11.0 INTERIM MEASURES WET WEATHER PLAN

Executive Summary: ALCOSAN's Draft Wet Weather Plan (WWP) was released for public and municipal comment on July 31, 2012. Overall, the most prominent comments received related to the potential for utilizing green stormwater infrastructure (GSI) and other source controls as an alternative to the grey infrastructure (pipes, tanks and tunnels) proposed in the Draft WWP. As required, ALCOSAN submitted its Draft WWP to the regulatory agencies in January 2013. Along with the Draft WWP, ALCOSAN also provided all the public and municipal comments received, and requested more time to thoroughly address the comments surrounding the use of GSI.

Following submission of the Draft WWP, ALCOSAN and the regulatory agencies began negotiating an amended Consent Decree (CD) that fully embraces the use of GSI and inflow/infiltration (I/I) reduction and recognizes the financial infeasibility of implementing all CD requirements by 2026. Through these discussions, the regulatory agencies required a compliance strategy to proceed with the design and construction of an Interim Measures Wet Weather Plan (IWWP) that provides opportunities to integrate GSI and other source reduction practices, while prioritizing the regionalization of inter-municipal trunk sewers and key grey infrastructure projects, where cost effective.

Since the identification of specific flow reduction project commitments requires on-going coordination with customer municipalities, the amended CD is premised on a phased and adaptive implementation framework that supports early implementation of green projects, demonstration of effectiveness, and the substitution or reduction of grey infrastructure where GSI and I/I reduction can be shown to cost effectively provide equivalent performance. Accordingly, the amended CD includes several adaptive management milestones where new information can be used to propose modifications to IWWP projects and implementation schedules. Furthermore, the IWWP was divided into three phases. Phase 1 elements focus on flow reduction, flow optimization, regionalization, existing infrastructure inspection and rehabilitation, wastewater treatment plant (WWTP) expansion, and preliminary planning. Phase 2 elements include projects that might be influenced by Phase 1 projects and are dependent on the completion of preliminary planning to proceed, including expanding total wet weather treatment capacity to 600 mgd and construction of the Ohio River tunnel segment. Phase 3 projects represent adaptive projects that may be influenced and modified based on the outcome of Phase 1 and Phase 2 evaluations and demonstration projects.

The IWWP currently includes $1.6 billion (in 2010 dollars) in identified ALCOSAN projects, plus an additional commitment to invest $200 million in a Regional Flow Optimization Strategy. Through the adaptive management framework, the IWWP will be revised to include additional ALCOSAN and municipal projects up to a $2 billion affordability threshold. It is expected that municipal flow reduction projects will be identified in the Municipal Source Reduction Studies (MSRS), and that municipal flow reduction plans will be incorporated into legally binding agreements. In addition, once regionalization is complete, ALCOSAN will identify priority projects to control overflows along transferred sewers and municipalities will identify grey infrastructure projects that are needed to control municipal overflows which remain their responsibly after regionalization.

Section 11.2 describes the IWWP elements, including ALCOSAN's Green Revitalization of our Waterways (GROW) municipal green project partnership program and regionalization initiatives. Section 11.3 provides an implementation plan; including a schedule, financial impact analysis, and adaptive management framework. Upon completion of the IWWP, post construction monitoring and modeling will be conducted to assess the need for additional controls (Final Measures) to meet the full requirements of the CD.

11.1 Wet Weather Plan Comments and Modified Consent Decree

ALCOSAN's Draft WWP was released for public and municipal comment on July 31, 2012 and submitted to the agencies in January 2013, along with all the comments received. Section 2.6 summarizes these comments. In brief, the most prominent public comment was for ALCOSAN to incorporate more GSI into the plan, while the comments received from the 83 customer municipalities were focused on additional time to coordinate their improvements with ALCOSAN's, particularly from a scheduling perspective.

Lodged in 2008, ALCOSAN's original CD did not fully embrace United States Environmental Protection Agency's (USEPA) evolving acceptance and encouragement of GSI as a combined sewer overflow (CSO) control measure. The 2008 CD required ALCOSAN to plan, design and construct for the volumetric equivalent of all wet weather flow generated in the service area. As a result, ALCOSAN's 2013 WWP identified a control strategy based on customer municipalities conveying most of their flows to the ALCOSAN interceptor system and included limited use of flow reduction solutions such as GSI and I/I reduction.

In light of the comments received and the 2008 CD framework, ALCOSAN requested additional time to more thoroughly address the use of flow reduction (GSI and I/I reduction) in coordination with its customer municipalities. ALCOSAN initiated a regional study that identified numerous opportunities to include flow reduction measures in the WWP as presented in Section 10: *Starting at the Source: How Our Region Can Work Together for Clean Water*. The municipalities are currently undertaking their own local studies to assess flow reduction as a part of their municipal orders.

While ALCOSAN and the municipalities proceeded with their evaluations of flow reduction opportunities, ALCOSAN and the regulatory agencies proceeded with negotiating an amended CD that fully embraces the use of GSI and I/I reduction and recognizes the infeasibility of completing all CD requirements by 2026. The agencies directed moving forward with an IWWP that provides opportunities to integrate GSI and other source reduction practices, while prioritizing the regionalization of inter-municipal trunk sewers and key grey infrastructure projects where cost effective. In particular, after reviewing the three affordable alternatives presented in Section 9.7 and the comments received on the Draft WWP, the agencies identified an IWWP that modified the Water Quality Priority Alternative presented in Section 9.7 and provided flexibility for replacing grey infrastructure projects with green.

Since the identification of specific flow reduction/optimization project commitments requires on-going coordination with customer municipalities, the amended CD is premised on a phased and adaptive implementation framework that supports early implementation of green infrastructure and sewer rehabilitation projects, demonstration of effectiveness, and the

substitution or reduction of grey infrastructure where GSI, I/I reduction, and/or flow optimization strategies can be shown to provide equivalent system-wide performance. Accordingly, the amended CD includes several adaptive management milestones where new information can be used to propose modifications to IWWP projects and implementation schedules. These adaptive management provisions are described further in Section 11.3.7. Section 11.2 describes the IWWP projects in more detail, including flow reduction and regionalization initiatives. Section 11.3 presents the IWWP implementation plan.

11.2 Interim Measures Projects and Flow Reduction Initiatives

The Water Quality Priority Alternative focused on maximizing overflow volume reduction via regional treatment and conveyance capacity upgrades, control of overflows to sensitive areas, and the assumed implementation of municipal projects communicated via preliminary planning information provided by the municipalities. The agencies used this alternative as the basis for establishing the IWWP, with some revisions, most notably those surrounding municipal projects and flow reduction.

A prominent revision was to focus the municipalities on flow reduction and regionalization, both of which could significantly alter the scope and responsibility for previously identified municipal projects. The Pennsylvania Department of Environmental Protection (PaDEP) and the Allegheny County Health Department (ACHD) issued revised orders requiring that each municipality submit a Source Reduction Study by December 2017. Correspondingly, the USEPA directed ALCOSAN to establish flow targets for each customer municipality by January 2017 in anticipation of ALCOSAN and the municipalities entering into legally binding flow reduction agreements by January 2025, which must include long term plans to achieve such flow targets.

Since the on-going assessment of flow reduction opportunities, targets, and commitments could impact the need for, or sizing of, grey infrastructure projects, the IWWP was divided into three phases. Phase 1 elements focus on flow reduction, flow optimization, regionalization, WWTP expansion, and preliminary planning. Phase 2 projects include those that might be influenced by still evolving flow reduction/optimization and regionalization initiatives and/or are dependent on the completion of preliminary planning. Phase 3 projects represent adaptive projects that may be influenced and modified based on the outcome of Phase 1 and Phase 2 evaluations and demonstration projects.

Table 11-1 provides a listing and description of ALCOSAN IWWP program elements. The Phase 2 improvements will include additional regulator adjustments/modifications and construction of new regulators to increase flow to the plant via the existing and proposed tunnels to maximize the use of the increased conveyance and treatment capacity. Since Phase 2 and 3 project needs are to be re-assessed once municipal flow reduction commitments are more clearly established and preliminary planning is complete, corresponding sizing information is subject to change.

Figure 11-1 shows a map of the major grey infrastructure elements of the IWWP. Each element of the IWWP shown in Table 11-1 is described further in the WWP section identified in the table. The IWWP currently includes $1.6 billion (in 2010 dollars) in identified projects, plus an

additional commitment to invest $200 million in a Regional Flow Optimization Strategy. Through the adaptive management framework, the IWWP will be revised to include additional projects up to a $2 billion affordability threshold. It is expected that municipal flow reduction projects will be identified in the MSRS and priority projects to control SSOs along transferred sewers will be identified once regionalization is complete.

Upon completion of the IWWP, post construction monitoring and modeling will be conducted to assess the need for additional controls (Final Measures) to meet the full requirements of the CD. The Post Construction Monitoring Plan is presented in Section 11.3.3. A Final Measures Wet Weather Plan (FMP) and schedule will be submitted one year after the completion of post construction monitoring and will constitute Phase 4.

Table 11-1: Interim Measures Wet Weather Plan
Summary of Program Elements and Estimated Capital Costs

WWP Section	Capital Improvements (outfall/consolidated flow group in parenthesis)	Size / Capacity	Estimated Capital Cost[1] (millions)
PHASE 1			
11.2.1 11.2.2 11.2.4	Regional Flow Optimization Strategy and Preliminary Planning		
	Green Revitalization of Our Waterways (GROW) Municipal Flow Reduction Project Partnership Program[2]		$ 200
	Inspection and rehabilitation of existing infrastructure		
	Regionalization and rehabilitation of Inter-Municipal Trunk Sewers and Associated Facilities		
	Preliminary Planning		$ 12
	Subtotal Regional Flow Optimization Strategy and Preliminary Planning		**$ 212**
11.2.5	Woods Run WWTP Expansion		
	Expand main pump station capacity	to 480 MGD	$ 31
	Wet weather headworks	to 600 MGD	$ 105
	Major on site conveyance		$ 63
	Wet weather disinfection	to 600 MGD	$ 90
	Sludge thickening facilities		$ 9
	Subtotal Phase 1 Woods Run WWTP Expansion		**$ 298**
PHASE 2			
11.2.5	Woods Run WWTP Expansion		
	Expand primary treatment capacity	to 600 MGD	$ 44
	Wet weather pump station	up to 120 MGD	$ 148
	Subtotal Phase 2 Woods Run WWTP Expansion		**$ 192**

Table 11-1: Interim Measures Wet Weather Plan
Summary of Program Elements and Estimated Capital Costs

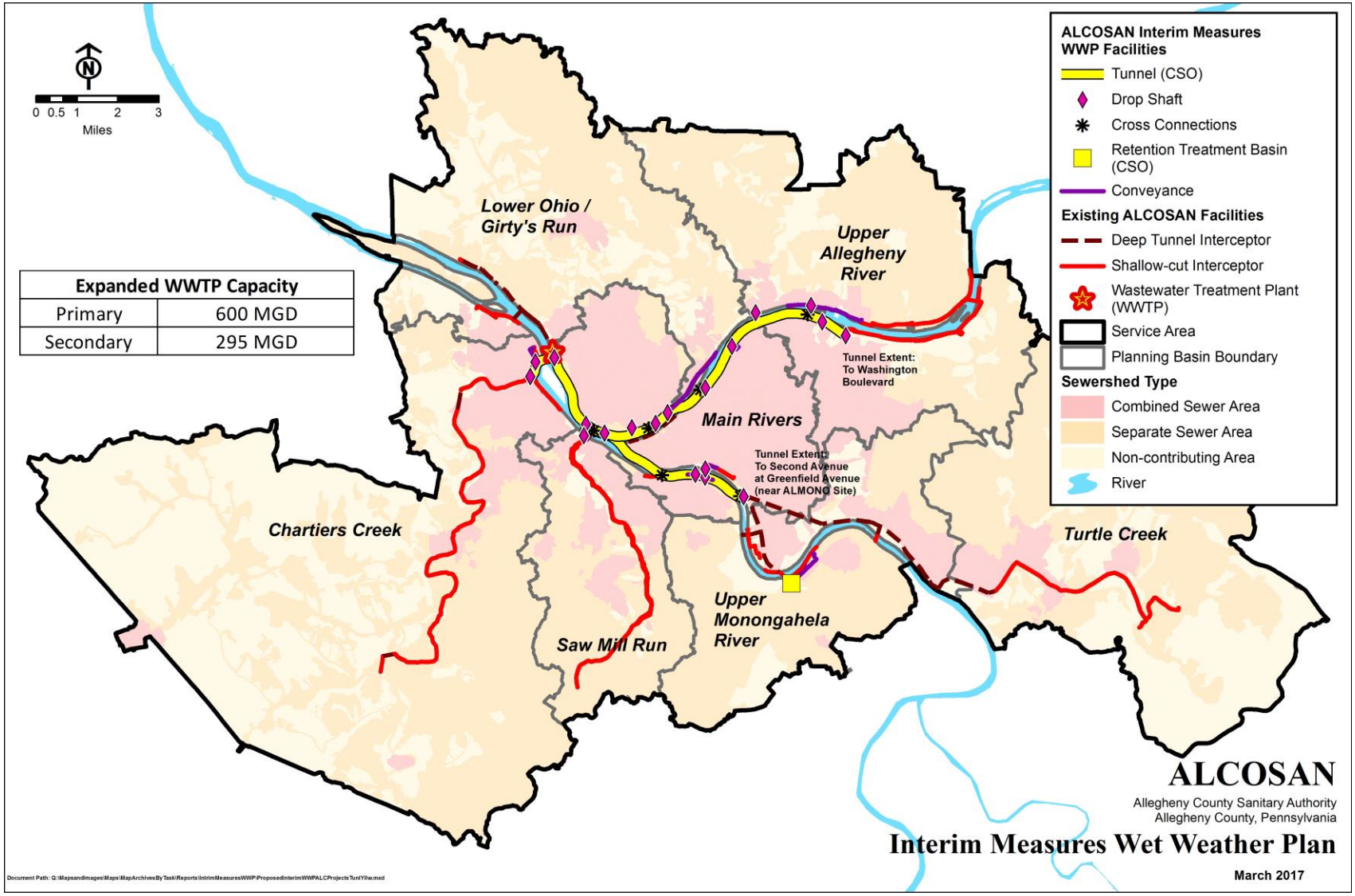
WWP Section	Capital Improvements (outfall/consolidated flow group in parenthesis)	Size / Capacity	Estimated Capital Cost[1] (millions)
11.2.7	Ohio River Tunnel and Facilities		
	Ohio Tunnel	12 MG / 1.9 miles / 14 ft. diameter / 2 drop shafts	$ 83
	CSO consolidation sewers – MR Basin (O-27, MR_CF11)		$ 13
	Tunnel cross connection		$ 19
	Chartiers Creek River Crossing	5 MG / 0.8 miles / 14 ft. diameter / 2 drop shafts	$ 38
	CSO Consolidation Sewers and PS – CC Basin (O-06, O-07)		$ 62
	Saw Mill Run River Crossing and consolidation sewer (O-14E, O-14W)	2 MG / 0.3 miles / 14 ft. diameter / 1 drop shaft	$ 27
	Subtotal Ohio River Segment		**$ 242**
PHASE 3			
11.2.5	Woods Run WWTP Expansion		
	Secondary expansion	to 295 MGD total	$ 37
11.2.8	Allegheny River Tunnel and Facilities		
	Allegheny Tunnel	48 MG / 7.9 miles / 14 ft. diameter / 10 drop shafts	$ 301
	CSO consolidation sewers – LOGR Basin (LNA_CF10)		$ 45
	CSO consolidation sewers – MR Basin (MR_CF04, A-22, MR_CF32, MR_CF34, MR_CF36, O-43)		$ 45
	CSO consolidation sewers – UA Basin (A-68, UA_CF04, A-41, A-42)		$ 54
	Tunnel cross connections		$ 37
	Subtotal Allegheny River Segment		**$ 482**

Table 11-1: Interim Measures Wet Weather Plan
Summary of Program Elements and Estimated Capital Costs

WWP Section	Capital Improvements (outfall/consolidated flow group in parenthesis)	Size / Capacity	Estimated Capital Cost[1] (millions)
11.2.9	Monongahela River Tunnel and Facilities		
	Monongahela Tunnel	28 MG / 4.5 miles / 14 ft. diameter / 4 drop shafts	$ 150
	CSO consolidation sewers – MR Basin (MR_CF07, MR_CF19, MR_CF20, M-29)		$ 47
	Tunnel cross connection		$ 28
	Subtotal Monongahela River Segment		**$ 225**
11.2.10	Upper Monongahela CSO Retention Treatment Basin		
	CSO RTB and consolidation sewers (UM_CF02)	60 MGD RTB and influent pump station	**$ 106**
Total Interim Measures Wet Weather Plan			**$ 1,794**

1 – in 2010 dollars, to maintain consistency with prior WWP estimates
2 – GROW projects are to be funded through ALCOSAN retained earnings and will require municipal matching funds

Figure 11-1: Interim Measures Wet Weather Plan Grey Infrastructure Projects



11.2.1 Flow Reduction Program

While GSI and I/I reduction can't eliminate the need for traditional grey facilities, they can lead to significant reductions in sewer overflows, cost savings and community benefits. ALCOSAN is committed to lead Allegheny County into a future with sustainably clean water and green communities. Towards this goal, ALCOSAN is implementing the following Green Initiatives, including a Green Revitalization of Our Waterways (GROW) program to support implementation of municipal green partnership projects:

1. Green Revitalization of Our Waterways Program
    - ALCOSAN is committing financial support towards municipal flow reduction partnership projects over a period of eight years.
    - ALCOSAN will provide municipalities with technical support resources for developing and implementing municipal GSI, direct stream inflow removal, and sewer rehabilitation projects.
    - ALCOSAN will expand its pursuit of outside funding on behalf of interested municipalities and facilitate partnering opportunities between municipalities and key stakeholders, including public-private partnerships.
2. Work cooperatively with customer municipalities to develop flow reduction plans.
3. Collaborate with the municipalities, the County and other stakeholders towards developing service-area wide model stormwater management, planning and development ordinances, procedures and regional utility coordination efforts.
4. Expand its long-standing program of sewer flow monitoring to assist the municipalities in identifying and confirming GSI and I/I project locations and in evaluating the efficacy of flow reduction projects.
5. Accept ownership of, and responsibility for, inter-municipal trunk sewers transferred from municipalities to ALCOSAN. ALCOSAN anticipates that regionalization will support flow reduction initiatives, including the prioritization of sewer rehabilitation projects to reduce I/I along transferred trunk sewers.
6. Include greenspace community enhancements and public education at ALCOSAN wet weather control facilities, wherever feasible.

The goal of ALCOSAN's program initiatives is to capitalize on the benefits that GSI, flow reduction and regionalization can bring to the region. Success will require intensive and on-going coordination amongst many regional stakeholders; including ALCOSAN, its customer municipalities, 3RWW, the regulatory agencies, community and neighborhood groups, and regional planning and governmental agencies.

11.2.1.1 Green Revitalization of Our Waterways (GROW)

ALCOSAN has established and begun implementing a municipal green project partnership program that assists customer municipalities in the design and construction of flow reduction projects. In the first funding cycle ALCOSAN has already awarded $9 million in matching grants for municipal GSI, I/I reduction, direct stream inflow removal and sewer separation

projects. Future funding is contingent upon the continued implementation of the rate increase strategy for 2014 through 2018 that was approved by the ALCOSAN Board of Directors in 2013. ALCOSAN's assistance is limited to customer municipalities and municipal authorities. All ALCOSAN supported projects require matching funds from the partnering customer municipality or municipal authority. The funding level for each project varies based on the efficiency of the overflow reduction on a dollars-per-gallon basis. The ALCOSAN grant match minimum is currently 25% of the total eligible project cost, and the maximum grant match is currently 85% of the total eligible project cost.

ALCOSAN solicits applications for source reduction project concepts from its customer municipalities and municipal authorities for consideration of funding in a two-step process. First, the municipalities are asked to submit a Letter of Interest (LOI) that provides a brief overview of the proposed project for ALCOSAN to review the merits of the project concept relative to the goals of the program. LOI project concepts that meet ALCOSAN's vision for the program are asked to submit a full application for consideration. ALCOSAN provides technical assistance to aid any communities that require support in developing a LOI project concept that meets the goals of the program. The second step, the project application, requires the municipal applicant to provide technical and non-technical information which ALCOSAN evaluates. The evaluation criteria that make up the GROW Application scoring system are intended to measure and assess a project for the following overflow reduction program considerations:

- The contribution of the proposed project to improve water quality by reducing CSOs and SSOs;
- The flow reduction expected after implementation of the source reduction measure;
- The cost of the proposed project;
- The overall environmental benefits;
- The feasibility of the proposed project;
- The inclusion of work to remove streams (where applicable); the elimination of an outfall (where applicable);
- The needs and resources of the community;
- The distribution of GSI across the ALCOSAN service area;
- The contribution of the proposal in eliminating the estimated flows not captured by the *Interim Measures Wet Weather Plan*;
- The timing and coordination of the project with the requirements of the applicable *Wet Weather Plan*; and
- Impacts to Consent Decree defined sensitive areas

For each application cycle, ALCOSAN reviews project applications and evaluates the technical and non-technical information to develop a project score. A team of reviewers develops initial scores and presents their findings to the Green Subcommittee of the ALCOSAN Board of Directors along with ALCOSAN staff. Upon review of all project scoring and additional criteria, the Subcommittee recommends projects for funding in a given funding cycle, with final approval of funding awards made by the ALCOSAN Board of Directors.

The general process and schedule for the GROW Program from initial Letter of Interest to Grant Award offer are outlined below. The post-award process and schedule are tailored to individual project needs and requirements, in conformance with the Program Guidelines. Once an applicant accepts an award offer, the project agreement has defined limits to the term of the contract.

- Month 0 – ALCOSAN announces opening of Letter of Interest Phase
- Months 0-2 – Municipalities and sewer authorities within ALCOSAN's service area generate materials for concept source reduction projects and submit Letter(s) of Interest (LOI) and accompanying documentation to ALCOSAN.
- Month 3 – ALCOSAN reviews Letters of Interest, the Green Subcommittee of the ALCOSAN Board of Directors approves LOIs invited to submit GROW Project Application
- Month 4-5 – Invited applicants develop GROW Project Applications and accompanying documentation for submittal to ALCOSAN
- Month 5-7 – ALCOSAN performs a comprehensive review of all applications and proposed projects are ranked using program criteria.
- Month 8 – Final determination of projects receiving GROW grant awards is made by the ALCOSAN Board of Directors. Agreement and commitment letters are issued for projects offered a GROW grant award.

As a condition of project funding, ALCOSAN requires that all recipients commit to operating and maintaining the flow reduction project as designed for at least 20 years. The recipients also need to notify the regulatory agencies when the flow reduction projects are fully constructed and operational with mechanisms in place to assure continued operation. All projects are required to include provisions to include performance monitoring into the design. ALCOSAN may not implement performance monitoring devices into every completed project, but desires to have the ability to monitor performance for all projects, if feasible.

Flow Reduction Project Development Support

Also, as a part of the GROW program, ALCOSAN proposes to expand its ongoing flow reduction project support through the provision of technical services, and the pursuit of external funding (e.g. Water Resource Development Act funding through the Army Corps of Engineers). In particular, ALCOSAN will work with customer municipalities to advance project concepts and aid municipalities by identifying additional opportunities. The type of ALCOSAN project support activities might include:

- Development of minimum technical standards for flow reduction projects implemented by ALCOSAN or supported by ALCOSAN to ensure projects count towards wet weather program compliance and funds are used cost-effectively;
- Conduct as-needed monitoring, such as long term SSO monitoring for certain outfalls where I/I reduction may be cost-effective, to help advance cost-effective opportunities;
- Manage Sanitary Sewer Evaluation Survey (SSES) and sewer rehabilitation contracts[11-1];
- Once inter-municipal trunk sewers are transferred to ALCOSAN, review proposed alternatives presented in the Municipal Feasibility Studies (MFSs) and consider alternatives that use source controls and/or satellite storage as alternatives to increased conveyance;
- Facilitate projects by identifying partnering opportunities with key stakeholders;
- Provide technical services (identify projects, analyze benefits, assist in preparing funding applications, conduct infiltration testing, etc.);
- Encourage municipalities to implement flow reduction incentives to retail customers (e.g. stormwater fee/credits);
- Work with municipalities and other stakeholders to advance project opportunities identified in this study through implementation; and
- Evaluate additional GSI, I/I reduction and other flow reduction opportunities that municipalities and potential project partners express interest in.

The value of these ALCOSAN services can be used as in-kind matches for federal and state grant programs that require local cost sharing.

Third-Party Funding Assistance, Partnership Development, and Outreach

ALCOSAN will continue and expand its pursuit of outside resources to help municipalities with their source reduction projects. This will include working with public agencies, our state and federal legislative delegations, and municipalities to obtain state and federal funding through existing programs and appropriations. ALCOSAN will also help municipalities to identify project funding, volunteer labor, and in-kind support from foundations, environmental, and civic organizations.

As evidenced by the creation of the Division of Communications, ALCOSAN is committed to expanding its public education and outreach activities. Building on its current outreach activities, ALCOSAN anticipates the following expanded activities:

- Regular upgrades and updates to ALCOSAN's public and municipal websites;
- Incorporation of the GROW Program initiatives into ALCOSAN's green scholastic outreach program; and
- Promote green practices to the public and municipalities.

[11-1] With the ability for municipalities to buy into these contracts to obtain lower costs from economies of scale

11.2.1.2 Municipal Flow Reduction Plans

The regulatory agencies are keenly focused on establishing municipal flow reduction plans that will reduce the amount of stormwater and groundwater that reaches municipal collection systems. A March 27, 2015 PaDEP letter offered each municipality an opportunity to extend its expiring consent orders. Later in 2015, the ACHD and PaDEP provided new Consent Order and Agreements (COAs) to the municipalities that require the development of a MSRS using a phased approach along with other flow reduction provisions. Additional details of ALCOSAN coordination with municipal flow reduction include:

Flow Targets

In June 2015, the USEPA issued ALCOSAN a Clean Water Act (CWA) Section 308 information requirement to establish flow targets for each customer municipality by January 2017 in anticipation of ALCOSAN and the municipalities entering into legally binding flow reduction agreements. As a part of complying with this requirement, ALCOSAN solicited input from customer municipalities and participated in a 3RWW Wet Weather Working Group Source Flow Reduction and Flow Targets Sub-committee established to facilitate collaborative development of flow targets, which were submitted to the agencies on schedule in January 2017.

Municipal Source Reduction Agreements

As a requirement of the modified CD, the agencies are requiring that ALCOSAN undertake good faith efforts to enter into legally binding agreements with each customer municipality by January 31, 2025. The agreements should establish flow targets and include a long-term plan that will achieve those flow targets. The long-term plan should identify the activities and the schedule that will be undertaken by the Customer Municipality and provide for periodic revisions to incorporate technological developments, changes in ownership of whole or in part of the collection systems, and revisions to flow targets. This requirement does not apply to municipalities that are subject to similar requirements under enforcement orders with PaDEP, ACHD, or USEPA.

11.2.1.3 Flow Reduction Ordinance Support

Section 10 highlights the overflow reduction potential stormwater management ordinances can provide over the long term. Other regions are leveraging this mechanism to motivate sustainable development practices that manage stormwater on newly developed or re-developed properties. Similar ordinances are in place in the Pittsburgh region and elsewhere that motivate sustainable maintenance of private property sewer laterals.

As a part of this program element, ALCOSAN proposes providing technical support as requested for the development of county-wide (or ALCOSAN service area-wide) model ordinances and templates for stormwater management and sewer use ordinance language that encourages wet weather flow reduction through GSI and I/I reduction. This effort could be coordinated with requirements in the municipal orders and with Phase 2 of the ongoing Act 167 stormwater planning being implemented by Allegheny County.

The model ordinance provisions could include:

- Requirements that property developments and redevelopments over a specified size manage stormwater runoff on site, using GSI where feasible;
- Requirements that private property sewer laterals be periodically inspected, and repairs required for excessive infiltration or structural faults meeting certain criteria; and
- Requirements that address other sources of excessive infiltration on private property.

ALCOSAN will also work with the municipalities, their authorities, and departments (e.g. departments of public works) and other agencies (e.g. PennDOT) to further regional utility coordination efforts. For example, coordinating and integrating GSI into economic development or street resurfacing projects.

11.2.1.4 Long Term Flow Monitoring Program

ALCOSAN will also continue to work with customer municipalities in support of a wastewater flow monitoring and flow isolation program in select sewered areas. The goals and objectives of this program are to assist municipalities in their effort to develop a comprehensive understanding of existing municipal collection system hydrology and hydraulics, and system responses during dry weather periods and various wet weather events. In addition, the program will include nighttime instantaneous flow rate readings in order to 'isolate' smaller areas of the municipal collection systems that are contributing significant amounts of system infiltration. This data collection effort will support planning and design work associated with the IWWP.

ALCOSAN will support base line flow monitoring and analysis in selected areas where a demonstration project is proposed or where a municipal flow reduction project(s) has potential to eliminate/reduce previously identified wet weather improvements. ALCOSAN will also support post-construction monitoring and analysis to determine the performance of flow reduction projects. In addition, ALCOSAN will conduct long-term flow monitoring on selected interceptors and trunk sewers to assess flow reduction progress and trends which will support the evaluation of opportunities to reduce the need for grey infrastructure projects.

11.2.1.5 Regionalization of Inter-Municipal Trunk Sewers

As ALCOSAN and its customer municipalities evaluated compliance strategies for the WWP, they concluded that the regionalization of inter-municipal trunk sewers would facilitate WWP implementation, including incentivizing the use of flow reduction measures such as GSI and I/I reduction. As a result, ALCOSAN and the municipalities are currently working towards the voluntary transfer of at least 200 miles of sewer. This WWP program element is described in Section 11.2.2. ALCOSAN anticipates that regionalization will support flow reduction initiatives, including the prioritization of sewer rehabilitation projects to reduce I/I along transferred trunk sewers and more holistic cost benefit analyses with regard to the implementation of GSI.

11.2.1.6 Flow Reduction Enhancements for ALCOSAN Facilities

ALCOSAN is committed to working with the affected municipalities towards identifying potential green community enhancements to complement its investments in wet weather facilities. Many of the potential projects will require the acquisition of land for facilities. To help

realize opportunities for community benefit, greenspace enhancements will be considered in the design of new wet weather facilities for which ALCOSAN acquires land.

In addition, ALCOSAN will continue its use of GSI for new and refurbished buildings on its treatment plant campus and other structures throughout the system. GSI was installed at its Customer Service and Training, Operation and Maintenance building and one other existing building. In addition, sustainable design features were incorporated into its new vehicle maintenance garage.

ALCOSAN will also continue its efforts to reduce I/I from its existing regional conveyance system. Successful ongoing activities include outfall gate rehabilitation (to reduce river backflow into the system) and the rehabilitation of portions of its shallow-cut regional interceptor lines based on ALCOSAN's ongoing inspection program.

11.2.2 Regionalization

As ALCOSAN and its customer municipalities evaluated compliance strategies for the WWP, the region began considering the merits of regionalization. This initiative would help overcome some of the institutional challenges and inefficiencies associated with fragmented collection system ownership, operation, and maintenance. To this end, ALCOSAN initiated a Regionalization Study and solicited the support of the Allegheny Conference on Economic Development to establish and facilitate an independent Regionalization Review Panel. The panel was comprised of representatives from ALCOSAN, customer municipalities, business groups, universities, and environmental groups.

After 18 months of study, the committee produced a report which concluded that the regionalization of inter-municipal trunk sewers would facilitate WWP implementation and help incentivize the use of flow reduction measures such as GSI and I/I reduction. In addition, it would help ALCOSAN to optimize the proposed projects from the Municipal Feasibility Studies, since ALCOSAN would now own many of these sewers. Subsequently, a Sewer Regionalization Implementation Committee (SRIC) was established to advise on moving this important initiative forward.

The SRIC has proposed that the ownership of inter-municipal trunk sewers of 10 inches or greater in diameter could be voluntarily transferred from the municipalities to ALCOSAN. In addition, existing facilities that address wet weather flow along these trunk sewers, such as pump stations, equalization tanks and diversion chambers, would also be transferred. ALCOSAN would assume responsibility for the operation and maintenance of the trunk sewers, existing wet weather facilities, and for improvements needed to control wet weather overflows along the trunk sewers. As currently envisioned:

- At least 200 miles of inter-municipal trunk sewers will be eligible for voluntary municipal transfer to ALCOSAN, with additional length likely as explained below;
- The municipalities will not be paid for the transferred sewer lines and ALCOSAN will not assume any related municipal debt;

- The inter-municipal trunk sewers must be in compliance with the inspection and repair requirements of the 2004 municipal orders when transferred; and
- ALCOSAN's acceptance of the lines ceded by the municipalities will start in 2016.

