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June 28, 2019

Mr. Layne Pemberton
Enforcement Analyst
Enforcement Branch
ADEQ Office of Water Quality
5301 Northshore Drive
North Little Rock, AR 72118

Ref: City of Forrest City; Permit No.: AR0020087
Comprehensive CAP Report per Item 11, 16 & 17 of the CAO

Dear Mr. Pemberton,

In accordance with the Consent Administrative Order (CAO) signed by the City of Forrest City dated October 23, 2017, the City of Forrest City (COFC) is required to submit to ADEQ a comprehensive Corrective Action Plan (CAP) to correct the violations described in paragraph 11, 16 and 17 of the CAO for review and approval. The CAP is to be based on a Sewer System Evaluation Study of the sewer collection system performed with an "overall goal of eliminating capacity and non-capacity related SSO's" referred in the CAO. The plan is to be developed by a P.E. licensed in the State of Arkansas.

In accordance with the agreement, we prepared a two phase work plan to develop the required CAP. The plan was submitted to the ADEQ on March 7, 2018 for review and acceptance. An Inflow Infiltration study of the Forrest City wastewater collection system is to be performed in the first phase of the plan. The study started in April 2018. The final report was completed earlier this month. A copy of the final report is submitted herewith for your review and acceptance.

Based on the results of the I/I report a second phase work plan is developed to perform follow up studies to locate specific location of inflows within the system and to perform corrective measures to eliminate those sources. The work plan is attached herewith for your review and acceptance. We also prepared a milestone schedule for the second phase workplan. The schedule is also attached herewith for your review and acceptance

We will continue to submit reports as outlined in the CAO. Please feel free to contact me if you need additional clarifications. I can be contacted at 501-375-178

Sincerely,

Mizan Rahman, P.E.
Principal

CC: Mayor Cedric Williams, City of Forrest City
Mr. Calvin Murdock, Manager, Forrest City Water Utility

SSES - PHASE 2
WASTEWATER COLLECTION SYSTEM EVALUATION

IDENTIFICATION OF INFLOW LOCATION FOR DEVELOPING CORRECTIVE ACTION PLANS

CITY OF FORREST CITY

BACKGROUND

City of Forrest City (COFC) entered into a Consent Administrative Order (CAO) with the Arkansas Department of Environmental Quality (ADEQ) on October 23, 2017. The CAO requires that COFC submit a Corrective Action Plans (CAP) to remedy all Sanitary Sewer Overflow (SSO) incidents reported to ADEQ by the City of Forrest City Water Utility (FCWU) between March 1, 2014 and July 20, 2016 (Ref. Paragraph 10 and 16 of the Consent Administrative Order).

PLAN REQUIREMENTS

The CAO stipulates that the COFC submit to ADEQ a CAP that is based on a Sewer System Evaluation Study. The CAO lists the following items to be included in the SSES plan.

1. Perform smoke testing in all areas of the collection system, beginning with the highest priority area;
2. Perform televising of lines in areas deemed necessary based on smoke testing in order to locate leaks and to determine method of repair;
3. Develop a plan to address deficiencies through rehabilitation, repair, or replacement;
4. Develop a manhole inspection program, beginning in the highest priority area; and
5. Recommend a method of repair and develop a cost estimate for such.

These criteria were included in the CAO as a means to identify portions of the sewer system where field investigations are warranted. These field investigations are intended to evaluate the condition of sewer assets that may contribute to the Sanitary Sewer Overflows in the Forrest City waste water collection system. Therefore, it is clear that SSES planning involves the identification and prioritization of service areas which will require SSES field activities and subsequent analysis.

CORRECTIVE ACTION PLAN

Forrest City Wastewater collection system provides services to 3219 households and 8 industrial clients. It has approximately 480,000 linear feet of various size sewer gravity lines, 19 sewer pump station and 1600 manholes.

COFC proposed a two-step investigative process to develop CAP. In the first step a system wide Infiltration Inflow study is to be undertaken. The infiltration/inflow analysis is performed to determine the extent of the existence/non-existence of excessive infiltration/inflow in each sewer tributary of the Forrest City wastewater collection systems. Through a systematic investigation of the wastewater subsystem, we will identify the flow rate, and type of infiltration/inflow conditions which exist in the wastewater system. A detail scope of work for the I/I study was submitted earlier.

