



**City of Clinton, OK
Water Study**

PEC Project No. 434-12K14-6994



**CITY OF CLINTON, OKLAHOMA
WATER STUDY IMPLEMENTATION REPORT**

Custer County, Oklahoma

City of Clinton, Oklahoma

June 2012

Prepared By

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Overview

The City of Clinton, Oklahoma is located in Custer County, west of Oklahoma City, Oklahoma. The City is currently experiencing surface water supply shortages in their raw water source, Clinton Lake. Therefore, the City has been relying solely on their treated water allocation from the Foss Reservoir. A long-term water study was conducted by Garver USA, LLC, and the City requested that Professional Engineering Consultants, P.A. (PEC) review the findings and develop recommendations.

Population

The City states that there is currently a residential population of approximately 10,000, with an additional 2,000 non-resident workers. This City estimate is higher than what was reported by the report titled *City of Clinton Long Term Water Supply Evaluation* by Garver USA, LLC, as many residents do not participate in the U.S. Census survey. Based on historical population data and input from the city, the population is projected to grow at a rate of 1.5% per year. Table 1 below shows the City’s projected growth in five-year increments.

Table 1: City of Clinton’s Projected Population Growth

Year	Population
2010	9,702
2015	10,457
2020	11,265
2025	12,136
2030	13,073
2035	14,084
2040	15,172
2045	16,345
2050	17,608
2055	18,969
2060	20,453

The current average daily water demand is 2.07 MGD, with 0.56 MGD of that demand being commercial or industrial. Therefore, the current residential water demand is 1.51 MGD, or 155 gpcd. The historical peaking factor is 2.0, therefore, the maximum daily residential demand is 310 gpcd. The residential and commercial demands were determined by adding 0.56 MGD, with a yearly growth of 1.00%, to the residential demands. Table 2 below shows the water demands for the next fifty (50) years.

Table 2: City of Clinton's Future Water Demands

Year	Population	Average Daily Demand (MGD) Residential	Maximum Daily Demand (MGD) Residential	Average Daily Demand (MGD) Residential + Commercial	Maximum Daily Demand (MGD) Residential + Commercial
2010	9,702	1.50	3.01	2.06	3.57
2015	10,457	1.62	3.24	2.20	3.82
2020	11,265	1.75	3.49	2.36	4.10
2025	12,136	1.88	3.76	2.52	4.40
2030	13,073	2.03	4.05	2.70	4.72
2035	14,084	2.18	4.37	2.88	5.07
2040	15,172	2.35	4.70	3.09	5.44
2045	16,345	2.53	5.07	3.31	5.87
2050	17,608	2.73	5.46	3.55	6.28
2055	18,969	2.94	5.88	3.80	6.74
2060	20,453	3.17	6.34	4.07	7.24

Foss Master Conservatory District

The City of Clinton is a stakeholder in the Foss Master Conservatory District and has 48.6% of the allocation rights, which is 2.19 MGD of the 4.5 MGD capacity. However, the water treatment plant cannot continually produce 4.5 MGD, with the firm production rate being 4.1 MGD, with poor water quality.

Finished Water

The City of Clinton is capable of producing approximately 2.5 MGD with a conventional treatment process. The plant is operated by Severn Trent, and was built in 1985. Though twenty-seven (27) years old, the plant is being rehabilitated following a chlorine gas rupture, but is structurally sound and in good condition. The plant has not been in service due to lack of water in Clinton Lake since November 2011.

The water treatment plant is capable of treating both surface water and ground water. In addition to the surface water treatment process, it has a ground water filter and a chlorine injection system. Treated water enters the distribution system on site through a 24-inch line, and is transferred to the City.

The water quality in Clinton Lake is generally good; the lake experiences low turbidity, moderate alkalinity, and is generally easy to treat.

Current Water Conservation Plan

The City of Clinton has begun a water conservation program by passing an ordinance requesting voluntary water conservation. In 2011, the City requested that residents water their property for no more than one (1) hour per zone, or up to ¾-inch. Properties with even addresses could water on even days, and properties with odd addresses could water on odd days of the month. By minimizing nonessential water usage, such as recreational and landscape usage, the City can continue to support commercial businesses and industrial users.

