ARCADIS Design & Consultancy for natural and built assets

Metropolitan Sewer District of Greater Cincinnati

10142910 LUDLOW RUN SUSTAINABLE SOURCE CONTROL

Quality Control Plan

Planning Phase

FINAL

July 21 2020

QUALITY CONTROL PLAN ACKNOWLEDGEMENT FORM

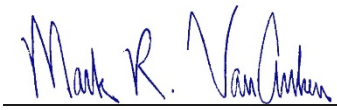
Project Name:	Ludlow Run Sustainable Source Control
Design Status:	Planning
Project Number	10142910

The undersigned have read and concur with this Quality Control Plan:

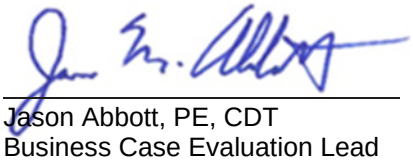
Kristen Benick, PE
Project Manager

Sue Pressman, PE
Technical Advisor

Hazem Gheith, PhD, PE
Technical Advisor



Mark Van Auken, PE
Technical Advisor



Jason Abbott, PE, CDT
Business Case Evaluation Lead

Neila Salvadori, PE
Model Lead

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1 PROJECT DESCRIPTION

The Ludlow Run Sustainable Control project includes planning, design and construction phase services for a Wet Weather Improvement Plan (WWIP) project (or projects) to reduce the volume of the combined sewer overflows in the Ludlow Run watershed (CSO's 151, 109, 110,111,112, 162 and 024). The project will also address asset management needs within the Ludlow Run watershed.

The Ludlow Run sub-watershed, located in King's Run watershed, includes portions of Cincinnati neighborhoods: Northside, College Hill, Winton Hills, and Winton Place. CSO 024, referred to as the Ludlow Run Regulator is located on the west bank of Mill Creek at the three-way intersection of Spring Grove Avenue, Dooley Bypass, and Dane Avenue. Six CSOs are nested within CSO 024 sub-watershed. Listed from north to south within the sub-watershed, CSOs 151, 109,110, 111, 112, and 162 overflow into Ludlow Run, which then enters the combined sewer system and contributes to overflow at CSO 024.

Arcadis will provide all planning serves and may provide the supplemental design and construction phase services. The proposed improvement designed during the supplemental design phase services shall be designed in accordance with the latest version of the MSDGC *Rules and Regulations Governing the Design, Construction, Maintenance, and Use of Sanitary Combined Sewers*.

Project Understandings:

1. Arcadis will execute a similar approach to the planning, design and construction of the Ludlow Run Sustainable Source Control project that we have been refining through continuous improvement practices on past and current MSDGC source control projects.
2. The culmination of the Planning Phase will be in the modeling report and subsequently the Alternative Analysis Report and Business Case Evaluation (BCE).
3. The design services will be based off of the approved solution from the BCE

2 QUALITY CONTROL ORGANIZATION

The objective of this quality control (QCP) plan is to provide guidance to the project planning team for developing and implementing project-specific QCPs for water resources practice services. The Arcadis Water Division Quality Program, led by Jack Kane in the Columbus office, has a long history of providing quality results with a commitment to understand, plan for, and meet clients' expectations while consistently conforming to the standards of professional practice. The foundation for the Arcadis Quality Assurance program is that technical resources beyond the project team and QA/QC efforts will be allocated in accordance with project risk. It is a people-based program starting with assignment of the right people at the pursuit stage, aided by processes and tools throughout the project cycle to support the project team. Thorough consideration of risks and documentation of mitigation strategies upfront helps to engage the right resources - to do the right project - the right way.

When we pursue work, we look internally to make sure that we have the capabilities to deliver as well as the availability to deliver. If there is a match, technical resources are assigned to the project during the pursuit phase. Quality assurance includes:

- Monitoring and Surveillance

- Compliance with Customer Requirements
- Continual Improvement

Monitoring and Surveillance

Monitoring and surveillance include systematic as well as random reviews. Systematic reviews on a project schedule, budget, risk and quality level occur monthly. Quality reviews also occur prior to deliverables.

Monthly project reviews occur with the Project PM, Operations Leader, and Business Unit Manager. The standard review includes a discussion of the above topics. If corrective actions are identified, they are communicated and implemented. Based on the nature of the actions, the result may require client or team communication.

Random reviews can occur at any time in the form of a financial audit or quality audits.

Compliance with Customer Requirements

Compliance with customer requirements can be simply stated as customer satisfaction. We are in the business of professional service and customer satisfaction is paramount. We begin with this in mind when we make our decision to pursue a specific project. During the Go/No Go decision making process, we compare the customer needs with our internal capabilities and availability. If required, we add skills to our team. Technical resources are committed to the pursuit as alignment is found between our capability and availability and customer needs.

Throughout project pursuit and into project scoping and negotiation, customer expectations are more clearly defined as well as the team's understanding of these expectations. As the project begins, a formal set of initial meetings are conducted to formally record project team and client team expectations.

Compliance with requirements is reviewed and monitored formally through project delivery both internally to the team and by the client through deliverable review, workshops and meetings. Non-compliance is resolved through changes, both formal and informal depending on the needs and severity required.

Satisfaction is measured directly through surveys and indirectly through conversation.

Continual Improvement

Continuous process improvement is the ownership of our Service Lines and Community of Practices within our Water Division. Greg Osthues is the leader of this group and has created standard templates and internal processes to gather improvement data and transmit it at the project level. There are two paths to deliver this information to the team.

The first is through the assignment of Technical Advisors to the project. These advisors are assigned based on alignment between their knowledge, skills and capabilities and the project needs. They serve in this capacity on many projects and therefore are able to infuse lessons learned and improvement into the team through engagement. There are touchpoints between the advisors and the team throughout the project execution.

The second is through the creation and implementation of community of practice teams. These community of practice teams are formal groups of internal professionals that maintain the best practices

for our firm. They are an internal resource that is available to help. Many of the project team members are on community of practice teams.