Following the flow monitoring result, the subsystems will be ranked/prioritized based on the result of the I/I study. If infiltration/inflow analysis results indicate presence of excessive I&I in these sub-system groups a SSES may be proposed to determine

remedial action. A plan will be developed for the SSES. The plan will outline the tasks to be performed in the study and their estimated costs. SSES will be performed as a follow up to the I/I analysis to locate and identify specific Infiltration & Inflow sources in the sewer system within the specific basin. By identifying the type of each I/I source and the flow from that source during the SSES, appropriate CAP (rehabilitation methods) can be developed. Subsequently, a study will be undertaken to determine the cost effectiveness of the removal of the I/I source. The data collected during the SSES will also be used to confirm the findings of the Infiltration/Inflow analysis and, in particular, the extent of additional investigation needed to develop appropriate rehabilitation, and/or system improvements required in the areas investigated during the SSES.

INFILTRATION/INFLOW STUDY

In April 2018, RJN Group, Inc. was retained by ETC Engineers and Architects on behalf of the City of Forrest City to initiate a wastewater collection system infiltration and inflow reduction survey in Forrest City, Arkansas. The study consisted of developing basin boundary areas and performing flow monitoring throughout the City. The purpose of the flow and rainfall monitoring was to quantify dry and wet-weather flows in the system, prioritizing the areas with excessive amounts of inflow and infiltration. Wet-weather flows were analyzed to determine which areas of the system contribute excessive infiltration/inflow (I/I) to the wastewater system. The flow monitoring and analysis were completed early this year. A final report on the study was submitted to the COFC on June 24, 2019. This report presents the findings of the yearlong study.

RJN Group, Inc. performed a flow monitoring program during late spring and early summer of 2018. The wastewater collection system of Forrest City, Arkansas was divided into sixteen basins to evaluate the individual flow characteristics of each basin. The table below provides a summary of each basin and associated, approximate footages that are contained within each basin.

The project scope consisted of monitoring sanitary sewer flow and rainfall from sixteen (16) flow meters and four (4) rain gauges that were installed between April 16th and April 20th. The beginning of the flow monitoring period started on April 21, 2018. All flow monitoring was completed on June 25, 2018. Infiltration may enter the system through pipe joints, sewer line defects (including main sewer lines and building sewer lines), and defective manhole walls, benches, and pipe seals. Peak infiltration is defined as the maximum, extraneous flow that enters the sanitary sewer system during high-groundwater conditions after the inflow effects of a rain event have ended.

BASINS

Basin	Linear Footage
FC-01	26,198
FC-02	47,278
FC-03	22,575
FC-04	23,191
FC-05	18,547
FC-06	25,504
FC-07	30,673
FC-08	25,185
FC-09	20,124
FC-10	29,949
FC-11	54,208
FC-12	40,099
FC-13	35,111
FC-14	28,872
FC-15	38,832
FC-16	34,383
Total Linear Footage: 500,729	

INFILTRATION CONDITIONS

Determining peak infiltration requires analysis of flow data obtained during dry-weather/high-groundwater conditions. Days that are too close to rainfall events were excluded to avoid including residual inflow (rainfall induced infiltration) that may lead to an over-estimation of peak infiltration. Generally, periods following significant rainfall, excluding the day immediately following a rain event, are used for determining peak infiltration.

Average dry-weather/high-ground water flow was determined using hourly flows during high-groundwater periods. Average peak monitored infiltration was determined by subtracting the average dry-weather/low-groundwater flow from the average dry-weather/high-groundwater flow. Peak infiltration during the study period was determined to be 0.645 mgd in the study area.

A summary of peak infiltration for each monitored basin is given in Table below. The peak basin unit infiltration rate expressed in gallons per day per inch diameter miles (gpd/idm), shown on the Table, is a method of expressing the magnitude of peak infiltration relative to other basins. **According to industry standards, excessive infiltration occurs when the basin peak infiltration is greater than 5,000 gpd/idm.**

The study shows that the Infiltration was found to be **negligible for basins 10 and 15. All other basins have less infiltration than the 5,000 gpd/idm standard.** The report did not recommend any additional infiltration related study. Therefore, COFC will not develop any CAP related to infiltration induced extraneous flow reduction in the collection system.

