# Project Technical Memorandum

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| **Project Name:** | **Springfield Supplemental Water Supply Project** |
| **Project Number:** | **325216041.02.01** |
| **Date:** | **November 2016** |
| **To:** | **Ted Meckes, City of Springfield, CWLP**<br>**Jim Kelley, USACE Rock Island District** |
| **Subject:** | **Cost Comparison Review of the Hunter Lake, Havana Lowlands Well System, Illinois River Well System, Dredging Lake Springfield, and Lick Creek Reservoir** |

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## 1.0 Introduction

The United States Army Corps of Engineers (Corps) intends to prepare a Supplemental Environmental Impact Statement (SEIS) to address the proposed Springfield Supplemental Water Supply Project in Sangamon County, IL. The Corps, working in conjunction with the City of Springfield, Office of Public Utilities, also known as the City Water, Light & Power (City), is preparing a supplement to the previously prepared Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et. seq.). This Supplemental EIS (SEIS) is intended to evaluate environmental impacts associated with a range of alternatives considered to provide supplemental water supply to meet a projected deficit in water availability. In conjunction with the SEIS the City has undertaken an update to the water demand analysis, threatened and endangered species bat surveys, wetland delineations, programmatic agreement related to cultural resources, water quality anti-degradation analysis, and mitigation plans. This memorandum summarizes the review of cost analyses previously developed for the following alternatives for the Springfield Supplemental Water Supply Project: Hunter Lake, Havana Lowlands Well System, Illinois River Well System, Sangamon River Well and Gravel Pit System and Lick Creek Reservoir. An estimate of the cost of dredging Lake Springfield based on current information provided by the City is also included in this memorandum.

This review is one task in the larger effort to prepare a SEIS for the above-referenced project. Its purpose is to support the NEPA analysis in conjunction with the project.

## 2.0 Methods

The documents reviewed for this summary are as follows:

> Hanson. 2014. *Hunter Lake Construction Cost Estimate Updated to 2014 Dollars*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.
>
> Crawford, Murphy, and Tilley (CMT). 2015. *Water Supply Alternatives Cost Update of 1998 Feasibility Study – Havana Lowlands Well System*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

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CMT. 2015. *Water Supply Alternatives Feasibility Study – Illinois River Well System*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

CMT. 2008. Preliminary Plan to Develop a Sangamon River Valley Backup Water Supply. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

U.S. Army Corps of Engineers. 2000 *Final Environmental Impact Statement for Proposed Water Supply Reservoir – Hunter Lake*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

# 3.0 Alternatives

## 3.1 Hunter Lake Reservoir

The Hunter Lake Reservoir alternative would be located southeast of the existing lake Springfield and north of Pawnee, Illinois. The reservoir would be formed by constructing an earthen dam on Horse Creek, a tributary to the South Fork of the Sangamon River. The resulting reservoir would inundate portions of both Horse Creek and Brush Creek; the confluence of these creeks being within the project area.

The Hunter Lake 2014 cost update includes costs for both design and construction (see Table 1). Construction costs include land acquisition, wetland and stream mitigation, road and bridge relocation, reroute of wastewater from secondary communities, permit fees, and archeological services. Where adequate data was available, unit costs were revised to 2014 costs. Where adequate data was not available, the unit costs were inflated by a Construction Cost Index (CCI) rate of 3.1% per year from 2005 to 2014.

## 3.2 Havana Lowlands Well System

The CMT Havana Lowlands Well System Report updated costs originally developed in 1998 for two conceptual systems; one producing 12 million gallons per day (mgd) and one producing 17.75 mgd. The Havana Lowlands Well System would be located north of Springfield in Mason County. The 12 mgd system includes six wells located in one well field, two pump stations, two water storage tanks, and approximately 38 miles of 30” piping discharging into the wet well at the Low Service Pumping Station at Lake Springfield. The 17.75 mgd system includes 10 wells located at two well fields, four pump stations, four water storage tanks, and over 47 miles of 36” piping.

There were five significant changes from the 1998 report which also were factored into the updated cost estimate. There are:

- Well field “A” was moved slightly to the south
- Pump selections were made based on actual available pump designs rated near the required horsepower.
- Some pump stations were moved to provide more consistent horsepower.
- Costs for an option to upsize the pipe for the 12 mgd option to facilitate future expansion of the 17.75 mgd option was included
- The Lake outlet structure was changed to an intake pipe connection at the wet well at the existing Low Service Pump Station
- The 6% interest rate originally used for the present worth calculations was replaced by a 3.5% interest rate for bonds, a 1% discount rate, and 2.5% inflation rate for calculation of net present values for annual debt service, maintenance costs, energy costs, and total cost.