The transfer of inter-municipal trunk sewers to ALCOSAN is discretionary on the part of the municipalities. By December 2017, ALCOSAN will provide the agencies with a map of existing sewers and associated existing wet weather facilities to be transferred to ALCOSAN. ALCOSAN will undertake good faith efforts to then take ownership of identified sewers and facilities by January 2020, including operation and maintenance responsibility. Under the adaptive management provisions of the modified CD, ALCOSAN will submit to the regulatory agencies by January 2024 a revision to the WWP that identifies projects necessary to control SSOs along transferred sewers. This revision will include identifying priority SSO control projects that can be affordably completed as part of the IWWP, with the remaining projects deferred for later implementation as a part of the FMP.

In summary, the regionalization of inter-municipal trunk sewers is an important step forward for the region. The approach follows the SRIC recommendations, complies with regulatory requirements in the modified CD, and respects the interests of ALCOSAN's customer municipalities. Regionalization provides the following benefits to the region:

- Streamlines wet weather compliance responsibilities by transferring responsibility for overflows along transferred sewers to ALCOSAN
- Facilitates more holistic and cost-effective decision making regarding overflow reduction strategies and priorities
- Resolves historic complexities associated with allocating costs for inter-municipal trunk sewer maintenance and improvements
- Enables efficiencies in operational control of wet weather facilities
- Promotes flow reduction and integrated planning
- Facilitates prioritization of repairs from a system-wide perspective
- Provides more accurate and updated information about the condition and connectivity of these sewers
- Respects local decision making, since transfers are voluntary

Current Status

Up to 67 of the 83 customer municipalities have sewers and facilities under consideration for transfer based on the original criteria established (the sewer evaluation process is still ongoing). The inter-municipal trunk sewers and structures/facilities proposed for transfer per the original criteria include:

- Approximately 265 miles of sewers
- 77 diversion chambers
- Four pump stations

- Four equalization tanks

Initial meetings were held with 75 customer municipalities in 2015 to review proposed regionalization sewer extents and to discuss and obtain additional data from the municipalities. Based on those meetings and subsequent developments, additional inter-municipal trunk sewers and structures/facilities are now being considered for transfer. ALCOSAN is currently working closely with affected municipalities to determine their appropriateness for transfer. As of August 2017, the following additional amounts are being considered:

- 56 miles of sewers which municipalities have requested be transferred even though they do not meet the original criteria
- 40 diversion chambers
- Eight pump stations
- Four equalization tanks

Since 2015 ALCOSAN has also reviewed all municipal CCTV inspection data for sewers proposed to be transferred and determined which data will meet ALCOSAN's current needs and standards. For sewers without acceptable data, ALCOSAN is currently conducting CCTV inspections to establish current conditions including identification and rating of any defects. Physical inspections and surveys of facilities that address wet weather flow are also being performed. Other activities include ongoing municipal coordination and establishment of asset management protocols that can be used to prioritize needed repairs based on risk and criticality.

11.2.3 Proactive Flow Reduction and System Upgrade Projects

Over the past fifteen years, ALCOSAN has proactively completed a number of projects that help to reduce overflows and improve receiving stream water quality. Although these completed and ongoing projects are not formal components of the WWP, they represent investments of more than $180 million. Key examples of these projects are described in Table 11-2.

Table 11-2: Proactive Flow Reduction and System Upgrades

Category	Project	Description
Completed Regional Conveyance and Treatment Enhancements	Wastewater Treatment Plant Hydraulic Expansion	An upgrade of the Woods Run WWTP increased the treatment capacity to 250 mgd, and along with other improvements, established the foundation for future wet weather capacity expansion.
	Conveyance System Rehabilitation & Enhancements	ALCOSAN's ongoing program of rehabilitation and system enhancements to its 90 miles of interceptor system.
	43rd Street Access Shaft & M-51 Access Shaft	Installation of two new access shafts along the Allegheny and Monongahela River deep tunnel interceptors to provide access for robotic cleaning equipment. These projects also demonstrated preferred construction methods that address the construction risks of adding access shafts to the existing interceptors.
	Outfall Flap Gate Installation	ALCOSAN has installed new flap gates at a number of locations and also replaced some existing flap gates to minimize the potential for river water intrusion during flood conditions, thereby reducing downstream wet weather overflows.
	Ella Street Pump Station	ALCOSAN rebuilt and assumed ownership from McKees Rocks Borough of the Ella Street pump station.
Completed Green Flow Reduction Projects	Pine Hollow Run Direct Stream Inflow Removal	Pine Hollow Run drains a watershed of around 300 acres in Kennedy Township, and formerly drained via a trunk sewer which serves Stowe Township and McKees Rocks Borough. This DSI was redirected to dedicated culvert to convey creek flow to Chartiers Creek, thereby reducing basement backups and combined sewer overflows in ALCOSAN sewersheds C-09 and C-13.
	Jack's Run Direct Stream Inflow Removal	ALCOSAN, the City of Pittsburgh / PWSA, Ross Township and Bellevue Borough partnered to remove a major direct stream inflow into ALCOSAN's Lower Ohio River interceptor sewer.
	Orr Street Direct Stream Inflow Removal	An unnamed stream draining 26 acres flowed into the portion of the Stowe Township combined sewer system that connects to ALCOSAN's O-03 regulator structure. ALCOSAN rerouted the stream into a dedicated culvert which discharges into the Ohio River.
	Carnegie Park Direct Stream Inflow Removal	Two unnamed streams drained a watershed of around 120 acres in and around Carnegie Borough's municipal park and flowed into the Borough's combined sewer system in the C-40 sewershed. ALCOSAN rerouted the streams through a new storm pipe which discharges into Chartiers Creek. ALCOSAN partnered with PennDOT in removing this direct stream inflow.

Table 11-2: Proactive Flow Reduction and System Upgrades

Category	Project	Description
	Millvale Industrial Park Direct Stream Inflow Removal	A stream along the State Route 28 Allegheny River Transportation Corridor was located above the former Millvale Industrial Park and was connected to the municipal sewers upstream of ALCOSAN Diversion Structure A-66.
Completed Green Stormwater Infrastructure Projects	Schenley Park Green Stormwater Infrastructure Project in Panther Hollow Watershed	ALCOSAN partnered with the City of Pittsburgh, Pittsburgh Parks Conservancy (PPC) and PWSA for two projects in Pittsburgh's Schenley Park. The first installation routes stormwater runoff into infiltration trenches along Bartlett and Beacon Streets. The second project, incorporates retentive grading areas within the Bob O'Connor Golf Course to slow stormwater runoff and retain and infiltrate the runoff into groundwater.
Completed Green Stormwater Infrastructure Projects	West View Borough Green Stormwater Infrastructure Project	ALCOSAN partnered with West View Borough to incorporate a series of GSI installations in a previously impervious parking area and lawn road divider along Center Avenue. Pervious paver block installations with additional rain garden areas were used to allow stormwater infiltration.
	ALCOSAN Customer Service and Training Building	ALCOSAN installed a bioretention/infiltration trench system into the parking lot of their Leadership in Energy and Environmental Design (LEED) Gold Certified Customer Service Building located just outside of the Woods Run WWTP in the City of Pittsburgh.
	ALCOSAN Operations and Maintenance Building	ALCOSAN installed a porous parking area and green roof installations within their LEED Silver Certified Operations and Maintenance building located at the Woods Run WWTP.
	ALCOSAN Vehicle Maintenance Garage	ALCOSAN installed GSI elements in its new vehicle maintenance garage, including a series of surface rain gardens and subsurface storage elements aimed to retain, infiltrate and slowly release stormwater runoff in accordance with the City of Pittsburgh's land redevelopment ordinances.
	ALCOSAN Main Pump Station	ALCOSAN installed a green roof on a building connected to its main pump station.
Completed Stream Restoration Projects	Nine Mile Run Stream Restoration	The Nine Mile Run stream within Pittsburgh's Frick Park is one of the few remaining surface flowing streams within the City. The stream restoration has been a focal point for a wide group of partners including the U.S. Army Corps of Engineers, the City of Pittsburgh, Nine Mile Run Watershed Association, PPC, ALCOSAN, and the Boroughs of Edgewood, Swissvale and Wilkinsburg.
	Jack's Run Direct Stream Restoration	Once the stream's water was rerouted from the municipal combined system, the original stream bed was restored to support a riparian environment. The stream banks were stabilized and indigenous plants were installed.

Table 11-2: Proactive Flow Reduction and System Upgrades

Category	Project	Description
On-Going Regional Conveyance Enhancements	Outfall Flap Gate Installation	ALCOSAN is continuing its ongoing program of installing new flap gates and replacing existing flap gates to minimize the potential for river water intrusion during flood conditions and reduce the amount of river sediment deposition to the interceptor system.
	Grit Trap Projects	While it is best to minimize the grit and sediment entering the municipal combined sewers by rerouting the streams from the sewers and to the rivers, in some cases this can be cost prohibitive due to distance to a receiving stream. As an alternative, ALCOSAN is evaluating the feasibility of grit and sediment traps at trunk sewer points of connection to ALCOSAN into which certain streams discharge. ALCOSAN is planning to construct a pilot grit trap project to remove the Tassey Hollow direct stream inflow.
On-Going Green Stormwater Infrastructure Projects	East Pittsburgh Borough, Grandview Avenue Green Stormwater Infrastructure	ALCOSAN is partnering with East Pittsburgh Borough to design a GSI installation that will also provide a community amenity. The project will collect stormwater runoff from Grandview Avenue and adjacent streets and route the stormwater to a series of parcels to be acquired by the Borough. This project is part of a community revitalization effort to develop a community amenity from vacant land and buildings that are slated for demolition. The Borough desires to build a community park or gathering area on the properties with the GSI elements as a central focus. The project is intended to reduce peak runoff and combined sewer overflow volume in the T-02 sewershed.
	Homestead Borough, Frick Park Green Stormwater Infrastructure	ALCOSAN and Homestead Borough are embarking on designing a series of GSI installations within the Frick Park area of the Borough and surrounding residential neighborhood. The GSI projects envisioned include bioretention/infiltration trenches within the park and potential retrofits along residential roads including tree pits, swales and bump-outs. These projects are intended to reduce peak runoff and combined sewer overflow volume in the M-45 sewershed.
	McKinley Park Green Stormwater Infrastructure Installation	ALCOSAN is partnering with the City of Pittsburgh, PWSA and PPC to develop GSI projects in McKinley Park. The size and layout of the park offers potential for numerous GSI projects, with an initial project under development in the lower park area along Bausman Street. The project design is under development, and envisioned to collect stormwater runoff from Bausman and adjacent streets and incorporate bioretention/infiltration elements along the perimeter of the park area.
On-Going Green Flow Reduction Projects	Dooker Hollow Direct Stream Inflow Removal	An acid mine drainage (AMD) stream discharges into the North Braddock Borough combined sewer system. ALCOSAN is investigating the treatment and re-use of the AMD.

Table 11-2: Proactive Flow Reduction and System Upgrades

Category	Project	Description
	Sheraden Park Direct Stream Inflow Removal and Stream Restoration (Ongoing)	ALCOSAN, the City of Pittsburgh, PWSA and the U.S. Army Corps of Engineers have and continue to partner in the removal of direct stream inflows into PWSA's combined sewer system in Sheraden Park. With the completion of the rerouting of the combined sewer system from the culverted stream flowing through the park, the stream is being daylighted and will flow into a constructed wetland at its confluence with Chartiers Creek. Construction of the final phase of the project is currently underway.
Woods Run WWTP Expansion Early Action Projects	New Operation & Maintenance (O&M) Building	ALCOSAN has constructed a new O&M Building located near the main entrance to the WWTP. This building has new maintenance shops, storage facilities, a laboratory, staff offices and locker rooms, and a visitor receiving area. The new O&M Building replaces buildings that must be demolished for construction of new wet weather headworks and the expansion of primary treatment facilities proposed in the WWP.
	Pilot Disinfection Study	ALCOSAN completed an engineering evaluation and pilot study of alternative wastewater disinfection processes, such as ultraviolet radiation and chlorination, for the WWTP secondary effluent and primary sedimentation effluent. This study advanced the concept development of disinfection alternatives for selection and design of new disinfection facilities as part of the proposed WWTP expansion.
	Vehicle Maintenance Garage	To make room for the proposed wet weather headworks, ALCOSAN recently completed construction of a new vehicle maintenance garage. Once in full use the existing vehicle maintenance garage can be demolished to prepare for the headworks expansion.

11.2.4 Regional Flow Optimization Strategy and Preliminary Planning

During Phase 1 of the IWWP, ALCOSAN will work jointly with its customer municipalities to assess the effectiveness of green infrastructure, stream inflow removal, I/I reduction, and existing system asset management through preliminary planning and demonstration projects. As a part of its effort to adopt and maintain an affordable IWWP, ALCOSAN will take the lead, in cooperation with its municipal customers, to develop and implement regional I/I reduction and green infrastructure measures in its service area, consistent with the approach described in Section 11.2.1: Flow Reduction Program. This strategy will include goals of (1) maximizing peak flows managed while controlling flows to be conveyed and treated, (2) minimizing the need for expanded local and regional storage and conveyance and (3) rehabilitation of the regional collection system. The resulting regional flow optimization strategy will identify flow management measures to be adaptively incorporated into Phases 2 and 3.

ALCOSAN will provide financial support for the regional flow optimization strategy, regional green infrastructure measures and I/I reduction demonstration projects (which will require municipal matching funds), rehabilitation of inter-municipal trunk sewers and associated facilities under ALCOSAN's control and existing system optimization projects of up to $200 million through 2024. Priority consideration will be given to projects demonstrating the effectiveness of regional source reduction, especially: (1) green infrastructure measures within the municipalities, and (2) I/I projects within the municipalities (including rehabilitation work on inter-municipal trunk sewers under ALCOSAN's control).

In consideration of the regional flow optimization strategy and flow reduction plans submitted by the municipalities, preliminary planning will determine the most cost-effective approach for IWWP projects. The planned projects identified in Table 11-1 and schedules identified in Figure 11-11 may change. Preliminary planning will establish the optimal means of obtaining 600 mgd of wet weather treatment capacity and the basis of design for Phase 2 and Phase 3 tunnel projects and the Upper Monongahela RTB, including any appropriate downsizing and refined tunnel and consolidation sewer construction schedules. The preliminary planning process is envisioned to include the following activities and culminate in the issuance of a Basis of Design Report.

- Evaluation of potential expansion of the main pumping station from 480 mgd to 600 mgd
- Establishing tunnel extent, alignment, and sizing refinements
- Evaluation of wet weather and tunnel dewatering pump station alternatives
- Geotechnical investigations and assessments
- Property evaluation and assessment
- Tunnel system hydraulics and surge analysis
- Flow management and operational strategies, including
    - Locations and capacities of any tunnel cross-connections

  - Cost effective improvements to optimize the existing tunnel storage and conveyance capacities
  - New and existing tunnel O&M and dual tunnel system optimization strategies
- Evaluation of construction packaging and project delivery alternatives

11.2.5 Woods Run WWTP Expansion

ALCOSAN will expand the Woods Run WWTP wet weather treatment capacity to 600 mgd with a secondary treatment capacity of 295 mgd from its currently permitted full treatment capacity of 250 mgd. As proposed, peak wet weather flows in excess of 295 mgd, up to an additional 305 mgd, would receive primary treatment and disinfection prior to discharge. The phased implementation of the WWTP expansion presented in this section includes initially expanding primary (and total) wet weather treatment capacity to 480 mgd during Phase 1 by upgrading the existing main pump station, expanding the headworks capacity and increasing disinfection capacity. During Phase 2, a separate Wet Weather Pump Station will be added with a capacity of up to 120 mgd, producing a total wet weather pumping capacity of 600 mgd. Expansion of secondary treatment capacity to 295 mgd is Phase 3 of the plant expansion.

Table 11-3 summarizes ALCOSAN's approach for phasing expansion of the plant's treatment capacities and Figure 11-2 illustrates the proposed wet weather process flow routing at the WWTP after the completion of all three phases.

After Phase 1 of the IWWP, wet weather peak flows up to 480 mgd will be conveyed to the WWTP through the existing interceptor system and the existing Main Pumping Station. Following Phase 1 and Phase 2, peak wet weather flows in excess of 250 mgd will receive primary treatment and disinfection prior to discharge. The WWTP wet weather operating mode will be to transition into and out of secondary bypass operation as quickly as possible while still maximizing wet weather treatment.

Following completion of Phase 2 of the IWWP, the Main Pump Station in combination with a new Wet Weather Pump Station will allow for a total sustained wet weather treatment capacity of 600 mgd. The flow distribution between the two pumping stations will vary; however, the maximum flow from the Wet Weather Pump Station will be 120 mgd with the balance handled by the Main Pumping Station. All pumped flows will receive primary treatment and disinfection prior to discharge.

Table 11-3: Phasing the Woods Run WWTP Expansion

Phase	Primary Treatment Capacity (mgd)	Secondary Treatment Capacity and Disinfection (mgd)	Total Wet Weather Treatment Capacity (mgd)
IWWP Phase 1	480		480
IWWP Phase 2	600		600
IWWP Phase 3		295	

Figure 11-2: Woods Run WWTP Expansion – Wastewater Treatment Process Flow Diagram

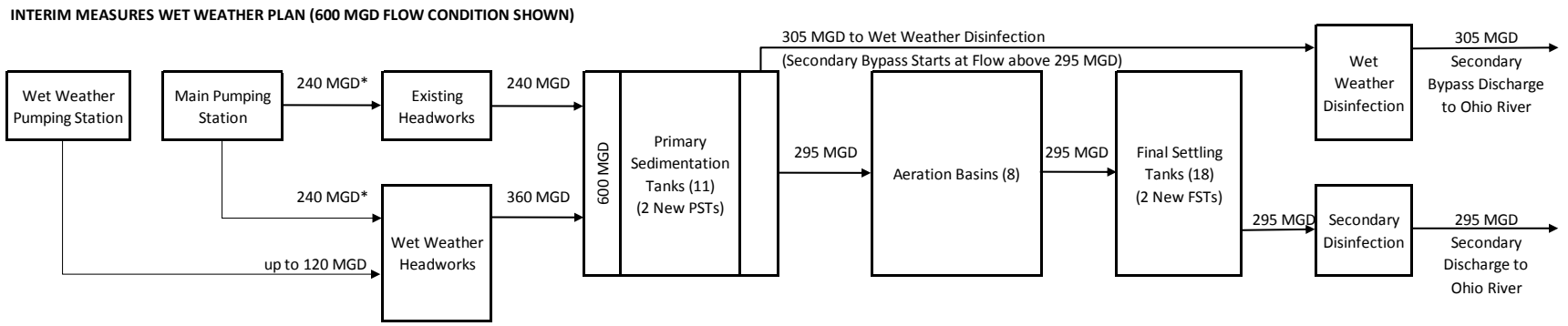


Figure 11-3 illustrates a conceptual layout for the recommended WWTP expansion in the IWWP which includes the following modified and new treatment process units:

Main Pumping Station – Replacement of the six raw sewage pumps will provide a minimum sustained pumping capacity of 480 mgd. This work is complete. Flow meters will be retrofitted in the pump discharge lines during Phase 1 of the IWWP. The raw sewage pumps discharge configuration will be modified during Phase 1 to control flow distribution between the existing headworks and the new Wet Weather Headworks.

Wet Weather Pumping Station – Phase 2 of the IWWP includes a 120 mgd expansion of the total raw wastewater pumping capacity to generate a total of 600 mgd of sustained wet weather treatment capacity, in combination with the Main Pump Station. While different options to achieve this pumping capacity will be evaluated during Phase 1, this WWP update assumes that the 120 mgd Wet Weather Pump Station will be constructed to dewater the proposed Phase 2 and Phase 3 regional tunnel segments.

Wet Weather Headworks - New wet weather headworks, including screenings and grit removal process equipment, are proposed with a minimum sustained capacity of 360 mgd. The existing headworks will remain in service with a capacity of 250 mgd and the flow distribution between the existing and the proposed wet weather headworks will be optimized to provide efficient and reliable operation. The combined total wet weather capacity, with the existing headworks operating at 240 mgd (two raw sewage pumps running), provides a sustained preliminary treatment capacity of 600 mgd. This work is included in Phase 1 of the IWWP for constructability and economic reasons. In addition, the proposed process units will provide greater redundancy and operational flexibility to handle peak flows of up to 480 mgd between the existing headworks and new wet weather headworks at the completion of the IWWP.

Primary Treatment – The existing nine primary sedimentation tanks provide a firm capacity of 480 mgd with eight tanks in service at the proposed high-rate operation. Modifications are proposed for wastewater flow routing to the primary sedimentation tanks to allow for construction of two new tanks during Phase 2 which will increase sustained process capacity to 600 mgd.

Secondary Treatment – Two final settling tanks are proposed including plant conveyance modifications and a new return activated sludge (RAS) pumping station to provide a sustained secondary treatment capacity to 295 mgd. The tanks will be added under Phase 3.

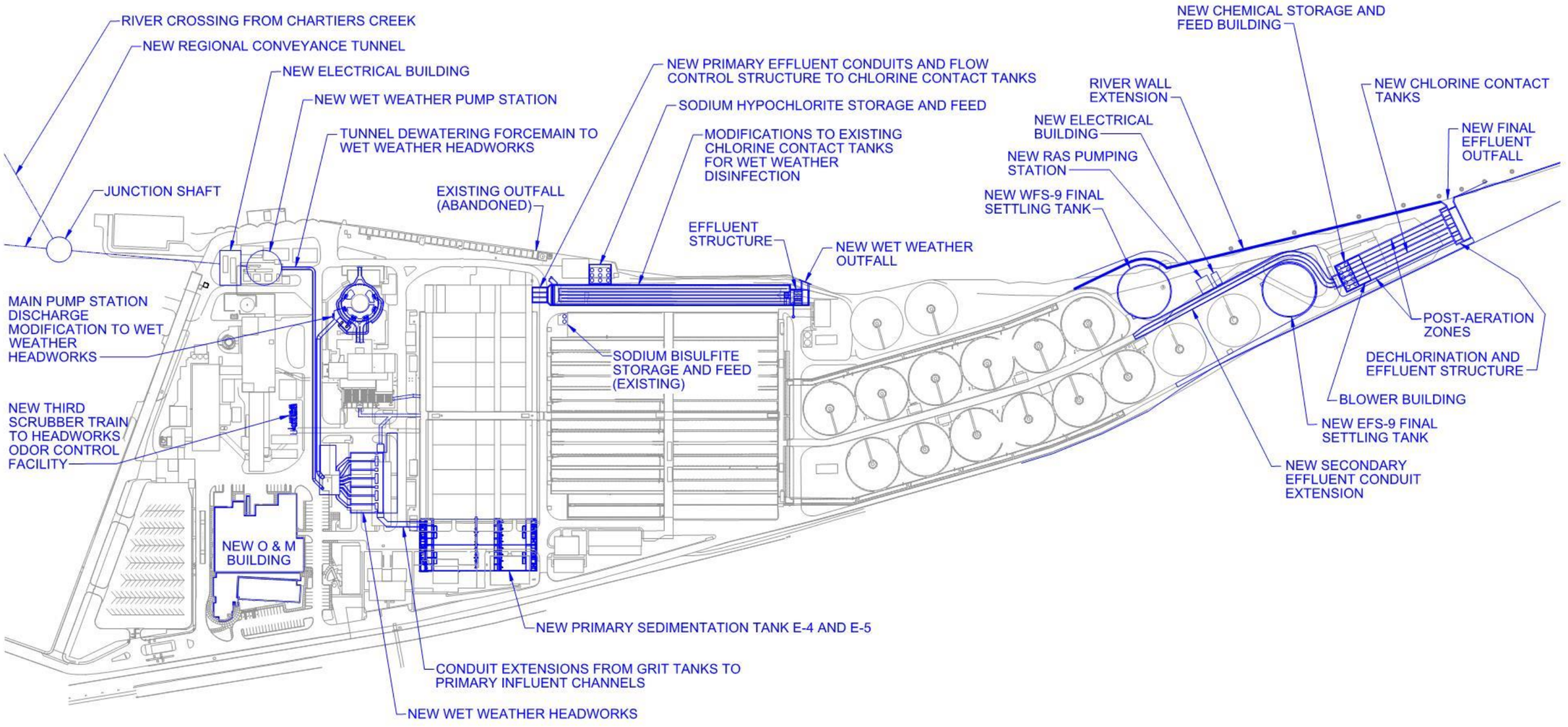
Disinfection - New secondary effluent chlorination/dichlorination disinfection facilities with a sustained capacity of 295 mgd are proposed followed by post-aeration and discharge via a new plant outfall. The secondary disinfection facilities will be constructed during Phase 1.

Wet Weather Disinfection - Primary treated effluent flow exceeding secondary treatment capacity would be routed to the existing chlorine contact tanks which will be used for high rate disinfection. The existing chlorination/dechlorination processes would be modified to provide up to 305 mgd capacity followed by post aeration and discharge at a new outfall. The existing

outfall would be abandoned, since it does not have sufficient hydraulic capacity for a discharge of 305 mgd.

Due to the one-time nature of the modifications to the existing chlorine contact tanks the process capacity would be expanded to 305 mgd during Phase 1, necessary for the Phase 2 expansion to 600 mgd of sustained treatment capacity.

Figure 11-3: Recommended WWTP Expansion Conceptual Site Plan



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11.2.6 Regional Tunnel and Dewatering Pump Station

The ALCOSAN IWWP includes a new regional CSO conveyance/storage tunnel with associated structures, and consolidation sewers. The tunnel design is still subject to modification as part of preliminary planning, which will also evaluate a wet weather pump station that would increase the total raw wastewater pumping capacity to 600 MGD. The sections which follow assume that the additional pumping capacity would be provided via a tunnel dewatering pump station. The proposed ALCOSAN regional tunnel parallels the existing deep tunnel interceptor system along each of the three main rivers, terminating in the vicinity of the Woods Run WWTP. A preliminary tunnel alignment is shown in Figure 11-4. The proposed tunnel would convey/store excess wet weather combined sewage to a terminal tunnel dewatering pump station that pumps flows to treatment during and after wet weather events.

The Allegheny River tunnel segment would begin near Point of Connection (POC) A-42 and would convey inflow to a new junction shaft at the upstream end of the Ohio tunnel segment near POC O-39. The Monongahela River tunnel segment would begin near POC M-29 and would convey inflow to this same junction shaft near POC O-39. The Ohio River tunnel segment conveys flows from the two upstream tunnel segments and other inflows to a proposed junction shaft at the Woods Run WWTP. The Ohio River tunnel segment also includes tunnel crossings under the Ohio River to convey flows from up to POC C-04 in the Chartiers Creek and from POC O-14E/W in the Saw Mill Run basin. The WWTP junction shaft would convey flows to the deep tunnel dewatering pump station. The Ohio, Allegheny and Monongahela River tunnel segments are described in further detail in Sections 11.2.7, 11.2.8, and 11.2.9, respectively.

As part of the FMP, facilities required to control overflows along the exiting Saw Mill Run interceptor will be evaluated in light of municipal flow reduction and integrated planning efforts currently underway. If necessary, a future tunnel serving the Saw Mill Run planning basin could be tied into the upstream end of the river crossing tunnel at POC O-14E and O-14W. Similarly, Final Measures facilities necessary to control remaining overflows in the Upper Monongahela and Turtle Creek Basins will be evaluated following IWWP implementation and post construction monitoring, with the Monongahela River tunnel segment extending upstream to near POC M-51 as a possibility.

The proposed regional tunnel is 14 feet in diameter, and may be subject to future refinement. The portion of the regional tunnel included in the IWWP would total about 15 miles with a volume of up to 90 MG. The regional tunnel will vary from 35 to 55 feet deeper than the existing deep tunnel interceptor, with a constant 0.1% slope and a downstream invert elevation of about 565 feet.

Along the tunnel, certain groupings of CSO outfalls were selected for conveying excess wet weather flow via consolidation sewers to the new regional tunnel. These groupings were selected to address the largest overflows by volume and also to provide an enhanced level of control to CSO outfalls which are directly impacting Sensitive Areas. The consolidation sewers would be constructed using either open-cut or trenchless tunneling methods. New regulator structures and connector sewers will be located upstream or downstream of existing regulator structures for conveying flow to new consolidation sewers, and modifications will also be made

to some existing regulator structures. These "consolidated flow groups" and associated conveyance improvements are shown on Figure 11-4. All conveyance routes are preliminary and will depend in part on the final drop shaft locations and the final alignment of the regional tunnel. The conveyance pipes to the new regional tunnel are sized to convey all excess wet weather flows to the regional tunnel drop shaft in the typical year.

To manage costs, excess flows from CSOs which have smaller annual overflow volume and /or less frequent discharges are not tied into the regional tunnel. Instead these smaller CSOs are controlled to the extent needed to not preclude attainment with water quality standards. The regulator modifications proposed in the plan for these smaller outfalls are non-structural modifications like adjusting or removing tipping gates or adjusting orifice openings.

For wet weather events that cannot be fully captured by the tunnel system, overflows will occur through the existing outfalls and through several new relief outfalls along the proposed tunnel which act to ensure that the tunnel does not worsen current flooding in the existing collection system. Controls for the outfalls which directly impact Sensitive Areas are designed to eliminate overflows during the typical year, except for the A-67 outfall which will be designed to overflow once during the typical year.

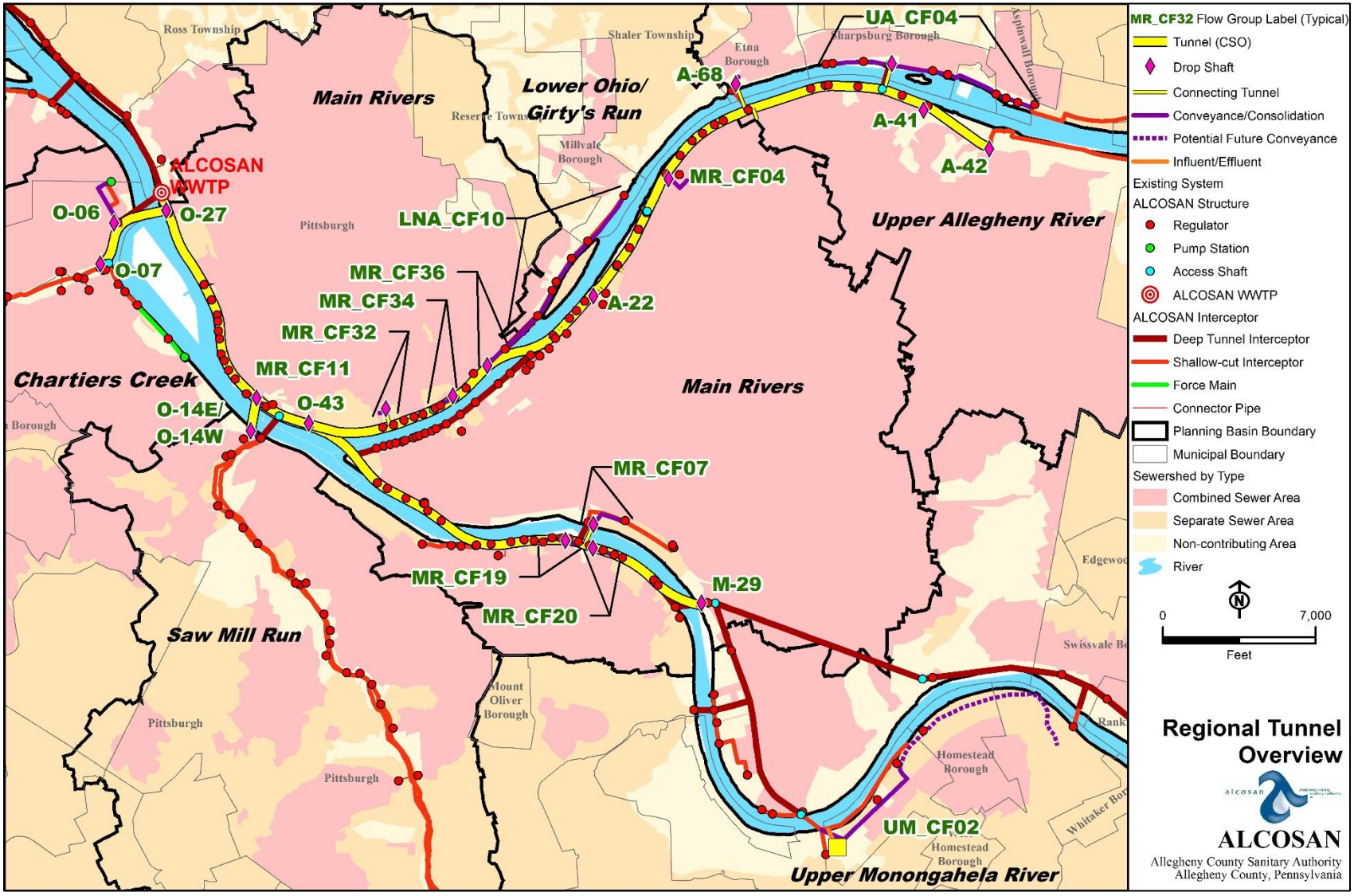
Tunnel Construction

The proposed regional tunnel will be constructed in rock using a tunnel boring machine (TBM). A two-pass TBM method is assumed for tunnel construction. The first pass would consist of excavation of rock, with an initial tunnel support system typically consisting of rock bolts, and possibly mesh and shotcrete depending upon groundwater inflows and the nature and behavior of the rock during excavation. The second pass would consist of the final permanent lining of cast in place concrete installed along the length of the tunnel.