Internal feedback to the Service Lines group is provided through the technical advisors and through the knowledge teams as a part of our culture. We communicate feedback both verbally and through email during meetings our informal communications.

Team feedback is gathered after major deliverables through coordination calls. Typical topics include a discussion of what went well, what can be improved, and how.

Organizational Chart

Each member of the project team listed in the project organization chart in Figure 1 and each was chosen to build a team with the best mix of green infrastructure, combined sewers, asset management and modeling experience for this project. These team members have consistently delivered wet weather compliance projects to similar municipalities and were chosen based on their knowledge of your systems and facilities, as well as proximity and availability to perform.

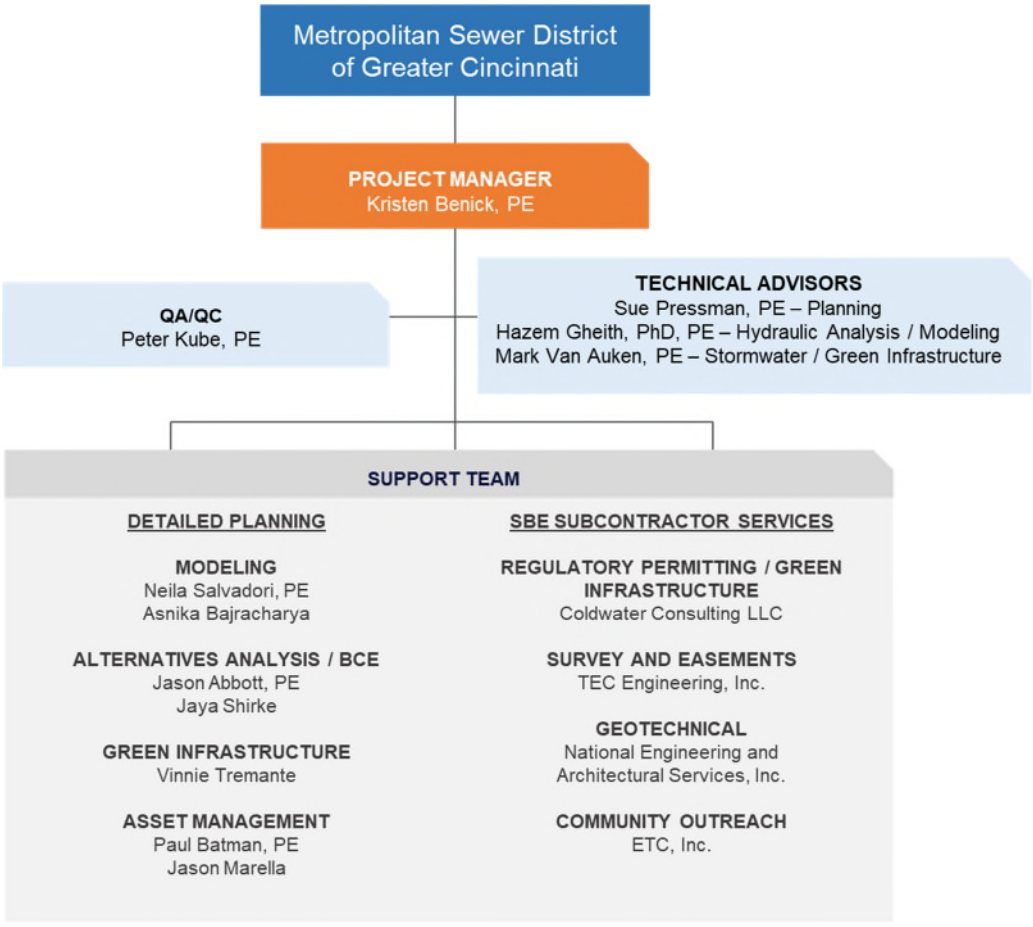

Figure 1: Project Organization Chart

3 PROJECT TEAM

The key personnel recruited to work on this planning project who are in charge of QC procedures are listed in Table 1 and include the project manager, technical advisors, and technical leads. They will interface with each other and other technical staff throughout the duration of the project to provide the expected level of quality. The resumes for key personnel are attached in Appendix A.

Table 1: List of Key Personnel

Key Personnel	Project Role
Kristen Benick	Project Manager
Sue Pressman	Technical Advisor
Hazem Gheith	Technical Advisor
Mark Van Auken	Technical Advisor
Peter Kube	QA/QC
Jason Abbott	Alternatives Analysis and BCE Lead
Neila Salvadori	Model Lead

4 LIST OF DELIVERABLES

Project team members who are responsible for the deliverable will conduct QC checks according to the list below. At a minimum, these reviews need to be done prior to milestone submittals of deliverables. The scheduled dates for reviews are included in the project schedule, submitted separately. QA reviews are performed by our technical advisors and our QA/QC lead as applicable. Table 2 below shows the list of deliverables, name of person responsible, the QA reviewer, and estimated completion dates. Kristen Benick as the Project Manager will review all deliverables.