SUMMARY OF PEAK MONITORED INFILTRATION

Basin	Basin Footage (lf)	Basin Peak Infiltration (mgd)	Basin Peak Unit Infiltration (gpd/IDM)	Ranking
FC-01	26,198	0.042	925	6
FC-02	47,278	0.075	983	5
FC-03	22,575	0.065	2,406	2
FC-04	23,191	0.051	1,652	3
FC-05	18,547	0.010	450	14
FC-06	25,504	0.027	866	7
FC-07	30,673	0.030	773	8
FC-08	25,185	0.014	491	13
FC-09	20,124	0.106	3,206	1
FC-10	29,949	insignificant	insignificant	15
FC-11	54,208	0.065	599	10
FC-12	40,099	0.042	757	9
FC-13	35,111	0.041	513	12
FC-14	28,872	0.050	1,148	4
FC-15	38,832	insignificant	insignificant	16
FC-16	34,383	0.025	514	11
Total	**500,729**	**0.645**	**1,092** (Average)	

INFLOW CONDITIONS

Inflow in a sanitary sewer system is defined as extraneous flow that is a direct result of stormwater runoff. Inflow may enter the sanitary sewer system through directly connected downspouts, area drains, cleanouts, and building sewers. Stormwater may also enter the system through direct or indirect connections between the sanitary sewers and storm drains or ditches, sewer line defects, and through defective manhole covers, frame seals, corbels and manhole walls. The flow monitoring program was conducted during a season with multiple rain events with varying intensities. Based on the analysis performed on the remaining basins, it was concluded in the report that there is excessive inflow for approximately 73% of the monitored system. **The industry standard of acceptable inflow is 10,000 gpd/1,000 linear feet of sewer pipe. Twelve (12) out of the sixteen (16) basins experience excessive inflow.** A summary of peak inflow for each monitored basin is given in Table below.

SUMMARY OF PROJECTED INFLOW RATES

Basin No.	Basin Size (lf)	Basin Peak 1-Year/60Min Inflow Rate (mgd)	Basin Unit Inflow Ratio (gpd/1,000 lf)	Basin Peak 5-Year/60Min Inflow Rate (mgd)	Basin Unit Inflow Ratio (gpd/1,000 lf)	Basin Unit Inflow Ratio 1-Year Ranking
FC-01	26,198	0.475	18,123	0.282	10,764	8
FC-02	47,278	0.713	15,081	0.909	19,227	11
FC-03	22,575	0.501	22,193	0.699	30,964	4
FC-04	23,191	0.382	16,472	0.468	20,180	10
FC-05	18,547	0.353	19,032	0.404	21,782	7
FC-06	25,504	0.663	25,996	0.764	29,956	1
FC-07	30,673	0.152	4,955	0.213	6,944	15
FC-08	25,185	0.442	17,550	0.595	23,625	9
FC-09	20,124	0.142	7,056	0.151	7,504	13
FC-10	29,949	0.118	3,940	0.164	5,476	16
FC-11	54,208	0.362	6,678	1.243	22,930	14
FC-12	40,099	1.000	24,938	1.748	43,592	2
FC-13	35,111	0.671	19,111	1.223	34,833	6
FC-14	28,872	0.593	20,539	0.950	32,903	5
FC-15	38,832	0.948	24,413	5.195	133,780	3
FC-16	34,383	0.402	11,698	0.387	44,389	12
Total	**500,729**	**7.917**	**16,111** (Average)	**15.395**	**30,553** (Average)	

Note:
1/ Based on 1-year/60-minute rainfall of 1.49 in. and 5-year/60-minute of 2.00 in.

The report recommends that the City develop a plan to identify the sources of all potential inflows in the 12 basins that exhibited an above industry standard amount of acceptable inflow (inflow is greater than 10,000 gpd/1,000 linear feet of sewer pipe). The report also prioritizes the basins in accordance with the severity of inflow starting with basins with the highest inflow as Priority 1. A detailed ranking of the 12 basins sorted from highest priority to lowest priority is shown in the Table below. The report recommends that upon completion of the SSES and any subsequent rehabilitation a post rehab flow monitoring is be performed to evaluate the work and provide a score card on the reduction of inflow.