The cost estimate included costs for construction, capital (bond amount), annual maintenance, operation energy, drought operation, and property acquisition (see Table 1). A 50-year net present value (NPV) analysis was included in the cost analysis for both options.

### 3.3 Illinois River Well System

The CMT Illinois River Report updated costs originally developed in 1998. The Illinois River Well System cost update includes costs for two conceptual systems; one producing 12 mgd and one producing 17.75 mgd. The Illinois River Well System would be located west of Springfield near Winchester, IL. Both systems include one or more radial collector wells, four water storage tanks, four intermediate pump stations, and over 57 miles of piping which discharges into Lake Springfield. The cost estimate includes costs for construction, capital (bond amount), annual maintenance, operation energy, drought operation, and property acquisition. A 50-year NPV analysis was included in the cost analysis for both options.

There were several significant changes from the 1998 report which also were factored into the updated cost estimate (see Table 1). These are:

- The Illinois Department of Transportation indicated the original pipeline alignment along several miles of Interstate 72 is no longer possible and a new alignment was developed south of the old one along state, county and township roads.
- The pipeline outfall was moved from Lick Creek three miles west of Lake Springfield near Route 4 to avoid absorption of the water into the dry creek bed.
- The locations of the pump stations were moved.
- Pump selections were made based on actual available pump designs rated near the required horsepower.
- Costs were developed to upsize the pipe for the 12 mgd option to facilitate expansion to the 17.75 mgd option.
- The 6% interest rate originally used for the present worth calculations was replaced by a 3.5% interest rate for bonds, a 1% discount rate, and 2.5% inflation rate for calculation of net present values for annual debt service, maintenance costs, energy costs, and total cost.

### 3.4 Lick Creek Reservoir

Construction of a reservoir on Lick Creek was identified as a potential supplemental water supply option in the 2000 FEIS. Lick Creek Reservoir would be located west of Springfield near Loami, IL. The resulting reservoir would cover 1,948 acres with a maximum depth of 35 feet and an average depth of 10 feet. This would provide a capacity of 20,000 acre-feet of storage and would result in a drought yield of 8.3 mgd. In the 2000 EIS, the Lick Creek Reservoir alternative was only considered in combination with other alternatives as a supplemental water supply source.

Cost information concerning the Lick Creek Reservoir alternative as presented in this memorandum was derived from the 2000 EIS (see Table 1). The estimate included costs associated with the same general categories as identified for Hunter Lake, but details were not provided.

### 3.5 Sangamon River Valley Well System and Gravel Pits

Amec Foster Wheeler included a review of cost estimates from this alternative to support future consideration of a well field alternative from the Sangamon River Valley. The well fields and

gravel pits are located northeast of Springfield. However, as discussed below, this alternative requires redevelopment and refinement as an alternative in the SEIS.

In 1998, separate cost estimates were developed for the Sangamon River Well System and the Gravel Pit Water Withdrawal System. Information from these reports is summarized in the 2000 FEIS. The 1998 cost estimate for the Sangamon River Valley Wells was develop based on the construction of 36 wells within 9 clusters that would transfer 12 mgd of water from a 36-mile stretch of the Sangamon River Valley aquifer to Lake Springfield. The 1998 cost estimate developed for the Gravel Pit Water Withdrawal System was based on the use of the gravel pits which covered a total of 545 acres with a net drought yield of 4.8 mgd. Although the FEIS provided cost of wells by cluster as well as costs to develop the gravel pit system, these costs were not evaluated or updated given the uncertainty relating to the potential future use of the gravel pit system and the uncertainty related to the cluster or clusters of wells that would be included in the development of this system as a future alternative.

Costs identified in the 2008 study are based on a refinement of a combination of the Sangamon River Wells and Gravel Pits. Under this alternative, the size and anticipated yield of the gravel pits was increased (estimated at 682 acres with a yield of 7.4 mgd) and the number of wells needed was reduced to 14 (yield of 4.6 mgd) to produce the total required yield of 12 mgd augmentation for Lake Springfield. Options to pump at a higher rate from the gravel pits were also evaluated. However, based upon the analyses performed by Lane Hydro in 2013, gravel pit yields were found to be notably lower (1.6 mgd). Nonetheless, while the use of the gravel pits as a potential water supply is limited, costs of this combined alternative were reviewed and updated to 2014 values to provide a potential basis for any future alternative consisting of the development of a Sangamon River Valley well system (see Table 1). Cost information components are similar to the Havana Lowland Well and Illinois River Systems, however project costs presented in the Sangamon River Valley Well System cost analysis are in 2006 dollars.

