HICKORY LOG CREEK RESERVOIR: A NEW APPROACH TO SUSTAINABLE WATER MANAGEMENT

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Abstract: The Hickory Log Creek (HLC) Reservoir is the conceptual prototype of a new type of federal-non-federal partnership – possibly the first of its kind in the U.S. – in the development of new sources of municipal water supply. The project is planned to effectively meet future water demand growth while capitalizing on unique opportunities for conjunctive use of water resources and existing infrastructure, listed as follows:

- Site location on a small tributary of the Etowah River upstream of Lake Allatoona, a multipurpose reservoir managed by the U.S. Army Corps of Engineers (USACE)
- Site topography offering significant off-channel storage in the confines of a narrow valley
- Recent federal water resource development policy initiatives promoting sustainable water development through more efficient and beneficial uses of existing multipurpose reservoirs
- Public demand for reliable water supply at minimal economic cost and with minimal environmental impact.

From this perspective the HLC Reservoir is not a stand-alone project but an integral component of a two-reservoir system (HLC and Allatoona) conjunctively serving multiple conservation and flood control objectives.

INTRODUCTION

Water supply is critical to sustaining the economy, and increasingly water demand must be met in more environmentally sustainable ways. Better use of existing water projects to meet these demands obviates the need for new projects or larger projects than would otherwise be necessary, avoiding as a result significantly larger capital costs and more serious environmental impacts. Conservation storage in USACE reservoirs can be managed adaptively to meet present and future demands without the need for physical alteration of the impounding dams.

Costs historically charged to municipalities for use of storage in federal reservoirs have created strong disincentives for water supply. These costs have traditionally been based on sunk costs, despite the fact that many of these reservoirs have been in service well beyond their planned useful and economic lives. While many of these projects have been completely amortized by the flood control and conservation benefits they have provided over many decades of continuous operation, communities desiring to use storage for water supply have traditionally been required to pay an allocated share of original construction costs, escalated by inflation over the many years since constructions. Increasingly, some communities are discovering that 'going it alone' by constructing new single-purpose water supply reservoirs may be cheaper than purchasing storage in existing federal multipurpose reservoirs for water supply use. As a consequence, both the economy and the environment suffer and future generations are left with fewer options to meet their needs.

The Corps has undertaken to make water supply storage reallocations less burdensome through policy initiatives and proposed legislation. New policies provide incentives for water supply use of flood control storage when practical to reduce economic impacts to existing conservation users insofar as possible without increasing flood risk. Recent legislative proposals on pricing of reallocated storage would reduce costs to municipalities while maintaining overall revenue neutrality, providing economic incentives for wise use of water and storage. The HLC project is designed to take advantage of these initiatives to yield more water at less cost and with fewer environmental impacts than a stand-alone project of comparable size and environmental footprint.

PROJECT DESCRIPTION

The HLC project is designed to support increased water withdrawals by the City of Canton from its existing Etowah River intake, and to increase the yield of storage in Lake Allatoona currently allocated to the Cobb County-Marietta Water Authority (CCMWA). The current storage contract allocates 13,140 acre-feet to the CCMWA and permits water withdrawals of 34.5 mgd on an annual average basis. The HLC dam will be approximately 180 feet high and impound approximately 15,000 acre-feet of usable storage. The project may be classified as a non-integral or off-channel pumped-storage reservoir, pumping to refill during periods of high flow and releasing during low-flow periods to supplement Allatoona inflows and enable Canton's withdrawals. The project location is shown in Figure 1, and a project schematic is shown in Figure 2.

Operationally, HLC is planned to function as an extension of Lake Allatoona, effectively adding its conservation storage to storage currently allocated to the CCMWA, increasing its yield and enabling increased future water withdrawals. Operational strategies to accomplish this objective range from pumping and releasing to maintain the HLC as full as possible to balancing the HLC and Allatoona pools, i.e. maintaining equal portions of conservation storage in both pools at all times. Because Allatoona operates for multiple purposes independently of HLC, the latter strategy would involve frequent pumping and spilling to induce drawdown and refilling of HLC concurrently with Allatoona.

The manner of integration of HLC and Allatoona operation will affect the terms imposed by the Corps of Engineers (Corps) and costs assessed the CCMWA for the use of water supply storage. It will also profoundly influence the design, yield and financial performance of the HLC project.