Secondary structures are needed to convey flow from the collection system into the CSO tunnel. Secondary structures include new or modified CSO regulating structures, and near-surface consolidation sewers which collect flow from two or more CSO regulators to a tunnel drop structure. Drop shafts serve as the vertical connector between the near-surface collection system and the deep tunnel storage. Drop structures will contain a CSO vortex structure which collects and conveys flow vertically to a CSO drop shaft, where flow drops to a deaeration chamber, and flows through a horizontal connector (or adit) which brings flow directly into the tunnel. A total of 19 drop shafts are proposed for the regional tunnel, shown in Figure 11-4.

The existing regional tunnel interceptor will use the proposed regional tunnel as a relief sewer to convey combined sewage to the WWTP using several cross connections between the two tunnels. These connections, shown in Figure 11-1, function similarly to the connection of surface structures to the regional tunnel. Flow will leave the existing tunnel through a primary control structure and enter a secondary vortex structure, upon which it will be conveyed vertically through a drop shaft, into a deaeration chamber and finally through an adit and into the new tunnel.

Figure 11-4: Proposed Regional Tunnel Extent for Interim Measures Wet Weather Plan



Background Geology Investigation

Geology plays an important role in selecting a tunnel alignment and in making assumptions regarding tunnel construction. Preliminary planning assumptions proposed tunneling in sound rock to increase the likelihood of consistency in excavation. The proposed tunnel is assumed to be in Pennsylvania bedrock consisting of shale, sandstone and limestone. Preliminary investigations of the soil-rock interface elevations, locations of coal layers as a geologic reference point, and presence of less structurally preferred layers of rock have indicated no fatal flaws for tunnel construction with a tunnel boring machine within the proposed tunnel extent.

Construction of the existing ALCOSAN deep tunnel interceptor provided geotechnical evaluations of the subsurface conditions along portions of the proposed new tunnel alignment with supplemental information provided through other state and national geologic investigations within the ALCOSAN service area. This research information is valuable in conceptual planning; however, due to the advances in boring investigation methods and modern construction, more and different types of data will be needed to evaluate the rock conditions required for a TBM tunnel investigation. Additional subsurface investigation will be required along the project tunnel alignments. This investigation will be implemented as a phased program.

Tunnel Dewatering Pump Station

The planning concept for the regional tunnel conveyance system is to convey captured flow to the Woods Run WWTP for treatment. Therefore, the Tunnel Dewatering Pump Station needs to be located at the lower end of the system, which is at the WWTP and approximately 150 feet below grade. Pump stations of this depth are typically circular in design configuration and constructed within a vertical shaft. This shaft could also serve as the launching shaft for the tunnel boring machine. However, considering the need for a shaft near the WWTP for junction of the regional tunnel and a proposed tunnel crossing of the Ohio River to the Chartiers Creek planning basin, the pump station will likely be constructed separately from the junction shaft for hydraulic design considerations.

Ideally, the Tunnel Dewatering Pump Station will be located within ALCOSAN's currently owned properties. One potential location within the existing WWTP site is near the Main Pumping Station as shown on Figure 11-3. This location aligns well with the conceptual tunnel routing and allows for a direct pumping route to the proposed wet weather headworks. However, this site area currently has several underground utilities, including the Ohio River Interceptor, process drains, and medium voltage electrical duct banks, that conflict with and present challenges to construction of a deep tunnel dewatering pump station. Other locations in the WWTP site and nearby properties will be explored during preliminary planning for the regional tunnel system and WWTP expansion.

The Tunnel Dewatering Pump Station as proposed will have a firm capacity of up to 120 MGD to convey flows from the regional tunnel to the headworks for treatment during wet weather events and to dewater the tunnel for treatment after the end of an event. This capacity will also provide the additional pumping capacity needed to augment the 480 MGD Main Pumping Station capacity. The combined sustained capacity of the Tunnel Dewatering Pump Station and the upgraded Main Pumping Station is 600 MGD which matches the planned WWTP wet

weather treatment capacity. Other components and features of the Tunnel Dewatering Pump Station include the following:

- The WWTP distributed control system will be extended to the Tunnel Dewatering Pump Station to coordinate its operation with the Main Pumping Station
- Odor control will be extended from existing facilities on the plant site, or otherwise provided in the new facilities.
- The pump station will be sized to dewater the tunnel in two days based on the largest event in the typical year, with shorter dewatering times for smaller events.

Operation

The proposed regional tunnel is to be used for storage and conveyance of combined sewage. New or modified CSO regulators will be designed to divert flow (up to some limit) from trunk sewers into the new tunnel via a drop shaft structure, with use of consolidation sewers to combine flow from multiple CSO regulators into a single drop shaft. Based on the operating scheme currently envisioned, untreated overflows will be conveyed through existing outfalls, or through tunnel relief outfalls to ensure the tunnel hydraulic grade lines have no adverse impact on upstream municipal systems. Based upon the operating scheme currently envisioned, the new tunnel will also act as a relief to the existing interceptor system, by accepting flows from that interceptor by way of several cross connections between the two tunnels.

As under present conditions, it is assumed that normal operation of the existing interceptor system will be based on maintaining a constant main pump station wet well elevation. During a wet weather event as the hydraulic grade line (water surface) rises in the existing interceptor, it will reach the cross-connection elevation and spill from the existing interceptor to the new tunnel. Flow will also enter the new tunnel via new drop shafts. Flow entering the regional tunnel will be controlled with either a passive or active control approach, which is yet to be determined. Passive control has been assumed for all planning purposes, but either approach will require measures to mitigate transient flow conditions which can occur during rapid filling of deep tunnel systems.

Operation of the proposed regional tunnel in wet weather would be dependent on the magnitude of the wet weather event. Small wet weather events would be conveyed by the existing interceptor if the hydraulic grade line (HGL) stays below the elevation of the cross-connections to the proposed tunnel, and if all wet weather flows can be handled by existing interceptor regulators and drop shafts. Under these conditions, flows would be pumped to the existing headworks and potentially the wet weather headworks of the Woods Run WWTP with the existing pump station. When flows approach the secondary treatment capacity the plant will switch to wet weather operations. The secondary bypass will be activated when flows exceed the secondary treatment capacity.

Larger wet weather events will send excess wet weather flow to the new tunnel by way of the new drop shafts and through the cross connections to the existing tunnel. As the tunnel begins to fill, if the existing pump station is pumping less than 480 MGD, the dewatering pump station will begin supplemental pumping as soon as possible to maximize the use of the available treatment capacity at the WWTP.

For some of the largest wet weather events when the main pump station wet well elevation cannot be maintained at its normal constant elevation, the hydraulic grade lines in the two interceptors will rise above the point where overflows may occur. Overflows will occur from the existing CSO outfalls and via one or more relief outfalls along the proposed tunnel.

11.2.7 Ohio River Tunnel and Facilities

Controls along the Ohio River are conveyance based, predominantly consisting of a segment of the ALCOSAN regional tunnel with associated structures, shafts and consolidation sewers that carry excess wet weather combined sewer flows to the tunnel drop shafts. The controls also include adjustments to a number of existing regulators to maximize conveyance to the existing interceptor drop shafts, thereby reducing overflow frequency. This tunnel segment may also include a tunnel relief outfall at the downstream end, and one cross-connection to the existing tunnel at the upstream end. In addition, the Ohio River tunnel segment will have connections to the Chartiers Creek and Saw Mill Run basins via tunneled river crossings. A preliminary alignment of the Ohio River tunnel segment and associated controls is shown in Figure 11-5.

Regional Tunnel

The Ohio River segment of the ALCOSAN regional tunnel will begin at a proposed junction shaft near ALCOSAN structure O-39 and continue downstream, paralleling the existing deep tunnel interceptor until it reaches a proposed junction shaft at the Woods Run WWTP. The WWTP junction shaft would also receive flows from tunneled river crossing to Chartiers Creek and would convey the combined flows to the up to 120 MGD deep tunnel dewatering pump station. The tunnel segment will convey excess wet weather flows from two drop shafts and from at least one drop shaft cross-connection with the existing interceptor.

At the upstream end of this segment, the regional tunnel will also receive flow from the Allegheny and Monongahela tunnel segments. In addition, the Ohio River tunnel segment will receive flows via a tunneled river crossing connection to the Saw Mill Run basin. As part of the FMP, a future tunnel serving the Saw Mill Run planning basin could be tied into the upstream end of this river crossing tunnel at POC O-14E and O-14W, if necessary. A summary of the drop shafts for the Ohio River tunnel segment is included in Table 11-4. Points of connection shown in red correspond to outfalls which are directly impacting Sensitive Area.

Ohio River Crossing to Saw Mill Run Basin

The Ohio River Tunnel Segment crosses the river to connect to the Saw Mill Run Basin near ALCOSAN structures O-14E and O-14W, and will collect flows from the O-14E and O-14W points of connection. The river crossing may be constructed with a TBM as an extension of the Ohio River tunnel segment or may be constructed with other methods. The construction method and configuration of the river crossing connection will be addressed in the Preliminary Basis of Design Report. The need for the Saw Mill Run tunnel will be re-examined in the future when the FMP needed to achieve full compliance must be identified.

Ohio River Crossing to Chartiers Creek Basin

The Ohio River Tunnel Segment crosses the river to a point in the Chartiers Creek Basin near ALCOSAN access shaft O-07, and will receive flows from two drop shafts. One drop shaft will serve the O-06 point of connection and the other will relieve flows from the existing Chartiers Creek interceptor via a new connection to shaft O-07. The river crossing will likely be constructed with a TBM as an extension of the Ohio River tunnel segment.

Table 11-4: Ohio River Tunnel Segment Drop Shafts

Flow Group	ALCOSAN Points of Connection Served	Drop Shaft Capacity[1] (MGD)
O-06[2]	O-06	TBD[4]
O-07[2]	Interceptor Relief Connection	670
O-27	O-27	220
MR_CF11	O-39, O-40, O-41	60
O-14E/O-14W[3]	Interceptor Relief Connection	50

[1] Based on peak flow during Typical Year model simulations
[2] Portion served by the Chartiers Creek River Crossing
[3] Portion served by the Saw Mill Run River Crossing
[4] To be determined as part of Preliminary Planning and included in the Preliminary Basis of Design Report

Consolidation and Connector Sewers

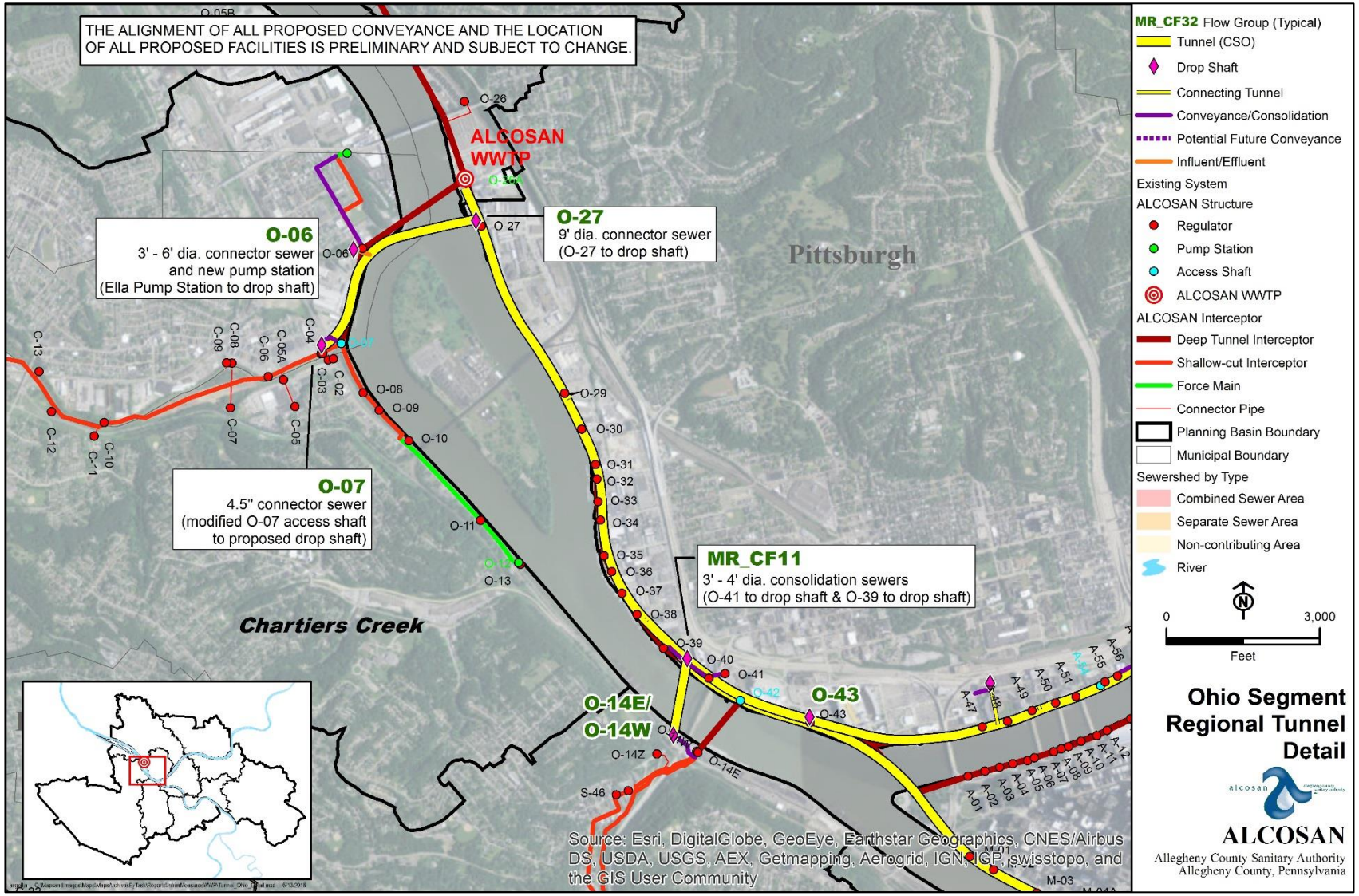
Consolidation and connector sewers will convey excess wet weather flows (which exceed the capacity of connections to the existing interceptor) to the regional tunnel drop shafts as shown in Figure 11-5. Controls for O-40 and O-41 are sized to eliminate overflows in the typical year as they are directly impacting a Sensitive Area.

Flows from Saw Mill Run POCs O-14E and O-14W will be conveyed via a nearby drop shaft and tie into the Ohio River tunnel segment near O-39.

The most upstream drop shaft serving the Chartiers Creek basin is in the vicinity of ALCOSAN access shaft O-07 and will not receive flow from one or several POCs like most other drop shafts. Instead, the drop shaft will relieve the existing Chartiers Creek interceptor when flows exceed the existing interceptor capacity. A new junction chamber will receive wet weather flows from the O-07 shaft and direct them to the new tunnel drop shaft, and may be designed to accommodate two other influent pipes that could be connected in the future. The first influent pipe would be a parallel Chartiers Creek relief interceptor. The second would be a wet weather relief sewer serving sewersheds O-01 through O-05B. Such a future connection would handle excess wet weather flows from the southern portion of the Lower Ohio basin (POCs O-01 through O-05 plus O-05A and O-05B).

The other proposed drop shaft serving the Chartiers Creek basin is near ALCOSAN structure O-06. Flow to this proposed drop shaft will be conveyed by gravity in dry weather conditions. As currently envisioned, wet weather flows will be conveyed to the proposed drop shaft by a new pump station located near the existing Robb Street Pump Station, as seen in Figure 11-5. The new pump station near O-06 will replace both the Ella Street Pump Station and the Robb Street Pump Station. As part of the advanced planning process, the alternatives for conveying flow to this drop shaft will be revisited and modifications may be submitted for Agency approval.

Figure 11-5: Ohio River Tunnel Segment



11.2.8 Allegheny River Tunnel and Facilities

Controls along the Allegheny River are conveyance based, predominantly consisting of a segment of the ALCOSAN regional tunnel with associated structures, shafts and consolidation sewers that carry excess wet weather combined sewer flows to the tunnel drop shafts. The controls also include adjustments to a number of existing regulators to maximize conveyance to the existing interceptor drop shafts, thereby reducing overflow frequency. This tunnel segment may also include a tunnel relief outfall at the upstream end, and several cross-connections to the existing tunnel. A preliminary alignment of the Allegheny River tunnel segment and associated controls is shown in Figure 11-6.

Regional Tunnel

The Allegheny River segment of the ALCOSAN regional tunnel will begin at a proposed shaft near ALCOSAN structure A-42 and continue downstream, paralleling the existing deep tunnel interceptor until it reaches a proposed junction shaft near ALCOSAN structure O-39. The segment will likely be constructed in two different tunneling reaches with an intermediate construction shaft. The entire Allegheny River tunnel segment will convey excess wet weather flows from ten drop shafts and from several cross-connections with the existing interceptor. At the downstream end of this segment, the regional tunnel will connect to the Ohio River tunnel segment. A summary of the Allegheny River drop shafts is included in Table 11-5. Points of connection shown in red correspond to outfalls which are directly impacting Sensitive Area.

Table 11-5: Allegheny River Tunnel Segment Drop Shafts

Flow Group	ALCOSAN Points of Connection Served	Drop Shaft Capacity[1] (MGD)
UA_A-42	A-42	1340
UA_A-41	A-41	500
UA_CF04	A-69, A-70, A-71, A-72, A-73, A-74, A-75, A-76, A-77, A-78	430
UA_A-68	A-68	170
MR_CF04	A-29, A-29Z	110
MR_A-22	A-22	500
LNA_CF10 / MR_CF36	A-60, A-61, A-62, A-64, A-65, A-67	210
MR_CF34	A-56, A-58	120
MR_CF32	A-47, A-48	130
MR_O-43	O-43	12

[1]Based on peak flow during Typical Year model simulations

Figure 11-6: Allegheny River Tunnel Segment, Part 1 of 2

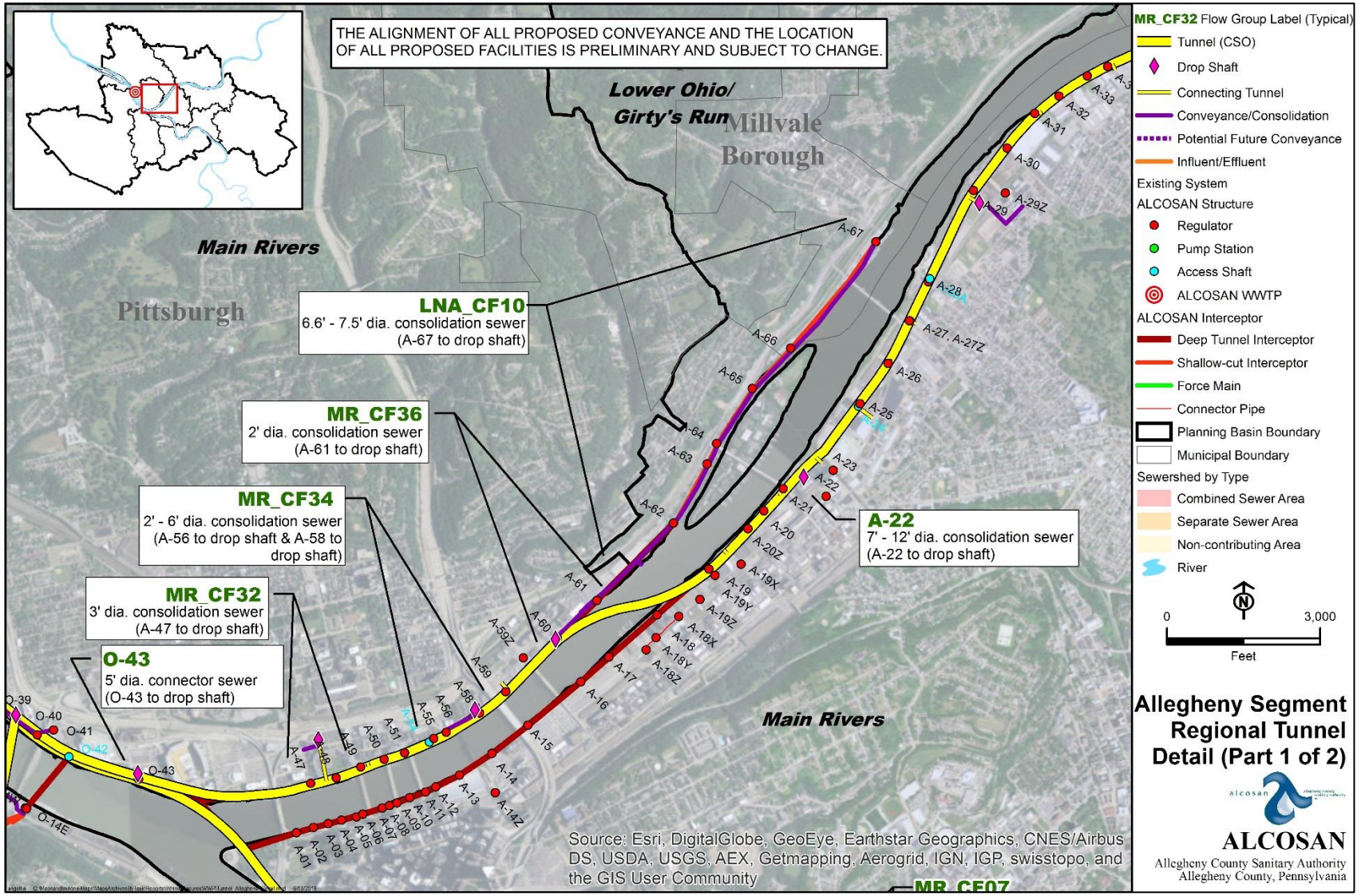
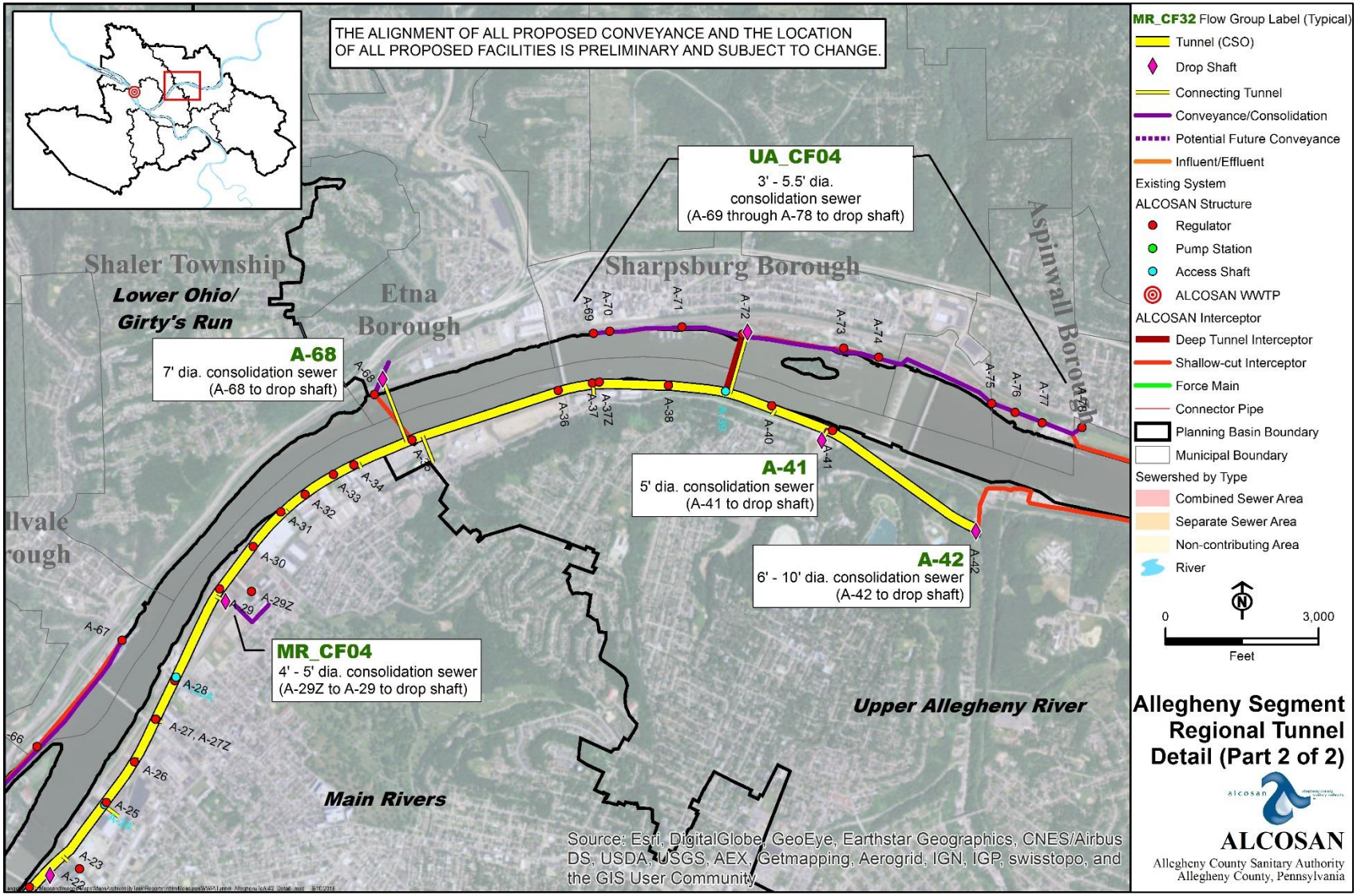


Figure 11-6: Allegheny River Tunnel Segment, Part 2 of 2



Consolidation and Connector Sewers

Consolidation and connector sewers will convey excess wet weather flows (which exceed the capacity of connections to the existing interceptor) to the regional tunnel drop shafts as shown in Figure 11-6. Controls for consolidation group LNA_CF10 (A-62, A-64, A-65 and A-67) and O-43 are sized to eliminate overflows in the typical year as they are directly impacting a Sensitive Area.

11.2.9 Monongahela River Tunnel and Facilities

Controls along the Monongahela River are conveyance based, predominantly consisting of a segment of the ALCOSAN regional tunnel with associated structures, shafts and consolidation sewers that carry excess wet weather combined sewer flows to the tunnel drop shafts. The controls also include adjustments to a number of existing regulators to maximize conveyance to the existing interceptor drop shafts, thereby reducing overflow frequency. This tunnel segment may also include a tunnel relief outfall at the upstream end and a cross-connection to the existing tunnel. A preliminary alignment of the Monongahela River tunnel segment and associated controls is shown in Figure 11-7.

Regional Tunnel

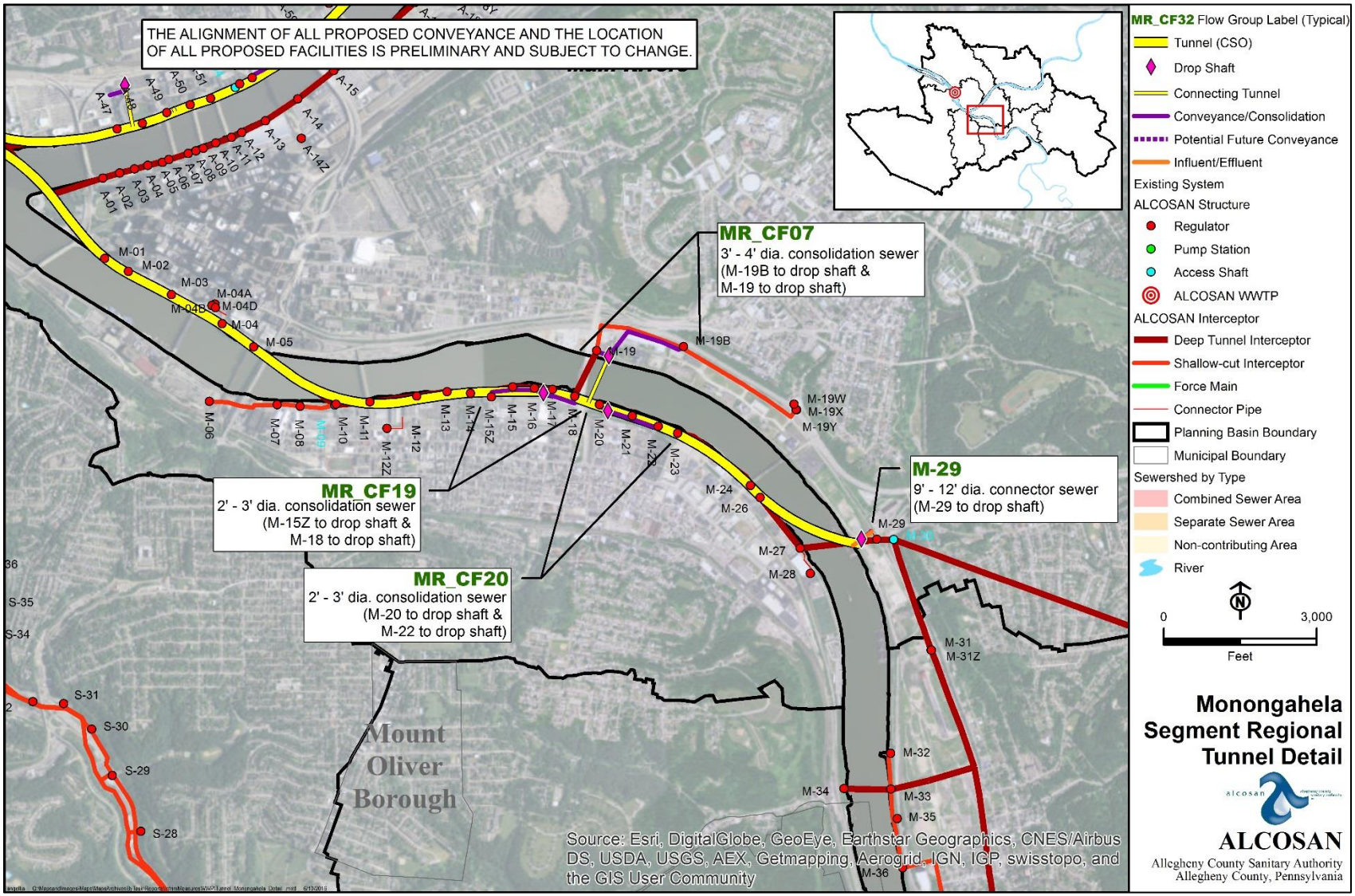
The Monongahela River segment of the ALCOSAN regional tunnel will begin at a proposed shaft near ALCOSAN structure M-29 and continue downstream, paralleling the existing deep tunnel interceptor until it reaches a proposed junction shaft near ALCOSAN Structure O-39. The tunnel segment will convey excess wet weather flows from four drop shafts and from the cross-connection with the existing interceptor. At the downstream end of this segment, the regional tunnel will connect to the Ohio River tunnel segment. If necessary, as part of the FMP, a future extension of the Monongahela River tunnel could extend up to near M-51, conveying flow from several drop shafts and a cross-connection to where it will tie into the first Monongahela River tunnel segment. A summary of the Monongahela River drop shafts is included in Table 11-6 below. Points of connection shown in red correspond to outfalls which are directly impacting Sensitive Areas.

Table 11-6: Monongahela River Tunnel Segment Drop Shafts

Flow Group	ALCOSAN Points of Connection Served	Drop Shaft Capacity[1] (MGD)
MR_CF19	M-15Z, M-15, M-16, M-17, M-18	170
MR_CF07	M-19, M-19B	180
MR_CF20	M-20, M-21, M-22	50
M-29	M-29	420

[1]Based on peak flow during Typical Year model simulations

Figure 11-7: Monongahela River Tunnel Segment



Consolidation and Connector Sewers

Consolidation and connector sewers will convey excess wet weather flows (which exceed the capacity of connections to the existing interceptor) to the regional tunnel drop shafts as shown in Figure 11-7. Controls for consolidation group MR_CF20 (M-20, M-21 and M-22) and M-18 are sized to eliminate overflows in the typical year as they are directly impacting a Sensitive Area.

11.2.10 Upper Monongahela CSO Retention Treatment Basin

Controls in the Upper Monongahela basin include a CSO retention treatment basin (RTB), a consolidation sewer and associated regulator modifications. A preliminary location for the RTB and associated conveyance is displayed in Figure 11-8. These improvements are sized to control the M-42, M-43 and M-44 CSOs, but may be sized to also accommodate future control of the M-45 and M-49 CSOs via a future extension of the consolidation sewer and expansion of the RTB. Controls for outfall M-43 will be sized to eliminate overflows in the typical year as it is directly impacting a Sensitive Area. The preliminary sizing described below assumes all upstream municipal source reduction measures are not constructed. However, the need for this project and is sizing may change significantly before proceeding with preliminary design depending on municipal flow reduction efforts and regionalization.