Potential Raw Water Sources

The City of Clinton, Oklahoma's primary water source is Clinton Lake, and is supplemented by the purchase of treated water from the Foss Reservoir. Given the recent drought conditions, the water demand has been met solely with the Foss Reservoir. Due to these conditions, the City will need to have additional water supply to meet the increasing water demand. There are several options for securing water for the City: purchasing water from nearby communities, surface water sources and groundwater sources.

Purchasing Water

The City can purchase water from east Custer County, if the source is agreeable. There are existing active wells utilizing ground water in the area. These wells have numerous accounts of arsenic above the maximum contaminant level (MCL), and therefore must be treated for arsenic prior to distribution.

The amount of water available to the City of Clinton would depend on the potential water supplier's demand and treatment ability. Should the City of Clinton decide to purchase water, a distribution pipeline would be constructed.

Surface Water

Potential surface water sources include Fort Cobb Reservoir, which is located in Caddo County, approximately thirty (30) miles outside of the City of Clinton. The Fort Cobb Reservoir covers approximately 4,100 acres of water, and has a total capacity of 80,010 acre-feet. Fort Cobb Lake has an average turbidity of 13 NTU and a pH range of 7.3-9.09. The general water clarity rating is good. According to the Lakes of Oklahoma Maps by the Oklahoma Water Resources Board, Fort Cobb Reservoir's public and private water supply usage is severely impaired, meaning it may not be a suitable long-term water source.

Another potential surface water source is the Rocky Lake, located approximately twenty (20) miles southwest of the City of Clinton. Rocky Lake is similar in size to Clinton Lake, approximately 350 acres, with a capacity of 4,120 acre-feet. The average turbidity is 52 NTU, with a poor water clarity rating. The overall water quality is poor. Like Fort Cobb Reservoir, its private and public water supply is severely impaired.

The Lugert-Altus Reservoir is located approximately thirty-five (35) miles southwest of the City of Clinton Water Treatment Plant. It has an area of 6,260 acres, with a capacity of 132,830 acre-

feet, and currently no use is threatened. The average turbidity is 21 NTU, with a fair water clarity rating. The overall water quality is good. The City of Clinton could pump water from the Lugert-Altus Reservoir to the water treatment plant and either fill Clinton Lake or treat directly. There is available public water supply in the Lugert-Altus Reservoir. Table 3 is a summary of the surface water sources.

Table 3: Surface Water Sources

Lake	County	Distance from City of Clinton	Area (acres)	Capacity (acre-feet)	Water Quality	Water Availability
Foss Reservoir	Custer	9.5 miles	8,800	256,220	Poor	Fair
Clinton Lake	Washita	-	335	3,980	Good	Poor
Fort Cobb Reservoir	Caddo	30 miles	4,100	80,010	Good	Fair
Rocky Lake	Washita	20 miles	350	4,120	Poor	Poor
Lugert-Altus Reservoir	Greer	35 miles	6,260	132,830	Good	Fair

Groundwater

There are several available aquifers in western Oklahoma for public water sources, all of which are bedrock aquifers. Bedrock aquifers are geologic bedrock units that have porosity and permeability such that are able to release water. Water in these units are located in the spaces between the rock grains or in the fractures within the more solid rock. Bedrock aquifers are fairly well defined in terms of their areal extent. The two (2) potential aquifers for the City of Clinton raw water supply are: Rush Springs and Elk City. The following information was provided by the USGS.

The Rush Springs aquifer has an area of approximately 896,000 acres in central/ west Oklahoma. This aquifer is located in parts of Blaine, Caddo, Comanche, Custer, Dewey, Grady, and Washita Counties. This formation consists of the Rush Springs Sandstone and the Marlow Formation. The Rush Springs Sandstone region has a maximum thickness of more than 300 feet in the south in Caddo County, while the Marlow Formation has a maximum thickness of 125 in the western area. The Marlow Formation yields moderate amounts of water with fair chemical quality.

