CONSULTING SERVICE AUTHORIZATION

DATE:

CONSULTANT: Kimley Horn and Associates, Inc.

SERVICE AUTHORIZATION NO. 12 - 21 FOR CONSULTING SERVICES

CITY P.O. NO. _____ CITY EXPENSE CODE _____

TITLE: DELRAY BEACH DISTRIBUTION SYSTEM RESIDUAL CHLORINE DEPLETION STUDY

CITY PROJECT NO._____

This Service Authorization, when executed, shall be incorporated in and shall become an integral part of the "Agreement for General Consulting Engineering Services" Contract, dated February 22, 2012.

I. PROJECT DESCRIPTION

Kimley-Horn and Associates, Inc. ("KHA", "Consultant") is pleased to submit this service authorization request to the City of Delray Beach ("Client" or "City") for providing services for a Distribution System Residual Chlorine Depletion Study. Our project understanding, scope of services and fee follow.

The Delray Beach water distribution system requires frequent free chlorine maintenance operations and application of additional chlorine in outlying areas of the distribution system in order to restore chlorine residuals in the water to acceptable levels. These are symptoms of organic growth in the distribution system which consumes the available chlorine and will reduce the chlorine residual below acceptable levels as well as levels mandated in the state regulations. This condition is likely caused by the availability of ammonia, placed in the water system at the water plant as a treatment process to prevent disinfection byproduct (DBP) formation, which then serves as a food source for the biological growth to begin which then begins the spiral of reduction in free chlorine which leaves behind additional free ammonia which then accelerates growth of the organic growth. The reduction in chlorine residual is compounded by those areas within the distribution system that have very low flow rates leading to stagnant water which provides additional time for organic growth to occur and further decline the level of free chlorine. Ammonia is added to the water at the water treatment plant to react with the chlorine and form chloramines. Chloramines are less likely than chlorine to form DBP's. Addition of ammonia to drinking water in South Florida is commonplace in order to avoid formation of disinfection byproducts at concentrations greater than allowed by state regulations. Although the use of chloramines is greatly beneficial in meeting the DBP regulations, as stated above it can lead to the issues being faced in the Delray Beach distribution system. Formation of DPB's by reaction of chlorine with organics present in the water is dependent on a number of factors, including chlorine concentration, organic concentration, type of organics, bromide concentration, temperature, and time of free chlorine contact.

Based on this understanding, the following scope of services will be performed by the Consultant:

II. SCOPE OF SERVICES

TASK 1 – DISTRIBUTION SYSTEM RESIDUAL CHLORINE DEPLETION EVALUATION

Kimley-Horn will conduct an evaluation of the City of Delray Beach's existing chlorine and ammonia addition facilities and distribution system hydraulics in order to generate recommendations for the operation of the City's disinfection operations and flushing program. It is anticipated that a kickoff meeting and up to four roundtable meetings as described in Task 1.6 will be held as part of this evaluation. The following is a list of the tasks that will be performed as part of this evaluation and a description of the scope of work involved for each task.

Task 1.1

Task 1.1 will consist of assessing the chlorine and ammonia addition facilities present in the water treatment plant. The rate of ammonia application must be carefully controlled to prevent free ammonia from being initially present in the distribution system as the water leaves the water treatment plant. The rate of ammonia addition must be based on the rate of product water flow and concentration of free chlorine. Both of these must be measured accurately and continuously. It is extremely important that the chlorine and ammonia ratio be maintained at a specific level at all times during operation of the water plant. Work by Kimley-Horn will include assessing the type of ammonia used, the equipment used for application of ammonia, location of chlorine and ammonia applications, and ability to monitor water quality after addition of chlorine and ammonia. Kimley-Horn will engage Dr. Steve Duranceau as a subconsultant to assist in evaluating the treatment process and potential for DBP formation. This task will not be concluded until the water quality testing contained in Task 1.3 is completed. This task is expected to culminate with recommendations for location of chemical applications, method of chemical applications, equipment that is best suited for the needs of Delray Beach, and required monitoring devices or frequency of sampling and testing.