### 3.6 Dredging Lake Springfield

CWLP dredged the upper portion of Lake Springfield over the period 1987-1990 to restore lost recreational uses, fishery and habitat, and sediment trapping capacity. During this time period, nearly 3.2 million cubic yards of sediment were hydraulically dredged from the portion of the lake upstream of I-55. The dredging restored more than 650 million gallons of storage capacity which reduced lake-level fluctuations due to water supply withdrawals during drought periods. The cost of that project was approximately 7.8 million dollars.

CWLP estimates that approximately 52 million cubic yards ~~would~~ of sediment would need to be removed from Lake Springfield in order to provide the needed capacity (12 mgd during drought). Amec Foster Wheeler prepared an estimate of the cost to dredge this material as explained below (see Table 1).

## 4.0 Cost Review Findings

Comments prepared for the cost estimates for each of the alternatives evaluated in this document are presented in this section. Although there were some inconsistencies noted between cost analyses, none of these are anticipated to significantly impact the planning level assessment of cost that will be used in the screening of alternatives presented in the SEIS. However, elements of some of the cost analyses are missing and this information needs to be provided to facilitate analysis in the SEIS. These elements are identified in Section 6, Recommendations.

Differences in common elements of each cost estimate include:

- The Engineering Design cost was estimated at 10% of the total construction cost for the Sangamon River Valley wells, 9% of the total construction for the Havana Lowlands and Illinois River well systems alternatives, 8% of the total construction cost for the Hunter Lake alternative, and 1.8% of the total construction cost for the Lick Creek Reservoir.

- The Legal and Administrative cost was estimated at 15% of the total construction cost for the Sangamon River Valley wells 10% of the total construction cost for the Havana Lowlands and Illinois River well systems, 1.5% of the total construction cost for the Lick Creek Reservoir alternative, and 0.85% for the Hunter Lake alternative.

- The Contingencies cost was estimated as 25% of the total construction cost for the Sangamon River Valley wells, 20% of the total construction cost for the Havana Lowlands and Illinois River well systems, 15% for the Hunter Lake alternative, and 5% for the Lick Creek Reservoir alternative.

- All of the cost estimates previously prepared include “lump sum” pay items which can make it difficult to determine if anything was omitted during the development of these costs.

### 4.1 Hunter Lake Reservoir

The 2014 cost analysis states that where actual construction cost data was not available, an average annual rate of 3.1% per year was used to update costs to 2014 dollars based on the Construction Cost Index (CCI) performed by the Engineering News Record (ENR). The 3.1% rate used was compared to the Historical CCI’s published by RSMeans. RSMeans is North America’s leading supplier of construction cost information. The RSMeans estimated a 35% total increase from 2005 to 2014, or 3.8% per year. The total costs calculated by RSMeans were 2.7% higher than those calculated by Hanson. Since the RSMeans Historical CCI was based upon actual data and not just an average annual rate, the RSMeans Historical CCI should have been used in lieu of the CCI average from ENR because it is a more conservative estimate of cost increases. However, to facilitate comparison of alternative costs, the 3.1% annual CCI increase was used to update the costs for the Lick Creek alternative, and as the annual CCI increase was not specified for the Havana Lowlands and Illinois River Well Systems, this update is not necessary to facilitate the review in the SEIS.

The 2014 Hunter Lake cost estimate includes costs for land acquisition, infrastructure relocations, road and bridge relocation, further archaeological studies, cemetery relocation, lake access areas, shoreline stabilization, joint sewer construction project, mitigation measures, and modifications at Pawnee for flood protection. The cost estimate also included funding for public involvement prior to and during construction. However, the estimate does not include costs for any required operation or maintenance of the lake and spillway. Operations and maintenance costs were included in the 2000 EIS.

The 2014 Hunter Lake cost estimate does not provide a 50-year net present value (NPV) analysis. However, this analysis was included in the cost analyses prepared for the two well system alternatives. Annual costs for operation and maintenance of Hunter Lake were not provided. Amec Foster Wheeler prepared NPV calculations to support the NEPA analysis for the SEIS. Amec Foster Wheeler used estimates of annual maintenance and 18-month drought operation costs provided by the City to facilitate the NPV calculation for proper comparison of alternatives.