According to the USGS, the Rush Springs aquifer is unconfined, with typical well yields of 200 to 600 gallons per minute. The aquifer water has a dissolved solids concentration of less than 500 mg/L in central Caddo, eastern Custer, and western Blaine Counties. To the west and east of this area, the dissolved solids concentrations exceed 1,000 mg/L. There have been incidences of arsenic found within the aquifer, which would require treatment. Approximately six million gallons per day are drawn for public water supply. Establishment of a well field will likely have to take place approximately 8-17 miles east of the City of Clinton.

The Elk City aquifer, located in southwestern Oklahoma, consists of Elk City sandstone and terrace deposits, dune sands and gravel from the Ogallala formation. The aquifer covers an area of approximately 193,000 acres and supplies ground water for irrigation, domestic and industrial purposes in Beckham, Custer, Roger Mills, and Washita Counties. Wells in the Elk City aquifer yield 25-300 gallons per minute. The aquifer has dissolved solids concentrations ranging from

300 – 500 mg/L, and has generally good water quality. Wells with the greatest yields are located approximately 18-20 miles southeast of the City of Clinton.

The City of Clinton currently has a well field located near Burns Flat, which consists of 20 wells. This well field is located within the Elk City Sandstone Aquifer, and was built in 1957. The total water rights held by the city is 1500 gpm. The City has not relied on this well field in the last 40 years, due to a sufficient supply of surface water. Currently, the City has water rights for 329 acre-feet per year, from the four (4) active permits. To obtain 569 acre-feet per year, the City would have to obtain the permit held by OSIDA (#1993-612).

Cost Estimates

The following tables are preliminary cost estimates for each water supply source. The cost estimates do not include easements.

Table 4: Fort Cobb Lake Intake and Transmission Line

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMobilIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	TRAFFIC CONTROL	1	LS	\$ 2,500.00	\$ 2,500.00
3	WATER LINE	158,400	LF	\$ 85.00	\$ 13,464,000.00
4	INTAKE STRUCTURE	1	LS	\$ 750,000.00	\$ 750,000.00
5	ADJUSTMENT TO EXISTING UTILITIES	1	LS	\$ 5,000.00	\$ 5,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 14,231,500.00

Table 5: Rocky Lake Intake and Transmission Line

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMOBILIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	TRAFFIC CONTROL	1	LS	\$ 2,500.00	\$ 2,500.00
3	WATER LINE	105,600	LF	\$ 85.00	\$ 8,976,000.00
4	INTAKE STRUCTURE	1	LS	\$ 750,000.00	\$ 750,000.00
5	ADJUSTMENT TO EXISTING UTILITIES	1	LS	\$ 5,000.00	\$ 5,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 9,743,500.00

Table 6: Lugert-Altus Intake and Transmission Line

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMOBILIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	TRAFFIC CONTROL	1	LS	\$ 2,500.00	\$ 2,500.00
3	WATER LINE	184,800	LF	\$ 85.00	\$ 15,708,000.00
4	INTAKE STRUCTURE	1	LS	\$ 750,000.00	\$ 750,000.00
5	ADJUSTMENT TO EXISTING UTILITIES	1	LS	\$ 5,000.00	\$ 5,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 16,475,500.00

The preliminary cost estimates for the groundwater sources are based on the estimated distance from the City of Clinton, and a set yield. The cost estimates were calculated based on the maximum estimated distance from the City of Clinton, and with both the minimum and maximum well water yields. For the Rush Springs aquifer, a distance of 17 miles and yields of 200 gpm and 600 gpm were used. For the Elk City aquifer, a distance of 20 miles and yields of 25 gpm and 300 gpm were used. The quantity of wells required is based on a 4.5 MGD water demand, which is the estimated demand for the average day in 2060. The cost estimates do not include easements.