Task 1.2

Task 1.2 will consist of examination, updating, and testing of the current InfoWater hydraulic model of the distribution system that was developed by City staff. The goal of this update and examination will be to refine the model so that it can be used to predict water flow rates throughout the system which in turn will lead to the ability to determine water age throughout the system. As stated above, age of the water is a primary factor in depletion of available chlorine.

Kimley-Horn will perform the following as part of this task:

- Collect information on the existing water system, including areas of known low chlorine residual measurements, pump curves, and operation descriptions of distribution system

remote tanks and pump operations and record drawings for the storage tanks and pumping facilities.

- Incorporate the specific physical hydraulic features into the model. Examples of these features include tank sizes, control valve settings, pump curves, and several node elevations such as high service pumps.
- Populate the elevation of the distribution system nodes using USGS GIS data.
- It is understood that the City has developed the demand scenario in the model using geocoded billing data. Kimley-Horn will define the appropriate average daily flow and maximum daily flow to be used in the model based on MOR data and will scale the existing demand scenarios to develop Average Daily Flow and Maximum Daily Flow Scenarios for today's conditions.
- Develop a diurnal water demand curve for the system demands. If the typical 24-hour flow information is not available from the City, industry accepted peak factors will be applied to calculate the diurnal curve.
- Develop an extended period simulation for maximum daily flow and average daily flow demand scenarios using the diurnal water demand curve. It is assumed that for each demand scenario up to three extended period sub-scenarios will be developed to look at different operations for the storage tanks and pumping stations in the distribution system.
- Adjust the friction factors of the pipes as needed to be consistent with industry standards.
- Use the City's GIS shapefile which includes fire hydrants to identify and assign a prefix to fire hydrants in the model. This information will be used to perform the flushing scenarios as part of Task 1.4.
- Once the existing model has been updated, Kimley-Horn will perform field pressure testing of up to nine (9) locations to observe if the field pressure readings are in general agreement with the hydraulic model. It is assumed that this testing can be performed with up to 3 hours of field time for up to 3 Kimley-Horn staff members. Kimley-Horn will work with City staff to define the operating conditions for the distribution system for the day that the field pressures are observed. Kimley-Horn will compare these readings to the pressures predicted by the model. If it is found that there are significant discrepancies between the field data and model predicted pressure, Kimley-Horn may recommend that additional field testing be performed to identify closed valves and calibrate the model. Additional field testing, if required, will be performed as an additional service.
- Accompany City staff during a scheduled flushing event in order observe and measure fire hydrant flows and pressure readings during a flushing event. It is assumed that this effort will consist of up to 8 hours of field time for up to two Kimley-Horn staff members. Kimley-Horn will compare the field data to the hydraulic model. If it is found that there are significant discrepancies between the field data and model predicted data, Kimley-Horn may recommend that additional field testing be performed to identify closed valves and calibrate the model. Additional field testing, if required, will be performed as an additional service.
- Run up to twelve extended period simulations to identify the water age throughout the distribution system and to generate recommendations for distribution system operation in order to keep the water age below the acceptable levels per industry standards.

Task 1.3

Task 1.3 will consist of determination of the DBP formation potential in the water produced at the Delray Beach water treatment plant. Testing will be conducted in conjunction with the University of Central Florida to develop time based curves of DBP formation using water collected on site after

softening but prior to chlorination. This water will be filtered on site and then transported to UCF where the water will be chlorinated and then samples drawn on a frequent interval, chlorine in that sample quenched, and the DBP's measured. By repeating this over a four hour period a curve will be developed that predicts the increase over time of the DBP formation after the softened water is chlorinated. This information will allow determination of the appropriate length of free chlorine contact time to avoid formation of DBP's in excess of the regulated limits. KHA will use this information during our work on Task 1.1 with the intent to have the longest possible free chlorine contact time with forming excessive DBP's. Free chlorine is a better disinfectant and should do a more thorough job of reducing the organic matter present in the raw water