Mitigation costs for Hunter Lake were also reviewed. We noted that unit costs for several of the mitigation elements were particularly low (e.g., mitigation ratios and installation costs for forested wetlands, upland forest, prairie, etc.). Based upon current practices and experience in dealing with mitigation requirements on other projects authorized by the Corps (Rock Island District) we anticipate that mitigation requirements may result in substantially greater costs than that which is reflected in the 2014 updates. Such mitigative measures may include more extensive development and application of mitigative measures to address water quality concerns in support of Section 401 Water Quality Certification. Such measures may include the use of extensive BMPs, development of wetland and sediment detention systems in tributary arms, and costs for monitoring. While habitat mitigation for potential impacts to bat and bird habitat is also expected, we believe that the extensive forested habitat development that is incorporated in the plan will provide the required compensation. In short, it is expected that an additional amount of approximately $3-6 million may be required for mitigation (subject to more detailed analysis).

### 4.2 Havana Lowlands and Illinois River Well Systems

The 2015 analyses state that the ENR CCI's (Construction Cost Index) were used in order to update the costs; however, the report does not state the annual percentage rate used.

The cost estimate includes the number of valves and flush points required for the piping system but does not state the criteria used to determine this information and the criteria does not appear to be consistent for the two well system locations. For example, the Havana Lowland Well System shows the relief valve interval is approximately 1 valve for every 6,100 linear foot (LF) of pipe, but the Illinois River Well System has this interval at 1 valve for every 7,400 LF of pipe.

The easement areas for the piping element of these systems assumes a 100-foot wide construction area. It is expected that this may be larger than that actually required for typical construction of a 36-inch diameter pipe. The wider easement area can however, be used as a bounding value for environmental impact assessment. However, the cost for these easements seems low. These easements are typically paid for per square foot, not per acre, and range from $2.00 per square foot for a permanent easement and $0.50 per square foot for a temporary construction easement (TCE) based on past experience with similar projects. The easement cost shown in these analyses result in a cost of $0.014 per acre for rural areas and $0.023 per acre for urban areas. The easement cost estimates for the wells, pump stations, and flush point wash-out seem reasonable based on both the cost and size of these facilities.

The cost estimates also identified areas for further study, such as groundwater contamination, environmental impacts, test borings and pumping tests. No specific costs were identified for these items.

### 4.3 Lick Creek Reservoir

The 1997 cost analysis for the Lick Creek Reservoir option does not include a detailed breakdown of cost information as all cost items are listed as lump sum. Therefore, it is difficult to determine what is included in the cost items as well as best way to update cost estimate.

The easement acquisition cost is not broken out in this cost estimate. The alternative states that the total project area for this alternative is 5,555 acres. The easement cost listed in the cost estimate is $300,000. This breaks down to just $54 per acre, or $0.0012 per square foot. These easement costs seem unreasonably low for a project of this size. Additionally, mitigative costs for this alternative would be expected to be substantially increased in a manner similar to that related to the Hunter Lake alternative as described above.

### 4.4 Sangamon River Well System and Gravel Pits

Many of the costs in this cost estimate were shown as "lump sum" pay items which makes it difficult to determine if there were any omissions in the development of those costs.

The easement acquisition cost for this alternative seems to be low for a project of this size. The well system easement acquisition cost (temporary and permanent easements) is shown at $0.022 per square foot and $0.115 per square foot, respectively. The gravel pits easement acquisition cost is equal to the well system for the cost of the temporary and permanent easements only if the property is located within a floodplain. The permanent easement cost is slightly elevated for areas outside of floodplain, but they are still low, estimated at $0.23 per square foot. As stated above, these easements are typically paid for per square foot, not per acre, and based on past experience with similar projects, range from $2.00 per square foot for a permanent easement and $0.50 per square foot for a TCE. The calculated land acquisition cost for the purchase the gravel pit areas; however, seems to be reasonable.

### 4.5 Dredging Lake Springfield

CWLP estimates that approximately 52 million cubic yards would of sediment would need to be removed from Lake Springfield in order to provide the needed capacity (12 MGD during drought). A unit cost of $12.86 per cubic yard for hydraulic dredging was obtained from RSMeans for Springfield, Illinois in 2014 dollars. The resulting cost for dredging 52 million cubic yards from Lake Springfield would be $668,720,000. The analysis only includes an estimate for the dredging of material. The cost estimate does not include disposal of the dredged material. Large lake dredging operations are typically performed by barge and the slurry of dredged material is pumped to a settling basin nearby. In most cases, construction of settling basins requires a large amount of grading and earthwork and available land in close proximity to the dredge. In general, multiple basins in series are required in order to ensure that all material has settled out of the water before it can be discharge off site. The unit cost and total cost above assume dredge material can be pumped to a discharge point within 1000 feet of the dredge. Significant additional costs for land acquisition, design and construction, mitigation, permitting, site restoration, and hauling of dewatered material associated with sedimentation basins will be required for this alternative. These costs were not calculated for this planning level assessment. .