Table 2: List of Deliverables

Deliverable	Name of Person Responsible	QA Reviewer	Estimated Completion Date
Draft Project Management Plan and Baseline Schedule for MSDGC Review	Kristen Benick	Sue Pressman	June 3, 2020[1]
Draft QA/QC Plan	Kristen Benick	Sue Pressman	June 3, 2020[1]
Draft Risk Management Plan	Kristen Benick	Sue Pressman	June 3, 2020[1]

Deliverable	Name of Person Responsible	QA Reviewer	Estimated Completion Date
Final Project Management Plan	Kristen Benick	Pete Kube	July 1, 2020
Final QA/QC Plan	Kristen Benick	Pete Kube	July 1, 2020
Final Risk Management Plan	Kristen Benick	Pete Kube	July 1, 2020
Draft Data Review Tech Memo	Kristen Benick	Pete Kube	September 16, 2020[2]
Final Data Review Tech Memo	Kristen Benick	Sue Pressman	October 13, 2020
Draft Model Review Tech Memo and Flow Monitoring Plan	Neila Salvadori	Hazem Gheith	September 23, 2020
Final Model Review Tech Memo and Flow Monitoring Plan	Neila Salvadori	Hazem Gheith	October 21, 2020
MSDGC Preliminary Review Checklist	Neila Salvadori	Hazem Gheith	September 28, 2021
MSDGC Detailed Model Review Checklist	Neila Salvadori	Hazem Gheith	October 26, 2021
Draft Modeling Report and Model Files	Neila Salvadori	Hazem Gheith	November 30, 2021
Final Modeling Report and Model Files	Neila Salvadori	Hazem Gheith	January 4, 2022
Draft Alternatives Analysis Report	Jason Abbott	Pete Kube Sue Pressman	May 24, 2022
Final Alternatives Analysis Report	Jason Abbott	Kristen Benick	June 28, 2022
Draft BCE	Jason Abbott	Pete Kube Sue Pressman	July 26, 2022
Final Business Case Evaluation Report	Jason Abbott	Kristen Benick	August 30, 2022

[1]Contractual Date
[2]Contractual Dates based on an assumed NTP for Task 2 of June 18, 2020

5 PLAN DESIGN REVIEW PROCESS

Plans Checking Procedure

The general procedure for checking work on this project is as follows:

- **Ongoing and at Completion:** Responsible staff members check work for errors and omissions throughout the project and at substantial completion
- **Checking:** QC reviewers check all work. Revisions are made in red.
- **Concurrence:** Responsible staff back-check comments for concurrence.
- **Incorporation:** Incorporate revisions. Highlight each revision on check plans with yellow highlighter as it is made.
- **Approval:** QC reviewers verify incorporations of revisions, as appropriate.

Computation Procedure Guidelines

The project team should maintain electronic files containing approved design criteria, design computation, quantity takeoff calculations, etc. Computations should conform to the following:

General

Computations should be clear and legible and include sketches showing the problem and its solution.

1. Headings on each sheet should be filled in completely.
2. Computations should show the complete solution of a problem – no auxiliary scraps of paper or auxiliary files containing calculations.
3. Computations should be in a format appropriate for the work being performed. Always keep in mind that someone else will be using the computations – perhaps several years from now – so the designer should place him or herself in the reviewer's position of having to understand what the designer has done.

Method

Computations should contain the following properly labelled information, as applicable:

1. The problem
2. A drawing of sketch
3. Known data
4. Plan references
5. Text references
6. Assumptions
7. Method of solution
8. Answer
9. Diagrams, if applicable

Whenever possible, make a sketch that accurately shows the problem and solution. Identify all points on the sketch clearly and simply. Record all answer on the sketch. Clearly show the conclusion or answer by underlining or highlighting and labelling the work "answer." When a problem requires several iterations to arrive at a correct solution, label those iterations appropriately.

Check Computations

The checker will obtain a copy of the original calculations and indicate the correct information by striking out and indicating the corrections on the copy. The checker will make no changes or erasures on the original calculations sheet. The maker will check the corrections and change the original sheets as required. The checker will back-check the original sheets after corrections have been made and initial them if correct. As this is performed in excel, revised files will be created maintaining date control.

Supplementary Computations

As necessary, clearly reference supplementary computations to the original computation sheets. Mark the original computation sheets plainly to indicate that additional computations have been prepared.

Superseding Computations

Sometimes computations are superseded because of changes in design. The design team members will take care to avoid using superseded computations. Clearly indicate on the new computations which computations replace them. The deposition of the superseded computations will be left to the discretion of the task package manager. If the task manager in uncertain about disposition, he or she should consult with the project manager.

Filing Computations

The task manager will verify that all computations are properly labelled and filed. Filed computations should be labelled to include the project number, project name, and contents. All calculations should be consolidated and filed by the project manager at the completion of the project.

Quality Control Acknowledgment Form

This form (Appendix B) will be used for major deliverables such as the model report, the stormwater separation memorandum, and the BCE to confirm that these documents have been reviewed and corrected according to quality procedures.

Planning Checklist

6 DOCUMENT CONTROL

To facilitate document searches and identify document contents, documents will follow a standard naming convention as follows:

- **Draft Documents:** 10142910 Ludlow Run Source Control_YYYY-MM-DD_Keyword_DRAFT
- **Final Documents:** 10142910 Ludlow Run Source Control_YYYY-MM-DD_Keyword_FINAL

Keywords will be representative of the document type or deliverable name.

7 SUB CONSULTANT QUALITY CONTROL

All subconsultants are responsible for the quality of the work they perform. Each is responsible for completing QC procedures consistent with this QC plan as appropriate for the nature of the work

performed. They may employ processes and tools they have developed and routinely use in the QC programs.

Arcadis is responsible for the performance of all subconsultants work. The Arcadis project manager will confirm that each subconsultant has performed the requirements set forth in this QC plan. Each subconsultant will utilize the Arcadis QA/QC acknowledgment form or may use their own acknowledgment form to confirm that the QC plan has been implemented. These forms will be submitted to the Arcadis project manager as a subconsultant deliverable. Arcadis will review each subconsultant deliverable for quality and adherence to the QC plan.

8 COMPUTER AIDED DESIGN (CAD) MANAGEMENT

At this time, CAD is not within the scope for this project. However, as this is a planning conveyance project, the MSDGC CAD Standards will be followed should CAD drawings be created for any purpose.

9 SCHEDULE MANAGEMENT

The baseline schedule will be reviewed by project team and MSDGC to check for concurrence of expected deadlines and will be submitted 30 days after notice to proceed (NTP). Project changes or delays will be discussed by both Arcadis and MSDGC and the schedule will be revised when appropriate to account for these changes. It is anticipated the schedule will be updated six times during the project duration.