Task 1. 4

Task 1.4 will consist of conducting multiple operations and trial runs using the hydraulic model of the system. These trial runs are intended to determine the sensitivity of the system to flushing flow rates, flushing locations, and flushing durations. Trial runs will also be conducted applying closed valves at strategic locations that would assist in minimizing the amount of looped piping in the system which would tend to allow more thorough flushing of the larger pipes. The work under this task is judgmental in nature and requires meetings with City staff to determine if proposed flushing locations, durations, and flow rates have been tried in the past and what results were obtained. It is important to note that this task is relatively "trial and error" with the trials being based on professional judgment. We have included up to 2 meetings with City staff to perform this Task.

Task 1.5

Task 1.5 will consist of examination of the expected effectiveness in the outpost chlorination stations. The goal of this program is to eliminate the outpost chlorination stations by significantly reducing the decay of chlorine residual throughout the system. However, extensive changes to the existing distribution system are not likely possible and some areas may require application of additional chlorine. These stations require control of the application rate of chlorine based on flow rate of water past that station and chlorine and ammonia residuals. KHA will prepare a technical memorandum outlining the findings of our review of these outs post-chlorination stations and recommendations for elimination or improvements at selected stations.

Task 1.6

Task 1.6 will include conducting a kickoff meeting and up to four (4) roundtable discussions with water department and other city staff members by Kimley-Horn staff and Dr. Steve Duranceau. Kimley-Horn will engage Dr. Duranceau as a consultant on this project to help guide the technical aspects of the project as well as contribute to assisting city staff in understanding the complexities of organic formation and the resulting chlorine.

TASK 2 – DISTRIBUTION SYSTEM RESIDUAL CHLORINE STUDY DOCUMENT

- Kimley-Horn will prepare a summary report of the findings and recommendations developed during this project.
- We will attend up to one (1) meeting to discuss the findings and recommendations and respond to up to one (1) round of reasonable review comments before finalizing the document.
- We will provide five (5) hard copies of the document including all appendices.

ADDITIONAL SERVICES

KHA believes the proposed scope of services to be generally inclusive of the required tasks. However, KHA will provide additional services at the request of the City and upon receipt of written authorization to proceed. KHA also will provide additional services that arise due to unforeseen circumstances with prior written authorization from the City. Additional services that we can perform upon request of the City include, but are not limited to, the following:

- Additional Modeling Efforts beyond what is referenced in the above scope of services.
- Additional Field Testing
- Permitting services.
- Construction drawing
- Meetings not specifically referenced in the above scope of services.

Additional services will be performed based on proposals approved by the City in advance of the performance of those services.

SCHEDULE

KHA will begin work upon receiving a notice to proceed from the Client. We propose the following schedule:

- Client issues Notice to Proceed (NTP).
- Conduct the Distribution System Residual Chlorine Depletion Evaluation over a 4-5 months period
- Prepare and submit the Distribution System Residual Chlorine Study Document in 6 to 7 months from the NTP

We will endeavor to meet this deadline with the schedule as outlined above.

III. BUDGET

Fee and Expenses

KHA will perform the Services in Tasks 1 - 2 on an hourly basis not to exceed the fees below without City permission. Fees will be invoiced monthly based on the actual amount of service performed and expenses incurred. Payment will be due within 25 days of your receipt of the invoice. Individual task amounts are informational only.

Reimbursable Expenses billed under this contract could include: in-house duplicating, facsimiles, postage, express delivery services, large-format color printing, construction drawing printing, specification printing, and other out-of house printing. Reimbursable expense will be billed as incurred and back up documentation will be provided for these expenses.

Additional services which may be identified as needed at a later time will be negotiated at that time.

TASK	DESCRIPTION	FEE
1	Distribution System Residual Chlorine Depletion Evaluation	$104,598
2	Distribution System Residual Chlorine Study Document	$18,171
	Estimated Reimbursable Expenses	$500
Total (Including Reimbursable Expenses)		$123,269

IV. COMPLETION DATE

This service authorization is approved contingent upon the City's acceptance of and satisfaction with the completion of the services rendered in the previous phase or as encompassed by the previous service authorization. If the City in its sole discretion is unsatisfied with the services provided in the previous phase or service authorization, the City may terminate the contract without incurring any further liability. The CONSULTANT shall commence work on any service authorization approved by the City to be included as part of the contract without a further notice to proceed.

