US Army Corps of Engineers ®
Wilmington District

PHILPOTT LAKE, VIRGINIA
WATER STORAGE REALLOCATION
FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

DRAFT APPENDIX C ECONOMIC ANALYSIS
July 2022

Wilmington District – U.S. Army Corps of Engineer

C.1 Purpose of Economic Evaluations in a Reallocation Study

As stated in the Institute for Water Resources (IWR) Water Supply Handbook (Revised IWR Report 96-PS-4):

> "U.S. Army Corps of Engineers and other Federal reservoirs represent a combination of large economic investments and commitments of valuable natural resources. These reservoirs can make important contributions to the nation's economy. Over time, as population shifts and growth and need changes, the purposes of some Federal reservoirs may no longer satisfy the original project priories. To meet these changing needs, the Corps is continually turning to reallocation. Reallocation of storage to municipal and industrial water supply has been considered in a number of different ways. However, any new reallocation agreement must provide the states or others with financial incentives not available elsewhere and the use of existing storage in Corps facilities must be cheaper for the potential user than the construction of new or additional facilities. Corps policy for reallocated storage is to charge the user the cost of the storage as if it were constructed today."

According to the same manual, there are three conditions that create an opportunity to reallocate flood control storage to water supply storage, which are:

- Where reallocated flood control storage volumes are small and do not affect flood protection. If the effect is large, Congressional action is required.
- Where the downstream floodplain has changed, or supplemental protection has been provided; and
- Where reservoirs have been designed to a maximum site capacity that is larger than required by hydrologic analysis.

The purpose of this economic evaluation is to determine the impact of reallocating water from the conservation pool and flood control pool at the USACE's Philpott project. The proposed changes to the base condition (alternatives) are then compared to the base condition in order to determine their affects and aid the planning effort.

C.2 Facility Background

C.2.1 Project Location

Philpott Dam is located on the Smith River approximately seven miles northwest of Bassett, Virginia, and about 34 miles south of Roanoke Virginia. Philpott Dam impounds Philpott Reservoir (also known as Philpott Lake), which extends approximately 13 miles upstream from the dam. The reservoir encompasses approximately 2,880 acres under normal operating

conditions and lies within Henry, Franklin, and Patrick counties. The drainage area of the Smith River basin above Philpott Dam is approximately 212 square miles.

C.2.2 Related Projects

Philpott Dam is furthest upstream of three dams on the Smith River. The other two are the Smith River Dam in Martinsville, Virginia, and the Spray Cotton Mills Dam in the Eden, North Carolina. Philpott Dam is authorized and managed for recreation, flood control, hydroelectric power generation, fish and wildlife conservation, public water supply and low flow augmentation. There are numerous low-head dams along the Smith and Dan Rivers built for power and water intake diversions. The primary purpose of both the Smith River Dam and the Spray Cotton Mills Dam is hydroelectric power generation.

C.2.3 Watershed

The Smith River is the largest tributary of the Dan River. At the confluence of these two rivers, the Smith River has a contributing drainage area of approximately 540 square miles and the Dan River has a drainage area of approximately 1,130 square miles (Weaver, 1996). The Dan River crosses the North Carolina-Virginia state line eight times on its way from the Blue Ridge Mountains to John H. Kerr Reservoir. The 3,300 square mile Dan River basin comprises approximately one-third of the Roanoke River Basin (DRBA, 2013). The Roanoke River basin is comprised of approximately 9,580 square miles, stretching from the foothills of the Blue Ridge Mountains in Virginia in a southeast direction to the Atlantic Ocean at the Albemarle Sound near Plymouth, North Carolina. The Roanoke River terminates in the second largest estuary system (Albemarle-Pamlico) in the United States (NCDWQ, 2001). John H. Kerr Dam, constructed in the early 1950s for flood control and hydroelectric power generation, is the largest dam in the Roanoke basin system (RRBA, 2012).

C.2.4 Functions, Services and Benefits

The Roanoke River watershed has historically been an area of significant natural resource production. Currently, approximately 60% of the land in the basin is forested and about 22% is cultivated cropland. Cotton, peanuts, tobacco and soybeans are among the most common crops grown. Only six percent of the land falls into the urban or built-up land category (NCDWQ, 2001).