10 FIELD SURVEY QUALITY CONTROL

Since topographic services are needed to verify critical elevations, Arcadis will engage Professional Licensed Surveyors. They will be required to perform their field survey in accordance with their standard QC Plan.

11 QUALITY CONTROL CHECK PROCESS

This QC Plan has been distributed to all key personnel listed in this plan and has been signed and dated in acknowledgement of the specifics contained herein. An example Quality Control Review Acknowledgement Form is included in Appendix B. Appendix C includes the MSDGC Planning Checklist that is part of the Business Case Evaluation process. This checklist will be utilized during the planning portion of this project as a part of the quality control check process.

APPENDIX A

Appendix A – Resumes of Key Personnel

EDUCATION
BS, Civil Engineering, University of Dayton, 2000

YEARS OF EXPERIENCE
Total – 19 years

PROFESSIONAL REGISTRATIONS
Professional Engineer – OH, KY

PROFESSIONAL AFFILIATIONS
Ohio Water Environment Association

Water Environment Federation

KRISTEN BENICK, PE

PROJECT MANAGER

Ms. Benick is a civil engineer with extensive planning experience evaluating capacity-deficient collection systems with sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) and developing solutions to mitigate. She has experience modeling storm and sanitary collection systems using InfoWorks and PCSWMM software.

PROJECT EXPERIENCE

CSO 488 Strategic Sewer Separation Phase A
MSDGC, Cincinnati, OH

Model lead for the strategic sewer separation evaluation for the expansion of ODOT I-75 to mitigate increase in CSO flows. Project includes model update, calibration, alternatives analysis and business case evaluation.

LMCPR Post Construction Monitoring and Modeling
MSDGC, Cincinnati, OH

Project engineer responsible for the hydraulic modeling of the Kings Run CSO 217/483 watershed future conditions model in the pre-revised calibration version to confirm that future condition improvements provide the required level of control as regulated in the Consent Decree.

Kings Run CSO 217/483 Source Control Project
MSDGC, Cincinnati, OH

Project engineer responsible for hydraulic modeling for the Phase B In-Line Storage Analysis and continued calibration and validation efforts for the Kings Run watershed and ultimately the Phase B design of the CSO Storage Tank. The preferred alternative includes three detention basins discharging into the combined sewer to reduce CSO volume at CSO 217, strategic sewer separation of major roadways, one detention basin that provides water quality treatment and flood control, a CSO storage tank, and ultimately a segment of stream restoration.

Kings Run Project Analysis
MSDGC, Cincinnati, OH

Project Manager responsible for the evaluation of options identified during brainstorming and technical meetings that occurred with MSDGC, the Sierra Club, Wooden Shoe Hollow residents and Hamilton County. Planning included the modeling and evaluation of alternatives discussed with Wooden Shoe Hollow residents that will meet or exceed the consent decree goals for the Kings Run watershed and CSOs 217 and 483. The Wooden Shoe residents were interested in separation of stormwater from the combined sewers, mitigating the volume and speed of flow through Kings Run Creek, and eliminating the proposed storage tank.

CSO 198/518 Basin Study
MSDGC, Cincinnati, OH

Project manager responsible for basin study including field investigations, data review, modeling, alternative analysis and development of a recommended solution to address basin challenges. The CSO 198 & 518 Basin Study addressed hydraulic, structural, solids and odor challenges associated with the collection system and developed a basin plan utilizing a risk-based method and the hydraulic model. The final Basin Plan included a 20-year capital plan to address structural deficiencies through rehabilitation and replacement of sewer assets and hydraulic deficiencies though limited hydraulic improvements.

ARCADIS Design & Consultancy for natural and built assets

SUE PRESSMAN, PE

TECHNICAL ADVISOR – PLANNING

Ms. Pressman has 23 years of experience in civil engineering that consists of applying sustainable or triple-bottom-line approaches to solve collection system and stormwater issues. She has strong project management and controls skills that enable her to manage complex wet-weather project implementation for consent-decree-driven projects. Her diverse background also includes project controls (budget and schedule management), affordability and rate studies, and watershed analysis. Her experience includes presenting at numerous public involvement meetings, environmental stakeholders, and meetings with regulators. Many of her clients' projects were driven by aggressive compliance schedules with administrative orders and Consent Decrees and she has prepared many compliance deliverables.

EDUCATION
MS, Environmental Engineer, The University of Texas, 1995

BS, Civil Engineering, Purdue University-Main Campus, 1993

YEARS OF EXPERIENCE
Total – 23 years

LICENSES & CERTIFICATIONS
Professional Engineer

Certified Construction Documents Technologist (CDT)

PROFESSIONAL AFFILIATIONS
Kentucky-Tennessee Water Environment Association

Ohio Water Environment Association

Water Environment Federation

PROJECT EXPERIENCE

Lower Mill Creek Partial Remedy Revised Plan
MSDGC, Cincinnati, OH

Project manager for evaluation of an alternative plan for controlling combined overflows for the Mill Creek WWTP. The consent decree also provides flexibility with a three-year time frame to develop an alternative plan to remove an equivalent volume (1.78 billion gallons using model v3.2) of CSO within this watershed by 2018. As part of a multi-firm team, performed project reviews, including SWMM model and cost estimate reviews for the candidate sustainable projects as an alternative to the deep tunnel. Non-monetary factors such as O&M requirements, water quality improvements, flexibility with the final solution, job creation, plus many others were assessed in the decision-making process.

CSO 488 Strategic Sewer Separation Phase A
MSDGC, Cincinnati, OH

Project manager for the strategic sewer separation evaluation for the expansion of ODOT I-75 to mitigate increase in CSO flows. Project includes model update, calibration, alternatives analysis and business case evaluation.

West Fork Branch Model Update
MSDGC, Cincinnati, OH

Project manager for the West Fork model update using the SWMM groundwater module and continuous calibration approach to better estimate runoff in the collection system and overflows from 15 CSOs. Use of a physically based model allowed for efficient analysis for source control options. The West Fork watershed wet weather projects were analyzed for verification of design sizing of sewer separation, detention basins and basin discharge pipe.