Approved by:

CITY OF DELRAY BEACH:

Date _____

_____
Cary D. Glickstein, Mayor

_____
Witness (Signature)

_____
Witness (Printed)

Attest: _____

Approved as to Legal Sufficiency

_____
City Attorney

KIMLEY-HORNAND ASSOCIATES, INC.

Date 3/15/2016

By: _____

(Seal) KIMLEY-HORN AND ASSOCIATES, INC. CORPORATE SEAL NC

STATE OF FLORIDA
COUNTY OF PALM BEACH

BEFORE ME, the foregoing instrument, this 15TH day of MARCH, 2016, was acknowledged by JOHN E. POTTS on behalf of the Corporation and said person executed the same free and voluntarily for the purpose therein expressed.

Witness my hand and seal in the County and State aforesaid this 15TH day of MARCH, 2016.

_____
Notary Public
State of Florida
My Commission Expires:

DIXIE L. MCGAFFICK
Commission # FF 155950
Expires September 24, 2018
Bonded Thru Troy Fain Insurance 800-385-7019

ESTIMATE FOR ENGINEERING SERVICES

PROJECT:	Delray Beach Distribution System Residual Chlorine Depletion Study						SHEET 1 of 1			
CLIENT:	City of Delray Beach						FILE NO.			
ESTIMATOR:	John Potts/Fannie Howard						DATE:	07/15/15		
							ALLOCA	0.0000		
DESCRIPTION: See Scope of Services	DIRECT LABOR (MAN-HOURS)									
	Senior Principal	Principal	Senior Professional	Professional	Analyst	Analyst	Support Staff	SUB	EXP	LINE TOTAL
	JP	MM	FH	SG	TS/NB	TS/NB				
Task 1 - Distribution System Residual Chlorine Evaluation										
1. Water plant chemical addition assessment	32.0		20.0		24.0		2.0	1600.0		$15,576
										$0
										$0
2.Examine and test existing hydraulic model	10.0		70.0		6.0	120.0	10.0			$28,486
										$0
										$0
3. DBP Testing	8.0		10.0		18.0		2.0	6700.0		$12,414
										$0
										$0
4. Multiple Hydraulic Runs	10.0		30.0			70.0	2.0			$15,054
										$0
										$0
5. Examine and evaluate outpost chlorine stations	30.0		25.0		30.0		4.0			$15,138
										$0
										$0
6. Kickoff Meeting/Additional RoundTable Meetings (up to 5 total)	20.0		25.0		30.0		10.0	4800.0		$17,930
										$0

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DESCRIPTION: See Scope of Services	DIRECT LABOR (MAN-HOURS)									
	Senior Principal	Principal	Senior Professional	Professional	Analyst	Analyst	Support Staff	SUB	EXP	LINE TOTAL
	JP	MM	FH	SG	TS/NB	TS/NB				
Task 2 - Distribution System Residual Chlorine Study Document										
Preliminary Draft Study Submittal	8.0		32.0		27.0	15.0	6.0			$12,386
										$0
Review Meetings with the City (up to 1 times)	4.0		4.0				1.0			$1,768
										$0
Revise Study (up to 1 time)	4.0		8.0		8.0	5.0	4.0			$4,017
										$0
Reimbursable Expenses									$500	$500
	126	**0**	**224**	**0**	**143**	**210**	**41**	**13100**	**0**	
	244.00	**203.00**	**180.00**	**135.00**	**101.00**	**101.00**	**72.00**	**1.00**	**1.0**	
	0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
	30,744.00	**0.00**	**40,320.00**	**0.00**	**14,443.00**	**21,210.00**	**2,952.00**	**13,100.00**	**500.00**	**$123,269.00**