Table 7: Rush Springs Aquifer Well Field and Intake – Maximum Yield

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMOBILIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	GROUNDWATER WELL	5	EA	\$ 100,000.00	\$ 500,000.00
3	WATER LINE	132,000	LF	\$ 85.00	\$ 11,220,000.00
4	WELL HOUSE	1	LS	\$ 200,000.00	\$ 200,000.00
5	TESTING	1	LS	\$ 30,000.00	\$ 30,000.00
6	CLEAN UP	1	LS	\$ 15,000.00	\$ 15,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 11,975,000.00

Table 8: Rush Springs Aquifer Well Field and Intake – Minimum Yield

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMOBILIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	GROUNDWATER WELL	11	EA	\$ 100,000.00	\$ 1,100,000.00
3	WATER LINE	132,000	LF	\$ 85.00	\$ 11,220,000.00
4	WELL HOUSE	1	LS	\$ 200,000.00	\$ 200,000.00
5	TESTING	1	LS	\$ 30,000.00	\$ 30,000.00
6	CLEAN UP	1	LS	\$ 15,000.00	\$ 15,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 12,575,000.00

Table 9: Elk City Aquifer Well Field and Intake – Maximum Yield

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMOBILIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	GROUNDWATER WELL	11	EA	\$ 100,000.00	\$ 1,100,000.00
3	WATER LINE	105,600	LF	\$ 85.00	\$ 8,976,000.00
4	WELL HOUSE	1	LS	\$ 200,000.00	\$ 200,000.00
5	TESTING	1	LS	\$ 30,000.00	\$ 30,000.00
6	CLEAN UP	1	LS	\$ 15,000.00	\$ 15,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 10,331,000.00

Table 10: Elk City Aquifer Well Field and Intake – Minimum Yield

ITEM	DESCRIPTION	QUAN.	UNIT	UNIT PRICE	TOTAL PRICE
1	MOBILIZATION/DEMOBILIZATION	1	LS	\$ 10,000.00	\$ 10,000.00
2	GROUNDWATER WELL	125	EA	\$ 100,000.00	\$ 12,500,000.00
3	WATER LINE	105,600	LF	\$ 85.00	\$ 8,976,000.00
4	WELL HOUSE	1	LS	\$ 200,000.00	\$ 200,000.00
5	TESTING	1	LS	\$ 30,000.00	\$ 30,000.00
6	CLEAN UP	1	LS	\$ 15,000.00	\$ 15,000.00

TOTAL ESTIMATED CONSTRUCTION COSTS:

\$ 21,731,000.00

Recommendations

It is recommended that the City of Clinton begin a short-and long-term plan for their raw water supply that relies on multiple sources including surface and ground water.

Short Term

The City of Clinton should begin a mandatory water conservation policy with the goal to limit the maximum daily demand to 2.19 MGD, the City's maximum allocation from the Foss Reservoir. Residents of Clinton should be required to limit their water usage and minimize non-essential water usage. The residents should be made active participants in water conservation

with incentives to comply and fines for non-compliance. For example, the City of Clinton could provide incentives for the most sustainable yard.

Additionally, the highest industrial and commercial users in the City of Clinton could explore water reuse options. The City has existing wells that have very hard water, and those wells can be used for industrial supply, with the installation of a Zeta-Core catalytic water conditioning system by the Water Lady, or similar point-of-use treatment system. These systems have been successful in treating hard water for many private wells, and have been used by farmers in the area. While this system will not be effective for the entire public water supply, it can be used to treat water for individual businesses. Therefore, water from irrigation wells with poor water quality could be utilized. In addition, heavy industrial water users should form a task force with the City to discuss water usage.

The City of Clinton must continue to utilize their allotment from the Foss Reservoir. The Foss Reservoir is the only dependable water source available in the short term. As water becomes available in Clinton Lake, the City can begin to supplement the treated water from Foss with water from Clinton Lake.

The City should investigate the existing well field on the in Washita County for yield and water quality. If the existing well field does not prove satisfactory, additional test wells could be constructed. The City has existing water rights in the Elk City aquifer, and should use their allocation if at all possible. Should there be sufficient water supply and yield for the short term, the wells, stand pipe and transmission lines should be investigated for structural integrity and condition, and rehabilitated if necessary.