Contemporary water management in the basin evolved over decades to include flood control and hydropower generation. The numerous dams within the watershed have significantly reduced flood damages and augmented water supply capacities through the region. In addition, the dams have generated a multitude of recreation opportunities, including fishing, boating and swimming, among other activities.

C.3 Demographics

C.3.1 Population

Due to the nature of reallocation, the existing and future without project (FWOP) conditions are assumed to be equal with the exception of population growth. Philpott Dam is located in Henry County, VA which will be the central focus along with the state of Virginia.

The following tables display the basic population, population projections, demographic, and poverty statistics information for each portion of the study area as estimated by the Census Bureau 2022 American Community Survey 5-year estimates.

Table 1: Population

Area	1960	1970	1980	1990	2000	2010	2020
State of Virginia	3,966,966	4,651,487	5,346,818	6,187,358	7,079,030	8,001,024	8,631,393
Henry County, VA	40,335	50,901	57,654	56,942	57,930	54,151	50,948

Table 2: Population Projections

Area	2025	2030	2035	2040	2045
State of Virginia	8,993,343	9,331,666	9,604,197	9,876,728	10,149,260
Henry County, VA	48,875	46,764	44,418	42,073	39,728

Table 3: Demographics

Area	Minority (all persons except white, non Hispanic)	Percentage minority (all persons except white, non Hispanic)	Persons below poverty	Percent age of persons below poverty	Percent of female persons	Percent of persons 65 years and over	Percentage of persons aged 17 and younger
State of Virginia	3,487,082	40.4%	794,088	9.2%	50.8%	15.9%	15.9%
Henry County, VA	15,997	31.4%	6,572	12.9%	51.9%	24.5%	21.8%

C.3.2 Education

Table 4 shows the percent of people over the age of 25 with no high school diploma. This is an important statistic due to its correlation with higher rates of unemployment and underemployment. This percentage is 9.7% in the stage of Virginia and 19.8% in Henry County, VA. Also, the below table shows the percentage of persons with bachelor's degrees which is 39.5% for the state of Virginia and 15.1% for Henry County, VA.

Table 4: Education

Area	Percentage of persons with no high school diploma (age 25+)	Percentage of persons with bachelor's degree (age 25+)
State of Virginia	9.7%	39.5%
Henry County, VA	19.8%	15.1%

C.3.3 Businesses

Table 5: Business

Businesses	Area	
	State of Virginia	Henry County, VA
Total Employer Establishments, 2019	203,467	798
Total Employment, 2019	3,455,993	11,033
Total Annual Payroll, 2019 ($1,000)	197,418,070	381,426

C.3.4 Income & Poverty

Table 6: Income & Poverty

Area	Median household income (in 2020 dollars), 2016 2020	Per capita income in past 12 months (in 2020 dollars) 2016 2020
State of Virginia	$76,398	$41,255
Henry County, VA	$38,511	$23,051

C.4 Derivation of User Cost

The TSP includes a reallocation from storage at Philpott Dam for water supply to meet a future need of an estimated 8 (MGD) for the Henry County Public Services Authority. USACE guidance requires four different methods to be used to determine the cost of water supply storage to the user, which is discussed in the below paragraph. In addition to determining user cost, USACE

must ensure that reallocation of federal storage to water supply is the most economical alternative compared to other sources of water (including the Next Least Costly Alternative), which is discussed in Section 4.4.3. Reallocated storage to water supply can be repaid over a period not to exceed 30 years. Details of annual storage costs are discussed in Section 5.5.

USACE's Engineer Regulation (ER) 1105-2-100 specifies the four pricing methods used to calculate the value of storage considered for reallocation (i.e., the price to be charged for the capital investment for reallocated storage). The four methods include: benefits foregone, revenues foregone, replacement cost, and updated cost of storage. The value placed on the storage is the highest of the four methods.