## 5.0 Summary

A summary of costs for each alternative as described in this memorandum are presented in Table 1. Costs for some of the alternatives presented in the analyses reviewed were updated to reflect 2014 costs as indicated in the table footnote.

Amec Foster Wheeler calculated NPV for all alternatives for proper comparison of alternative costs.

**Table 1. Summary of Alternative Cost Information**

| | Hunter Lake Reservoir | Havana Lowlands Well System, 12 mgd | Havana Lowlands Well System, 17.75 mgd | Illinois River Well System, 12 mgd | Illinois River Well System, 17.75 mgd | Dredging Lake Springfield[1] | Sangamon River Valley Well System[2] (12mgd) | Lick Creek Reservoir[2] |
|---|---|---|---|---|---|---|---|---|
| Cost Year | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 |

| | Hunter Lake Reservoir | Havana Lowlands Well System, 12 mgd | Havana Lowlands Well System, 17.75 mgd | Illinois River Well System, 12 mgd | Illinois River Well System, 17.75 mgd | Dredging Lake Springfield[1] | Sangamon River Valley Well System[2] (12mgd) | Lick Creek Reservoir[2] |
|---|---|---|---|---|---|---|---|---|
| Total Capital | $108,273,900[5] | $122,044,000 | $182,785,000 | $150,265,000 | $199,948,000 | $668,720,000 | $66,300,000 | $92,800,000[5] |
| Annual Maint. | $120,000[3] | $319,000 | $406,000 | $356,000 | $440,000 | $0 | $519,000 | $355,000 |
| Capital $/mgd | $5,083,000 | $10,171,000 | $10,329,000 | $12,523,000 | $11,265,000 | $55,727,000 | $5,525,000 | $11,200,000 |
| 18-month Operation | $386,000[3] | $2,070,000 | $3,479,000 | $3,363,000 | $4,278,000 | $0 | $1,800,000 | $0 |
| NPV[4] | $111,524,000 | $131,863,000 | $196,235,000 | $162,412,000 | $215,098,000 | $668,720,000 | $80,506,000 | $101,127,000 |

n/a= not applicable
[1]Costs for dredging only. No costs for material dewatering and disposal costs are included.
[2]Costs were converted to 2014 dollars for comparison purposes by using the 3.1% CCI increase per year as described above.
[3]Annual Maintenance Costs and 18-month Operation costs provided by the City. Basis for costs to be verified.
[4]NPV based on 50-year life cycle using an interest rate of 3.5% and a construction cost inflation rate of 4%.
[5]Subject to revision due to higher mitigation costs

## 6.0 Recommendations

Based on the information reviewed, cost estimates should be updated as follows to facilitate the analysis of alternatives for the supplemental water supply for the SEIS for the above-referenced project.

- The permanent easement widths are considered excessive and the amount of permanent easement versus TCE should be reassessed. The cost per unit area is considered to be underestimated to the degree that may impact evaluation of the well system alternatives versus other alternatives.
- Mitigation cost estimates should be reviewed and redeveloped in consideration of on-going agency consultation.
- Costs for the Sangamon River Valley system should be redeveloped based upon a new configuration of wells needed to meet the project need.

All other cost review comments are not anticipated to significantly impact the cost comparison portion of the evaluation of alternatives.

## 7.0 References:

Crawford, Murphy, and Tilley. 2015. *Water Supply Alternatives Cost Update of the 1998 Feasibility Study – Havana Lowlands Well System.* Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

Crawford, Murphy, and Tilley. 2015. *Water Supply Alternatives Cost Update of the 1998 Feasibility Study – Illinois River System*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

Hanson. 2014. *Hunter Lake Construction Cost Estimate. Updated to 2014 Dollars*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power

Crawford, Murphy, and Tilley. 2008. Water Supply Alternatives Cost Update of the 1998 Feasibility Study – Havana Lowlands Well System. Prepared for the City of Springfield, Illinois – City Water, Light, and Power

US Army Corps of Engineers. 2000. *Final Environmental Impact Statement for Proposed Water Supply Reservoir – Hunter Lake*.