CSO LTCP Program Implementation
City of Fort Wayne Fort Wayne, IN

Task manager for development of an evaluation process using triple-bottom-line approach that will fairly and consistently evaluate the potential benefits of green infrastructure and related techniques. The City-specific metrics/criteria was developed in coordination with City staff, incorporating principals of stormwater management and green infrastructure initiatives already in use by the City.

Willow Run Combined Sewer Outfall Master Plan
Sanitation District No. 1 of Northern Kentucky (SD1), Fort Wright, KY

Project manager for development of a Master Plan for SD1's largest CSO. The Master Plan will provide a long-term roadmap, detailing activities, projects, and costs to reduce CSOs and basement backups during extreme rainfall events within the drainage area.

ARCADIS Design & Consultancy for natural and built assets

HAZEM GHEITH, PHD, PE

TECHNICAL ADVISOR – HYDRAULIC ANALYSIS / MODELING

Dr. Gheith has 32 years of experience in hydrologic and hydraulics modeling of urban drainage including stormwater and wastewater collection systems. He has developed a wide range of model application supporting tools to facilitate educated planning of collection systems improvements. His application tools include ArcGIS Vanue and Visual Basin Application, C# and Visual Basic stand-alone tools, and Python interfaces. Dr. Gheith has used his vast expertise in hydrologic and hydraulics applications to evaluate and mitigate street flooding, water-in-basement, sanitary sewer overflows and combined sewer overflows. He is an invited lecturer at CHI on modeling with SWMM and OWEA on GI modeling.

EDUCATION
PhD, Engineering Mechanics, The Ohio State University, 1995

MSC, Engineering Physics, Cairo University, 1990

BS, Civil Engineering, Cairo University, 1986

YEARS OF EXPERIENCE
Total – 32 years

PROFESSIONAL REGISTRATIONS
Professional Engineer – OH

PROFESSIONAL ASSOCIATIONS
Water Environment Federation

Ohio Water Environment Association

HONORS
Collection System Award, Ohio Water Environment Association

Adjunct Professor, Franklin University, Columbus Ohio

Adjunct Professor, Faculty of Engineering, Cairo University

Medal of Sci. Excel. Engineering Syndicate, Egypt

PROJECT EXPERIENCE

Blueprint Columbus - Miller/Kelton, Newtown/Bedford GI and I&I Improvements
City of Columbus, OH

Technical Manager to plan and design green infrastructure (GI) program to mitigate additional surface stormwater. GI units included rain gardens, bioretention cells with and without bump-outs, tree boxes, and pervious pavements. Filtration media type and footprint was selected and sized to achieve 20% TSS removal target. As member of the Pilot Area Technical Committee, prepared Blueprint Columbus Stormwater Modeling Guidelines to construct enhanced model platform to allow educated planning of the GI program. The model platform included using digital elevation model (DEM) data to add the street channels for surface flow routing, adding storm inlets from survey activities, and including downspouts discharge configuration from field investigation. To enhance green infrastructure siting, developed a GI Siting Application Tool that is adopted by the City as the pre-screening tool used by all 12 design consultants working on Blueprint Columbus projects.

West Fork Branch Model Update
MSDGC, Cincinnati, OH

Technical manager for the West Fork model update using the SWMM groundwater module and continuous calibration approach to better estimate runoff in the collection system and overflows from 15 CSOs. The approach facilitated the analysis for sizing of sewer separation, storm water detention basins and basin discharge pipe.

Wastewater Long Term Control Plan Phase II
City of Lancaster, OH

Technical manager for Phase II of the Long Term Control Plan (LTCP) update including system-wide flow monitoring program, model calibration and planning system improvements required to meet EPA CSO goals. Negotiated LTCP with OEPA. Phase II was approved 2014.

Hydraulic Model Expansion Project
Citizen's Energy Group, Indianapolis, IN

Technical manager for the hydraulic model expansion project to incorporate all sewers 12″ and larger, adding over 800 miles of pipes. The project also includes siting, oversight, and data review for over 640 temporary flow monitoring locations. Model enhancement involves "Modeling at the Source" approach to isolate I/I sources and use groundwater to calculate I/I. Provided workshops and knowledge transfer to Citizens in-house modeling staff.

BSA Collection System Model Recalibration
Buffalo Sewer Authority (BSA), Buffalo, NY

Technical manager for the update and extension of BSA's SWMM collection system model. Model is calibrated using data from 144 monitor locations. Model at the Source approach was implemented to facilitate planning a systemwide green infrastructure program.

ARCADIS Design & Consultancy for natural and built assets

EDUCATION
BS Civil Engineering
Michigan State University 1989

YEARS OF EXPERIENCE
Total – 29 years

PROFESSIONAL REGISTRATIONS
Professional Engineer – OH, MI, NC

Certified Professional in Municipal Stormwater Management (CPMSM)

Envision Sustainability Professional Credential

COMPANY TITLE
Senior Water Resources Engineer

MARK VAN AUKEN, PE

TECHNICAL ADVISOR – STORMWATER / GREEN INFRASTRUCTURE

Mr. Van Auken serves as national Storm Water Practice Leader, where he helps develop and lead storm water work. He has 29 years' experience in the analysis, design, and construction phases of a variety of storm water related projects. He specializes in municipal stormwater management, with experience that includes flow monitoring, sampling, modeling, permitting, design, green infrastructure, funding, maintenance, program management and risk-based asset management. Mr. VanAuken is an Envision Sustainability Professional and provides oversight on sustainability options for stormwater and green infrastructure projects for the firm. He is a Certified Professional in Municipal Stormwater Management, a member of Water Online's Water Intelligence Panel, and a former long-time member of the Executive Committee of the Ohio Stormwater Association.