- Benefits Foregone. Benefits foregone are generally estimated using the standard Nation Economic Development (NED) evaluation criteria in compliance with ER-1105-2-100. The benefits forgone are evaluated over a 50-year period of analysis.
- Revenues Foregone. Hydropower revenues foregone are defined as the reduction in revenues accruing to the Treasury as a result of reallocating storage from hydropower to water supply. The revenues are based on the existing repayment agreement between the power marketing agency and the USACE. Revenues forgone from other project purposes are the reduction in revenues accruing to the U.S. Treasury based on existing repayment agreements.
- Replacement Cost. Notwithstanding unforeseen circumstances, replacement costs are equal to benefits foregone. In the event that reallocated storage is being taken from the flood control pool, the USACE will estimate the replacement cost of equivalent protection if necessary.
- Updated Cost of Storage. The updated cost of reallocated storage is estimated by updating the cost of the joint use features from the midpoint of construction to the fiscal year in which the reallocation of storage is approved. The updated cost of the joint use features is then multiplied by the proportion of usable storage that is the reallocated to estimate the value of reallocated storage.

C.4.1 Hydropower Benefits Foregone

Philpott hydropower plant has three units for a combined Output of 15 MWs, two main units and a small house unit. Electrical power generated at Philpott hydropower plants is dispatched by Dominion Power, wheeled through Appalachian Power to Virginia Electric and Power Company System to customer of power from Philpott. Power from Philpott is marketed to customers under contract with Southeastern Power Administration of the US Department of Energy.

Water flow operations through the power plant for the period of record (1960-2019) is made using HEC-RESSIM, a sequential streamflow model to simulate daily Philpott Lake operations under alternative operations for water supply.

Simulated generation dispatch was developed from plan operations data available for 2010-2014. Daily averages were converted to ratios of weekly power flow for each month which

were applied to weekly power plan flow volumes from HEC-RESSIM model output. Daily power was then computed and validated using the available plant operations data.

The below table summarizes the Annual Hydropower Benefits Forgone.

Table 7: Estimated Annual Hydropower Benefits Under Base Case and Alternative Scenarios

	Annual Energy Benefits (foregone)				Annual Capacity Benefits (foregone)				Total Annual Hydropower Benefits (foregone)	
	MWh	Δ (MWh)	2022$	Δ ($)	MW	Δ (MW)	2022$	Δ ($)	2022$	Δ ($)
Base Case	22,770	n/a	$722,434	n/a	14.85	n/a	$2,157,480	n/a	$2,879,914	n/a
Reallocation from Cons. Pool	22,786	16	$723,551	$1,117	14.80	-0.05	$2,150,287	($7,194)	$2,873,837	($6,077)
Reallocation from Inactive Pool	23,227	457	$733,065	$10,631	14.79	-0.05	$2,149,509	($7,971)	$2,882,574	$2,660

C.4.2 Revenues Foregone

"Revenues foregone to hydropower are the reduction in revenues accruing to the U.S. Treasury as a result of the reduction in hydropower outputs based on the existing rates charged by the power marketing agency."

"The Corps does not market the power it produces; marketing is done by the Federal power marketing agencies (Southeastern Power Administration, Southwestern Power Administration, Western Area Power Administration, Bonneville Power Administration, Alaska Power Administration) through the Secretary of Energy. The rates are set by the marketing agency to: (a) recover costs (producing and transmitting) over a reasonable period of years (50 years usually); and (b) encourage widespread use at the lowest possible rates to consumers, consistent with sound business principles. …"

Revenue foregone is to be based on the current SEPA contract Rates applicable to power generation by the Ker-Philpott plants. The current rates are:

Energy Rate Total: $17.80/MWh

Monthly Capacity Charge: $4.40/kW-month ($52,800/MW-year)

To compute energy revenues foregone, the contract energy rate is applied to the average annual contract energy foregone, and the capacity charge is applied to foregone dependable capacity. The table below shows the Power Revenue Foregone for each of the alternatives.

Table 8: Annual Revenue Summary Across Water Supply Alternatives

Alternative	Energy (MWh)	SEPA Energy Rate ($/MWh)	Dependable Capacity (MW)	SEPA Capacity Rate ($MW year)	Revenue ($)	Revenue (foregone) ($)	
Base Case	22,770	$17.80	14.847	$52,800	$1,189,246	---	
Reallocation from Conservation Pool	22,786	$17.80	14.798	$52,800	$1,186,919	($2,327)	-0.20%
Reallocation from Inactive Pool	23,227	$17.80	14.793	$52,800	$1,194,477	$5,231	0.44%

C.4.3 Replacement Cost

No replacement cost was calculated for flood risk management and recreation as no serious effects were identified. The replacement costs of power is equivalent to the hydropower benefits forgone.