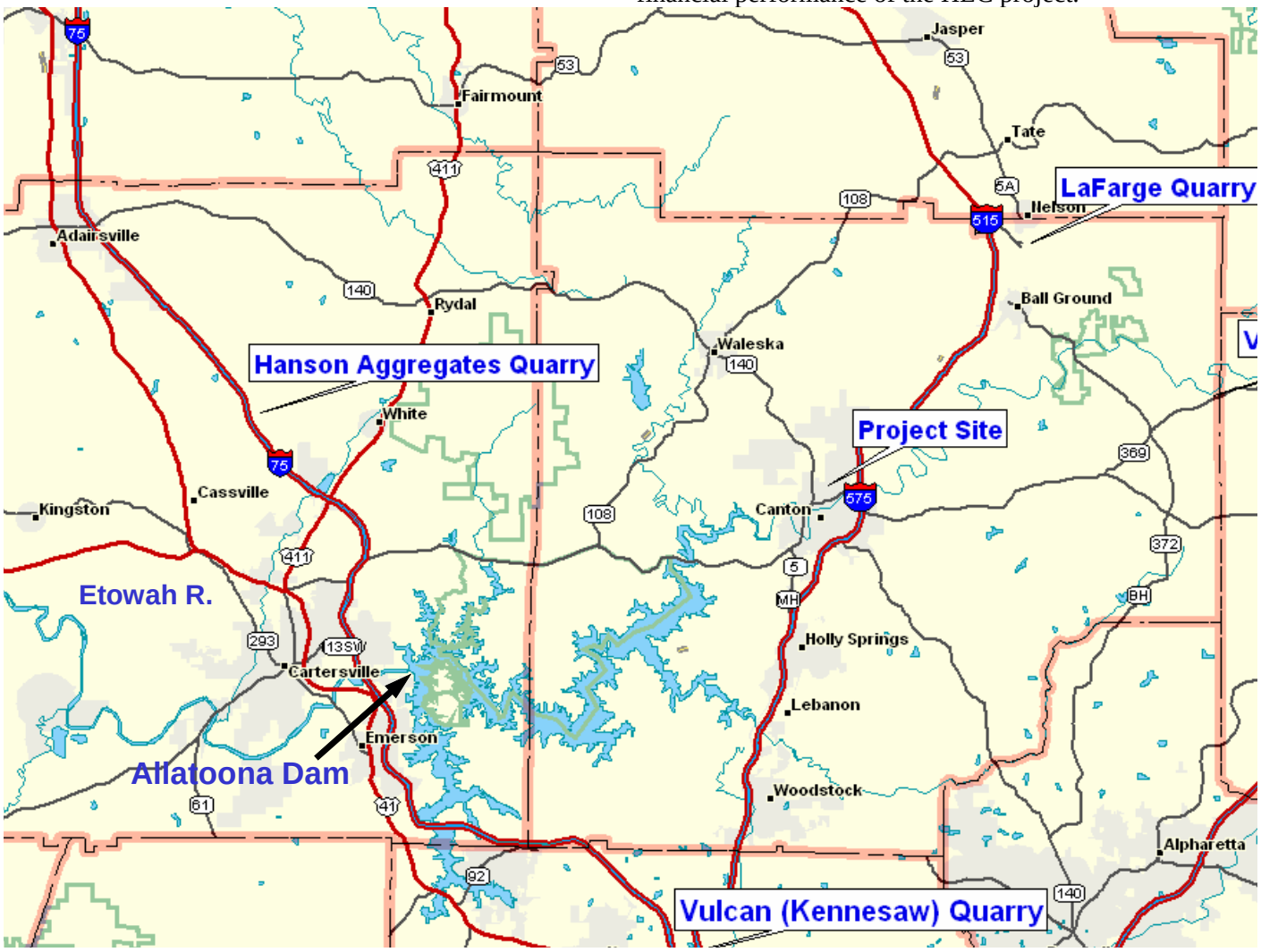

Figure 1. Hickory Log Creek Reservoir location map

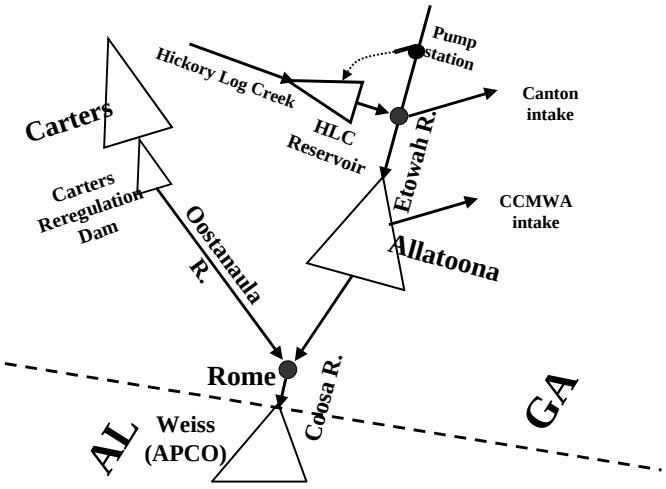

Figure 2. Hickory Log Creek Reservoir schematic

At a minimum, the following operational considerations will affect the yield, configuration and consequently the capital and operating costs of the HLC project:

- Site constraints on quantity and timing of pumping and releases from HLC related to usable storage and yield, minimum instream flows (MIFs), and other environmental protection and mitigation requirements. These constraints will affect the fixed and variable costs of the pump station and intake structure, the raw water pipeline, and the dam and appurtenant structures. The design will also be controlled to a large extent by Georgia Safe Dams criteria, and potentially could be affected by future hydropower additions should these prove to be a feasible means of cost recovery.
- Additional HLC operational requirements and assessed costs of Allatoona water supply storage, including storage-accounting and return-flow crediting policies implemented by the Corps.
- Construction and operating costs associated with alternative designs necessitated by failure to negotiate acceptable terms for water supply storage contracts accounting for HLC storage, i.e., a stand-alone project alternative.

Current plans for the HLC project call for a 39-mgd pump station on the Etowah River located in the vicinity of the Canton intake. Georgia instream flow requirements for off-channel reservoirs mandate operation to maintain annual 7Q10 (10-year 7-day low flow) or natural flow in the main channel, whichever is less. The 7Q10/natural flow is net of pumping, HLC releases and Canton withdrawals. The HLC reservoir will also maintain a 2-cfs continuous minimum flow in its tributary stream (Hickory Log Creek).

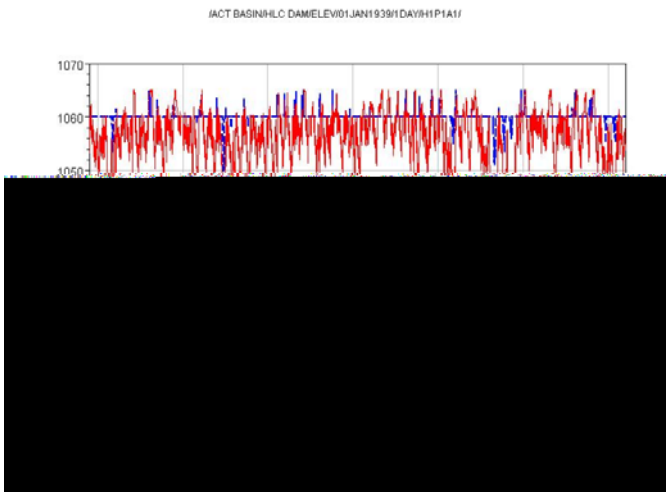

Figure 3. HLC elevation, full- and balanced-pool operation

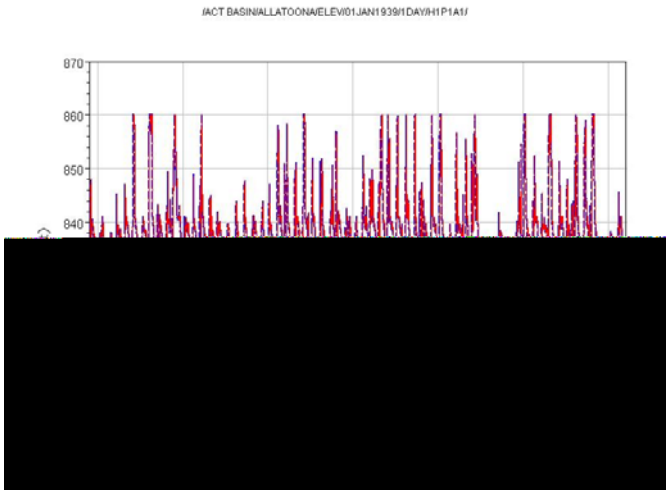

Figure 4. Allatoona elevation, full- and balanced-pool operation

Figure 3 compares simulated time-series reservoir data for HLC operated to maintain full pool and in balance with Allatoona, and Figure 4 compares Allatoona reservoir levels for these two cases. While HLC pool fluctuations are highly sensitive to operational policy, Allatoona's are not, a strong indication that HLC operation only marginally affects Allatoona's yield and capability to meet its operating objectives. However, pumping costs incurred under the balanced-pool operation are on average 2 – 3 times those under full-pool operation, ranging up to 10 times during extended droughts. In addition to increased energy consumption, other potential consequences of balanced-pool operation are diminished recreation, increased shoreline erosion, and increased risk of water supply and/or MIF shortages. Thus while balanced-pool

operation is marginally more conjunctive with respect to Allatoona yield and project outputs, the gains may not be justified in view of the energy, economic and environmental costs.