RECOMMENDED BASINS FOR ADDITIONAL SSES (Prioritized)

Basin	Number of Manholes[1] Ranking	Length[2] (lf)	Basin Unit Inflow Ratio (gpd/1,000 lf)	Ranking
FC-06	96	25,504	25,996	1
FC-12	171	40,099	24,938	2
FC-15	95	38,832	24,413	3
FC-03	85	22,575	22,193	4
FC-14	87	28,872	20,539	5
FC-13	129	35,111	19,111	6
FC-05	58	18,547	19,032	7
FC-01	75	26,198	18,123	8
FC-08	101	25,185	17,550	9
FC-04	85	23,191	16,472	10
FC-02	165	47,278	15,081	11
FC-16	112	34,383	11,698	12

PLAN REQUIREMENTS

The CAO stipulates that the City submit to ADEQ a Corrective Action Plan that is based on a Sewer System Evaluation Study. The CAO lists the following items to be included in the SSES plan.

1. Perform smoke testing in all areas of the collection system, beginning with the highest priority area;
2. Perform televising of lines in areas deemed necessary based on smoke testing in order to locate leaks and to determine method of repair;
3. Develop a plan to address deficiencies through rehabilitation, repair, or replacement;
4. Develop a manhole inspection program, beginning in the highest priority area; and
5. Recommend a method of repair and develop a cost estimate for such.

These criteria were included in the Consent Order as a means to identify portions of the sewer system where field investigations are warranted. These field investigations are intended to evaluate the condition of sewer assets that may contribute to the Sanitary Sewer Overflows in the Forrest City waste water collection system.

SSES WORK PLAN

Based on the recommendations of the I/I report COFC will undertake a multiyear SSES program to identify all locations of significant inflows within the 12 basins with greater than industry standard inflow. The tools to be included in the SSES program will be those that were specifically outlined in the CAO documents. No further investigations regarding infiltration into the collection system will be undertaken.

The proposed workplan is as follows:

Identify Inflow Sources -

The I/I report has established a ranking of all the basins based on severity of inflow quantity within the basin. COFC will initiate the following task to identify Inflow sources starting with the highest ranked basin first.

1. Smoke Testing

The purpose of smoke testing is to find potential points of inflow and infiltration in the public portion of the sanitary sewer system that could lead to high flows during storms events. Smoke testing is the most efficient and cost effective method to locate and identify where unauthorized water is entering the public and private portion of the sewer system. The smoke is harmless and will disappear after only a few minutes. The testing is also a cost-effective way to find areas of the sewer system that need improvement. Smoke testing will also help identify plumbing leaks in buildings.

Smoke testing can also help locate the following:

- Buildings that have downspout, cellar, yard or basement drains, and sump pumps
- Points of groundwater or surface water intrusion into the sewer
- Any cross connections between sanitary sewers and storm drains
- Defective sewer connections that could allow sewer gases into a building
- Cleanouts that are not capped

During smoke testing, field crews will blow air and smoke into the sanitary sewer system in the street and monitor where smoke escapes the system. The smoke under pressure will fill the main line as well as any connections and then follow the path of any leak to the ground surface, quickly revealing the source of the problem.

2. TV Collection System

Following Smoke Testing COFC will utilize its closed-circuit TV (CCTV) sewer line inspection system to further investigate the locations of smoke leaks along the collection line. TV inspection is utilized to pinpoint the exact location (s) of extraneous water entering the sewer system. This live inspection will provide valuable data which can be constructively used for analytical purposes. In addition, a permanent visual record can be made for subsequent review. Corrective measures to eliminate the entry points for extraneous flow will be developed and subsequently implemented.

Prior to conducting CCTV inspections, the gravity sewer pipes and manholes will be cleaned as required. Cleaning will consist of normal hydraulic jet cleaning or other appropriate means to facilitate the internal CCTV inspection. In general, gravity sewer lines and manholes undergoing CCTV inspections must be cleaned sufficiently to ensure that the CCTV equipment can easily pass through the gravity sewer system and record defects and observations. CCTV inspections will not be performed in sewer lines with flow depths that do not allow the CCTV equipment to freely pass through the gravity sewer system at the time of inspection.