C.4.4 Updated Costs of Storage

The cost allocated to the user under this pricing method updates the joint-use portion of the first costs of reservoir construction to present day price levels and then assigns a percentage of the costs based on the "Use of Facilities" (UOF) cost allocation procedure. Costs are updated from "as built" costs in 1950 (the mid-point of construction) to 1967 prices by use of the Engineering News Record (ENR) Construction Cost Index, and then from 1967 to current prices by use of the USACE's Civil Works Construction Cost Index System (CWCCIS). Land values are updated by the weighted average update of all other project features. Costs are indexed from the midpoint of the physical construction period to the beginning of the FY in which the contract for reallocated storage is expected to be approved (FY2022). Joint-use costs exclude infrastructure costs allocated to specific project purposes such as recreation facilities, hydropower turbines, etc.

Construction is considered as having been initiated at the start of the month when lands for the project were first acquired or on the date when the first construction contract was awarded whichever was earlier. Construction is considered as having been completed at the end of the government FY in which final deliberated impoundment of the reservoir point was initiated.

The USACE policy on pricing storage reallocated from one authorized project purpose to another is based on the UOF methodology. UOF methodology allocates join-use costs (costs that cannot be specifically allocated to a specific project purpose) based on overall percentage of storage reallocated. For example, if 15 percent of the usable storage is reallocated, then the reallocated storage is apportioned 15 percent of the joint-use costs. The cost of reallocated storage changes each government FY. This is due to the fact that the Federal discount rate changes on an annual basis as well as varying annual OMRR&R costs. Section 932 of the 1986 WRDA requires recalculation of the interest rate at 5-year intervals if the storage is paid annually over a 30-year period.

Table 7: Updated Costs of Storage

Category	Actual Joint use as of Mid point of construction 1950	1950 ENR Index Value	1967 ENR Index	ENR Ratio	1967 CWCCIS Index Base 100	Updated Joint Use as of 1967	Apr 2022 CWCCIS Index	Update Factor	FY 2022 Joint Costs
Lands and Damages	492,000	510	1074	2.11	100	1,036,000	1,148.94	11.51	11,928,000
Relocations	668,000	510	1074	2.11	100	1,407,000	1,158.95	11.59	16,306,000
Dam	7,993,000	510	1074	2.11	100	16,832,000	1,097.62	10.98	184,751,000
Roads, Railroads & Bridges	375,000	510	1074	2.11	100	790,000	1,158.95	11.59	9,156,000
Reservoirs	416,000	510	1074	2.11	100	876,000	1,165.77	11.66	10,212,000
Buildings, Grounds & Utilities	99,000	510	1074	2.11	100	208,000	1,163.43	11.63	2,420,000
Permanent Operation Equipment	73,000	510	1074	2.11	100	154,000	1,163.43	11.63	1,792,000
Total	10,116,000								236,565,000
Specific Costs Water Supply Conduit	Intakes already present								

Table 8: Lake Storage

Feature	Elevation, ft (NGVD 29)	Storage (Capacity) AC FT
Top of Flood Control	985	34,200.000
Top of Conservation Pool	974	111,200.000
Bottom of Conservation Pool	920	55,000.000
Usable Storage	920-985	145,400

C.4.5 User's Cost

Table 9: Costs to User

Total Usable Storage for Philpott Dam (STot)		**145,000**
Storage Recommendation (SRec)		5,200
Percent of Total Usable Storage		3.58%
Total Updated Cost of Strage for Philpott Dam (CTot)		$236,565,000
Annual Cost of Storage Recommendation (ARec)		$378,000
i(1+i)n-1 ARec=CRec (1+i)n-1	Where CRec = $ I=2.25% N=30 year	
Operation and Maintenance for Philpott Dam (O&M Tot)		$1,520,286
Philpott Dam Annual Operation and Maintenance Estimate (O&M Req)		$54,000
Replacement and Rehabilitation for Philpott Dam (R&R Tot)		$867,857
Philpott Dam Annual Replacement and Rehabilitation Estimate (R,R&Rreq)		$31,038
Total Annual Cost=ARec + O&MRec + R,R&Rreq		$463,038