PROJECT EXPERIENCE

Blueprint Columbus - Miller/Kelton, Newtown/Bedford GI and I&I Improvements
City of Columbus, OH

Technical consultant for development of gray and green design solutions for an urban neighborhood as part of the Blueprint Columbus integrated planning program.

Little Calumet River/Cal Sag Channel Gray/Green Infrastructure Resiliency Program
Metropolitan Water Reclamation District of Greater Chicago, IL

Planning lead for development of a stormwater master plan for a 6 square mile pilot area. This project redefined urban drainage by developing gray and green solutions to mitigate drainage issues from up to a 100-year storm event, and providing guidance on how communities can implement these alternative solutions to minimize flooding, optimize water quality, spur economic development and improve quality of life for its residents. Also assisted Cook County, IL (through MWRD) with pursuit of HUD funding for the project area as part of the NDRC grant program. Led development of conceptual plans and a benefit cost analysis of proposed improvements including social and environmental considerations.

Decision-Making Tool for Holistic Stormwater Management
The Nature Conservancy, Los Angeles, CA

Technical Consultant for development of a GI site selection model that provides a scalable analysis for a range of criteria at the parcel, storm inlet, subwatershed, watershed and county-wide level. The model is adaptable to changing conditions and criteria and will allow for cost-effective identification of the parcels/areas that can provide the greatest water quality & nature benefits.

Stormwater Master Plan
Hampden Township, PA

Planning Lead for the development of a stormwater master plan that identifies a plan of action for implementing a proactive stormwater management program.

CSO System-Wide Study
City of Akron, Ohio

Project Manager responsible for all tasks pertaining to the development and calibration of Storm Water Management Model (SWMM) using XPSWMM. The modeling work involved hydraulic and water quality calibration of both the City of Akron's 246-mile combined sewer system and the local receiving streams.

EDUCATION
BS Civil Engineering
University of Cincinnati
2002

YEARS OF EXPERIENCE
Total – 16 years

LICENSES & CERTIFICATIONS
Professional Engineer – OH, KY

CDT (Construction Document Technologist)

OSHA Occupational Safety and Health Training

PROFESSIONAL AFFILIATIONS
American Water Works Association

Water Environment Federation

PETER KUBE, PE

QA/QC

Mr. Kube's experience includes advanced planning, detailed design and construction administration for water and wastewater facilities. He also has experience planning and cost estimating for regional sewer conveyance strategies and alternative solutions. His specialized areas of expertise include wastewater treatment, pump stations, solids dewatering, liquid and dewatered sludge pumping, residuals/solids handling processes, facility automation, and combined sewer overflow remediation.

PROJECT EXPERIENCE

Parallel Interceptor Sewer Design
City of Dayton, OH

Project engineer for design of 16,000 feet of large interceptor sewer. Due to shallow construction, watertight 8'x6' precast box culvert cross section with low flow channel was selected. The challenging construction is located within the floodwall of the Great Miami River and has multiple hydraulic structures connecting siphons from the other side of the river. Construction of the new interceptor facilitates inspection and rehabilitation of the existing interceptor and will allow for in-line flow equalization during wet weather events.

Overflow 002, Gravity Sewer Improvements
City of Hamilton, OH

Lead designer of 4,500 feet of 18" gravity sewer that replaced a 12"-15" sewer that wound through the middle of extensively developed residential city streets. The improved sewer eliminated a sanitary sewer overflow to meet the requirements of the City's consent decree.

Staff Supplementation
MSDGC, Cincinnati OH

Provided staff supplementation services to the MSDGC to provide engineering manpower within the Project Business Development Division. This Division was responsible for planning and evaluating nominated conceptual projects and presenting them to upper management for a go/no go decision. Presentations to upper management were contained in a Business Case Evaluation that analyzed various alternatives to solve a problem and evaluated them based on a triple bottom line basis; capital cost, social cost, and environmental cost. This was originally a 1 year assignment and was extended by MSDGC into a 2.5-year assignment.

Avon Drive Sanitary & Storm Sewer Improvements
Sanitation District No. 1 of Northern Kentucky

Project Engineer for the Lakeside Park study consisting of preliminary engineering analysis and of the Van Deren sanitary and storm sewer improvements and the detailed design of the Avon Drive sanitary and storm sewer improvements. The alternatives analysis for the Van Deren area compared open cut replacement, trenchless rehabilitation, and a vacuum collection system to eliminate the 15 "common" sanitary with storm manholes and reduce I/I from the existing infrastructure. Open cut was selected for areas receiving other roadway repairs. CIPP Lining of main and laterals was selected for other areas.

High Meadows Pump Station Elimination
MSDGC, Cincinnati, OH

Design support for the design of approximately 2,400 lineal feet of 12"-16" sanitary sewer.

ARCADIS Design & Consultancy for natural and built assets

JASON ABBOTT, PE

ALTERNATIVES ANALYSIS / BCE / ENGINEERING & DETAILED DESIGN

Mr. Abbott specializes in bringing together teams of diverse individuals to listen to our clients and meet their needs. As a project leader on various water and wastewater projects, water supply plans, alternatives analysis and environmental assessments. His duties have ranged from construction contract administration to preliminary level planning and preparation of final detailed design drawings and specifications on these projects, all with a focus on delivering and managing sustainable water and wastewater solutions. He has assisted many clients with preparation of exhibits and presentations for public outreach and participated in many public meetings.