Gravity main inspections will be identified and tracked by recording the upstream and downstream manholes using manhole identifiers. CCTV inspections will be conducted from an upstream manhole to a downstream manhole in the direction of gravity sewer flow to minimize splashing and to allow a smoother pass of the CCTV equipment. The entire length of sewer line undergoing inspection will be recorded in this direction unless site conditions make it necessary to stop the CCTV inspection, in which case a reverse-flow set-up may be attempted. During the CCTV inspection, the CCTV camera must be temporarily stopped at each observed defect or service lateral in order to obtain a clear still picture and video image, as well as a verbal description of the observation. To assist in prioritizing any warranted maintenance or repair of gravity sewer lines within the system, a condition assessment grading system will be used to weigh the gravity sewer line defects that are observed during CCTV inspections. Staff will assigns a distinct code (1-5) for each structural defect and operational and maintenance defect observed during the CCTV inspection.

3. Manhole Inspection

COFC will utilize industry standard to evaluate the overall condition of manholes and sewer line access points. A standard coding/grading system as standardized by the American Society of Civil Engineers (ASCE) will be utilized to record all visual information.

Manhole condition assessments will include the documentation of the various components of manhole construction, any structural or operations and maintenance defects, as well as identification of I/I. In addition, influent and effluent pipe assets and condition assessments will be collected. COFC will utilize an electronic database to record defect observations, defect descriptions, and a condition scoring system that is substantially consistent with the standardized systems.

Manhole inspections will be performed using a pole camera capable of recording digital video and digital still images (in electronic format) of the manhole and each pipeline entering or exiting the manhole. Sanitary sewer manholes are considered confined spaces. If a pole camera is not used, any personnel entering a manhole must adhere to OSHA and HRSD protocol for confined space entry at all times while within the structure.

Color photographs (in electronic format) will be taken of the manhole to show, at a minimum, the above ground location, looking down at the manhole invert, and looking into the incoming and outgoing pipelines. Manhole defects will be recorded using standardized observation codes as indicated on the standard Manhole Field Inspection Form.

Manhole inspections will normally be performed during daylight hours, however, when night time inspections are required they will only be conducted when site conditions are deemed safe. If a manhole is found to be surcharged at the time of inspection COFC personnel will work to mitigate the cause of the surcharge so that a re-inspection of the manhole can be conducted. If the surcharge cannot be mitigated, the surcharged manhole will be re-inspected during a lower flow period.

FIND AND FIX

The Find and Fix concept provides a process by which repairs of the inflow sources can be made as they are identified in a more timely and cost-effective fashion. Find and Fix methodology employs the concept that when deficiencies warranting prompt repair(s) are found during condition assessment activities, actions will be taken to correct the problem(s) either by COFC personnel or on-call contractors. It is the responsibility of the field personnel conducting the SSES field activities to determine if the defects identified may meet the prompt repair criteria, and to present the findings to COFC department hierarchy for approval. Department personnel will make a final evaluation and provide necessary directives.

REHABILITATION PLAN

The output of the final condition assessment report will be a detailed list of deficiencies, locations of potential inflow and identification of any assets in the system at material risk of failure. This information will be used to develop a Rehabilitation Plan which will include a prioritized list of improvements and implementation schedule. The Rehabilitation Plan will include a schedule for design and construction of repairs, rehabilitation, improvements or replacement, as applicable. Capital cost estimates for the improvements will be included with the Rehabilitation Plan.

REHABILITATION PLAN IMPLEMENTATION SCHEDULE

A detailed SSES rehabilitation plan implementation schedule can not be fully outlined until the field condition assessment process is completed and a Rehabilitation Plan is finalized.

POST REHAB FLOW MONITORING

At the conclusion of the rehabilitation activities, a post rehab flow monitoring of the 12 basins where rehabilitation was conducted will be undertaken. The purpose of the post rehab flow monitoring is to determine the effectiveness of the rehabilitation activities. The flow monitoring program will be similar to the one that was conducted during the I/I analysis.

MILESTONE SCHEDULE

A milestone schedule is included in Attachment A

MILESTONE SCHEDULE

SANITARY SEWER OVERFLOW CORRECTIVE ACTION PLAN

FORREST CITY WATER UTILITY