CONCEPTUAL OPERATION

The principle benefit of conjunctive operation of the HLC project are (1) the avoidance of the environmental impacts, capital and operating costs of a new intake, water plant and distribution system at HLC, necessary for stand-alone use of the project by CCMWA as a supplemental water supply source, and (2) reduction in costs of water supply storage to CCMWA. Conjunctive operation allows the economical use and expansion of existing facilities owned by Canton on the Etowah River and by the CCMWA on Lake Allatoona, and offsets a significant portion of the costs of reallocation to the CCMWA to support future water withdrawals as well. Conjunctive operation is conceptually illustrated in Figure 5.

Historically, Corps policies on water supply storage reallocation did not specifically envision nor adequately accommodate water supply projects like the HLC-Allatoona system (Federal Interagency Committee 1958; U.S. Water Resources Council 1983; USACE 1990). However, recent revisions (USACE-IWR 1998; USACE 1999(b,c), 2000, 2003). provide new flexibility, encouragement and potential financial incentives for conjunctive water management and non-federal participation in federal water projects.

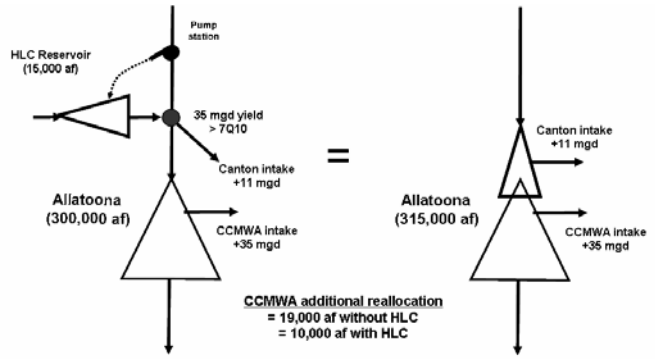

Figure 5. Conceptual HLC operation

One alternative for conjunctive reallocation involves direct crediting of HLC storage to the CCMWA. Additional storage to be purchased is that portion of total Allatoona conservation storage equivalent to the ratio of net additional water demand to remaining project yield (after existing withdrawals), less HLC storage added to the system, as follows:

$$\Delta S_A = \Delta W_{Canton + CCMWA} / Y_A \cdot (CS_A) - CS_{HLC}$$

Using current estimates of Allatoona and HLC yields, this calculation results in a net additional storage requirement of approximately 10,000 acre-feet. Total cost of water supply is the sum of reallocated storage and the construction and operating costs of HLC.

Another approach for determination of additional Allatoona water supply storage requirement treats HLC as an addition to the flood-control space of Allatoona that is 'reallocated' to the CCMWA using a procedure promulgated in recent Corps policy designed to incentivize water supply reallocations from permanent or seasonal flood-control rather than conservation storage, potentially reducing both the impacts to existing project purposes and the costs of storage to water supply (USACE 1999a). This procedure, known as Dependable Yield Mitigation Storage (DYMS), is invoked when water supply storage is reallocated from flood-control space, leaving existing purposes intact with respect to allocated storage but with slightly diminished yield due to inflows reduced by the amount of additional withdrawals. The DYMS procedure is as follows:

$$D_A = \{(\Delta W_{Canton + CCMWA})/(Y_A - \Delta W_{Canton + CCMWA}) - (\Delta W_{Canton + CCMWA})/(Y_A)\} \cdot (CS_A)$$

The DYMS storage requirement computed using previous estimates of yield and additional withdrawals is approximately 2,200 acre-feet, to be added to the costs of development and operation of HLC.

CONCLUSIONS

The HLC project is the prototype of a new approach to coordinated management of federal and non-federal water projects, one that takes advantage of unique opportunities for conjunctive use of water and land resources. By enabling the use of existing facilities and avoiding the energy and materials costs of a new water-treatment plant and distribution system, this conjunctive-use approach is superior to development of a stand-alone project and consistent with basic

principles of sustainable resource management, environmental protection and economic efficiency. Another important aspect of this approach is the demonstration of the adaptability of traditional federal planning policies formulated decades ago to current conditions.

ACKNOWLEDGMENTS

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NOTATION

The following units and symbols are used in this paper:

ΔS_A = additional Allatoona water supply storage requirement

$\Delta W_{Canton\ +\ CCMWA}$ = additional combined Canton and Allatoona water withdrawals

CS_A = total Allatoona conservation storage

CS_{HLC} = total HLC conservation storage

mgd = million gallons per day

Y_A = Net Allatoona yield after existing and before additional withdrawals