EDUCATION
BSCE Water Resources and Environmental Engineering The Ohio State University 1997

YEARS OF EXPERIENCE
Total – 22 years

PROFESSIONAL REGISTRATIONS
Professional Engineer

Certified Construction Documents Technologist (CDT)

PROFESSIONAL AFFILIATIONS
American Water Works Association

Water Environment Federation

PROJECT EXPERIENCE

Queen City and Cora Sewer Separation
MSDGC, Cincinnati, OH

Project engineer for the planning, design and construction of Queen City and Cora Avenues R/W Sewer Separation project, consisting of 145 acres of mostly undeveloped forested terrain with an overall topographic relief of approximately 240 feet and a span of approximately 4,700 feet. The planning work included alternative development, hydrologic and hydraulic modeling, open channel modeling, and detailed conceptual drawings. The design consists of 2,845 lineal feet (LF) of natural stream channel, 1,140 LF of storm sewer, and three wetland extended detention basins. The detention basins will be created using an early 1900s railroad embankment, a man-made depression, and enhancing an existing detention basin. The estimated runoff reduction for the total 265-acre urban sewershed is equivalent to the predevelopment runoff during a 100-year storm event.

Westwood Northern Bundle
MSDGC, Cincinnati, OH

Project engineer responsible for alternatives analysis and design of the CSO 525 sewer separation project. This project sought to meet the Consent Decree goal of reducing the overflow at CSO 525 to 2.5 MG for the typical year, address existing capacity problems, improve access to the regulator for maintenance and improve wildlife habitat. The alternatives analysis resulted in the design of 7,800 LF of 12” through 36” sanitary and storm sewer, a 690 LF access road and a new regulator with energy dissipating headwall. Multiple community meetings were attended, which resulted in design changes that balanced the needs of the community with the property owners who were directly affected.

West Fork Sustainable Watershed Alternatives Analysis
MSDGC, Cincinnati OH

Project engineer responsible for the compilation of and review of alternatives and development of the Business Case Evaluation for the entire West Fork basin. The recommended improvement alternative for this watershed was a comprehensive watershed solution, which created a sustainable infrastructure solution and an overall alternative to the 2006 Wet Weather Improvement Plan and served to assist MSDGC in renegotiating their existing Consent Decree. The recommended alternative entailed sewer separation projects at 10 CSOs and recommended installation of 4,700 feet of an 84” interceptor sewer, two 1.50 MG CSO storage tanks, two stormwater detention basins, 5,000 LF of channel renaturalization and 6,000 LF of stream rehabilitation. The recommended alternative is estimated to reduce CSO volume by 287 million gallons in the typical year. This project included multiple stakeholders meeting and multiple community meetings and an USEPA site tour.

NEILA SALVADORI, PE

HYDROLOGIC/HYDRAULIC MODELING

Ms. Salvadori has experience in collection systems modeling, evaluation, planning and design, which includes modeling of infiltration/inflow (I/I) and runoff sources, calibration of sanitary, combined and storm sewer systems, hydraulic evaluation, mitigation of sanitary and combined sewer overflows (SSOs and CSOs), water in basement and manhole flooding, integrated planning, future flow projection analysis, future redevelopment modeling and impacts assessment, stormwater controls, evaluation of system operation and real time controls (RTCs), rainfall and flow monitoring data processing. She completed projects on a variety of other water and wastewater infrastructures including wastewater facilities, water distribution systems and green infrastructures. Her work experience also includes groundwater modeling.

PROJECT EXPERIENCE

Blueprint Columbus
City of Columbus, OH

Blueprint Columbus is an innovative program to address sanitary sewer overflows, water in basements and stormwater quality through implementation of inflow and infiltration mitigation technologies and green infrastructures. Salvadori has been providing technical support on hydrology and hydraulics modeling, GIS data review and processing, field data interpretation. During integrated planning she applied I/I reduction technologies, evaluated implementation and effectiveness.

Sewer System Capacity Model (SSCM) Update 2012 and Sewer System Capacity Model (SSCM) Update 2020
City of Columbus, OH

Ms. Salvadori has been leading several engineering tasks to evaluate sewer system performance, address capacity limitation, mitigate water in basement and manhole flooding, reduce sanitary and combined sewer overflow. She worked on modeling, calibration, capacity and Level of Service analysis of combined, sanitary and storm systems. She has completed tasks on inflow redirection modeling and analysis, proposed storm systems sizing, stormwater controls, future scenarios modeling and assessment. She was also involved on evaluation of a real time decision support system for operation of the city-wide collection system.

MMSD Conveyance System Evaluation and Modeling Software Improvements
Milwaukee Metropolitan Sewerage District, WI

Ms. Salvadori is currently assisting tasks management and planning for MMSD collection system capacity analysis in existing and future conditions, modeling of future conditions and system operation evaluation and enhancement.

Ms. Salvadori is tasks leader of Ad Hoc Modeling Request 302. The project consists in application of the Model at the Sources modeling framework to four selected sanitary basins to investigate and quantify major I/I contributions, as well as to provide guidelines to the District for I/I reduction alternatives.

EDUCATION
MS, Environmental Engineering, Michigan Technological University, 2013
MS Environmental and Land Engineering, Università degli Studi di Trento, 2011
BS, Environmental Engineering, Università degli Studi di Trento, 2007

YEARS OF EXPERIENCE
Total – 7 years

PROFESSIONAL REGISTRATIONS
Principles and Practice of Engineering (PE), Ohio, USA
Environmental Engineering License, Italy
WEF Member since 2015
ASCE Member since 2014

APPENDIX B

Appendix B – QC Review Acknowledgment Form

ARCADIS Design & Consultancy for natural and built assets

QA/QC ACKNOWLEDGEMENT FORM

Project Name: Ludlow Run Sustainable Source Control

Project No.: 10142910

Milestone or Deliverable:

Briefly describe the project status of the "Quality Activity" that is being acknowledged with this form.

Additional Comments:(if needed)

Note: By signing below, we acknowledge our role in implementing the Quality Management System (QMS) for this project/deliverable. Refer to the Water Division Quality Manual for additional description on the roles in the QMS.

Prepared by – Staff responsible for work and checking for errors and omissions throughout the project.
Quality Reviewers – Assigned QC reviewers responsible for checking work. Refer to the Project Quality Plan (PQP)
Design & Quality Leader – Responsible charge of the technical work and implementation of the QMS.
Project Manager – Responsible for confirming the execution of quality assurance and control measures and activities.