The RTB will provide screening, settling, floatables control via fixed baffles, and disinfection of combined sewage. Coarse screens located upstream of the influent pumps for the storage basin will remove the larger solids and debris from the flow stream. ALCOSAN shall provide a preliminary basis of design for this structure as part of the preliminary basis of design report due October 1, 2020.

For small storm events which do not fill the RTB, captured flow and solids which remain in the RTB after the event shall be pumped back to the existing interceptor when the basin is dewatered after an event. For larger storm events that fill the RTB, the basin will begin operating in a flow through treatment mode and will discharge disinfected effluent to the Monongahela River through a new outfall. As with smaller events, captured flow and solids which remain in the RTB after the event shall be pumped back to the existing interceptor after the event. Flow in excess of the pumping and treatment capacity will be diverted around the RTB without disinfection, likely discharging to the Monongahela River through a new outfall which also conveys the RTB's treated effluent.

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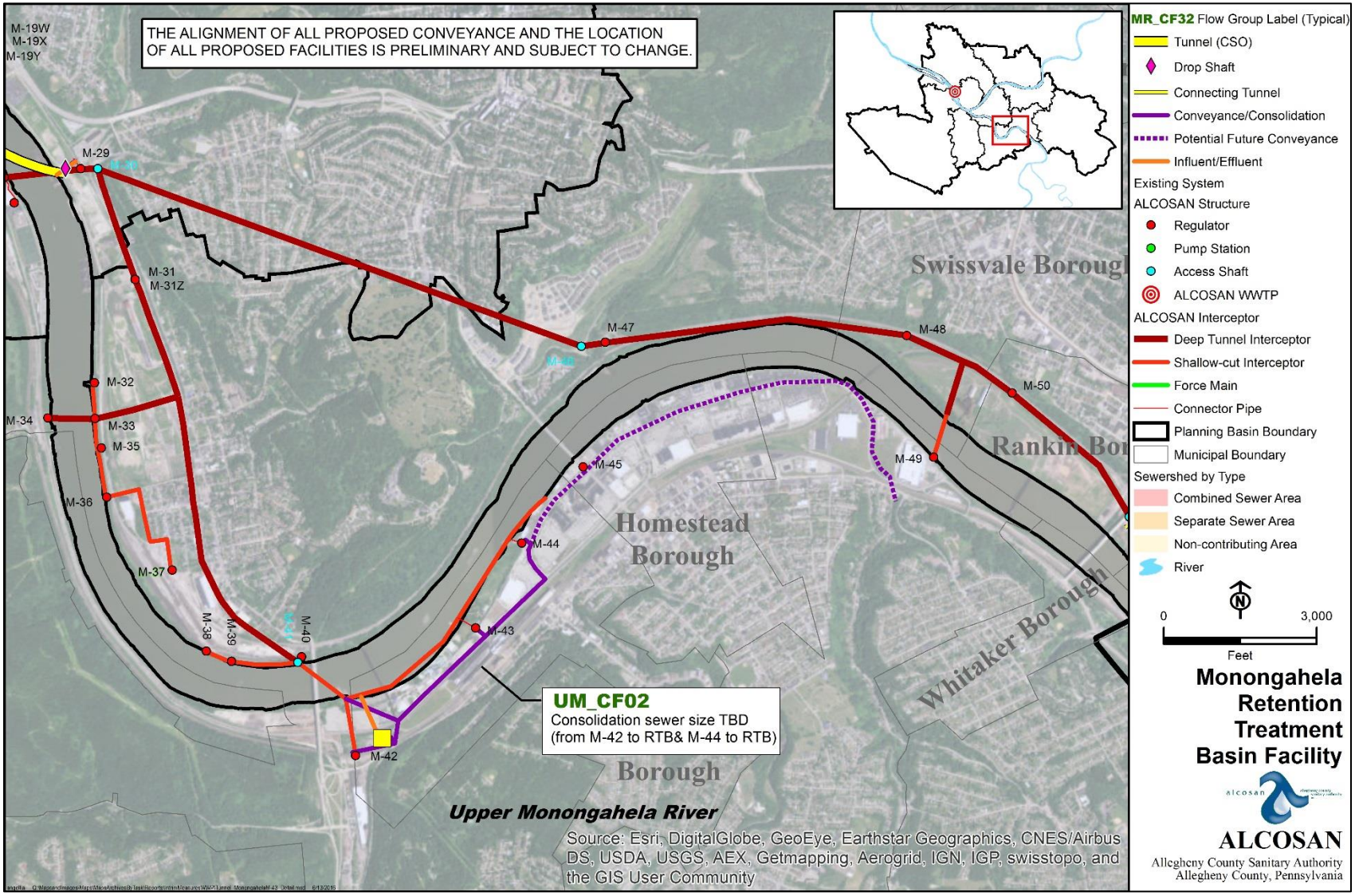
Figure 11-8: Monongahela Retention Treatment Basin Facility



11.2.11 Interim Measures Wet Weather Plan Performance

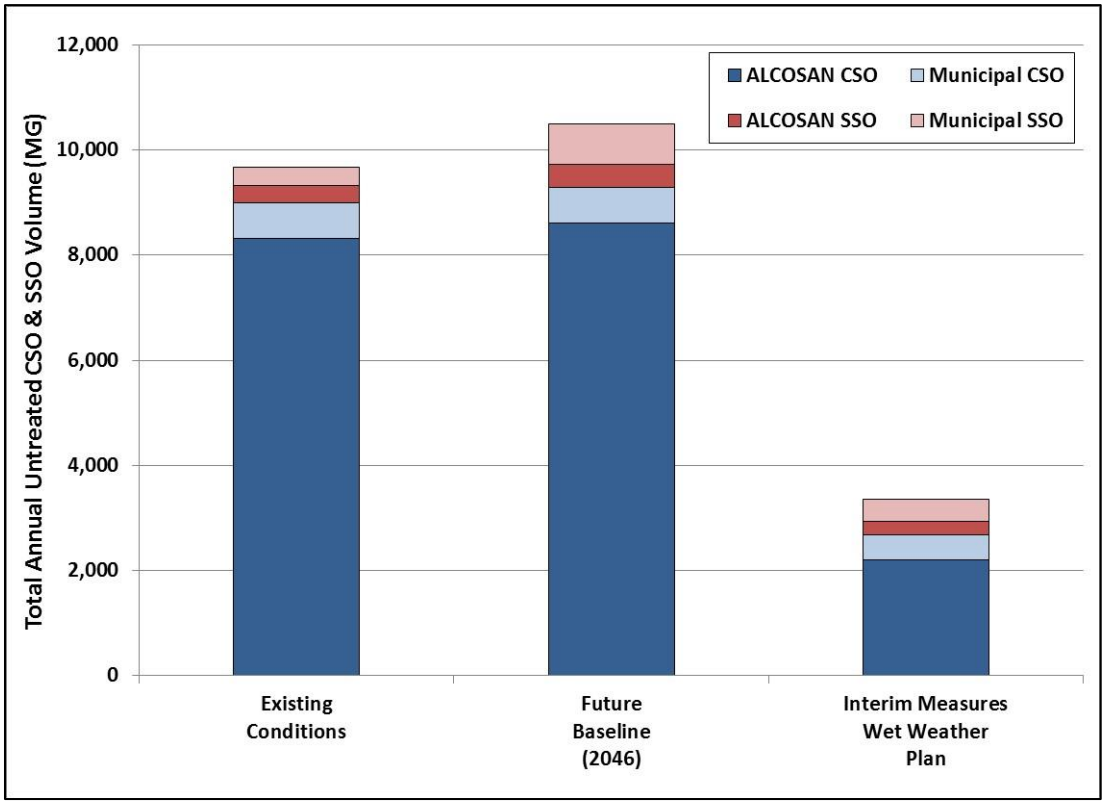
This section summarizes the anticipated performance of ALCOSAN's IWWP. Despite regional affordability constraints, the IWWP makes substantial progress towards CWA goals, which will be fully realized following implementation of the subsequent phases. The IWWP establishes a strong foundation for meeting all established objectives by focusing on priority improvements that allow for cost-effective adaptive expansion.

Since municipal wet weather projects in the service area have not yet been decided upon and the regionalization on intermunicipal trunk sewers is in progress, the performance presented and described in this section are based on future flow projections with no municipal improvements or flow reduction. The expected performance of the IWWP will be updated in the future after municipal projects have been determined, municipalities have entered into enforceable flow reduction agreements, and ALCOSAN has identified priority projects to control overflows along transferred sewers.

Reduced CSO and SSO Discharge Volumes

Under the IWWP, ALCOSAN and municipal CSO discharge volume is projected to decrease from 9.3 billion gallons per typical year (projected future baseline conditions) to 2.7 billion gallons. Figure 11-9 presents the substantial overflow reduction progress that will be accomplished, showing total annual untreated CSO and SSO volume discharged from ALCOSAN and municipal outfalls combined.

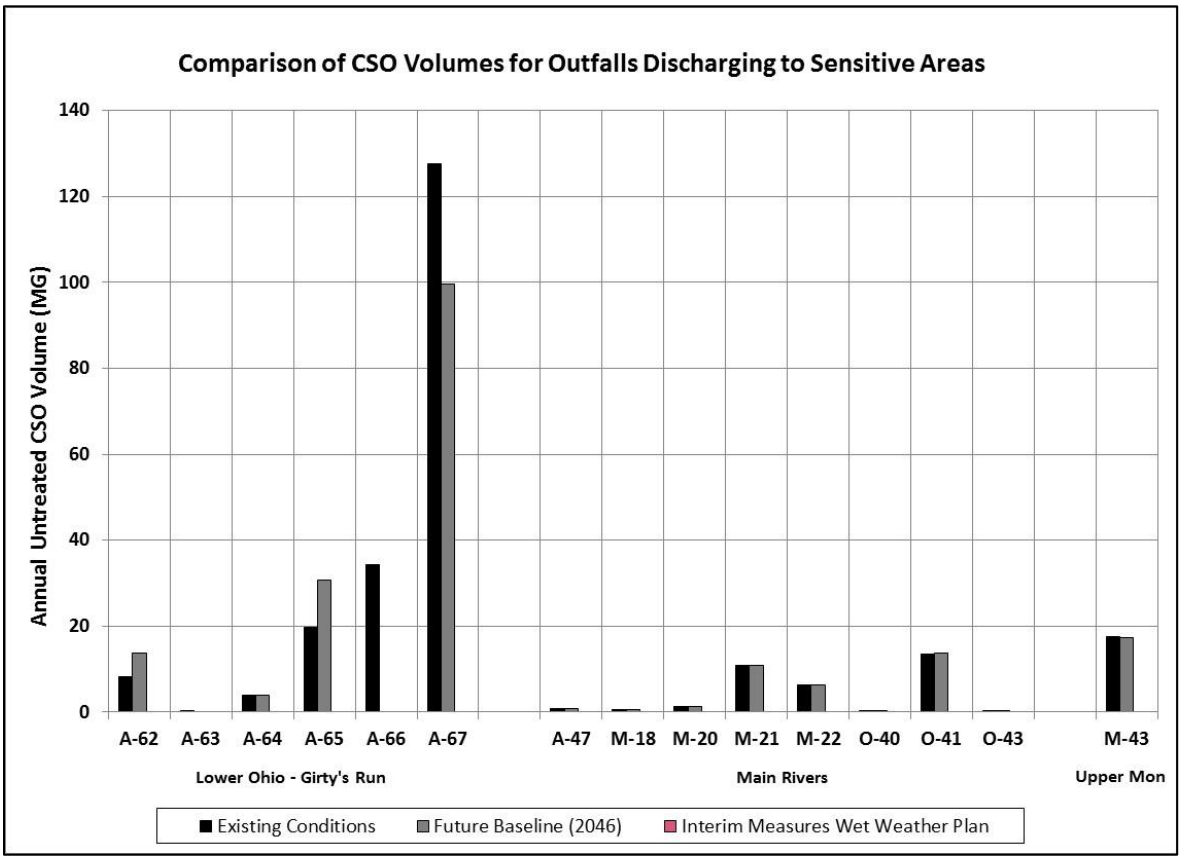
Figure 11-9: Overflow Volume Reduction Comparison for Interim Measures Wet Weather Plan



Enhanced Control of CSOs that Directly Impact Sensitive Areas

The IWWP provides a higher level of control to fifteen CSOs that discharge directly to Sensitive Areas. CSOs discharging to these areas are controlled to zero overflows/typical year or are re-located downstream of the Sensitive Area. Figure 11-10 shows the outfalls which directly impact sensitive areas and the volume of overflow associated with these outfalls for the typical year.

Figure 11-10: Sensitive Area CSO Volume Analysis for Interim Measures Wet Weather Plan



As the performance results presented within this sub-section show, the IWWP will achieve significant overflow reduction and initiates a long-term implementation strategy focused on cost effective and adaptive compliance with CD requirements. Since municipal flow reduction and regionalization impacts have not yet been integrated into the regional WWP, the IWWP is premised on adaptive implementation, as described in Section 11.3.7. ALCOSAN's phased and adaptive implementation framework will provide the flexibility necessary to integrate GSI and other source controls into the IWWP and subsequent phases of the WWP, as appropriate.

11.3 Implementation Plan

This section details ALCOSAN's plan for the successful delivery of the IWWP by December 31, 2036; and ALCOSAN's adaptive management strategy for the development of subsequent phased improvements.

11.3.1 Implementation Schedule

This section describes the proposed implementation schedule for the overflow control projects included in the IWWP. It also describes the basis of the schedule and identifies several factors that can affect the implementation schedule. Figure 11-11 shows the implementation schedule for the overflow control projects as included in the key described in Section 11.2.

ALCOSAN's implementation of the IWWP will proceed in an adaptive fashion in regards to flows contributed by its customer municipalities. As described in Section 9.3, prior municipal orders (COA or ACO) required the development of MFS to evaluate alternatives for elimination of SSOs and control of CSOs from municipal sewer systems. Those MFS were submitted to the regulatory agencies in July 2013 and largely reflect increased conveyance to the ALCOSAN system at a total cost of more than $500 million. Since that time the following developments which impact those projects have brought uncertainty to when and if those projects will be implemented:

- Another round of municipal orders has granted municipalities additional time to evaluate source reduction opportunities;
- The agencies have mandated that ALCOSAN establish flow targets for the customer municipalities which could result in significant reductions in the municipal flow projections used to size ALCOSAN conveyance and facilities; and
- 200 miles of inter-municipal trunk sewers are proposed to be transferred to ALCOSAN along with responsibility for needed improvement projects.

As a result, ALCOSAN's implementation of the IWWP will initially proceed using future flow rate projections at each ALCOSAN POC as reflected in the municipal feasibility studies. Such projections will be used by ALCOSAN to establish the initial basis of design for proposed ALCOSAN improvements in the IWWP. However, based on the many adaptive management provisions within the IWWP and the modified CD, ALCOSAN will update that basis of design in the future as specific municipal projects are identified and municipal flow reduction commitments are memorialized.

The implementation schedule presumes that the PaDEP will approve ALCOSAN's 537 Special Study and issue a Part 1 National Pollutant Discharge Elimination System (NPDES) permit by February 2018, and that the permit will reflect: a secondary bypass; high rate operation of the primary clarifiers; and a new outfall with effluent limits established in accordance with the proposed concept described in Section 11.3.2.

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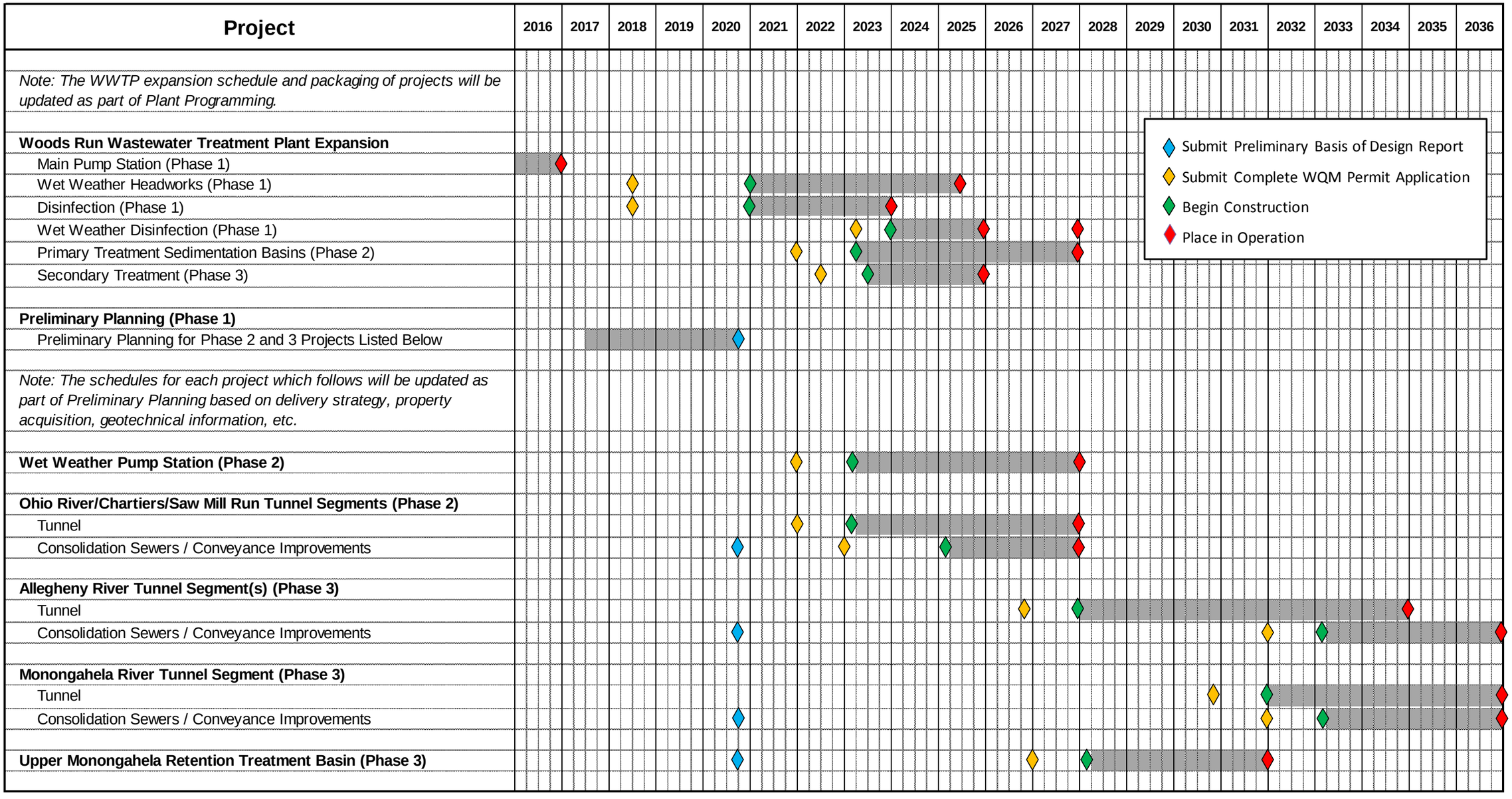
Figure 11-11: Schedule of Activities for ALCOSAN's Interim Measures Wet Weather Plan



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Schedule Factors

The foundation for the implementation schedule is the IWWP described in this Section 11. Recognizing the implementation schedule is for planning purposes, unexpected events and uncertainties will require that this schedule be adjusted accordingly. The following list summarizes a range of uncertainties that may affect the implementation schedule:

- Changes to the Clean Water Act, National CSO policy; USEPA or PaDEP rules, regulations, or water quality standards
- Changes to ALCOSAN's NPDES permits
- Future judicial or administrative orders
- Timing of land acquisition, permits and approvals for construction
- Findings of preliminary design
- Escalation of costs
- Fluctuation of labor and material markets
- Unforeseen construction issues
- Changes to funding capacities and mechanisms
- Changes to the assumed municipal improvements, municipal source control commitments, and the ultimate scope of regionalization could require modifications to particular components of the IWWP.

Throughout implementation of the IWWP, the schedule will be monitored and adjusted through periodic reviews to incorporate new data and assess impacts on all steps of the capital improvements. This is further described in Section 11.3.7: *Adaptive Management*.

11.3.2 Operation and Maintenance

ALCOSAN has a comprehensive operation and maintenance (O&M) program to ensure consistent and reliable operation of the existing collection and treatment system. This program has been documented as complying with the CSO policy requirements for Nine Minimum Controls and numerous other CD requirements that go beyond the Policy. This sub-section briefly summarizes the current O&M program and how that program will be updated as the Wet Weather Plan is implemented. In addition, since the WWP includes a proposed bypass of the secondary treatment process during some wet weather events, this sub-section describes the required wet weather routing plan for future operation with the bypass.

Current Operation and Maintenance Program

ALCOSAN's current O&M program consists of the following:

Operation & Maintenance Manuals – In accordance with paragraph 8 of Appendix I of the CD, ALCOSAN maintains two libraries at its treatment plant as central locations for current O&M manuals for equipment considered critical to its operations, including operation of the main sewage pumps and other pumps. In addition, manuals regarding specific pump operations are available at ALCOSAN's remote pump stations. The manuals are catalogued in a computerized

data base to provide ready access and location information. For new equipment, vendors must supply operating instructions, a maintenance summary, description and frequency of maintenance activity, lubricant list, and recommended spare parts. ALCOSAN has a procedure for cataloging and disseminating these manuals to the two on-site libraries and other appropriate locations. In addition, as new equipment is acquired, procedures are in place to add data to ALCOSAN's computerized maintenance management database and to place recommended spare parts into inventory.

MP-2 Automated Operation and Maintenance Management System - The MP-2® system is an automated O&M management system that develops work orders, documents and archives field maintenance activities, and produces reports for managerial staff. The primary use of the system is to schedule and manage preventive maintenance activities and ensure that complaints and needs observed in the field are resolved in a timely manner. Observed conditions, problems and corrective actions at critical facilities in the ALCOSAN conveyance system are documented and entered into the Regional Conveyance Interceptor (RCI) Data Retrieval System using an automated bar-code system known as the Dolphin® System. Automated preventive maintenance reports for ALCOSAN facilities are generated by the MP-2 system on a trimester basis in January, May and September. Both the MP-2® and RCI Data Retrieval systems are used to prepare monthly, quarterly, semiannual and annual reports for regulatory agency review and compliance. The system also is used to conduct trending analyses for key operational parameters of the system, including the frequency, duration and volume of overflows.

Revised Nine Minimum Control Plan – ALCOSAN submitted the Revised Nine Minimum Control Plan on February 17, 2009. The most recent agency review comments were received in June 2011. ALCOSAN responded to all agency comments in July 2011 but a formal approval of the Plan has not been received from the agencies. The Plan describes ALCOSAN's implementation of the Nine Minimum Controls (NMC) in accordance with USEPA guidance documents. ALCOSAN continues to employ the NMC practices documented in this Plan.

Sewage Treatment Plant Wet Weather Operating Plan – ALCOSAN's Wet Weather Flow Sewage Treatment Plant Operating Plan was approved by USEPA in its letter of February 2, 2009, and a revised Operating Plan was approved by USEPA in its letter of June 11, 2009. This Plan documents ALCOSAN's compliance with paragraphs 23 (Operation of Plant Influent Pumps) and 24 (Sewage Treatment Operating Plan) of the CD. The Operating Plan is not intended to be an explanation of ALCOSAN's wastewater treatment process, but rather is focused on the operating plan to be used before, during and after wet weather flow events. The Operating Plan considers wet weather flow events to be events that increase flows to and through the regional conveyance system such as rainstorms or snow melt. ALCOSAN's Operating Plan also addresses responses at the treatment plant necessary during those periods in which the Ohio River elevation rises through the various flood stages, referred to in the Operating Plan as river elevation events.

Operation and Maintenance Program Updates for Wet Weather Plan

As required by the CD, ALCOSAN will prepare annual updates to the current O&M manuals to incorporate any new facilities which are part of the IWWP that have been placed into operation in the preceding year. The annual updates will begin after the first proposed facilities from the IWWP are constructed and placed into operation, and will follow a two-step process:

Step 1: Proposed Operation and Maintenance Practices – ALCOSAN will submit to USEPA and PaDEP, for review and approval, the proposed best management practices for the O&M of each facility that is placed into operation for the first time in the prior year. The facilities are expected to be placed into operation in accordance with the sequence shown in the implementation schedule presented in Section 11.3.1.

Step 2: Operation and Maintenance Manual Updates – Upon approval by USEPA and PaDEP, ALCOSAN will incorporate the proposed best management practices into its e current O&M manuals.

In addition to the annual updates to the O&M manuals, ALCOSAN will make the following updates within six (6) months after placing tunnel segments, consolidation sewers and the retention treatment basin into operation. ALCOSAN will amend all applicable portions of submissions and databases required by the Appendices referenced in Section VI.F of the Amended Consent Decree to reflect substitutions or additions to the construction, operation and maintenance of the facilities.

Lastly, ALCOSAN will update its O&M Plan to incorporate all inter-municipal trunk sewers and associated facilities, once they have been transferred to ALCOSAN. The O&M Plan revision may also propose modifications to the Consent Decree appendix which governs operation and maintenance of the conveyance and treatment system.

Wet Weather Routing Plan

Since the proposed expansion of the Woods Run WWTP includes a bypass of secondary treatment during wet weather, the CD requires a Bypass Demonstration in accordance with Appendix T and a Wet Weather Routing Plan in accordance with Paragraph 62 to be included in the WWP. Section 9.2.5 summarizes the Bypass Demonstration for the WWTP in compliance with Appendix T and the Wet Weather Routing Plan is presented below.

The anticipated specific actions for wet weather operation of the WWTP at up to 480 mgd under Phase 1 of the IWWP are as described below. This preliminary plan is subject to refinement during the design phase of the WWP implementation:

Prior to Wet Weather Event

1. Inspect and verify raw sewage pumps in the Main Pumping Station are ready and set-up for wet weather operation with pump discharges appropriately aligned to existing headworks and wet weather headworks. A minimum of four pumps will be available for service.

2. Prepare additional screening and grit removal process trains for wet weather operation; pre-fill screening channels and grit tanks and initiate operation.

3. Prepare primary sedimentation tanks for wet weather operation; pre-fill tanks and initiate operation. Verify sludge blankets in the primary sedimentation tanks are low; pump down sludge blankets if necessary. Separate waste activated sludge thickening facilities are proposed as part of the capital improvements so that co-settling of primary

and waste activated sludge in the primary sedimentation tanks (current practice) is not performed during wet weather.

4. Verify wet weather disinfection process is ready for service and pre-fill chlorine contact tank if necessary.

5. Verify adequate number of aeration basins and final settling tanks are in service for operation at 250 mgd and similarly verify adequate secondary effluent disinfection is ready.

During Wet Weather Event

1. Operation of the Main Pumping Station will be automatically controlled based on water levels in the wet wells and flow monitoring feedback from the WWTP through the plant wide distributed control system. The maximum wet weather flow pumped to the WWTP is 480 mgd under Phase 1 of the IWWP.

2. As wet weather flow exceeds 250 mgd the secondary bypass will be initiated along with the wet weather disinfection process. Automatic flow controls will maintain flow to secondary treatment at 250 mgd throughout the wet weather event. Operational experience will determine optimum process operating conditions for the aeration basins and final settling tanks (i.e., return ratios, wasting rates and sludge blankets) during wet weather conditions.

3. Operators will monitor treatment processes by field inspection and the distributed control system to verify proper operation or identify problems and take corrective action.

4. Automatic sampling and instrumentation will provide continuous feedback on chlorine residual in the wet weather disinfection process and adjust chemical dosing as necessary and provide samples for laboratory analysis of discharge quality.

5. The maximum peak flow rate into the plant during wet weather will be 480 mgd as maintained through pump speed controls in the Main Pumping Station and flow monitoring in the WWTP.

After the Storm Event

1. As the plant influent flow drops below 250 mgd the secondary bypass and wet weather disinfection processes will be stopped and all flow will be directed to secondary treatment.

2. The plant will remain operationally ready for wet weather operation until it is determined the storm system has cleared and there are no additional storms anticipated.

3. Dry weather operation will be restored by sequentially taking process units out of service. Draining and cleaning operations will be sequenced to avoid excessive recycle flow and loadings on the WWTP.

The Wet Weather Routing Plan for operation of the WWTP under Phase 2 and 3 of the IWWP is essentially the same as described above except the operation of the new Tunnel Dewatering Pumping Station shall be coordinated with operation of the existing Main Pumping Station to provide total influent pumping capacity. The total influent pumping capacity and treatment capacity will be 600 mgd under Phase 2 of the IWWP and secondary treatment capacity will increase from 250 to 295 mgd under Phase 3 of the IWWP. Additional pumping, headworks and primary treatment process units are placed in-service for wet weather operation up to 600 mgd. The additional operational and maintenance measures required following the WWTP expansion will be integrated into the existing O&M procedures described in Section 11.3.2.

The size of the storm event and the resulting variation of wet weather flows to the WWTP do not change the basic wet weather operating strategy to maximize full secondary treatment of flow up to the proposed capacity of 295 mgd (or 250 mgd after Phase 1 and 2). The key factors for successful operation of the WWTP during storm events are the preparation of process units and the transition into secondary bypass when flows exceed 295 mgd.

The preparation element refers to those actions noted above as *Prior to Wet Weather Event* with the objective to have sufficient treatment process units in-service, or on ready standby. Smaller storms may allow for fewer process units to be placed in-service as future operating experience reveals.

The transition into wet weather operation at the WWTP via the initiation of a secondary bypass for flows above 295 mgd (or above 250 mgd after Phase 1 and 2) is a function of sequencing the diversion of primary effluent to wet weather disinfection facilities. Although the detailed transition procedures will be refined during design, the operating concept is the rate of flow entering the plant will ramped up to 295 mgd via control of the raw sewage pumping rate and held until the bypass control gate located at the west end of the primary effluent channel is opened and the wet weather chlorine contact tank is placed in operation. The wet weather chlorination/dechlorination disinfection process will be designed via automatic chemical feed controls to respond to variations in wet weather flow based on flow monitoring and chlorine residual monitoring instrumentation.

Section L (Paragraphs 62.c and 62.d) of the CD requires an estimated reduction in biochemical oxygen demand (BOD) and total suspended solids (TSS) that ALCOSAN shall achieve upon implementation of the Wet Weather Routing Plan and to propose a date when such percent reductions shall become enforceable under the CD. Two methods were employed to evaluate performance criteria for the proposed Wet Weather Routing Plan; primary stress testing and water quality modeling, as presented below.

Primary Stress Testing - As described in Sections 9.2.1 and 9.2.2, ALCOSAN performed full scale stress testing of the primary treatment process to evaluate hydraulic capacity and evaluate process performance at the proposed high rate operation during wet weather. The stress testing program provided a unique opportunity to obtain primary treatment process performance data without the influence of waste activated sludge (WAS) co-settling. The proposed Wet Weather

Routing Plan eliminates the current practice of co-settling in the primary tanks and separately handles WAS through a new mechanical thickening process prior to dewatering and disposal. This testing concluded that the primary sedimentation tanks have a unit hydraulic (peak flow) capacity of 60 mgd which corresponds to a peak surface overflow rate of 3,100 gpd/ft^2. Under stress testing conditions, the primary treatment process exhibited average daily BOD removals during dry and wet weather periods of 50% and 44%, respectively; and average daily TSS removals of 68% and 61% during dry and wet weather, respectively. The TSS and BOD percent removals were subject to wide fluctuations resulting from the variation in wet weather duration and influent concentrations. However, it was observed the primary effluent TSS and BOD concentrations were less subject to fluctuations and remained approximately 50 mg/L during dry and wet weather conditions.

An analysis was performed of the predicted discharge characteristics using the typical year flow model and the Woods Run WWTP expansion to 600 mgd peak flow capacity. The combined effluent quality of flows receiving full treatment and flows bypassing secondary treatment during wet weather resulted in TSS and BOD mass loadings and discharge concentrations below the current NPDES monthly maximum, weekly maximum and instantaneous maximum limits for the plant. The facility was also predicted to maintain a monthly overall TSS and BOD removal of 85% or greater.

Water Quality Modeling - Using the water quality model developed for the Selected Plan, an hourly time series of plant flow and influent TSS and BOD concentrations was prepared for the typical year rainfall pattern including future base flows. From this model, an analysis was conducted to determine the effects of primary treatment process performance (i.e., percent TSS and BOD removals) on the overall performance and quality of the plant discharges. This analysis assumed, based on historical data, that the plant effluent receiving secondary treatment has BOD and TSS concentrations at or below 10 mg/L and 15 mg/L TSS, respectively. The percent removals in the primary treatment process were varied to determine the lowest allowable percent BOD and TSS removals to maintain monthly average overall removals above 85 percent, as required in the NPDES permit. The analysis indicates the primary treatment process needs to achieve at least 25% BOD reduction and 60% TSS reduction to maintain above 85% TSS and BOD monthly average removals during the typical year.

