
- Professional grade GPS handheld unit with point locations

All sample points are located using professional grade handheld GPS units. At each point the cruiser carries out the measurement and monumentation practices described in the *Monitoring Method* section above.

All field data collectors receive field training and complete several plots with an experienced collector before heading off on their own. Data collectors are provided with data entry procedure documents that define species codes, product codes and overstory/regeneration tally methods. Tables of 10 BAF critical distances are provided to each forester to verify border trees.

At each sample plot live trees qualifying as "in" using a BAF 10 prism are recorded for all of the metrics described in the *Monitoring Method* section above. Where necessary, monumentation is modified to incorporate new "in" trees and replace degraded monumentation materials. Pocketdog inventory data collection software is used to record inventory plot data on HP ipaq handheld computers. Custom Pocketdog method sets are patterned and designed per documented inventory procedures and provided by Fountains Forestry. These custom method sets help to maintain the integrity of the data by prompting input, listing codes, and constraining entries with custom validation rules. In the event that technical difficulties are encountered with the HP handheld computers or Pocketdog program, paper datasheets are utilized.

All inventory data is uploaded, processed and compiled by TNC and WMS using TwoDog's OfficeDog software. This allows for the data to be easily converted to other formats for additional analysis pertaining to carbon offset generation. Multiple backups (to multiple hard drives) of raw data are performed each time cruise data is uploaded. After upload, TNC or WMS back up all inventory data and send a copy to Anew for statistical analysis and model updating. Anew then compiles all monitoring data and analysis and submits the required documentation for verification. Anew then stores all data in an online DropBox account for at least two years after the conclusion of the project.

Procedures for Auditing and Non-conformities:

Non-conformities are minimized by utilizing Twodog inventory software to analyze inventory plot data. Pocketdog inventory plots are uploaded directly from the ipaq handhelds into the Twodog inventory software to avoid transcription errors. Once uploaded, inventory plots are sorted into corresponding forest stands. As plots are sorted into appropriate stand types, data from each plot is automatically validated by the Twodog software. Twodog automatically return validation errors for any anomalous entry and trigger the data analyst to make appropriate corrections.

Sufficient field data is collected to ensure that the uncertainty thresholds within the protocol are upheld. Uncertainty (i.e. the 90% confidence interval as a percentage of the mean) for all measurement pools is maintained below 10% and a conservative approach is taken in the selection of parameter values.

Ultimately stand data summary reports are reviewed for reasonableness by WMS foresters, printed and entered into GIS stand layer attributes tables for archiving and use in day-to-day forest management activities. Additional review of the Twodog stand data reports and GIS attributes tables is performed as the stand data is analyzed.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The baseline net GHG Removals by sinks will be determined as:

$$\Delta C_{BSL} = \Delta C_{BSL,P} - GHG_{BSL,E} \quad (1)$$

where:

ΔC_{BSL}	Baseline net greenhouse gas removals by sinks; t CO_2-e
$\Delta C_{BSL,P}$	Carbon stock changes in all pools in the baseline; t CO_2-e
$GHG_{BSL,E}$	Greenhouse gas emissions as a result of forest management activities within the project area in the baseline; t CO_2-e

$$\Delta C_{BSL,P} = \Delta C_{BSL,tree} + \left(\Delta C_{BSL,DW}\right) + \left(\Delta C_{BSL,WP}\right) \quad (2)$$

where:

$\Delta C_{BSL,P}$	Carbon stock changes in all pools in the baseline; t CO_2-e
$\Delta C_{BSL,tree}$	Carbon stock changes in trees in the baseline; t CO_2-e
$\Delta C_{BSL,DW}$	Carbon stock changes in dead wood in the baseline; t CO_2-e
$\Delta C_{BSL,WP}$	Carbon stock changes in wood products in the baseline; t CO_2-e

$$\Delta C_{BSL,tree} = \frac{\left(\sum_{i=1}^{M_B} \Delta C_{BSL,AG|BG,i,100} * \frac{44}{12}\right)}{100} * t^* \quad (3)$$

where:

$\Delta C_{BSL,tree}$	Carbon stock changes in above-ground and below-ground biomass of trees in the baseline; t CO_2-e
$\Delta C_{BSL,AG\|BG,i,100}$	Summed annual net carbon stock change in above-ground and below-ground biomass for stratum *i*, (summed over the 100 year modeled baseline); t C
i	1, 2, 3 …M_B strata in the baseline scenario
t	1, 2, 3, … t^* years elapsed since the start of the IFM project activity
44/12	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

$$\Delta C_{BSL,DW} = \frac{\left(\sum_{i=1}^{M_B} \Delta C_{BSL,DW,i,100} * \frac{44}{12}\right)}{100} * t^* \quad (4)$$

where:

$\Delta C_{BSL,DW}$	Carbon stock changes in dead wood in the baseline; t CO_2-e
$\Delta C_{BSL,DW,i,100}$	Summed annual net carbon stock change in dead wood for stratum *i*, (summed over the 100 year modeled baseline); t C
i	1, 2, 3 …M_B strata in the baseline scenario
t	1, 2, 3, … t^* years elapsed since the start of the IFM project activity
44/12	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

$$\Delta C_{BSL,WP} = \frac{\left(\sum_{i=1}^{M_B} \Delta C_{BSL,WP,i,t} * \frac{44}{12}\right)}{100} * t^* \quad (5)$$

where:

$\Delta C_{BSL,WP}$	Carbon stock changes in wood products in the baseline; t CO_2-e
$\Delta C_{BSL,WP,i,t}$	Baseline annual net carbon stock change in wood products for stratum *i*, at time *t*; t C yr^{-1}
i	1, 2, 3 …M_B strata in the baseline scenario
t	1, 2, 3, … t^* years elapsed since the start of the IFM VCS project activity
44/12	Ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

Carbon stock changes in above ground and below ground biomass, dead wood biomass, and wood products: 12,301

Carbon emissions due to biomass burning as part of forest management: 0 tCO2e

Total Baseline emissions: 12,301

5.2 Project Emissions

Quantify project emissions and/or removals providing sufficient information to allow the reader to reproduce the calculation. Attach electronic spreadsheets as an appendix or separate file to facilitate the verification of the results.

Carbon stock changes in above ground and below ground biomass, dead wood biomass, and wood products: 32,647

Carbon emissions due to biomass burning as part of forest management: 0 tCO2e

Total Project emissions reduction: 35,959 tCO2e

5.3 Leakage

Market effects leakage = 0.2
Leakage emissions: =-8,990

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Buffer pool allocation	VCUs eligible for issuance
2021	12,301	33,647	-8,990	35,959	-4,495	31,464

*Net GHG emissions reported are prior to the removal of the 10% risk deduction for the buffer pool contribution, which is shown below. 10% is the risk deduction for both Tunkhannock and Wild Creek geographic areas.
Buffer Contribution: (12,301 + 32,647) *10% = -4,495
Issued VCUs: 35,959-4,495= 31,464

Long-term average GHG benefit: 896,493 (met in monitoring period 39)