	Signature –Click below to sign		*Signature –Click below to sign*
Prepared by:		**Quality Reviewer Signature:**	
		Reviewer:	
		Review Emphasis:	
Design & Quality Leader:		**Quality Reviewer Signature:**	
		Reviewer:	
		Review Emphasis:	
Project Manager:		**Quality Reviewer Signature:*****	
		Reviewer:	
		Review Emphasis:	

*** Continue Quality Reviewer Signatures on next page as needed to capture all reviews such as discipline reviews (civil, mechanical, electrical, etc), coordination reviews, constructability/biddability review, technical advisors, etc).

ARCADIS Design & Consultancy for natural and built assets

QA/QC ACKNOWLEDGEMENT FORM

Project Name: Ludlow Run Sustainable Source Control

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Milestone or Deliverable:

Continue the Quality Reviewer Signatures below as needed to capture all reviews such as discipline reviews (civil, mechanical, electrical, etc), coordination reviews, constructability/biddability review, technical advisors, etc).

Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	

APPENDIX C

Appendix C – MSDGC Planning Checklist

Project Name/Project ID: _____ **MSDGC Planning Checklist** (Used throughout planning phase)

Planner: _____**Initials & Date:**_____ **Peer Reviewer:**_____ **Initials & Date:**_____

1.0 Project Management

- ☐ ☐ Obtain Project Charter from AM&WP
- ☐ ☐ Planning Funding Source (CIP, Allowance, etc.)
- ☐ ☐ Planning Contracts (RFP, RFQ, PSA, etc.)
- ☐ ☐ Detailed Planning Schedule Established
  - ☐ ☐ Scheduling Requirements or WWIP Milestones Identified
- ☐ ☐ Planning Legislation Forecast (N/A if under Planning Allowance)
- ☐ ☐ Document Control and/or Electronic Planning Folder Established
- ☐ ☐ Technical Review Committee (TRC) Established
- ☐ ☐ Customer Service Plan Established for Complex or Public Involvement

2.0 Records Research

- ☐ ☐ CAGIS/Existing Facility Drawings/Records Research Performed
- ☐ ☐ Research Abandoned Utilities (streetcar tracks, etc.)
- ☐ ☐ Field Walk Down Performed
- ☐ ☐ OUPs Request
- ☐ ☐ Gather and Research Relevant Existing Reports and Studies
- ☐ ☐ Research Prior Legislation History

3.0 Data Collection

- ☐ ☐ Condition Assessments **Proposed in Design?** Y / N
- ☐ ☐ Flow Monitoring/Model Calibration **Proposed in Design?** Y / N
- ☐ ☐ Field Work/Survey Work **Proposed in Design?** Y / N
- ☐ ☐ Geotechnical Work **Proposed in Design?** Y / N
- ☐ ☐ Sampling & Analysis **Proposed in Design?** Y / N

4.0 Project Coordination

- ☐ ☐ Inter-Utility Coordination (water, gas, DOTE, ODOT etc.)
  - ☐ ☐ Construction Coordination Software information sent to ETS
  - ☐ ☐ MSD OUPs shapefile
  - ☐ ☐ Jurisdictional Paving Coordination
- ☐ ☐ MSDGC Coordination
  - ☐ ☐ WWT/WWC: (WWT System Asset Renewal CIP, etc.)
  - ☐ ☐ OOD/EPM: (Green shapefile)
  - ☐ ☐ CIP Projects: (CIP shapefile)
  - ☐ ☐ WWIP Projects: (Approved WWIP Document)
  - ☐ ☐ RDII: (RDII shapefile)
  - ☐ ☐ Assessment/HSTS: (Assessment shapefile, HSTS Area shapefile)
  - ☐ ☐ Dev. Services: (Development shapefiles, SSO/CSO Credits)

Planner Peer

5.0 Problem Diagnosis/ Boundary of Analysis/ Project Objectives

- ☐ ☐ Supports, enhances, or clarifies original nomination
- ☐ ☐ Evaluates potential opportunities and benefits to MSD

6.0 Strategy and Alternatives Analysis

- ☐ ☐ TBL Analysis Performed
  - ☐ ☐ Social/Environmental Scoring
  - ☐ ☐ NPV Analysis reviewed by Cost Estimating Group
  - ☐ ☐ FLAMROC Analysis

7.0 Recommended Alternative

- ☐ ☐ Stakeholder Input (Nominator, Operating Division, etc.)
- ☐ ☐ Modeling Report provided (or approved) by Modeling Group
- ☐ ☐ Risk Register (WWIP projects or projects >$1M in construction)
- ☐ ☐ Execution Plan
  - ☐ ☐ Clearly Defined Scope
  - ☐ ☐ Schedule Established (through project completion in years)
    - ☐ ☐ Project Dependencies Identified
  - ☐ ☐ Project Budget Established
    - ☐ ☐ Cost Estimate provided (or reconciled) by Estimating
    - ☐ ☐ Budget Deviation Form Completed
    - ☐ ☐ Design Legislation Strategy (CIP Book, Add, Year)
    - ☐ ☐ ROW costs provided by ROW Group
    - ☐ ☐ Funding Sources Identified
    - ☐ ☐ Potential Funding from Loans or Grants Identified
  - ☐ ☐ Easements Identified/ESA Performed
  - ☐ ☐ Anticipated Required Permits Identified
  - ☐ ☐ Value Engineering (projects >$5M in construction)

8.0 Review of BCE Document

- ☐ ☐ Planning Peer Review Complete & Comments Addressed

Planner Peer

Items 1.0 to 8.0 must be addressed prior to submittal of BCE for signature.
Peer Reviewer check is required for only Items 1.0 to 8.0.
Attach Checklist and TRC Comment Response Form with BCE for signature.

9.0 Business Case Review and Approval Procedure

- ☐ Use Procedure for BCE Review and Approval

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