Allowing one year for collection of WWTP performance data after the expanded plant is placed into operation, the anticipated date by which final performance criteria can be established, either as percent removals or limiting concentrations, is one year after the initiation of operation of the three phases of the plant expansion. As shown in the implementation schedule for the IWWP presented in Section 11.3.1, all three phases of the plant expansion are to be placed in operation by December 31, 2027, so the enforceable performance criteria would be submitted by December 31, 2028.

Staffing

In developing the WWP, ALCOSAN has prepared preliminary estimates of O&M costs – including labor – for purposes of evaluating and comparing various wet weather control alternatives. The actual level of staffing for O&M will be determined during the implementation of the program and gradually increased as the proposed facilities are constructed and placed into service. Operator experience gained with the first new facilities

placed into service will refine the staffing plans for later facilities. At a minimum, O&M staffing will be reviewed annually as part of the annual budget process.

11.3.3 Interim and Post-Construction Monitoring Plan

There are two primary objectives of the Interim and Post-Construction Monitoring Plan (IPCMP). The first is to confirm, via H&H monitoring and modeling that IWWP projects accomplish established performance expectations, once completed. The second objective is to support the development of a Final Measures Plan which identifies any remaining controls necessary, via receiving water quality monitoring and modeling, to meet the full requirements of ALCOSAN's CD. This section discusses the methods and tasks to achieve these objectives.

Regulatory Requirements: USEPA requires CSO communities to conduct a post-construction monitoring program during and after WWP implementation "to help determine the effectiveness of the overall program in meeting Clean Water Act requirements and achieving local water quality goals [11-2]." The program should collect data that measure the effectiveness of CSO controls and their impact on water quality, and should utilize existing monitoring stations used in previous studies of the waterways and sewer system in order to compare results to conditions before controls were put in place. The program should include a map of monitoring stations, a record of sampling frequency at each station, a list of data to be collected, and a quality assurance/quality control (QA/QC) plan.

In USEPA's December 2001 Report to Congress: Implementation and Enforcement of the Combined Sewer Overflow Control Policy, the Agency noted the difficulty of establishing a monitoring and tracking program for CSO control programs. "Monitoring programs need to be targeted and implemented in a consistent manner from year to year to be able to establish pre-control baseline conditions and to identify meaningful trends over time as CSO controls are implemented," the report said. "In practice, it is often difficult, and in some instances impossible, to link environmental conditions or results to a single source of pollution, such as CSOs. In most instances, water quality is impacted by multiple sources, and trends over time reflect the change in loadings on a watershed scale from a variety of environmental programs." The report also noted that weather conditions and rainfall totals vary significantly from storm to storm and year to year, making comparisons difficult.

The proposed IPCMP recognizes these challenges and limitations of a monitoring program and will utilize updated H&H Models, supplemented by an ongoing monitoring program, to determine if performance measures are achieved.

Purpose and Scope: The IPCMP will collect data needed to determine whether CSO control measures have met the established Performance Criteria and to document stream improvements that can be attributed to implementation of CSO control measures.

As part of the planning and development of the WWP, ALCOSAN developed and calibrated an H&H Model of the collection system. This model was then used to document the baseline CSO

[11-2] *Combined Sewer Overflows, Guidance for Long-Term Control Plan* (EPA 832-B-95-002, August 1995), p. 4-15.

characteristics. ALCOSAN also completed a comprehensive receiving water assessment documenting water quality conditions in major CSO-impacted receiving streams. This assessment established baseline conditions for in-stream water quality data, as documented in Section 5.4.

The monitoring program has been developed based upon the following scope of work:

- Execute Interim Monitoring: Based on the receiving water assessments, ALCOSAN identified bacteria as the primary pollutant of concern. ALCOSAN will use fecal coliform and *E. coli* bacteria to monitor interim baseline water quality during the construction and implementation of long term CSO control measures on receiving streams.

- Prepare 2034 Update to the Post-Construction Monitoring Plan: Utilizing information gained during interim water quality monitoring and the construction and implementation of the CSO control measures, the Post-Construction Monitoring Plan will be revised as necessary to better evaluate the established Performance Criteria and identify any remaining controls necessary to meet the full requirements of the CD.

- Prepare and Execute Post-Construction Monitoring: The collection system post construction monitoring program will determine whether CSO control measures are performing as proposed to meet its Performance Criteria. The program will also identify how ALCOSAN will collect data needed to document receiving waters improvements achieved through implementation of these control measures.

- Evaluate Results and Prepare Final Measures Plan: Upon completion of all interim and post-construction monitoring, ALCOSAN will prepare a Final Measures Plan that evaluates whether the constructed IWWP projects have achieved the anticipated results and identifies remaining controls necessary to achieve any requirements of the CD not yet fulfilled.

Program Elements

IWWP Performance Criteria: Performance Criteria are those used to assess the performance of controls to determine whether they are meeting the Wet Weather Plan goals. For the IWWP, ALCOSAN has established the performance criteria listed below.

1. Reduction of untreated ALCOSAN CSO volume to 2,700 MG/year in a typical year
2. Control the following ALCOSAN CSOs near Sensitive Areas to zero overflows in a typical year, with the exception of one overflow in a typical year at A-67

Lower Ohio – Girty's Run

A-62, A-63, A-64, A-65, A-67

Main Rivers

A-47, M-18, M-20, M-21, M-22, O-40, O-41, O-43

Upper Monongahela

M-43

ALCOSAN will carry out the evaluation of performance criteria by collecting precipitation and flow monitoring data after the implementation and successful operation of all IWWP control measures. ALCOSAN will update and validate the H&H model prepared during development of the WWP using the collected monitoring data. The models will then be used to generate appropriate simulations demonstrating "typical year" compliance with the Performance Criteria.

Receiving Water Quality Measures: Water Quality Measures are those used to assess improvements in water quality of receiving streams due to implementation of wet weather overflow control measures. ALCOSAN will use bacteria (fecal coliform and *E. coli*) as its water quality measure. ALCOSAN will collect data to measure and evaluate improvements to in-stream bacteria counts that can be attributed to wet weather overflow control measures. CSO and SSO controls alone will not result in attainment of bacteria standards for water contact recreation due to numerous bacteria sources in the environment. Therefore, there are no performance criteria for bacteria as a water quality measure for the IWWP. Instead, ALCOSAN will analyze trends in both dry and wet-weather bacteria values and compare them to historic monitoring data and modeling predictions to determine improvement in water quality.

Interim and Post-Construction Monitoring and Data Collection

CSO Outfall Monitoring: During post-construction monitoring for the IWWP, selected ALCOSAN CSO outfalls will be monitored for activations after each wet weather event. Approximately 20 outfalls will be monitored for activation for one year. Outfalls will be monitored either with a recording depth meter or marked with chalk and a fishing bobber placed in the overflow opening. If the chalk is washed away and the bobber has been dislodged, an overflow event will assume to have occurred. CSO outfall locations will be determined and documented in the 2034 PCMP update.

SSO Outfall Monitoring: SSO outfalls will continue to be monitored during the interim and post-construction period for activations consistent with Appendix L Section 1c of the CD using a bobber/chalk method. Selected SSO monitoring locations within the ALCOSAN service area, together with their monitoring rationale, monitoring frequency, and monitoring protocols are presented in Table 11-7. These SSO outfall locations are shown on Figure 11-12.

Collection System Monitoring: Flow monitoring is currently being conducted at 10 shallow-cut interceptor locations and HGL levels are being monitored at 9 locations in the existing deep interceptors. These monitoring locations will continue to be operated and maintained. In addition, HGL level in the new deep tunnel will be monitored at 5 locations.

Table 11-7: List of SSO Outfall Monitoring Locations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
A-45	Fairview Avenue (Verona Borough)	Allegheny River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
A-82	First Street (Blawnox Borough)	Allegheny River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
A-85	Powers Run (O'Hara Township)	Allegheny River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-21	L.B., end of Thornburg Sewer opposite Crafton Borough Sewer (Thornburg Borough)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-26	L.B. rear of Columbia Steel & Shafting Co, Foot of Arch St. ext. (Rosslyn Farms	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-33	Vine Street (Carnegie Borough)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-42	Right Bank, foot of Center Way (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-45	RB, approximately 30 ft. U/S of West Main St. highway bridge (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-45A	L.B., landward side of RR Culvert, approx. 550 ft. U/S of highway bridge (Carnegie	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk

Table 11-7: List of SSO Outfall Monitoring Locations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
C-46	Left Bank, end of Grant Avenue near RR Bridge (Heidelberg Borough)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-47	R.B., across creek from American Steel Band Company (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-48	R.B., approx. 30 ft. D/S of East Railroad St. Highway Bridge (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-49	R.B., approx. 20 ft. D/S of Collier St. Highway Bridge (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-50	L.B., approx. 750 ft. D/S of Woodville Rd. Highway Bridge (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-50A	R.B., approx. 250 ft. D/S of Woodville Rd. Highway Bridge (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-50B	R.B., approx. 1400 ft. upstream of P.C.Y. RR Bridge (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-52	L.B., approx. 100 ft. D/S of P.C.C. & St. L. RR Bridge (Collier Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-53	Approx. 100 ft. D/S of mouth of Painters Run (Scott Township)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-54	Right bank, mouth of McLaughlin's Run (Bridgeville Borough)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
C-55	R.B., approx. 120 ft. D/S of Pgh. W. Va. RR Bridge (Bridgeville Borough)	Chartiers Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-15	O-15 Outfall structure (Emsworth Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk

Table 11-7: List of SSO Outfall Monitoring Locations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
O-16	Western Avenue (Ben Avon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-17	Irwin Avenue (Ben Avon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-18	Spruce Run (Ben Avon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-18y	Cliff Street lateral (Ben Avon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-18z	Ridge Ave. lateral (Ben Avon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-19	Birmingham Avenue (Avalon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-20	Elizabeth Avenue (Avalon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-21	West Street (Avalon Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-22	Meade Avenue (Bellevue Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-23	South Fremont Avenue (Bellevue Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
O-24	Shiloh Avenue (Bellevue Borough)	Ohio River	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
SMR.CS-14	Interceptor Relief at Grove Road (Castle Shannon Borough)	Saw Mill Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk

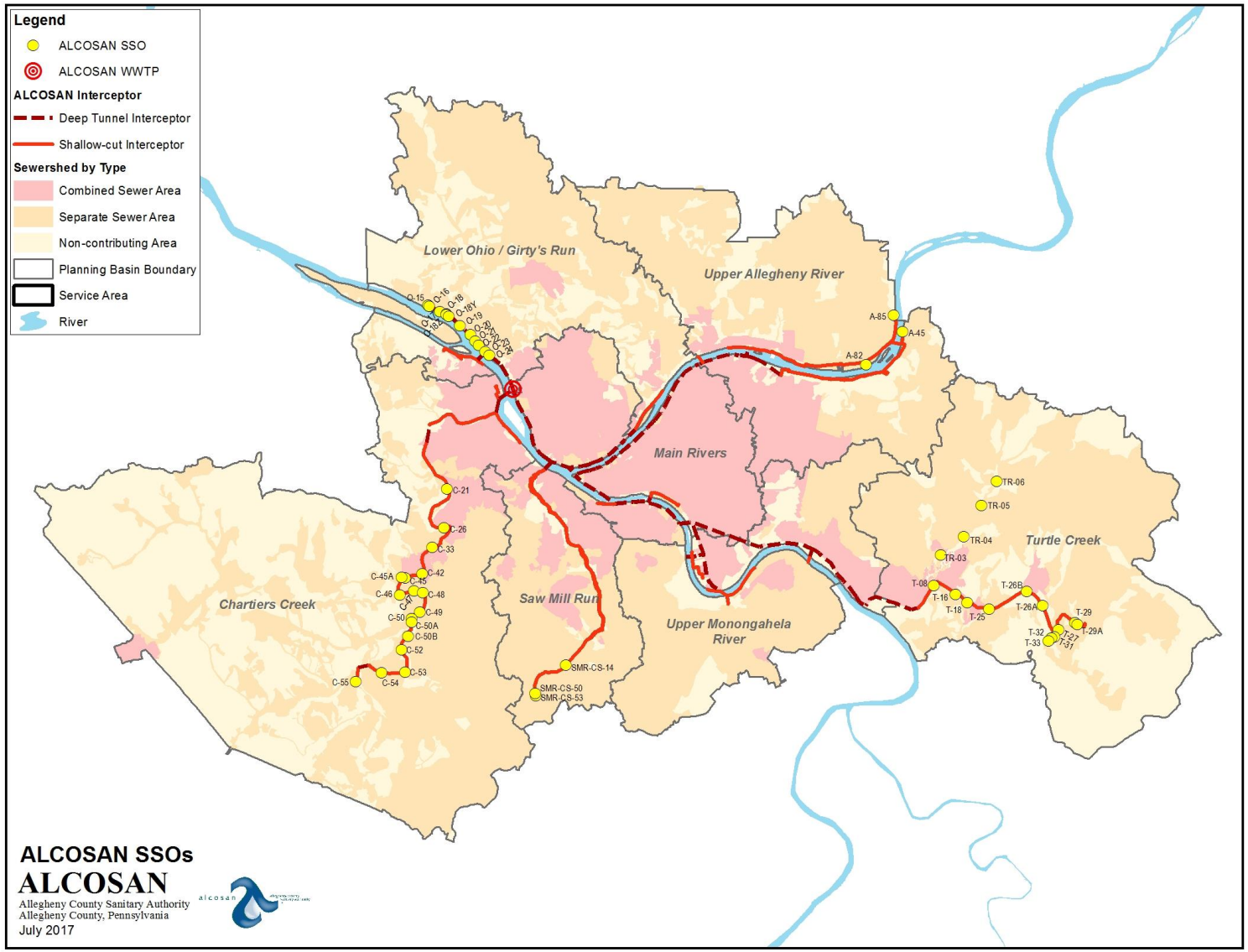
Table 11-7: List of SSO Outfall Monitoring Locations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
SMR.CS-50	Interceptor Relief at Smith St. (Castle Shannon Borough)	Saw Mill Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
SMR.CS-53	Interceptor Relief at Connor Rd. (Castle Shannon)	Saw Mill Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-08	L.B. Turtle Creek approx. 300 ft. D/S from mouth of Thompson Run (North	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-18	Left bank under Viaduct (Wilmerding Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-25	Left bank approx. 400 ft. downstream of Wall Bridge (North Versailles Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-26A	Moss Side Boulevard (Municipality of Monroeville)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-26B	S. Pitcairn connection for Monroeville Boro, just D/S of Bridge going to Pitcairn RR	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-27	Left bank under Pitcairn-Trafford Road Viaduct (Trafford Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-29	Left bank approx. 600 ft. D/S of Firth Sterling Company fence (Trafford Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-29A	Left bank approx. 200 ft. D/S of Firth Sterling Company fence (Trafford Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-31	Right bank Brush Creek approx. 250 ft. D/S from PA RR Bridge (Trafford Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
T-32	Right bank Brush Creek approx. 90 ft. upstream of PA RR Bridge (Trafford Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk

Table 11-7: List of SSO Outfall Monitoring Locations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
T-33	R.B. Brush Creek & Maple Street (Trafford Borough)	Turtle Creek	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
TR-03	Larimar Ave. (Wilkins Township)	Thompson Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
TR-04	Chalfant Run Culvert (Wilkins Township)	Thompson Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
TR-05	Eastmont (Wilkins Township)	Thompson Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk
TR-06	Lick Run (Municipality of Monroeville)	Thompson Run	Monitoring of SSO Activation	Continuous	Bobber/ Chalk

Figure 11-12: Map of SSO Outfall Monitoring Locations



Rainfall Monitoring: A radar rainfall system has been implemented and maintained 3RWW since April 2000 to provide high resolution, spatially distributed precipitation data for the ALCOSAN service area. The radar rainfall system accounts for the temporal and spatial distribution of rainfall in greater detail than would otherwise be possible with a traditional rain gauge network, resulting in additional accuracy and confidence in the model results. A regional network of 33 rain gauges is used to calibrate the recorded radar reflectivity and produce the precipitation data used to populate the radar-rainfall pixel grid with rainfall summed over 15-minute increments for each pixel of 1-km by 1-km (0.6 mile by 0.6 mile). A list of the rain gauge network supporting this system is provided on Table 11-8. A map of the rainfall gauge network and corresponding pixel grid for the ALCOSAN service area is provided on Figure 11-13.

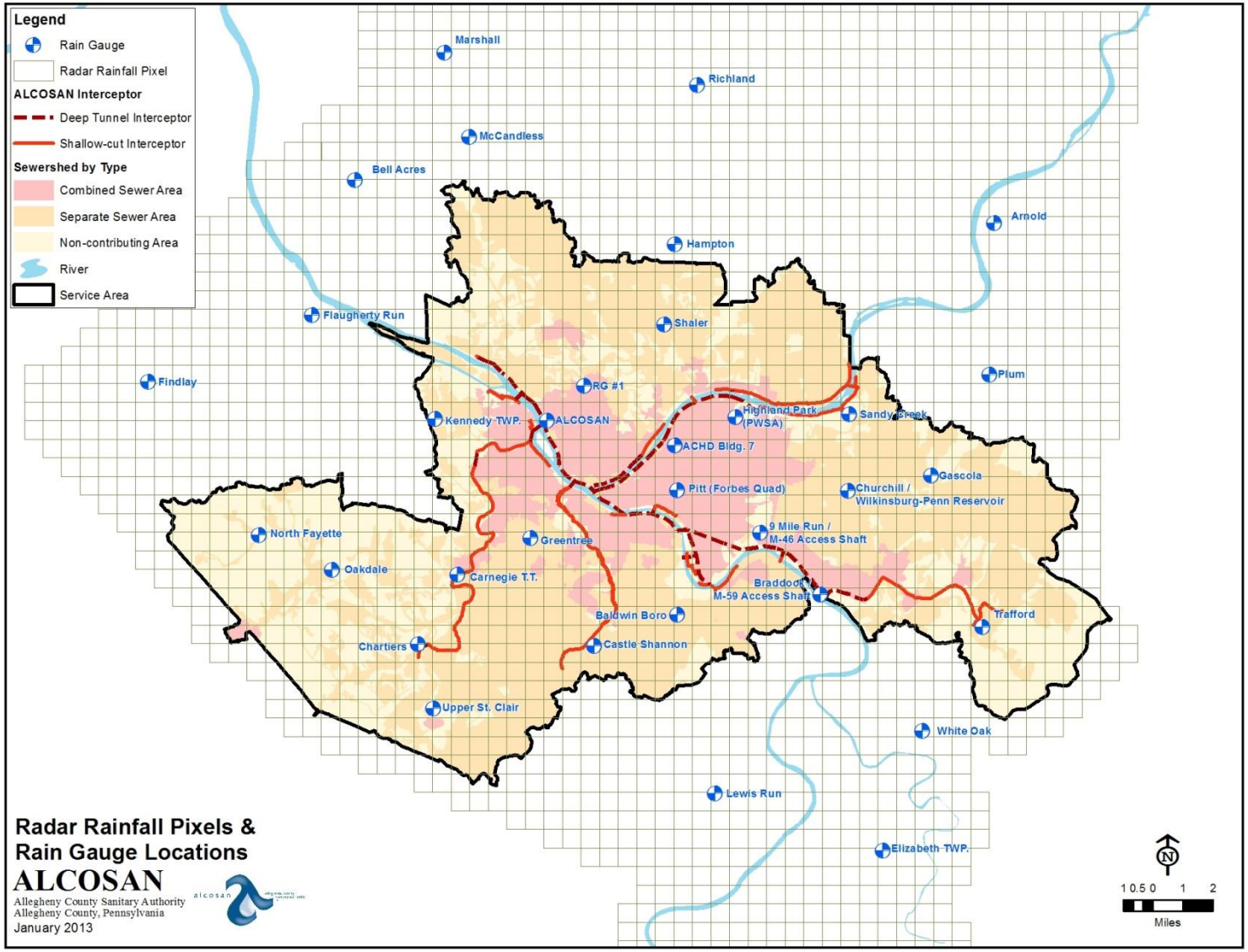
Table 11-8: List of Rain Gauges Supporting the Calibrated Radar-Rainfall System

Site ID	Location Description	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
RG1	PWSA (Montana Street)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG2	ALCOSAN (Alcosan Lime Bldg.)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG3	Shaler	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG4	Kennedy Twp.	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG5	Upper St. Clair (Mayview)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG6	Carnegie	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG7	Greentree	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG8	Lawrenceville (ACHD)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG9	University of Pittsburgh (Pitt)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG10	Highland Park (PWSA)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG11	Nine Mile Run (M46)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG12	Baldwin	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG13	Braddock (M59)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG14	Churchill	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG15	Trafford	Precipitation Monitoring	Continuous	3RWW Rain Gauge

Table 11-8: List of Rain Gauges Supporting the Calibrated Radar-Rainfall System

Site ID	Location Description	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
RG16	Castle Shannon	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG17	Bridgeville (SFA Chartiers PS)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG18	Oakdale	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG19	Penn Hills North (Sandy Creek)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG20	Penn Hills South (Gascola PS)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG21	Moon Twp. (Flaugherty Run)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG22	North Fayette	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG23	Findlay	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG24	Lewis Run (Pleasant Hills / Jefferson Hills)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG25	White Oak	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG26	Elizabeth Twp.	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG27	Marshall	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG28	Plum	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG29	Bell Acres	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG30	McCandless (Franklin Park / MTSA)	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG31	Hampton	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG32	Arnold	Precipitation Monitoring	Continuous	3RWW Rain Gauge
RG33	Richland	Precipitation Monitoring	Continuous	3RWW Rain Gauge

Figure 11-13: Rainfall Gauge Network and Pixel Grid



Water Quality Monitoring: Building upon the Receiving Water Quality Program (RWQP) used for development of the WWP, ALCOSAN will monitor bacteria (E. coli and fecal coliform) at selected water quality monitoring locations. These monitoring locations will be selected to allow for data collection needed to document stream improvements attributed to the implementation of the CSO controls. Wherever possible, sampling sites will be selected that correspond to sites sampled during the RWQP to allow for comparison.

Selected monitoring stations within the ALCOSAN service area, together with their monitoring rationale, monitoring frequencies, and monitoring protocols are presented in Table 11-9. Locations of receiving stream monitoring stations are shown on Figure 11-14.

Sampling will occur in three-year cycles during the defined recreational period of April 1 through October 15. For the three-year period of each cycle, three wet and three dry samples will be collected. Dry weather is defined by an antecedent dry weather period of 72 hours with less than 0.1 inches of precipitation with the dry weather conditions prevailing throughout the event. Wet weather events are defined as no precipitation greater than 0.1 inches in the local watershed for 48 hours followed by a minimum of 0.30 inches of rainfall (spatially averaged) over a 24-hour period along the Allegheny, Monongahela or Ohio rivers. Each sample will consist of a single vertical (SV), depth-integrated, isokinetic grab.

Table 11-9: List of Water Quality Monitoring Stations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
03049652	Allegheny River at Hulton bridge at Oakmont, 0.7 mi downstream from Deer Creek, at river mile 12.7.	Allegheny River	Track WQ Upstream of CSOs	Applicable to all sites: 3 dry and 3 wet events during each 4-year monitoring cycle	Bacteria
03049674	Allegheny River near Blawnox PA	Allegheny River	Track WQ Upstream of CSOs		Bacteria
03049677	Allegheny River at RM 8.1	Allegheny River	Track WQ Upstream of CSOs		Bacteria
03049825	Allegheny River at RM 2.5 Herrs Island Marina	Allegheny River	Track WQ Upstream of CSOs		Bacteria
03049832	Allegheny River at 9th St. Bridge (Transect at downstream end of Convention Center on left bank.)	Allegheny River	Track WQ Upstream of CSOs		Bacteria
03085290	Chartiers Creek near Bridgeville	Chartiers Creek	Track WQ Upstream of CSOs		Bacteria

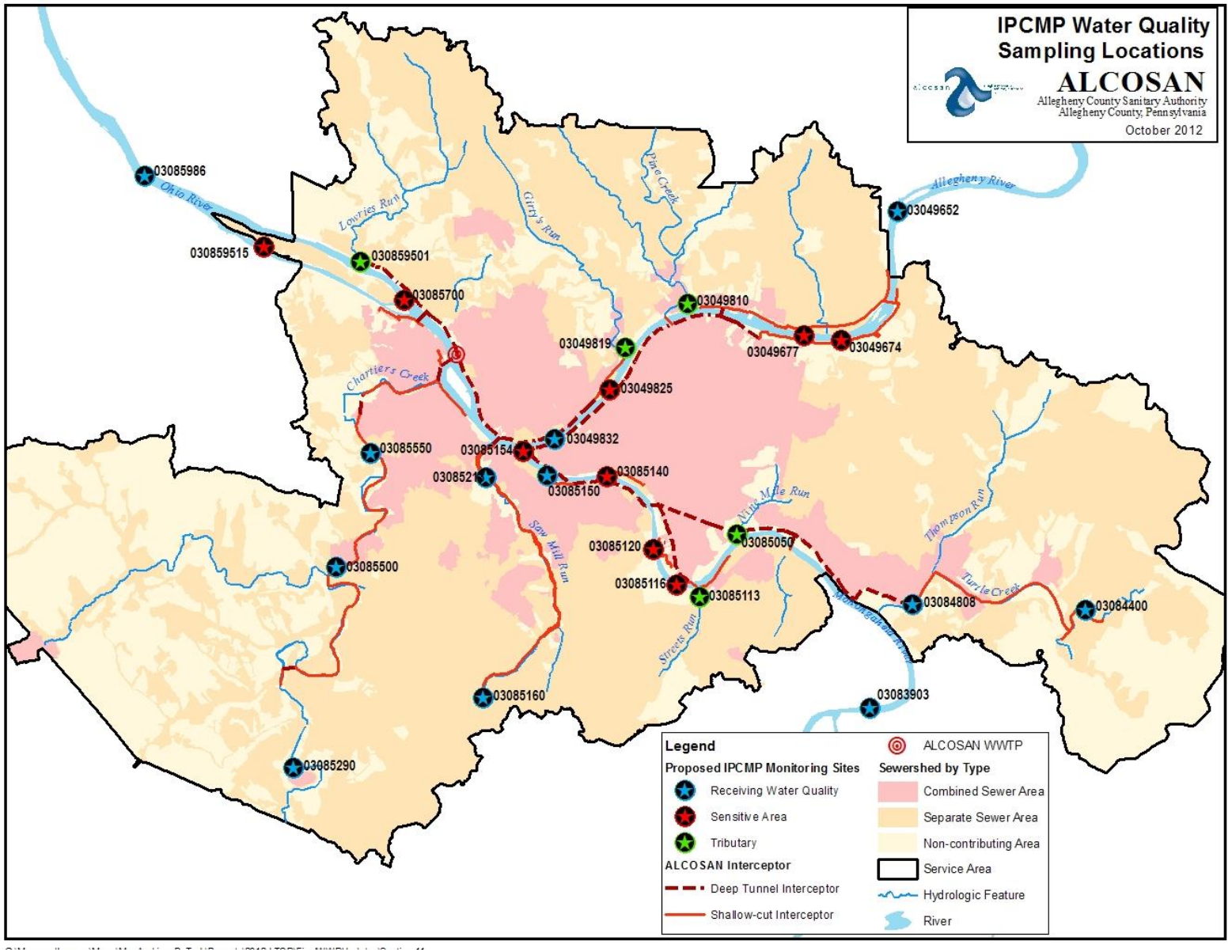
Table 11-9: List of Water Quality Monitoring Stations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
03085500	Chartiers Creek at Carnegie at gage.	Chartiers Creek	Track WQ of Receiving Water	Applicable to all sites: 3 dry and 3 wet events during each 4-year monitoring cycle	Bacteria
03085550	Chartiers Creek at Thornburg at Thornburg Bridge.	Chartiers Creek	Track WQ Downstream of new CSO Controls		Bacteria
03083903	Monongahela River at McKeesport at RM 14.7	Monongahela River	Track WQ Upstream of CSOs		Bacteria
03085116	Monongahela River at RM 5.5**	Monongahela River	Track WQ Immediately Downstream of Sensitive Area		Bacteria
03085120	Monongahela River at Pennsylvania American Water Intake, 20 yards upstream of intake.	Monongahela River	Track WQ Immediately Upstream of Sensitive Area		Bacteria
03085140	Monongahela River at RM 2.2 PAFBC Launch	Monongahela River	Track WQ Immediately Upstream of Sensitive Area		Bacteria
03085150	Monongahela River at Smithfield St. Bridge on upstream side of Matrix nightclub on left bank.	Monongahela River	Track WQ Downstream of CSOs		Bacteria
03085154	Ohio River at RM 0.0 at the Point at Pittsburgh	Ohio River	Track WQ Immediately Upstream of Sensitive Area		Bacteria
O1.4	Ohio River at RM 1.4 ORSANCO	Ohio River	Track WQ of Receiving Water		Bacteria
O4.3M	Ohio River at RM 4.3 ORSANCO	Ohio River	Track WQ of Receiving Water		Bacteria
03085700	Ohio River at West View Water Intake, 20 yards upstream of intake.	Ohio River	Track WQ Immediately Upstream of Sensitive Area		Bacteria

Table 11-9: List of Water Quality Monitoring Stations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
030859515	Ohio river on the back channel near Interstate 79	Ohio River	Track WQ of Receiving Water	Applicable to all sites: 3 dry and 3 wet events during each 4-year monitoring cycle	Bacteria
03085986	Ohio River at Sewickley	Ohio River	Track WQ Downstream of CSOs		Bacteria
03085160	Sawmill Run at Castle Shannon	Saw Mill Run	Track WQ Upstream of CSOs		Bacteria
03085213	Sawmill Run at Duquesne Heights at Minnotte Street Bridge.	Saw Mill Run	Track WQ Downstream of CSOs		Bacteria
03084400	Turtle Creek at Trafford	Turtle Creek	Track WQ Upstream of CSOs		Bacteria
03084808	Turtle Creek at East Pittsburgh at railroad bridge.	Turtle Creek	Track WQ Downstream of CSOs		Bacteria
03049819	Girty's Run above Grant Avenue at Millvale	Girty's Run	Track WQ Downstream of CSOs		Bacteria
030859501	Lowries Run below CSO downstream of Ohio River Blvd	Lowries Run	Track WQ Upstream of CSOs		Bacteria
03085050	Nine Mile Run at mouth at M46	Nine Mile Run	Track WQ Downstream of CSOs		Bacteria
03049810	Pine Creek at Industrial Park	Pine Creek	Track WQ Downstream of CSOs		Bacteria
03085113	Streets Run below CSO near mouth	Streets Run	Track WQ Downstream of CSOs		Bacteria

Figure 11-14: Receiving Stream Monitoring Locations

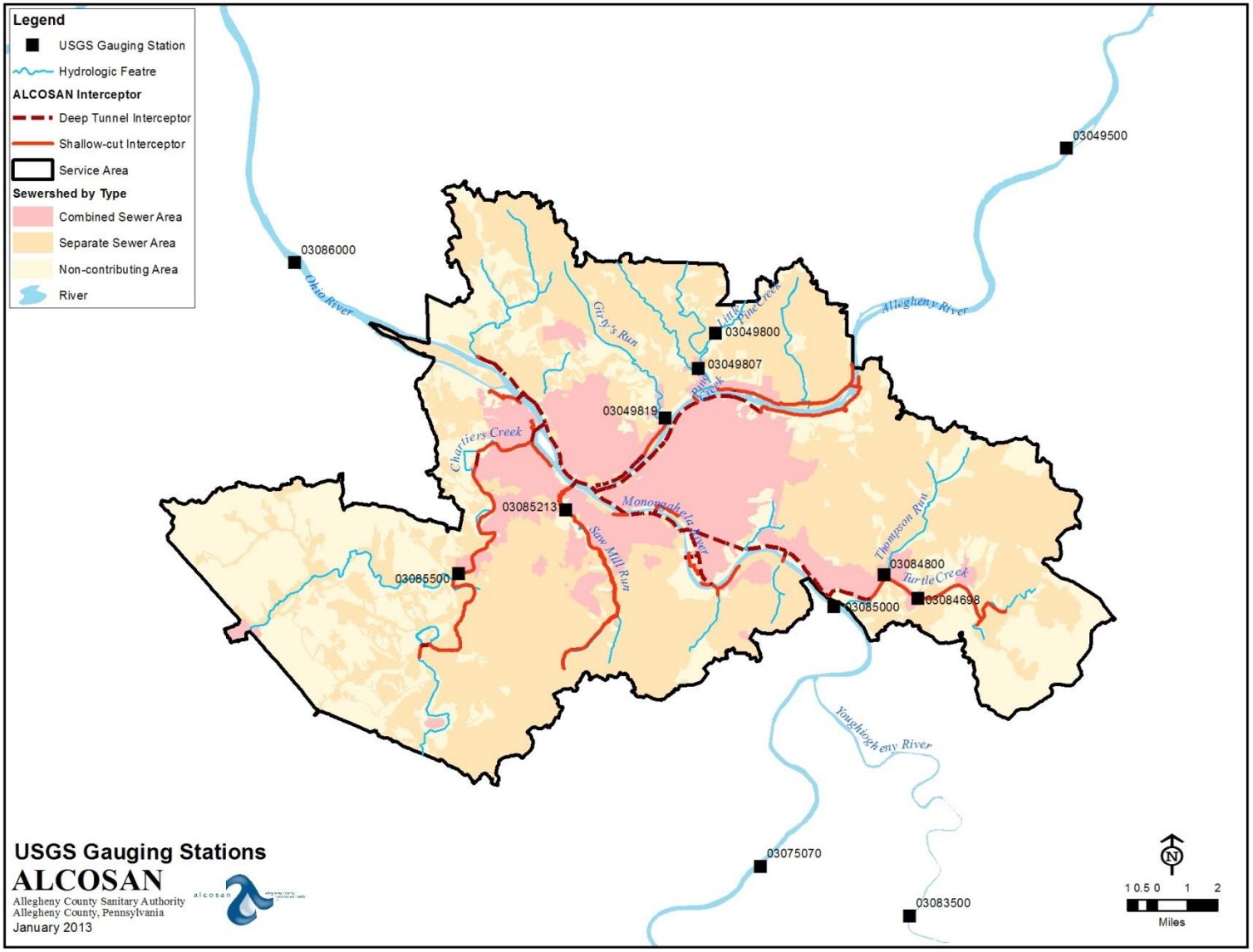


Stream Flow Monitoring: ALCOSAN will make use of 12 existing United States Geological Survey (USGS) real-time flow discharge and water stage gauging stations in and around the ALCOSAN service area to monitor flow in the receiving streams. These gauges are listed in Table 11-10 and are shown on Figure 11-15. In the event stream flow monitoring is discontinued by USGS at some locations, adequate historic data is available to estimate stream flow discharge using water depth measurements.