If Clinton Lake remains unutilized, the total available water, including the Foss Reservoir allotment, is 2.19 MGD. This will supply the City with the average daily water demand until 2015-2020. See Table 11 for the water balance. However, the peak daily demand would not be satisfied, making water conservation a necessary effort. If Clinton Lake fills, or if a secondary surface water source is used to fill Clinton Lake, then the City would have a total of 4.69 MGD available to them, as shown in Table 12. The 4.69 MGD is based on the maximum allotment from the Foss Reservoir and Clinton Lake. The long-term recommendations will be based on a lack of available water in Clinton Lake.

Table 11: Water Balance without Clinton Lake

Source	Yield (MGD)
Clinton Lake	0.00
Foss Reservoir	2.19
Elk City Well field	unknown
Total	2.19

Table 12: Water Balance with Clinton Lake

Source	Yield (MGD)
Clinton Lake	2.50
Foss Reservoir	2.19
Elk City Well field	unknown
Total	4.69

Long Term

A “do nothing” approach to the City of Clinton’s water supply is not a viable option. It is recommended that for the long-term the City of Clinton secure additional diverse water sources, either surface, ground water, or both, using the minimum allocation from Foss Reservoir of 0.70 MGD. The Foss Reservoir’s water plant is in poor condition, and the reservoir has poor water quality.

Alternative 1 consists of the construction of a transmission line from the Lugert-Altus Reservoir, and either augmenting Clinton Lake or directly treating it. While the Lugert-Altus Reservoir is currently experiencing lower water levels, it has the largest drainage basin of the surface water options, and has the highest probability of recovery. This alternative would require construction of an intake structure, pipeline, easements, and upgrading of the water treatment plant. Clinton Lake would have to supply approximately 3.8 MGD, which means the plant capacity would have to double. See Table 13 for the water balance.

Alternative 2 consists of obtaining water rights and constructing a well field in the Rush Springs aquifer. This water would require little treatment, and could be put directly into the distribution system. A test well, yield and quality analysis should be conducted. This alternative would require construction of a well field, transmission line and a disinfection station. The Clinton water treatment plant would not have to be upsized, but could not be used unless Clinton Lake filled. See Table 14 for the water balance.

Alternative 3 consists of both the construction of a transmission line from the Lugert-Altus Reservoir and the well field at the Rush Springs aquifer. The Lugert-Altus transmission line would be used to fill Clinton Lake in times of drought, and treated with the existing water treatment plant. Since the plant would have a capacity of 2.5 MGD, the Rush Springs well field would need to provide a yield of approximately 1.3 MGD. See Table 15 for the water balance for Alternative 3.

It is recommended that the City use Alternative 3 as the long term water source plan, with phased construction. Improvements to the Elk City well field should occur in Phase 1. Should the Rush Springs aquifer prove to be a good water source, construction of wells should occur in Phase 2. This well field will be in addition to the existing well field in the Elk City aquifer. The wells can be constructed based on the current needs of the community, with an incremental approach. After the wells have been constructed, Phase 3 would be the transmission line from the Lugert-Altus Reservoir to augment the water capacity in Clinton Lake. Improving Clinton Lake through

dredging and expanding the capacity is also recommended. The City should obtain water rights to both sources in the near future, to ensure that the rights are available when needed. In addition to this, the City should begin an enforceable water conservation program immediately, to reduce the nonessential recreational and landscape water usage. With these measures, the City of Clinton will have an adequate and diverse water supply.

Table 13: Water Balance for Alternative 1

Source	Yield (MGD)
Clinton Lake via Lugert-Altus Reservoir	3.80
Foss Reservoir	0.7
Elk City Well field	unknown
Total	4.5

Table 14: Water Balance for Alternative 2

Source	Yield (MGD)
Clinton Lake via Lugert-Altus Reservoir	0.00
Foss Reservoir	0.7
Elk City Well Field	unknown
Rush Springs Well Field	3.8
Total	4.5

Table 15: Water Balance for Alternative 3

Source	Yield (MGD)
Clinton Lake via Lugert-Altus Reservoir (Phase 3 construction)	2.50
Foss Reservoir	0.7
Elk City Well Field (Phase 1 construction)	unknown
Rush Springs Well Field (Phase 2 construction)	1.3
Total	4.5