Table 11-10: USGS Stream Gauging Stations

Site ID	Location Description	Receiving Stream	Monitoring Rationale	Monitoring Frequency	Monitoring Protocols
03049500	Allegheny River at Natrona, PA	Allegheny River	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03049800	Little Pine Creek near Etna, PA	Little Pine Creek	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03049807	Pine Creek at Grant Avenue at Etna, PA	Pine Creek	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03049819	Girty's Run above Grant Avenue at Millvale, PA	Girty's Run	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03075070	Monongahela River at Elizabeth, PA	Monongahela River	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03083500	Youghiogheny River at Sutersville, PA	Youghiogheny River	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03084698	Turtle Creek at Wilmerding, PA	Turtle Creek	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03084800	Thompson Run at Turtle Creek, PA	Thompson Run	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03085000	Monongahela River at Braddock, PA	Monongahela River	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03085213	Saw Mill Run at Duquesne Heights near Pittsburgh, PA	Saw Mill Run	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03085500	Chartiers Creek at Carnegie, PA	Chartiers Creek	USGS Gauging Station	Continuous	Stream Flow, Water Stage
03086000	Ohio River at Sewickley, PA	Ohio River	USGS Gauging Station	Continuous	Stream Flow, Water Stage

Figure 11-15: USGS Stream Gauging Station Locations

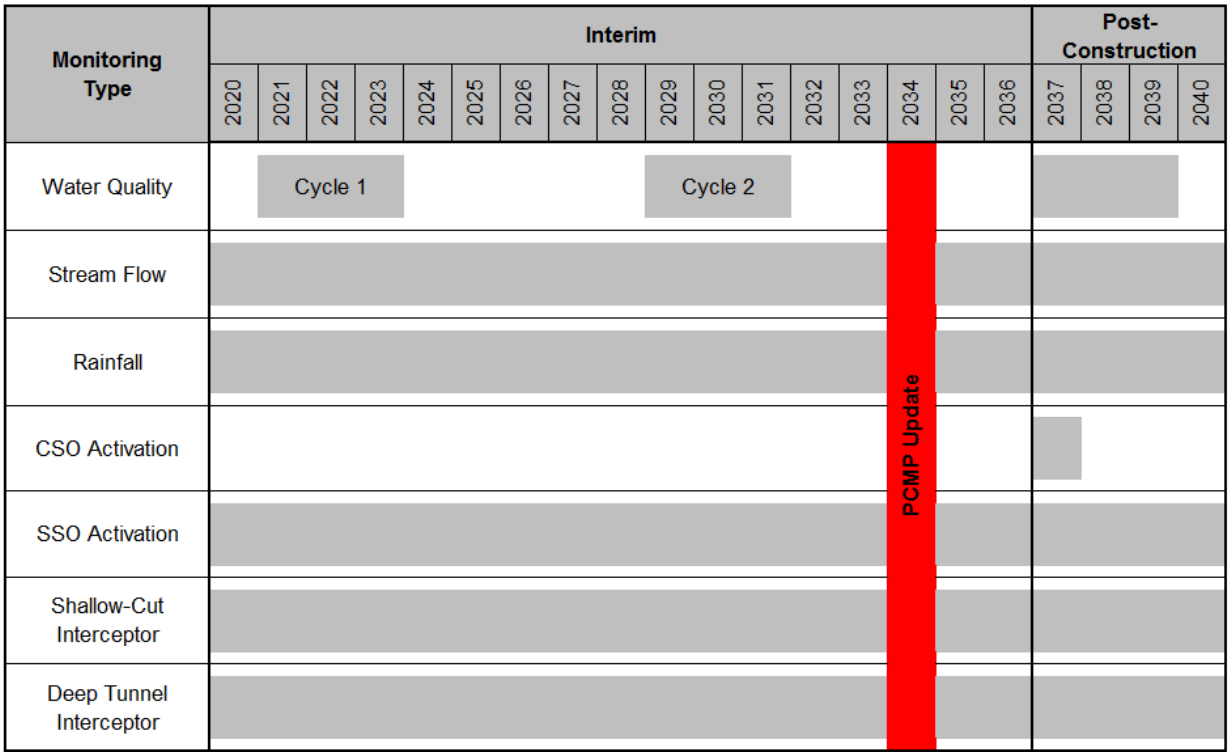


Monitoring Schedule: Interim water quality monitoring will commence in 2021 and consist of two three-year cycles. Post-construction water quality monitoring will begin in 2037 and last for three years.

SSO activation monitoring consistent with Appendix L, paragraph 1c of the CD, along with rainfall and stream flow monitoring, will continue throughout the interim and post-construction period. CSO monitoring will begin in 2037 and continue for one year.

The Interim and Post-Construction Monitoring Schedule is shown in Table 11-11.

Table 11-11: Interim and Post Construction Monitoring Schedule



In 2034 if appropriate, ALCOSAN will submit proposed modifications to the Post-Construction monitoring provisions of the Receiving Water Quality Monitoring Plan consistent with paragraph 9c of Appendix Q of the CD.

Data Retrieval, Management and Analysis

Data retrieval, management and analysis are an integral part of any monitoring program. ALCOSAN currently has a system to store, retrieve, and analyze existing data. This post-construction monitoring program was developed to make use of the existing database to facilitate evaluation of new water quality data which will be used, along with the water quality models, to measure the effectiveness of CSO controls. The program activities are designed to ensure collection of appropriate data, establish consistency of sampling methods and data acquisition, and define performance standards for maintaining data integrity. All necessary

measures will be taken to validate, track, store and manage the collected data to ensure that monitoring objectives are attained.

Specific sampling protocols are administered and performed by experienced personnel familiar with sampling procedures used in support of the ongoing monitoring program for ALCOSAN. As data are generated during interim and post-construction monitoring, the program may need to be revised to accommodate alternative data collection techniques or data evaluation approaches to meet monitoring objectives. Any revisions or additions to the data retrieval or management aspects of such program will be made after consulting with PaDEP and USEPA.

ALCOSAN has developed a dynamic H&H model that fully integrates the hydrology and hydraulics of the combined sewer system (collection system model). ALCOSAN will utilize sound engineering judgment and best industry practices, and take the following steps, to update and utilize the collection system model to determine whether ALCOSAN has achieved compliance with the Performance Criteria.

1. Collect flow and depth data in the collection system for the 12-month post-construction monitoring period as described in Section 11.3.3.
2. Perform quality assurance and quality control of the data collected in Step 1.
3. Utilize the H&H Model in its previously-calibrated state and the rainfall data collected during the monitoring period, to run a continuous simulation of CSO discharges for the 12- month post-construction monitoring period.
4. Compare the continuous simulation CSO discharge outputs to the CSO monitoring data for the 12-month post-construction monitoring period to determine whether re-calibration of the collection system model is needed. Model re-calibration will not be needed if the model achieves at least the same degree of calibration as was achieved for existing conditions during the WWP development process, and there is a high degree of agreement between the model output and CSO monitoring data for activation frequency for the 12-month post-construction monitoring period. Otherwise, model re-calibration will be needed in accordance with Steps 5-7.
5. If re-calibration is needed, select two or more appropriate rainfall events from the 12-month post-construction monitoring period for model recalibration.
6. Develop an initial data set for use with the model and perform successive applications of the model with appropriate parameter adjustment until there is a high degree of agreement between the model output and the CSO monitoring data for the 12-month post-construction monitoring period. In making such adjustments, ALCOSAN will consider the inherent variability in both the collection system model and flow monitoring data, and will exercise sound engineering judgment and best industry practices so as to not compromise the overall representativeness of the model.
7. Once the model has been re-calibrated in accordance with Step 6, ALCOSAN will verify the re-calibrated model by again utilizing the model and the rainfall data collected during the 12-month post-construction monitoring period, to run another continuous simulation for the 12-month post construction monitoring period. ALCOSAN will again

compare the continuous simulation CSO discharge outputs to the CSO monitoring data for the 12-month post-construction monitoring period as described in Step 4, to determine whether additional re-calibration of the collection system model is needed. Re-calibration will be determined to be adequate if the model achieves at least the same degree of calibration, as was achieved for pre-CSO Long-Term Control conditions during the WWP development process, and there is a high degree of agreement between the model output and CSO monitoring data for activation frequency for the 12-month post-construction monitoring period. Otherwise, further re-calibration will be needed in accordance with these Steps 5-7 until the model achieves at least the same degree of calibration as was achieved for pre-CSO Long-Term Control conditions during the WWP development process, and there is a high degree of agreement between the model output and CSO monitoring data for activation frequency for the 12-month post-construction monitoring period.

8. Once ALCOSAN has satisfactorily re-calibrated the model in accordance with Steps 5 through 7 (or shown that re-calibration is not necessary in accordance with Step 4), ALCOSAN will then utilize the original or recalibrated model (if recalibration was necessary in accordance with Steps 4-7) to run a continuous simulation of the typical year to determine whether ALCOSAN has achieved the Performance Criteria.

9. ALCOSAN shall be deemed to have achieved the IWWP Performance Criteria if:

   - ALCOSAN untreated CSO volume is less than 2,700 MG/year in a typical year
   - The following ALCOSAN CSOs near Sensitive Areas are controlled to zero overflows in a typical year, with the exception of one overflow in a typical year at A-67

     Lower Ohio – Girty's Run

     A-62, A-63, A-64, A-65, A-67

     Main Rivers

     A-47, M-18, M-20, M-21, M-22, O-40, O-41, O-43

     Upper Monongahela

     M-43

Quality Control

QA/QC will utilize many of the same procedures and processes that were developed and implemented during the development of the WWP. A summary of these procedures is given below along with references to more detailed descriptions.

Water Quality: The water quality monitoring and sampling program will employ similar data quality assurance review procedures to those used for development of the WWP to ensure that program objectives are met. Internal quality control checks will be performed on field and laboratory generated measurements as summarized herein.

Field Measurements: Field quality control checks consist of QA/QC samples that will be collected or prepared by the field crews and will be submitted for laboratory analysis. These samples consist of duplicates, field blanks, and equipment blanks. Acceptable control limits will be established, the data reviewed, and an assessment made of the adequacy of the quality control checks. When problems are identified; corrective actions will be discussed and implemented, as appropriate. In addition, quality control checks will be conducted in advance of, and following, the use of multi-parameter meters. Procedures will be similar to those used for the collection of data for development of the WWP.

Laboratory Measurements: The laboratory will perform quality control checks on all samples analyzed, which includes sample duplicates, matrix spikes, matrix spike duplicates, control samples, and method blanks as appropriate. The laboratory will conduct quality control procedures for analytical services in accordance with their standard operating procedures and the individual method requirements referenced by USEPA methods or Standard Methods (18th, 19th and 20th Editions) with acceptable control limits. Quality control check issues will be identified and corrective actions will be implemented.

Data Review, Validation and Usability: All environmental measurement data and samples collected will be subjected to quality control. This is a multi-step process where the Program Managers are responsible for verifying the data and the Quality Assurance Manager will conduct the data validation. The data generated from the sampling program will be subjected to a multi-tiered review process which includes:

- Review of the data at the bench (laboratory) and field levels
- Secondary review of field records by the Field Program Manager and laboratory analytical results by the Quality Assurance Manager to verify the data against method and standard operating procedure requirements
- Screening level review of the verified data by the appropriate Program Managers for reasonableness and to identify obvious data anomalies
- Validation and data usability by the Quality Assurance Manager

If data does not meet QA/QC criteria, additional review of the quality control checks and any relevant laboratory bench sheets will be conducted. Upon completion of QA/QC review, the data will be flagged appropriately, identifying the limitations of the data.

Data Verification

The data quality assurance review process includes a series of data verification activities that are conducted during field activities and in the laboratory.

Field Activities Data Verification - The Field Program Manager will be responsible for ensuring that the samples are collected and handled according to the procedures specified. Sample collection verification includes confirming that the samples are collected with the proper equipment at the appropriate locations with the appropriate frequency using proper labeling protocol. Sample handling verification includes confirmation by the laboratory that the samples are stored in the appropriate containers with the correct preservative, that the samples

were stored at the proper temperature during transport from the field to the laboratory, proper change-of-custody procedures were followed and that all appropriate information was logged on the chain-of-custody records.

Laboratory Activities Data Verification - The Laboratory QA/QC Manager is responsible for verifying and approving laboratory generated data. Laboratory verification includes assessing that the procedures used to generate the data are consistent with the method requirements as specified in the laboratory's Standard Operating Procedures (SOPs) and that the QA/QC requirements for each method are met. Examples of method requirements include verifying the calibration and data reduction procedures. Method QA/QC requirements vary by analyte. A laboratory report will be released to the Quality Assurance Manager after the data is verified and approved.

Data Validation Requirements - The Quality Assurance Manager − who is not directly involved with the field program, sample collection, or analysis – will perform data validation for this program which includes the following.

- Inspect the data verification and review records to ensure that no oversights were made during that process.
- Evaluate the data against the project's Data Quality Objectives.
- Evaluate the data in the context of the project's overall objectives, which include using the data collected to support the development, calibration and application of numerical assessment tools.
- Communicate the data validation results to the rest of the project team.
- Field measurements data collection, field sample collection, sample custody, laboratory analytical results and case narrative, laboratory data reviews, and laboratory quality control data will all be checked as part of the measurement data and analytical data validation activities. After a review of the laboratory data for compliance with the established quality control criteria, qualifiers will be assigned to the data.

A complete description of QA/QC procedures for water quality data can be found in *ALCOSAN's Receiving Water Quality Monitoring Plan, Revised April 2009*.

Rain Data: Monitoring equipment calibration, maintenance, and data quality assurance checks will be performed and/or verified by 3RWW such that monitoring accuracy is optimized, and is in conformance with the equipment manufacturers' recommendations.

CSO and SSO Outfall Monitoring: Outfall activation will be corroborated by use of independent chalk and bobber methods.

In-stream Flow Monitoring: Standard USGS equipment, procedures, and protocols will apply to all long-term stream monitoring data.

Reporting

Final Measures Wet Weather Plan: One year after completion of all interim and post construction monitoring, ALCOSAN will submit a Final Measures Wet Weather Plan that will summarize monitoring results, evaluate IWWP performance, and identify remaining controls necessary to achieve the full requirements of the CD. The report will contain the following information relative to the IPCMP:

- Summary of Interim and Post Construction Monitoring Results
- Summary of re-validation of the collection system models
- Evaluation of IWWP control measures, including whether or not the measures met the established IWWP Performance Criteria and the identification of any significant variances and impacting factors, if applicable
- Identification of remaining controls necessary to meet the full requirements of the CD

11.3.4 Financing Plan

This section describes ALCOSAN's strategy for financing the implementation of the IWWP. The parallel municipal financing of improvements for individual municipal collection systems is beyond the scope of this document.[11-3]

Capital Requirements

Based upon the projects listed in Table 11-1 and the implementation schedule outlined in Section 11.3.1, the IWWP currently includes $1.6 billion (in 2010 dollars) in identified ALCOSAN projects, plus an additional commitment to invest $200 million in a Regional Flow Optimization Strategy. Through the adaptive management framework, the regional IWWP will identify additional ALCOSAN and municipal projects up to a $2 billion affordability threshold. As a result, since discrete municipal flow reduction and other overflow control projects have not been identified to date and regionalization is not complete, the following analysis is premised on the simplifying assumption that all wet weather compliance costs identified in this IWWP will be borne by ALCOSAN.

The projected annual capital requirements are shown on Table 11-12. Based upon the anticipated implementation schedule as detailed in Section 11.3.1, ALCOSAN's annual capital needs for the IWWP are projected to average $139 million (inflated) and to peak at around $242 million (inflated) during the implementation of the IWWP. The aggregated rates of expenditures shown are preliminary estimates, pending detailed facilities planning and design.

[11-3] The original municipal orders do not address the financing of the municipal improvements. (See Paragraph 14(d) of the PaDEP COA and 15(d) of the ACHD ACO relating to the MFS). The second series of municipal orders are similarly silent on this item.

Table 11-12: Interim Wet Weather Plan Projected Annual Capital Expenditures

Year	ALCOSAN Annual Capital Cost ($ millions)		
	2010 Dollars	Inflated	%
2016	$40	$40	2%
2017	$48	$55	2%
2018	$42	$48	2%
2019	$37	$43	2%
2020	$42	$51	2%
2021	$117	$146	6%
2022	$104	$132	5%
2023	$162	$213	8%
2024	$180	$242	9%
2025	$149	$212	7%
2026	$123	$179	6%
2027	$110	$165	6%
2028	$96	$146	5%
2029	$105	$163	5%
2030	$105	$166	5%
2031	$100	$163	5%
2032	$112	$186	6%
2033	$112	$190	6%
2034	$112	$194	6%
2035	$52	$92	3%
2036	$52	$94	3%
Total	**$2,000**	**$2,921**	**100%**
Average	**$95**	**$139**	

In addition to the IWWP capital costs, ALCOSAN will maintain its aggressive and proactive Capital Improvements Program for improvements, renewal and replacements. The projected non-IWWP capital improvements are projected to result in annual expenditures averaging $30 million in 2010 dollars and totaling $627 million through 2036. Adjusting for inflation, this total is projected to be $889 million. Between the IWWP and the other CIP projects, total projected capital expenditures through 2036 are estimated to be $2.6 billion in 2010 dollars and $3.8 billion in inflated dollars. Annual projections are shown on Table 11-13.

Table 11-13: ALCOSAN Total Projected Capital Expenditures Through 2036

Year	ALCOSAN Capital Costs				Total	
	IWWP		Capital Improvement Program			
	2010 Dollars	Inflated	2010 Dollars	Inflated	2010 Dollars	Inflated
2016	$40	$40	$23	$23	$63	$63
2017	$48	$55	$27	$27	$75	$82
2018	$42	$48	$27	$27	$69	$75
2019	$37	$43	$27	$27	$64	$70
2020	$42	$51	$27	$27	$69	$78
2021	$117	$146	$31	$40	$148	$186
2022	$104	$132	$31	$41	$135	$173
2023	$162	$213	$31	$42	$193	$255
2024	$180	$242	$31	$43	$211	$285
2025	$149	$212	$31	$44	$180	$256
2026	$123	$179	$31	$45	$154	$224
2027	$110	$165	$31	$46	$141	$210
2028	$96	$146	$31	$47	$127	$193
2029	$105	$163	$31	$48	$136	$210
2030	$105	$166	$31	$49	$136	$215
2031	$100	$163	$31	$50	$131	$213
2032	$112	$186	$31	$51	$143	$237
2033	$112	$190	$31	$52	$143	$242
2034	$112	$194	$31	$53	$143	$247
2035	$52	$92	$31	$54	$83	$146
2036	$52	$94	$31	$55	$83	$149
Totals	**$2,000**	**$2,921**	**$627**	**$889**	**$2,627**	**$3,810**
Average	**$95**	**$139**	**$30**	**$42**	**$125**	**$181**

Capital Funding

Alternative Capital Funding Options: ALCOSAN evaluated alternatives to the municipal revenue bond market as capital sources as suggested in USEPA's LTCP guidance document[11-4] and other USEPA guidance.[11-5] As noted in the 1995 *Guidance for Funding Options*:

[11-4] Section 4.3.3, Combined Sewer Overflows - Guidance for Long-Term Control Plan, USEPA 832-0-95-002, September 1995.

[11-5] Combined Sewer Overflows Guidance for Funding Options USEPA 832-B-95-007, August 1995.

> "Grants will likely play only a limited role in future CSO funding. The reliance on direct federal wastewater construction grants has been replaced with a reliance on SRF loans and other local funding options."

The Federal funding situation since 1995 has not improved. Moving forward, ALCOSAN has and will continue to work with the region's state Legislative and Congressional delegations towards workable funding for wet weather controls. Funding that has been obtained to date as USEPA Special Appropriations Projects and from Sections 219 and 206 of the Water Resources Development Act through the Corps of Engineers has been used by ALCOSAN to support projects such as direct stream inflow removals.[11-6]

Some options listed in the Guidance are more applicable to the municipalities than to ALCOSAN due to eligibility or funding restrictions. For example, PennVest has a $20 million limit on total financing by any recipient. The Rural Utilities Services (RUS) provides low interest loans, and limited grants for municipal water and sewer infrastructure. This program would be more applicable to the ALCOSAN municipalities with populations of less than 10,000. ALCOSAN has worked with the local RUS office towards availing the municipalities of this program.

ALCOSAN's Capital Financing Strategy: ALCOSAN anticipates using combinations of pay-as-you-go funding utilizing accumulated reserve funds and revenue bond financing owing to ALCOSAN's strength in the municipal bond market. As of July 2016, ALCOSAN has underlying ratings of 'A' long-term (with a stable outlook) from Standard & Poor's Rating Services and A1 from Moody's Investors Services.

As a special purpose governmental enterprise established pursuant to the Pennsylvania Municipality Authorities Act, ALCOSAN has no legal authority to establish or levy property tax assessments. Therefore, ALCOSAN cannot issue general obligation bonds. ALCOSAN's upper-medium grade bond ratings are supported by the current contractual relationship between ALCOSAN and the municipalities wherein ALCOSAN's revenues flow from the municipalities rather than through retail billings. As a result, ALCOSAN's revenue bonds are arguably analogous to "double barreled" bonds as described in the USEPA guidance documents.

For planning purposes only, the financial modeling done in support of ALCOSAN's affordability analysis (Section 11.3.5) assumes that bonds will be sold as necessary to meet forthcoming construction draw requirements (typically annually). The actual size and timing of revenue bonds necessary to implement the IWWP will be determined by the eventual construction progress on the various components of the Plan and by the conditions in the municipal bond markets, and are therefore beyond the scope of this document.

Annual System Costs

The planning level estimated annual incremental annual costs resultant from the implementation of the IWWP are shown on Table 11-14.

[11-6] See Section 10.2 of the Wet Weather Plan document for additional details on some of these projects.

Table 11-14: Projected Annual O&M and Debt Service Costs ($ millions)

Year	ALCOSAN Current System	Additional IWWP	Total	Year	ALCOSAN Current System	Additional IWWP	Total
	a	*B*	*c*		*a*	*b*	*c*
2017	$140	$0	$140	2032	$217	$162	$380
2018	$144	$7	$151	2033	$228	$178	$406
2019	$148	$7	$155	2034	$239	$195	$434
2020	$152	$14	$167	2035	$251	$210	$461
2021	$157	$14	$171	2036	$264	$218	$482
2022	$161	$18	$179	2037	$277	$225	$502
2023	$166	$27	$193	2038	$287	$226	$513
2024	$170	$39	$209	2039	$302	$226	$528
2025	$176	$53	$229	2040	$317	$226	$543
2026	$175	$67	$242	2041	$325	$225	$550
2027	$183	$78	$260	2042	$339	$224	$564
2028	$188	$109	$298	2043	$358	$223	$581
2029	$194	$121	$315	2044	$377	$222	$598
2030	$200	$135	$334	2045	$389	$221	$610
2031	$207	$148	$356	2046	$405	$220	$625

Column "a" shows the projected annual costs for ALCOSAN's existing Regional Conveyance System and for the Woods Run WWTP, including operations, maintenance, and debt service costs. Column "b" shows the projected incremental costs related to the IWWP. The operation and maintenance costs are inflated annually. The debt service costs include the costs of amortizing ALCOSAN's existing debt, based upon existing amortization schedules plus projected new debt related to ALCOSAN's Capital Improvements Program beyond the IWWP. ALCOSAN's current amortization schedule may be revised as ALCOSAN refinances outstanding debt in response to favorable market conditions. The current system costs also include debt service as may be incurred in the future in support of ALCOSAN's ongoing Capital Improvement Plan.

ALCOSAN Rate History

As described elsewhere in the WWP, ALCOSAN has been proactively addressing wet weather issues since 1992. As noted in Section 10.2 of the 2012 WWP, ALCOSAN has invested more than $210 million in capital improvements as of 2012 in support of sewer overflow control and improved water quality. To finance these improvements, along with other cost pressures such as increased staffing to meet CD requirements and rising health benefit costs, ALCOSAN has increased its rates by an average of approximately 9% annually for the period of 2004 through 2017 as shown on Table 11-15.

Table 11-15: Rate Increase History

Year	Commodity Charge		Quarterly Service Charge	
	Rate	Increase		
2004	$2.50	12%	$5.25	12%
2005	$2.50	0%	$5.25	0%
2006	$2.75	10%	$5.78	10%
2007	$2.98	8%	$6.27	8%
2008	$3.25	9%	$6.83	9%
2009	$3.77	16%	$7.92	16%
2010	$4.04	7%	$8.48	7%
2011	$4.04	0%	$8.48	0%
2012	$4.32	7%	$9.07	7%
2013	$4.32	0%	$9.07	0%
2014	$5.05	17%	$10.61	17%
2015	$5.61	11%	$11.78	11%
2016	$6.22	11%	$13.08	11%
2017	$6.91	11%	$14.51	11%

Annual user rates necessary for the implementation of the IWWP will be set in the future to reflect the then current conditions including the costs of implementation and financial conditions. Preliminary analysis by ALCOSAN has indicated that annual ALCOSAN rate increases ranging from 6% to 8% through the implementation of the IWWP may be necessary.

ALCOSAN receives user charge revenues directly from the customer municipalities based upon a fixed service charge per account and a commodity charge (also described in Section 7.3). Additional surcharges are imposed for high strength compatible wastewater (wastewater with concentrations of BOD5 and TSS exceeding 300 and 275 milligrams per liter (mg/l) respectively. The rates are uniform across user classes pursuant to the requirements of Section 507(d)(9) of the Municipality Authorities Act which requires "reasonable and uniform rates".

As ALCOSAN moves into the implementation of this WWP, it may choose to evaluate refinements or alternatives to the cost allocation and cost recovery structure that is represented by its current user charge system towards enhanced cost allocation or revenue generation. Such evaluations and ultimate policy directions are beyond the scope of this document.

Alternative Revenue Streams

USEPA's 1997 financial capability guidance references four funding mechanisms and sources of funding "if loans and grants are not available or if a need exists to reduce the financial impact of

CSO controls on the users."[11-7] The applicability of these revenue sources to ALCOSAN may be summarized as follows.

- ***Establish special assessment district*** **–** Unlike municipalities, ALCOSAN as a municipal authority has no legal authority to establish or levy property tax assessments;
- ***Increase user fees*** **–**The implementation of ALCOSAN's WWP is premised on a series of substantial rate increases;
- ***Impose / increase taxes (such as income taxes, sales taxes or property taxes)*** **–** as noted above, ALCOSAN has no statutory authority to impose taxes. Even if ALCOSAN could impose taxes, the "affordability" of wet weather controls would not improve. The portion of tax revenue attributed to residential properties would need to be factored into the calculation of annual wastewater costs per household as a component of total wastewater service costs; and
- ***Privatize wastewater treatment*** **–** To date, the option of the privatization of wet weather control facilities has not appeared to be viable or advantageous.

Moving forward into the WWP implementation phase, ALCOSAN will evaluate evolving financial instruments as appropriate.

11.3.5 Affordability and Financial Capability Assessment

This section of ALCOSAN's WWP integrates the cost impacts of the IWWP with the current conditions financial and institutional assessment that was presented in Section 6. The estimated current dollar capital, operation and maintenance costs for improvements to ALCOSAN's regional conveyance and treatment system are summarized and are also presented on an annualized basis for the period of 2017 through the 2046 planning period.

The affordability of the IWWP is evaluated using the USEPA defined Residential Indicator (RI) through 2046. The RI is derived in this section by dividing the projected annual cost per household by the median household income at regional (ALCOSAN service-area wide) and municipal levels. The affordability analysis focuses on the key year of 2037, the first year after full implementation of the IWWP. These projections are based upon planning level assumptions for financing strategies and revenue requirements.

The impacts of the proposed wet weather program on the financial capabilities of ALCOSAN and the municipalities are also presented based upon the current conditions analysis that was presented in Section 6 and the projected capital costs of the IWWP improvements. For example, ALCOSAN's current annual debt service payments total approximately $52 million while the projected annual debt service for the IWWP upon full implementation in 2037 is more than $231 million.

[11-7] Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development, USEPA 832-B-97-004, Page 48

Key Institutional Assumptions

The analyses presented herein are based upon the following assumptions as to ALCOSAN's operating environment during the implementation of the WWP:

Current Cost Allocation and Rate Structure - ALCOSAN's current user cost allocation and rate structure described in sub-section 7.3 will continue to be utilized for this analysis.

Current Institutional Framework - This Financial Capability Analysis is based on the assumption that the current institutional framework will remain in place throughout the implementation of the IWWP. Wastewater services within the ALCOSAN service area are delivered by combinations of municipalities, municipal authorities and ALCOSAN. The municipal collection systems are typically owned and operated by a municipality or municipal authority. These sewers discharge into downstream municipal systems or into the ALCOSAN regional conveyance interceptor system. As described in Section 11.2.2, ALCOSAN and its customer municipalities are currently working towards the transfer of at least 200 miles of trunk sewers from municipal ownership to ALCOSAN. This will expand the physical scope of ALCOSAN's regional conveyance interceptor system; but the overall institutional framework between the municipalities and ALCOSAN will remain unchanged.

Future Conditions without Wet Weather Compliance Costs

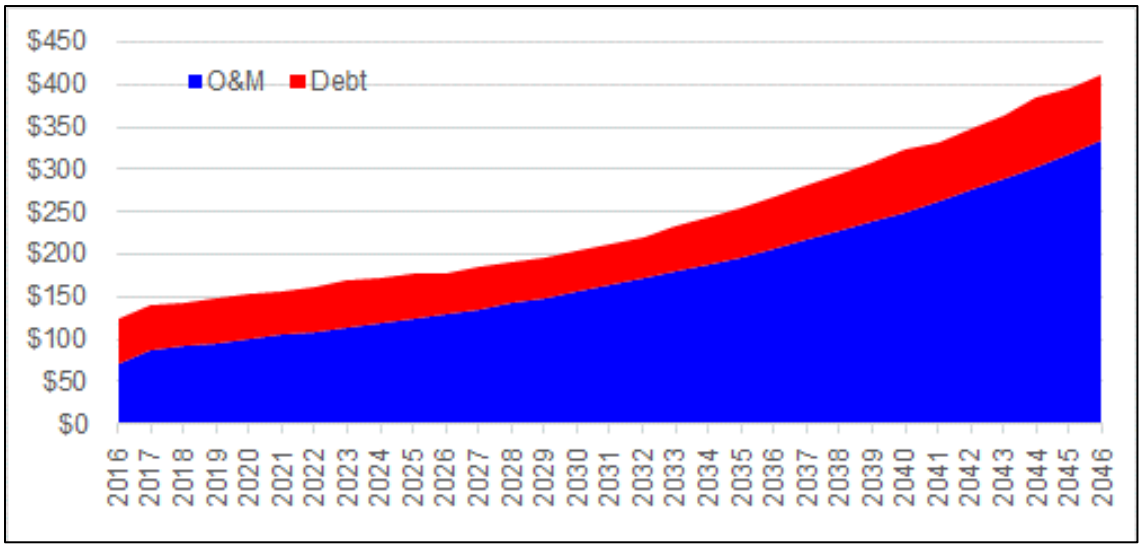
ALCOSAN System Costs (Without IWWP): The forces of inflation and the costs of ALCOSAN's ongoing Capital Improvements Program will result in steadily increasing annual costs for the existing ALCOSAN regional conveyance system and treatment plant without the incremental costs of implementing the IWWP. As summarized on Table 11-16, the annual costs for the current ALCOSAN facilities are projected to increase from an estimated $140 million in 2017 to $412 million in 2046. The projected costs in 2037, the first year of full operation of the facilities to be built under the IWWP, would be around $282 million without the IWWP.

Table 11-16: Projected Annual ALCOSAN Costs without the IWWP
($ millions – Including Inflation and Ongoing Capital Improvements)

ALCOSAN Annual Cost	2017	2037	2046
O&M	$88	$216	$334
Debt Service	$52	$66	$78
Total	$140	$282	$412

The projected annual costs are shown graphically Figure 11-16. Costs are projected through 2046 according to current and historical spending patterns. The revenue requirements for ALCOSAN necessary to maintain current level of service are provided as a baseline to which wet weather affordability impacts and spending can be compared.

Figure 11-16: Projected ALCOSAN Annual Costs for O&M and Debt Service Payments
(In Millions without Wet Weather Program Spending)



The typical cost per household for ALCOSAN's wastewater conveyance and treatment services has been estimated to be $390 in 2017. Without the IWWP, the annual ALCOSAN cost per typical household would be projected at $690 in 2037.

Municipal Collection System Cost Projections (Without IWWP): Budget projections for the 83 municipalities are not available. ALCOSAN is anticipating that municipal collection system costs will increase by at least the rate of inflation for operation and maintenance. The ALCOSAN service-area-wide weighted average cost per household for municipal collection systems is estimated to be $315 in 2017, increasing to $490 annually in 2037.

Total Annual Cost per Household (Without IWWP): The total cost per typical household in 2017 is approximately $705. The total cost per typical household in 2037 without the IWWP would be $1,176 annually. Household income is projected to increase at 2.4% annually based upon income growth rates within the ALCOSAN service area for the period of 1989 - 2014. The ALCOSAN service-area-wide median household income of $52,700 in 2016 would therefore increase to $86,700 in 2037. Dividing the total wastewater costs by the median income yields a Residential Indicator of 1.3%.

The projected costs per typical household without the wet weather controls for the planning period are shown on Table 11-17 for 2017, 2037 and 2046.

Table 11-17: Regional Residential Indicator without the IWWP

Year	RI	Cost per Household			Median Household Income
		ALCOSAN	Municipal	Total	
2017	1.3%	$390	$310	$700	$54,000
2037	1.3%	$691	$486	$1,176	$87,600
2046	1.4%	$855	$662	$1,517	$108,800

Annual Cost Impacts of the IWWP

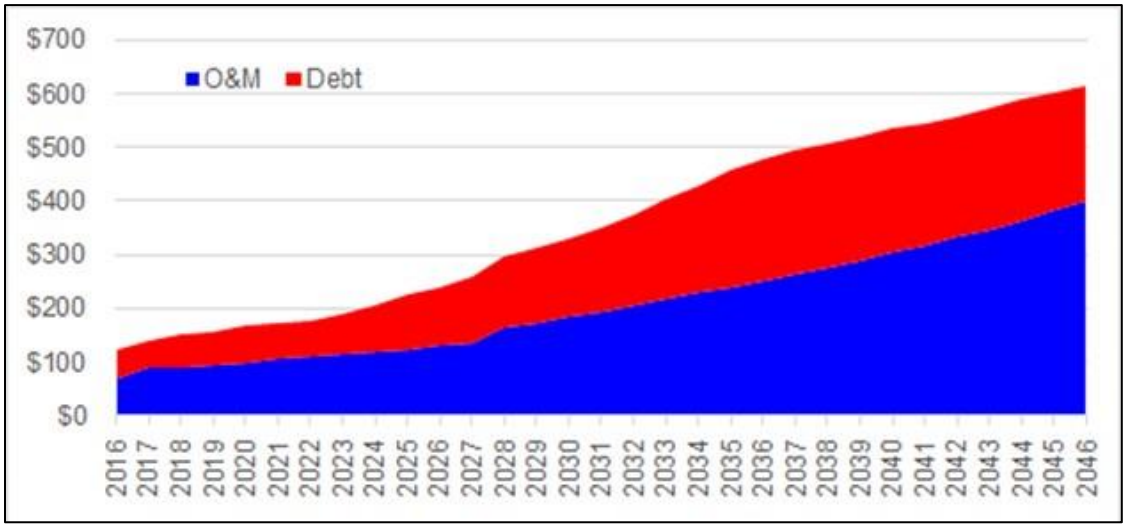
The projected ALCOSAN annual costs resulting from the implementation of the IWWP are summarized on Table 11-18 and are shown graphically on Figure 11-17 through the 2046 planning period. Total estimated ALCOSAN annual costs are projected to increase from $140 million in 2017 to $502 million in 2037, the first full year of operation for the IWWP facilities. This amount includes $210 million in incremental debt service (not including related reserves) and an additional $49 million in incremental O&M costs (2037 dollars).

Table 11-18: Estimated Annual Costs with the Implementation of the IWWP
(In $ millions)

Line Item	2017	2037	2046
Operations and Maintenance			
Current System	$88	$216	$333
IWWP	$0	$49	$67
Subtotal	$88	$265	$401
Debt Service			
Current Debt	$52	$27	$0
Incremental Debt Service*	$0	$210	$224
Subtotal	$52	$237	$224
TOTAL	**$140**	**$502**	**$625**

*Includes future borrowing for IWWP and non-IWWP capital expenditures

Figure 11-17: Projected ALCOSAN Annual Costs for O&M and Debt Service Payments
(In Millions with the IWWP)



Revenue Requirement Impacts of the IWWP

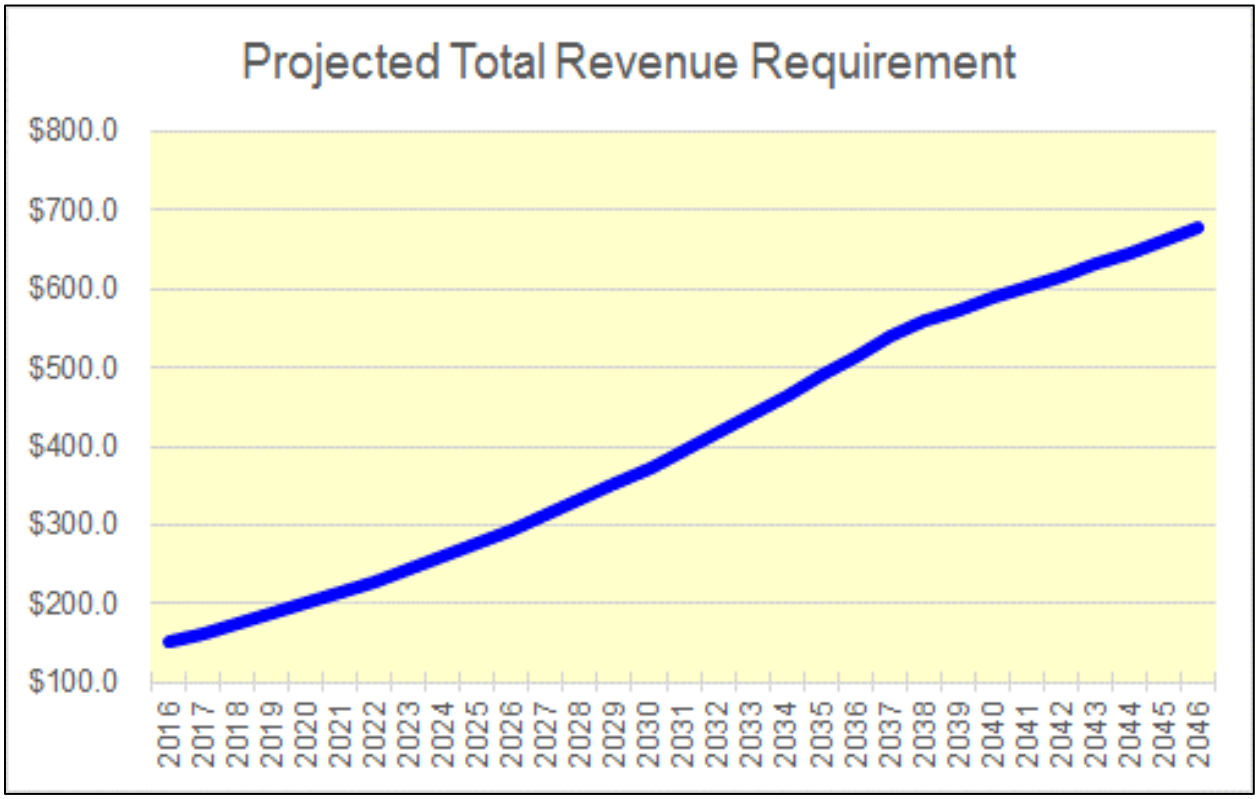
ALCOSAN Incremental Annual Revenue Requirements:

The projected ALCOSAN annual revenues and revenue requirements, including debt service coverage and reserves resulting from the implementation of the IWWP are summarized on Table 11-19 and are shown graphically on Figure 11-18 through the 2046 planning period. Total ALCOSAN revenue requirement are projected to more than triple for the first full year of operation for the IWWP facilities from $162 million in 2017 to $540 million in 2037.

Table 11-19: ALCOSAN Projected Annual Revenue Requirements with IWWP

Year	Non-Operating Revenues	Operating Revenues	Total Revenue Requirement	Year	Non-Operating Revenues	Operating Revenues	Total Revenue Requirement
2016	$0.7	$150.3	$151.0	2032	$0.6	$416.5	$417.1
2017	$0.5	$162.0	$162.5	2032	$0.6	$416.5	$417.1
2018	$0.3	$174.5	$174.9	2033	$0.6	$439.7	$440.3
2019	$1.0	$187.0	$188.0	2034	$0.6	$463.7	$464.2
2020	$0.8	$200.0	$200.8	2035	$0.5	$488.4	$489.0
2021	$0.5	$213.9	$214.4	2036	$0.5	$513.9	$514.5
2022	$0.3	$228.5	$228.8	2037	$0.6	$540.2	$540.8
2023	$0.4	$243.8	$244.2	2038	$0.6	$560.3	$560.9
2024	$0.4	$259.8	$260.3	2039	$0.7	$573.7	$574.3
2025	$0.5	$276.7	$277.1	2040	$0.7	$587.4	$588.1
2026	$0.5	$294.2	$294.8	2041	$0.7	$601.4	$602.1
2027	$0.6	$312.6	$313.2	2042	$0.8	$615.8	$616.5
2028	$0.6	$331.8	$332.4	2043	$0.8	$630.5	$631.3
2029	$0.5	$351.8	$352.3	2044	$0.8	$645.5	$646.4
2030	$0.5	$372.5	$373.1	2045	$0.8	$660.9	$661.8
2031	$0.5	$394.1	$394.7	2046	$0.9	$676.7	$677.6

Figure 11-18: Projected ALCOSAN Revenue Requirements



Affordability Impacts of the Interim Wet Weather Plan

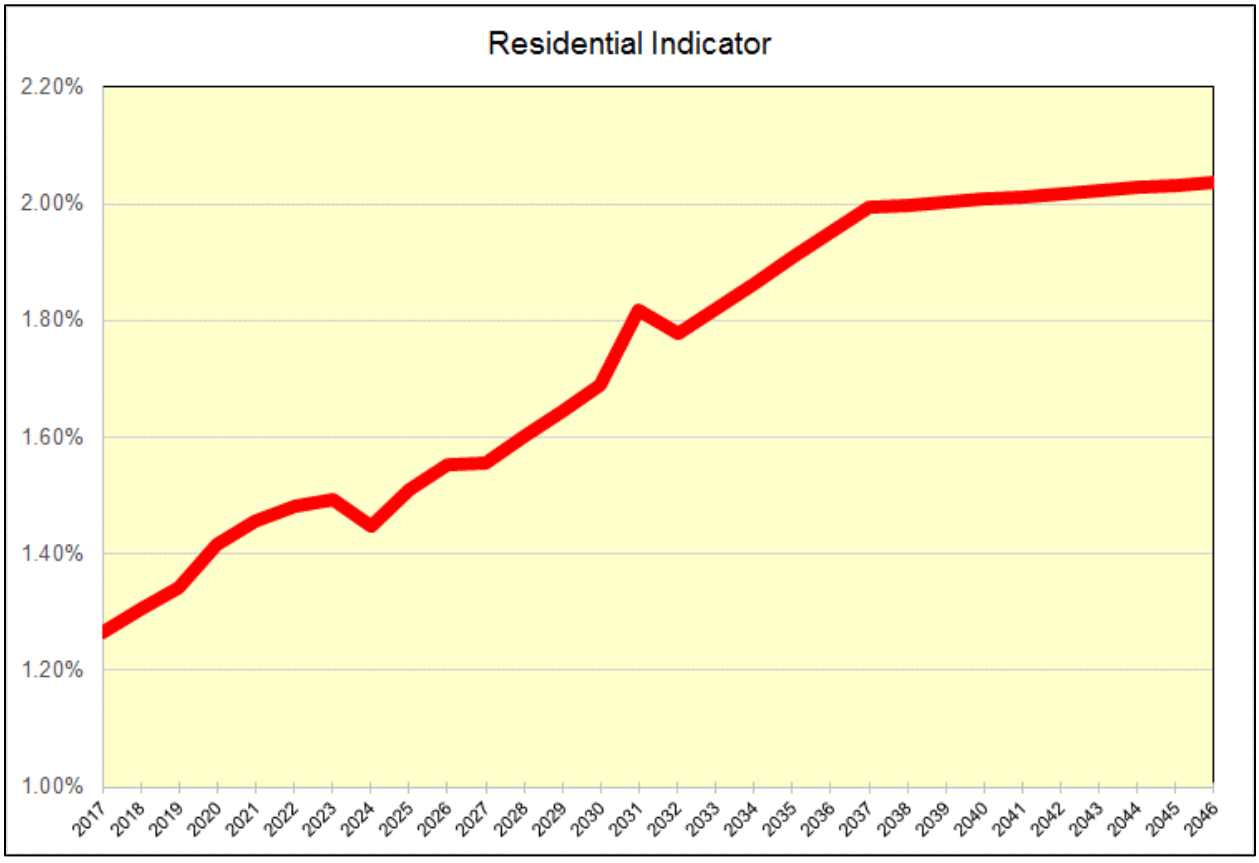
Projected Cost per Household: The projected costs per household resultant from the implementation of the IWWP are shown through the 2046 planning period on Table 11-20. The ALCOSAN cost per household is projected to be approximately $1,292 during the first full year of operation (2037 dollars). Projected municipal costs (ALCOSAN service-area-wide weighted average) will total about $454. Adding the projected ALCOSAN costs of $1,292 to the projected municipal costs of $454 results in an estimated cost per household of $1,746 in 2037.

Projected Regional Residential Indicator: The current (2017) ALCOSAN service-area-wide median household income of $54,000 is projected to increase at 2.4% annually to $86,700 in 2037. Dividing the projected annual cost per household of $1,778 by the projected MHI results in a Regional Residential Indicator of 2.0%, or a "high burden" based upon the USEPA criteria. The Regional Residential Indicator is projected to stay at or above 2% through 2046. The Residential Indicator trend line is shown on Figure 11-19.

Table 11-20: ALCOSAN IWWP Projected Annual Cost per Typical Household

Cost per Household	2017	2037	2046
ALCOSAN			
Current System Cost	$390	$624	$773
IWWP	$0	$668	$827
Subtotal	$390	$1,292	$1,600
Municipal (weighted average)	$310	$454	$618
Total	$700	$1,746	$2,218
Projected Median Household Income	$54,000	$87,600	$108,800
Residential Indicator	**1.3%**	**2.0%**	**2.0%**

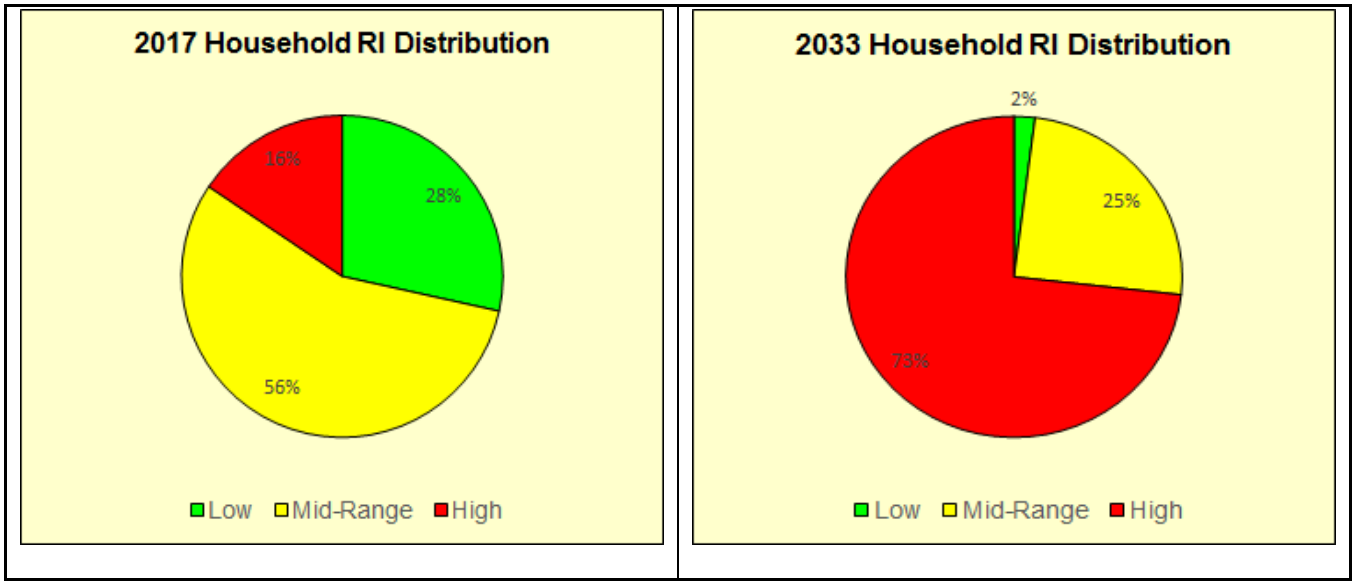
Figure 11-19: Residential Indicator Trend Line through 2046



Analysis of Impacts

Household Impacts: As shown in Figure 11-20, the implementation of the IWWP will result in a dramatic increase in the number of households within the ALCOSAN service area for whom annual wastewater costs will constitute a high burden. The number of households in the service area with a high burden is projected to increase from about 51,000 households (16%) to 240,000 households (73%). The number of households with a low burden is projected to decrease from 93,000 households (28%) to 7,000 (2%).

Figure 11-20: Burden Level of Households



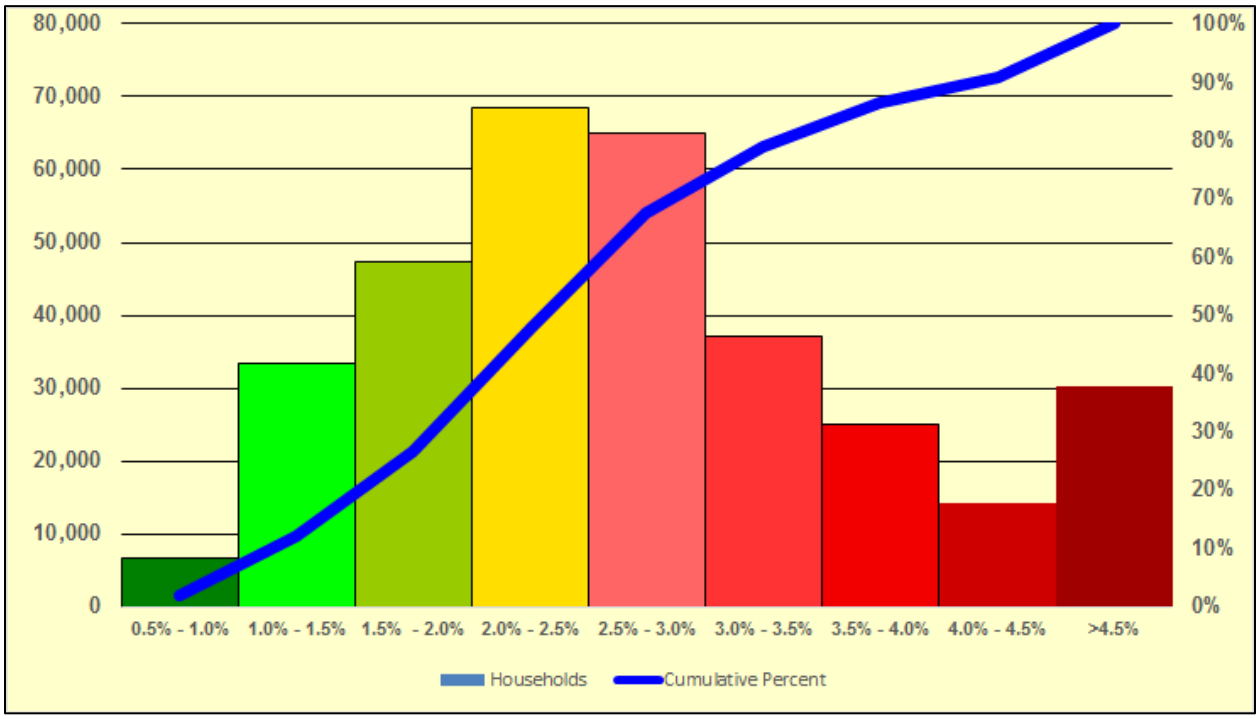
The household impact can also be evaluated in terms of a cumulative frequency distribution of residential indicators across the service area. A cumulative frequency distribution of the residential indicators by household is shown on Figure 11-21. Also shown are the relative number of households by residential indicator brackets (0%-0.5%, etc.).

The data underlying Figure 11-21 reveal the following statistics relating to the impact of the IWWP:

- The RI will meet or exceed 4.0% of household income for approximately 44,500 households or 111,000 residents, approximately equaling the populations of the Cities of Elgin Illinois, Wilmington Delaware, and Allentown Pennsylvania;
- The RI will meet or exceed 3.5% of household income for approximately 79,000 households or 173,000 residents within the ALCOSAN service area; representing the population equivalent of Grand Rapids Michigan, Salt Lake City Utah, and Tallahassee Florida;
- The RI will meet or exceed 3.0% of the household income for approximately 107,000 households or 267,000 residents, approximating the population equivalent of Toledo Ohio, Newark New Jersey and Fort Wayne, Indiana;

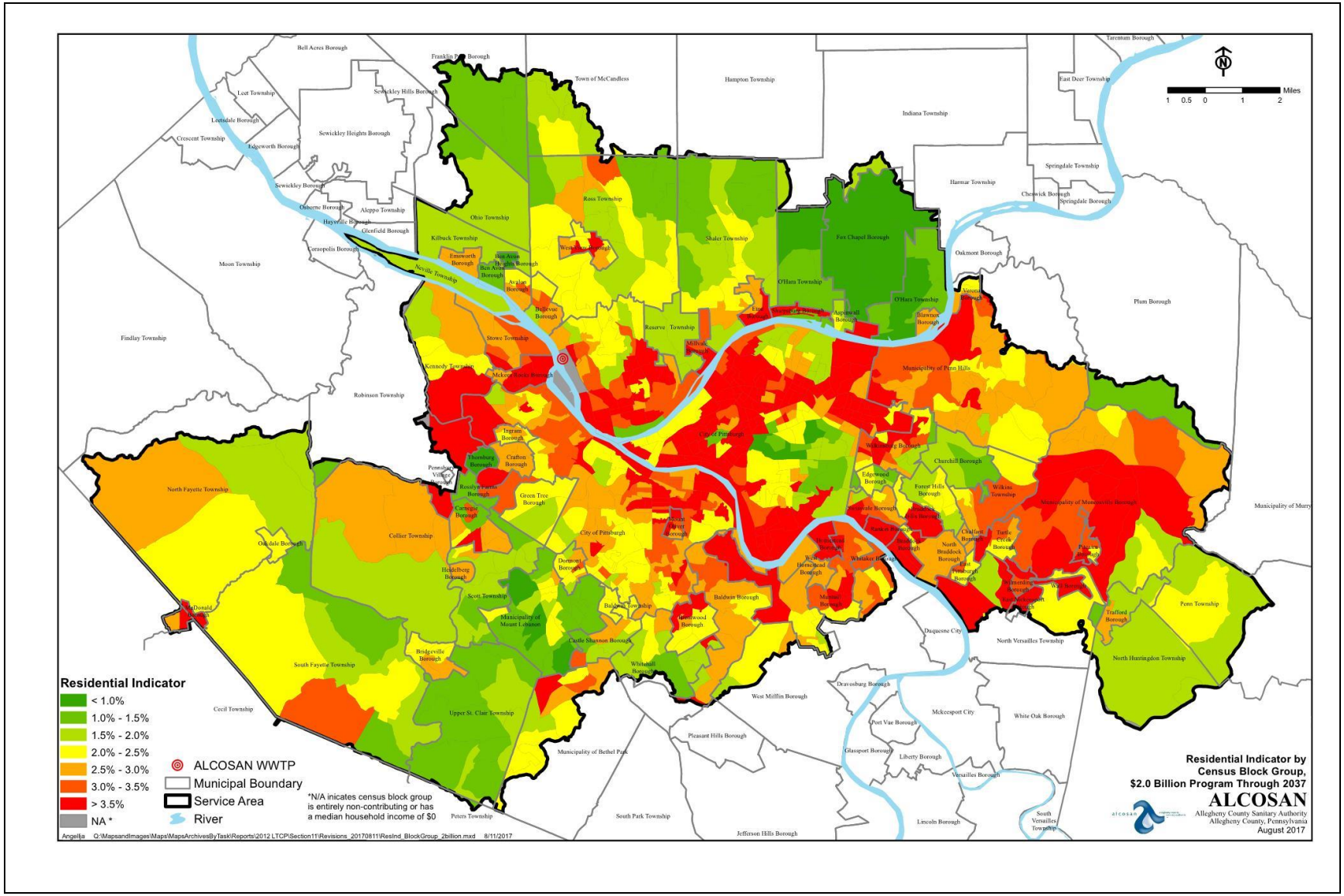
- The RI will meet or exceed 2.5% of household income for approximately 172,000 households or 430,000 residents, representing the population equivalent of Atlanta Georgia, Miami Florida and Colorado Springs Colorado; and
- The RI will meet or exceed 2.0% of the household income for approximately 240,000 households or roughly 600,000 residents, representing a population equivalent of the cities of Portland Oregon, Las Vegas Nevada and Milwaukee Wisconsin.

Figure 11-21: Residential Indicator Cumulative Frequency Analysis (Projected 2037)



The household level impacts can be shown geographically by Census block groups. Figure 11-22 maps the projected 2037 residential indicators amongst the Census block groups within the ALCOSAN service area, with seven gradations of residential indicator.

Figure 11-22: Projected 2037 Residential Indicators by Census Block Group



Municipal Analysis: The above analysis was based upon the aggregated ALCOSAN service area, including uniform ALCOSAN rates and the service-area-wide weighted average municipal collection system cost. Uniform ALCOSAN costs per household are utilized, along with the projected municipal collection system charges for current municipal systems, based upon extrapolation of the current municipal charges. The results of the municipal level analysis are provided on Table 11-21.

Table 11-21: Projected Cost per Typical Household with IWWP by Municipality

Municipality		Total Cost per Household	Projected Municipal MHI	Residential Indicator	EPA Score
		Projected for 2037			
1	Aspinwall	$1,457	$109,100	1.3%	Mid-Range
2	Avalon	$1,572	$65,400	2.4%	High
3	Baldwin Borough	$2,048	$91,300	2.2%	High
4	Baldwin Township	$1,818	$107,000	1.7%	Mid-Range
5	Bellevue	$1,547	$67,800	2.3%	High
6	Ben Avon	$1,292	$147,800	0.9%	Low
7	Ben Avon Heights	$1,770	$257,300	0.7%	Low
8	Bethel Park	$1,889	$119,500	1.6%	Mid-Range
9	Blawnox	$1,690	$61,000	2.8%	High
10	Braddock	$1,459	$40,100	3.6%	High
11	Braddock Hills	$1,591	$52,500	3.0%	High
12	Brentwood	$2,107	$87,900	2.4%	High
13	Bridgeville	$1,994	$76,400	2.6%	High
14	Carnegie	$1,942	$69,500	2.8%	High
15	Castle Shannon	$1,798	$80,700	2.2%	High
16	Chalfant	$1,734	$84,900	2.0%	High
17	Churchill	$1,877	$147,400	1.3%	Mid-Range
18	Collier	$1,834	$112,400	1.6%	Mid-Range
19	Crafton	$2,148	$89,600	2.4%	High
20	Dormont	$1,722	$95,200	1.8%	Mid-Range
21	East McKeesport	$1,690	$66,300	2.5%	High
22	East Pittsburgh	$1,576	$40,500	3.9%	High
23	Edgewood	$1,753	$113,900	1.5%	Mid-Range
24	Emsworth	$1,819	$88,800	2.0%	High
25	Etna	$1,819	$77,400	2.4%	High
26	Forest Hills	$1,746	$110,400	1.6%	Mid-Range
27	Fox Chapel	$1,857	$263,200	0.7%	Low
28	Franklin Park	$1,761	$196,100	0.9%	Low
29	Green Tree	$1,770	$112,400	1.6%	Mid-Range
30	Heidelberg	$1,869	$90,000	2.1%	High
31	Homestead	$1,716	$44,000	3.9%	High
32	Indiana	$1,907	$147,200	1.3%	Mid-Range
33	Ingram	$1,659	$80,300	2.1%	High
34	Kennedy	$2,056	$111,000	1.9%	Mid-Range

Table 11-21: Projected Cost per Typical Household with IWWP by Municipality

Municipality		Total Cost per Household	Projected Municipal MHI	Residential Indicator	EPA Score
		Projected for 2037			
35	Kilbuck	$1,691	$104,400	1.6%	Mid-Range
36	McCandless	$2,016	$132,400	1.5%	Mid-Range
37	McDonald	$2,086	$77,400	2.7%	High
38	McKees Rocks	$1,729	$49,300	3.5%	High
39	Millvale	$1,719	$51,700	3.3%	High
40	Monroeville	$1,889	$100,000	1.9%	Mid-Range
41	Mt. Lebanon	$1,679	$138,300	1.2%	Mid-Range
42	Mt. Oliver	$1,972	$47,900	4.1%	High
43	Munhall	$1,922	$81,300	2.4%	High
45	Neville	$2,358	$71,200	3.3%	High
46	North Braddock	$1,359	$49,400	2.8%	High
47	North Fayette	$2,009	$120,500	1.7%	Mid-Range
44	North Huntington	$2,118	$117,800	1.8%	Mid-Range
48	North Versailles	$1,889	$71,900	2.6%	High
49	Oakdale	$1,940	$93,100	2.1%	High
50	O'Hara	$1,511	$152,100	1.0%	Low
51	Ohio	$1,626	$173,900	0.9%	Low
52	Penn Hills	$2,030	$82,500	2.5%	High
53	Penn Township	$1,739	$90,800	1.9%	Mid-Range
54	Peters	$1,475	$184,600	0.8%	Low
55	Pitcairn	$1,646	$50,300	3.3%	High
56	Pittsburgh	$1,683	$69,300	2.4%	High
57	Pleasant Hills	$2,308	$108,900	2.1%	High
58	Plum Borough	$1,292	$115,200	1.1%	Mid-Range
59	Rankin	$1,493	$36,500	4.1%	High
60	Reserve	$1,292	$97,700	1.3%	Mid-Range
61	Robinson	$1,464	$81,200	1.8%	Mid-Range
62	Ross	$1,758	$109,800	1.6%	Mid-Range
63	Rosslyn Farms	$1,865	$214,800	0.9%	Low
64	Scott Township	$1,435	$107,000	1.3%	Mid-Range
65	Shaler	$1,534	$117,100	1.3%	Mid-Range
66	Sharpsburg	$1,690	$53,200	3.2%	High
67	South Fayette	$1,787	$126,100	1.4%	Mid-Range
68	Stowe	$1,722	$58,100	3.0%	High
69	Swissvale	$1,636	$63,200	2.6%	High
70	Thornburg Borough	$1,292	$220,600	0.6%	Low
71	Trafford	$1,300	$79,200	1.6%	Mid-Range
72	Turtle Creek	$1,543	$54,800	2.8%	High
73	Upper St. Clair	$2,262	$192,100	1.2%	Mid-Range
74	Verona	$1,292	$66,100	2.0%	Mid-Range
75	Wall	$1,815	$85,200	2.1%	High

Table 11-21: Projected Cost per Typical Household with IWWP by Municipality

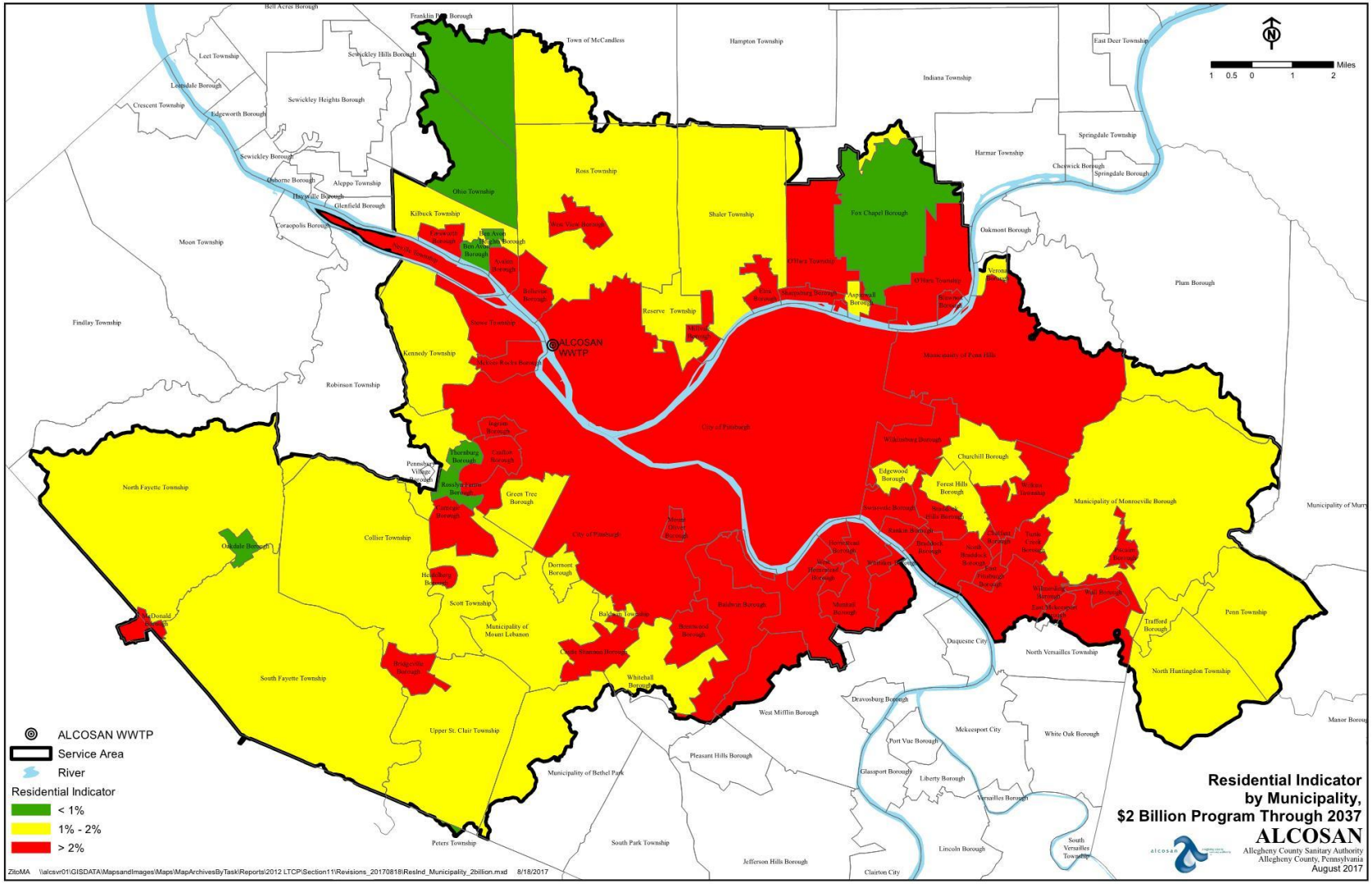
Municipality		Total Cost per Household	Projected Municipal MHI	Residential Indicator	EPA Score
		Projected for 2037			
76	West Homestead	$1,711	$85,100	2.0%	High
77	West Mifflin	$1,771	$85,600	2.1%	High
78	West View	$1,987	$97,200	2.0%	High
79	Whitaker	$1,889	$65,900	2.9%	High
80	Whitehall	$1,637	$99,600	1.6%	Mid-Range
81	Wilkins	$1,949	$87,900	2.2%	High
82	Wilkinsburg	$1,447	$55,000	2.6%	High
83	Wilmerding	$1,591	$40,800	3.9%	High

The impact of the IWWP and related municipal improvements on the municipal costs per household can be summarized as follows:

- The residential indicator is projected to exceed 2% of median household income in 45 of the 83 ALCOSAN municipalities;
- The residential indicator is projected to exceed 2.5% of median household income in 24 municipalities;
- The RI is projected to exceed 3% of median income in 12 municipalities;
- The RI is projected to exceed 3.5% in 7 municipalities;
- The projected RI for the City of Pittsburgh is 2.4%;

The projected 2037 residential indicator by municipality is shown on Figure 11-23.

Figure 11-23: Projected 2037 Residential Indicators by Municipality



Uncertainties

Key variables beyond ALCOSAN's control reduce the accuracy of long term financial projections, including household wastewater costs. Through sensitivity analysis, ALCOSAN has identified six factors that could materially affect the future residential indicator. These include: the residential share of wastewater costs, total capital cost, capital cost inflation, operations and maintenance cost inflation, income growth, and bond interest rates.

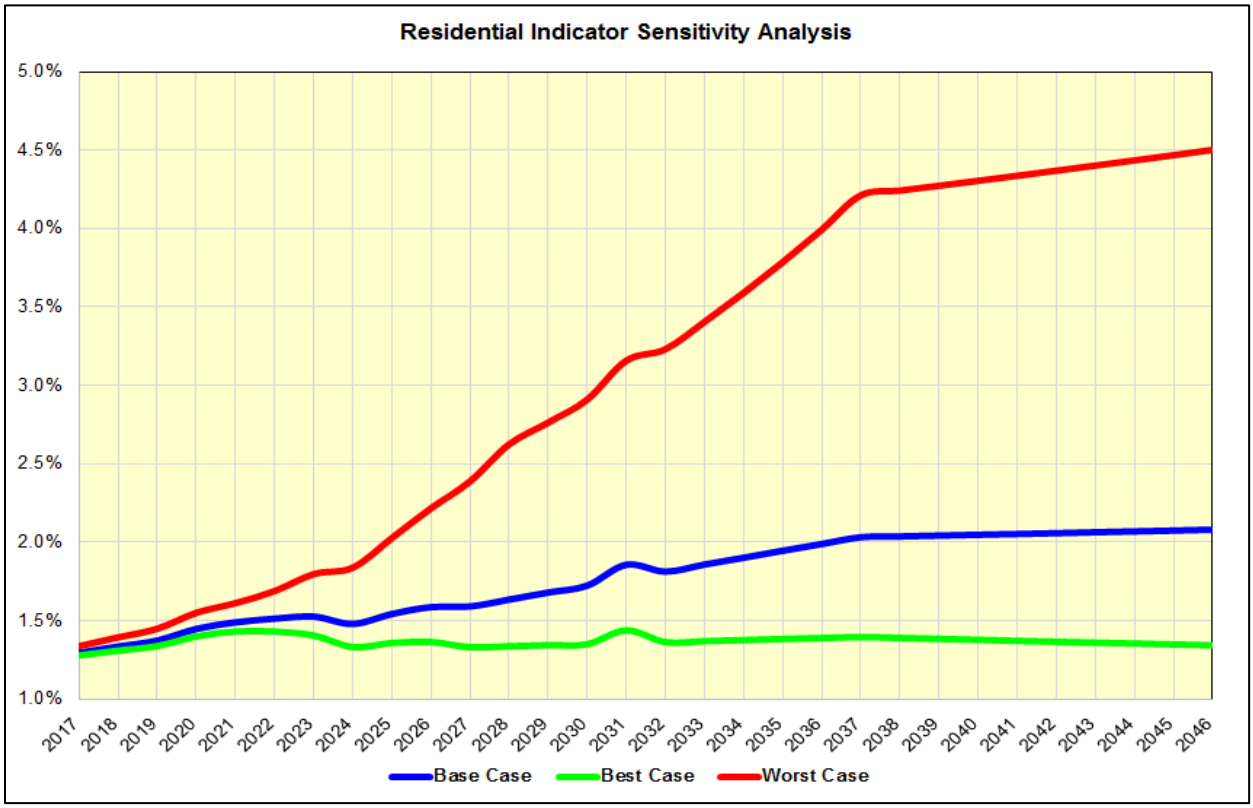
A default, best, and worst-case scenario were simulated in order to determine the possible range of regional affordability the service area. Table 11-22 displays the inputs used to generate the best, default, and worst-case scenarios for the residential indicator. The isolated effect of each input variable on the residential indicator (in 2037) is shown in the last two columns. Changes in total program capital cost have the highest impact on the residential indicator, followed by income growth rate and O&M Cost inflation.

Table 11-22: Sensitivity Analysis Variables

Variable Input	Default Case	Input Range Tested	Resulting RI	
			2037 Best Case	2037 Worst Case
Capital Cost Inflation	2.2%	1.5% - 4.0%	2.0%	2.4%
O&M Inflation	3.5%	2.5% - 5.0%	2.0%	2.3%
Income Growth	2.4%	1.5% - 3.0%	1.8%	2.5%
ALCOSAN Bond Interest Rate	5.8%	4.0% - 7.0%	1.9%	2.2%
Program Cost ($ Billions)	$2.0	$1.4 - $3.0	1.9%	2.6%
All Best Case / All Worst Case			1.4%	4.2%

The default scenario results in a projected residential indicator of 2.0% for 2037 and 2.1% for 2046. In 2037, a best and worst-case scenario for all inputs suggests the possibility of a residential indicator as low as 1.4% and as high as 4.2%. The input value trends continue over time, resulting in greater uncertainty as the time horizon expands, as shown by Figure 11-24.

Figure 11-24: Residential Indicator Sensitivity to Uncontrollable Variables



Phase 2 Analysis – Financial Capability Assessment

In this sub-section, the analysis of the six "financial capability" indicators that were presented in sub-section 6.3 will be refined to reflect the projected impacts of the estimated $2 billion in new public investments represented by the IWWP. The six financial indicators reflect the approach used by the municipal bond rating agencies to evaluate municipal general obligation bonds, the strength of which is evaluated based upon property taxation. As a municipal authority, ALCOSAN utilizes revenue bonds, which are evaluated against the projected revenues stream from the user charges for services rendered. Therefore, the applicability of financial indicators 2 through 6 is limited to the municipalities.

Indicator 1 - Bond Ratings

ALCOSAN Bond Ratings – ALCOSAN recently received a rating of 'A' long-term with a stable outlook from Standard & Poor's Rating Services and A1 from Moody's for its series 2016 sewer revenue refunding bonds. Standard & Poor's also recently affirmed its 'A' rating on ALCOSAN's outstanding debt. The 'A' revenue bond rating is the lowest that qualifies for a "strong" rating for the USEPA bond rating financial capability indicator.

The IWWP and current renewal and replacement levels will require ALCOSAN to increase its debt service payments over 450% to around $233 million per year in 2037. Further, the raw amount of debt ALCOSAN will take on during the implementation period, over $2 billion including existing renewal and replacement needs, will substantially increase ALCOSAN's debt

to equity ratio. The risks associated with carrying such a large amount of debt will put downward pressure on ALCOSAN's current bond ratings. Nonetheless, ALCOSAN remains committed to maintaining its historically favorable bond ratings through timely and sufficient rate increases as necessary and the maintenance of reserve funds adequate to maintain their ratings. The ALCOSAN score under the USEPA criteria will remain "strong" for a numeric score of 3.

Municipal Bond Ratings – Moody's rating methodology for municipal general obligation bonds is based on of analysis of four key rating factors: economic strength, financial strength, management and governance, and debt profile. Moody's credit rating assessment weights economic strength at 40% of its calculation, emphasizing the property tax base as the source of bondholder security and the economy as the source of leverage that supports municipal operations. The debt burden, debt structure and composition, and debt management, of a municipality is generally weighted at 10%.

Moody's regularly monitors absolute changes by seeking significant multi-year trends in annual financial disclosure documents and notes that "while economic factors carry the greatest weight in Moody's rating assessments, we have seen that over time, financial changes are most likely to drive rating movements"[11-8]. The amount of wet weather program spending marks a substantial financial change for many municipalities in the ALCOSAN service area and is likely to place downward pressure on Municipal Bond Ratings.

As described in sub-section 6.3, eighteen of the largest municipalities within the ALCOSAN service area have rated debt, for which the population weighted average of numeric score was 2.5, or a "mid-range" USEPA rating. The remaining 65 municipalities do not have bond ratings, as is typical for small towns.

It is anticipated that bond ratings will worsen over the span of the wet weather program. However, the current bond rating USEPA capability score is at 2.49, the uppermost "mid-range" value, and ratings changes are not expected to be so severe as to change the score for this indicator to "weak". Many of these smaller municipalities are also classified as subject to a "high" burden in the affordability analysis and are also rated as weak under the other financial criteria as detailed in Section 6 of the Wet Weather Plan. In aggregate, the un-rated municipalities would likely receive a weak rating if there were to be rated based upon current conditions. This assessment, coupled with the half of a billion dollars in new capital costs suggests that an overall weak rating for the municipalities would be reasonable.

Combining the ALCOSAN and municipal bond rating scores, an overall service area rating of mid-range and an USEPA numeric score of 2 is assigned.

Indicator 2 – Municipal Debt Burden

The USEPA financial capability assessment considers overall net debt as a percent of property value a measure of the local government's ability to issue additional debt. The current overall net debt calculated in sub-section 6.3.1 was found to be $3.38 billion for the service area and total market value of real estate was assessed at $51.6 billion. This results in a current

[11-8] Moody's U.S. Public Finance- general Obligation Bonds Issued by U.S. Local Governments Rating Methodology page 20.

population-weighted debt burden value of 6.4%, a "weak" financial capability rating. If the municipal compliance costs were financed using only general obligation debt, this would result in an increase of the indicator score to more than the 6.4%. It should be noted that the cutoff for a "weak" indicator score for municipal debt burden is 5%. A debt burden around 6.4 or higher% could rightfully be called "extremely weak" and have a larger impact on the financial capability score, if the USEPA criteria allowed for this magnitude to be captured.

Indicator 3 – Unemployment Rate

Under the USEPA methodology, unemployment rates that are within one percentage point of the national average are "mid-range". The December 2015 unemployment rate in Allegheny County of 4.2% is approximately eight-tenths of a percentage point lower than the national average of 5.0%.

Indicator 4 – Median Household Income

Like the unemployment rate, USEPA evaluates this criterion against the national value. USEPA suggests that a local median household income that is within 25% of the national median household income is "mid-range" in their metric. As documented in sub-section 6.3, the median household income within the ALCOSAN service area is approximately 85% of the national figure. Since 1990, the income in the greater Pittsburgh region has grown at around a 2.4% rate. This compares to a national income growth rate of around 2.6%[11-9]. If this close correlation continues through the planning period, the MHI in the ALCOSAN service area will remain with the $\pm$ 25% range.

Indicator 5 – Property Tax Burden

The property tax burden indicator is derived by dividing property tax revenue by the assessed full market value of taxable property. Total 2009 expected property tax revenue collected for the region was around $1.11 billion and total 2009 full market property value of the region was approximately $52 billion, resulting in a calculated property tax burden of 2.14%, a Mid-Range score.

Future incremental municipal debt service attributable to wet weather compliance is not known. A maximum annual debt service payment financed by additional property tax revenue was estimated by assuming that all WWP general obligation debt would be issued in one year with an interest rate of 6.5% and 20-year bond term and that the debt service payments would range between $10 million and $100 million. Using this analysis, the financial capability value of property tax burden for the region is projected to range between 2.25% and 2.35%, still within the USEPA "mid-range".

Indicator 6 – Property Tax Collection Rate

The current property tax collection rate is 93%, which corresponds to a financial capability score of "weak", the lowest capability score. Property tax collection rates are not anticipated to improve in light of increased taxes used to finance municipal borrowing for Wet Weather Improvements.

[11-9] State Median Household Income Patterns: 1990 – 2010 by Proximity.com based upon US Census American Community Survey.

Financial Capability Matrix Score and Implications

Based on the analysis above, despite the level of investment required by the Wet Weather Program, it is anticipated that the overall financial capability score will remain mid-range after full implementation. The lack of change to the financial capability score is more indicative of limitations of the USEPA methodology when applied to a diverse service area such as ALCOSAN's. For example, the exclusion of all revenue debt from the net debt calculation removes ALCOSAN's overlapping debt and municipal authority debt from the consideration of the municipal financial capability. Moreover, several of the criteria (municipal debt burden and tax collection rate) are already weak under the USEPA criteria; however, there is no provision under the USEPA scoring to quantify the magnitude of the weaknesses. Nonetheless, the large capital requirements for the region will have significant impacts which may be described qualitatively as shown on Table 11-23.

Table 11-23: Impacts on the Financial Capability Indicators

Financial Capability Indicator	Score	Qualitative Impacts	
		ALCOSAN	Municipal
1 Bond Ratings	2.0	Worse	Worse
2 Debt Burden	1.0	N/A	Worse
3 Unemployment Rate	2.0	N/A	Unknown – potential improvement
4 Median Household Income	2.0	N/A	Unknown – potential improvement
5 Property Tax Burden	2.0	N/A	Worse
6 Property Tax Collection Rate	1.0	N/A	Worse
Overall Score	1.67	(Sum of the scores divided by six)	

Implementing the IWWP and the related municipal improvements will result in a high burden Residential Indictor. As seen in Table 11-24, the Financial Capability Score of 1.67 falls into the bottom of the USEPA "mid-range", being 11% above the trigger score for a "weak" rating. Therefore, the overall matrix score is "high burden."

Table 11-24: Post Implementation Financial Capability Matrix

Residential Indicator (Cost Per Household as a % MHI)			
Financial Capability Indicators	**Low (<1.0%)**	**Mid-Range (1.0 - 2.0%)**	**High (>2.0%)**
Weak (<1.5)	Medium Burden	High Burden	High Burden
Mid-Range (1.5 - 2.5)	Low Burden	Medium Burden	**High Burden**
Strong (>2.5)	Low Burden	Low Burden	Medium Burden

11.3.6 Institutional Assessment

ALCOSAN's Authority to Implement the Plan

ALCOSAN is a body corporate and politic created in March 1946, under Pennsylvania Municipality Authorities Act (Act). The Authority is authorized to collect, transport, treat and dispose of sewage in Allegheny County, and certain adjacent areas. Key powers[11-10] under the Act include:

- To have existence for a term of 50 years and for such further period or periods as may be provided in articles of amendment;
- To sue and be sued;
- To acquire, purchase, hold, lease as lessee and use any franchise, property
- To finance projects by loan, mortgages, security agreements or any other instruments;
- To make bylaws for the management and regulation of its affairs;
- To fix, alter, charge and collect rates and other charges in the area served by its facilities at reasonable and uniform rates;
- To borrow money, make and issue negotiable notes, bonds, refunding bonds and other evidences of indebtedness or obligations;
- To make contracts and to execute all instruments necessary or convenient for the carrying on of its business;
- To pledge revenues of the authority as security for obligations of the authority;
- To have the power of eminent domain;
- To do all acts and things necessary or convenient for the promotion of its business and the general welfare of the authority to carry out the powers granted to it; and

[11-10] Condensed from 53 Pa.C.S.A. 5607(d).

- To contract with any municipality, corporation or a public authority.

Under the Act, ALCOSAN may not pledge the credit or taxing power of the Commonwealth or its political subdivisions; moreover, ALCOSAN's financial obligations are not obligations of the Commonwealth or its political subdivisions. Pursuant to the Act, ALCOSAN appears to have sufficient powers to implement the IWWP. ALCOSAN's tenure currently extends to the year 2060 as amended in preparation for issuing the 2010 new construction bonds.

Limits to ALCOSAN's Authority

While ALCOSAN has the requisite authority to build new conveyance, storage and treatment facilities; the 2008 CD, Pennsylvania statute and existing service contracts limit its ability to mandate or implement the reduction of wet weather flows from the municipal collection systems through green stormwater infrastructure or other flow reduction strategies.

Under its CD, ALCOSAN is required to design and construct facilities sufficient for a flow volume equivalent to ***all*** of the flow that is generated in the municipal sanitary sewer systems and to design and to construct facilities sufficient to capture and treat all flows conveyed from the combined sewered municipalities to meet the requirements of the CWA, consistent with CSO Policy. The CD precludes ALCOSAN from planning for source reduction from the municipal collection systems unless a municipality has constructed or is legally committed under an Enforceable Document to construct facilities or PaDEP and USEPA have determined that the municipality can comply with the CWA through means other than conveying the wet weather flow to ALCOSAN's conveyance interceptor system.[11-11]

Pursuant to their respective circa 2004 Administrative Consent Orders (ACO) with the ACHD (sanitary sewered municipalities) or the COAs with the PaDEP (combined sewered municipalities), each municipality was required to develop a MFS to address its respective wet weather strategy. The MFS, which would be the mechanism through which the municipalities would propose source controls, were due under the orders six months after ALCOSAN submitted its Draft WWP in January of 2013. Following the submission of MFS to the regulatory agencies, PaDEP and ACHD ordered each municipality to submit a MSRS by December 2017.

ALCOSAN has limited institutional abilities to implement flow reduction projects within the municipalities. As an authority, ALCOSAN does not have control over the municipal codes and policies covering zoning, building codes, stormwater management, etc. that would be necessary to implement an integrated flow reduction program. The tight implementation timeframe that is mandated by the CD coupled with ALCOSAN's lack of the jurisdictional controls in the municipalities necessary to assure the timely implementation of municipal flow reduction also push towards regional wet weather control.

ALCOSAN's municipal service agreements (detailed in Section 6.6) also restrict ALCOSAN's ability to mandate municipal flow reduction. The agreements provide for uniform sewage charges throughout the service area based upon metered or estimated water consumption.

[11-11] See paragraphs 17(a) and 18(b) of the ALCOSAN CD (U.S. District Court – Western PA District Civil Action 07-0737.

There were no provisions for metering actual wastewater flows to the ALCOSAN interceptor system which would have been infeasible at the time and remains infeasible due to the large number of points of connection with the ALCOSAN system and the large number of inter-municipal connections. In addition, with the exception of the more recent agreements as detailed in Section 6.6, the service agreements imposed no upper limits on the quantity or rate of flow arriving at the points of connection with ALCOSAN.

Municipal Institutional Capacities

The original circa 2004 municipal orders require that each municipality establish:

> "…with ALCOSAN the quantity and rate of sewage flow from the Municipality that ALCOSAN will be able to retain, store, convey and treat upon implementation of a Wet Weather Plan and/or LTCP" (by ALCOSAN)[11-12]

The 2004 ACOs and COAs did not include provisions addressing:

- The basis and mechanism for agency approval of the quantities and rates of sewage flows from the municipalities vis-à-vis ALCOSAN's planning projections in the WWP;
- The regulatory mechanism for the coordination and finalization of inter-municipal design flows between the municipalities sharing points of connection with the ALCOSAN regional conveyance system or with ALCOSAN;
- PaDEP and ACHD mechanisms to enforce the design flow quantities and flow rates from the municipalities that have served as the basis of ALCOSAN's wet weather planning and will serve as ALCOSAN's final basis of design.

The 2004 ACOs and COAs expired on March 30th, 2015. PaDEP and ACHD issued new COAs in October of 2015. Under the second orders, the customer municipalities are required to complete a MSRS by December 1, 2017 to identify municipal projects that would most effectively reduce wet weather flows. Correspondingly, the USEPA directed ALCOSAN to establish flow targets for each customer municipality by January 2017 in anticipation of ALCOSAN and the municipalities entering into legally binding flow reduction agreements by January 2025, which must include long term plans to achieve such flow targets.

As outlined in Section 6.6, ALCOSAN's eighty-three customer municipalities appear to have the legal powers and responsibilities to provide adequate wastewater services within their jurisdictions to implement wet weather controls. The required municipal collection system projects may however pose difficulties for the smaller municipalities. The relatively high level of turnover of municipal governing boards and their appointed managers can limit institutional commitment to long term projects such as sewer system upgrades.

Of the 83 municipalities within the service area, 45 are physically connected directly to ALCOSAN's regional interceptor system. The remaining 38 municipalities' sewers connect to downstream municipalities who are connected to the ALCOSAN system. Of the 45

[11-12] Paragraph 14(c)(i) of the PaDEP Consent Order and Agreement and paragraph 15(c)(i) of the ACHD Administrative Consent Order

municipalities that flow directly into the ALCOSAN system, 39 convey wastewater from upstream municipalities. Due to the jurisdictions over watersheds and sewersheds being fragmented between the many small municipalities, the institutional capacity to implement inter-municipal projects that may be recommended in the feasibility studies is expected to be problematic.

11.3.7 Adaptive Management

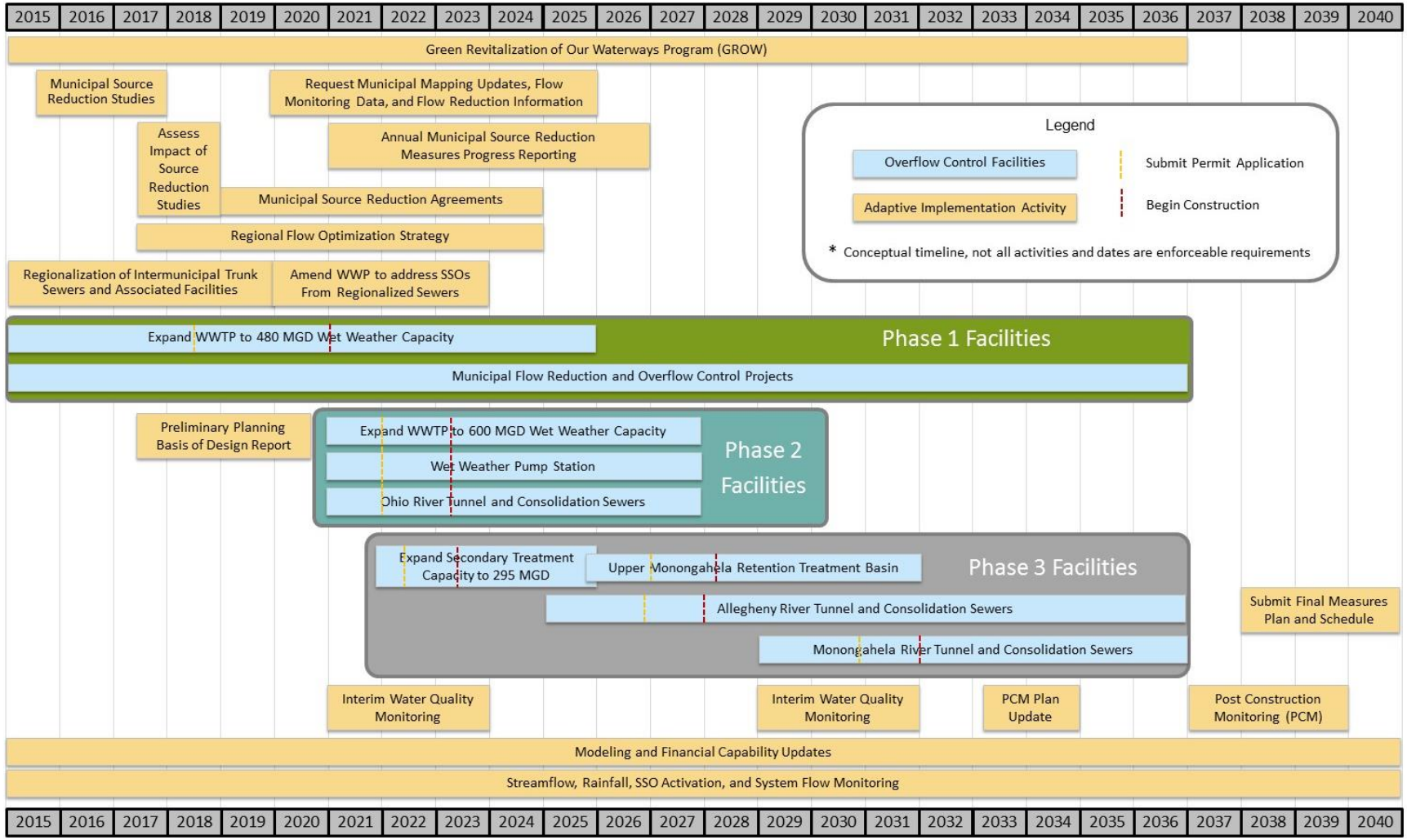
ALCOSAN has initiated a multi-billion dollar and multi-decade public investment program to comply with its CD in an ever-changing environment. The WWP was developed based on intensive stakeholder collaboration using the best information and technological resources available at the time, with the understanding that certain assumptions are required to recommend control strategies and move ahead with implementation. Long term planners realize that assumptions are the only way to advance important programs in the face of uncertainty and typically employ adaptive management principles during implementation so the program can benefit from the availability of improved information resources and respond to changing conditions or priorities. Figure 11-25 depicts the adaptive management continuous improvement cycle which is based on periodic program monitoring, evaluations and refinements.

Figure 11-27: Adaptive management principles are designed to produce improved outcomes by employing continuous monitoring, evaluation, and refinement of a plan during implementation

ALCOSAN remains committed to providing the region's rate payers with the most contemporary and affordable long-term solutions that take advantage of improved information or technologies and adjust to a changing environment. As a result, ALCOSAN has worked with the regulatory agencies to modify its CD to allow for WWP revisions during implementation. This sub-section identifies events, both anticipated and unanticipated, that could impact implementation decisions and the adaptive management milestones put in place to accommodate WWP refinements, in coordination with the regulatory agencies and customer municipalities.

Figure 11-26 provides an overview of the phased and adaptive implementation framework that has been established, including timelines for IWWP projects, planned information updates, and adaptive WWP milestones. Please note that the established framework allows for WWP revision proposals to the agencies at any time, whereas Figure 11-26 identifies specifically required check-in requirements and some optional but anticipated updates. The remainder of this section elaborates further on elements of this framework and timeline.

Figure 11-26: Interim Measures Wet Weather Plan Adaptive Implementation Timeline



11.3.7.1 Green Stormwater Infrastructure and Other Flow Reduction Measures

There is a strong regional interest in using green stormwater infrastructure (GSI) technologies to control wet weather overflows in the Pittsburgh region, as evidenced by the large number of public comments on this subject. Although ALCOSAN strongly supports GSI, it has limited ability to directly implement GSI technologies. This is because GSI works by preventing flows from reaching the municipal collection system and requires land use development and re-development influence, which are generally controlled by local municipalities and land owners. In the interest of regional leadership and advocacy for flow reduction, ALCOSAN conducted a regional study that identified numerous opportunities for GSI and I/I reduction to play a role in the WWP. This study is included as Section 10 of this WWP. The study led to ALCOSAN initiating the flow reduction program described in Section 11.2.1.

ALCOSAN's customer municipalities are also studying the merits of GSI and I/I reduction technologies, in part due to local interests, and in response to PaDEP or ACHD orders to submit a MSRS by December 2017. ALCOSAN will work jointly with its customers to assess the effectiveness of green infrastructure, stream inflow removal, I/I reduction, and existing system asset management through its GROW program and the development of a regional flow optimization strategy. The region clearly needs more time to fully develop its flow reduction strategies and coordinate integration into the broader WWP. The agencies, however, are insistent upon ALCOSAN committing to an aggressive schedule to complete the IWWP. Since the agencies recognize that still developing flow reduction strategies could impact Phase 2 and Phase 3 IWWP projects, they have agreed to certain regulatory flexibilities that will allow for revision of projects once flow reduction commitments are clearly defined. As a result, the design and construction of Phase 2 and Phase 3 projects are not scheduled to start until after the MSRS are submitted and ALCOSAN has had a chance to evaluate the impact municipal flow reduction commitments will have on the basis of design for Phase 2 and Phase 3 projects.

In exchange for these regulatory flexibilities that allow for implementation revisions to the WWP, the agencies have required a series of adaptive management milestone check points. The regulatory requirements, flexibilities, and adaptive management activities related to flow reduction have been incorporated into the modified CD and are summarized below. The sequencing of these activities is depicted on the IWWP Adaptive Implementation Timeline (Figure 11-26).

Green Revitalization of Our Waterways (GROW) Municipal Flow Reduction Project Partnership Program

ALCOSAN has voluntarily offered to sponsor a regional GROW municipal flow reduction project partnership program to support municipalities in implementing GSI and other flow reduction projects as described in Section 11.2.1. This program aims to promote the implementation of projects that can be used to demonstrate flow reduction performance and inform future implementation strategies. ALCOSAN will award assistance to the customer municipalities on a matching fund basis each calendar year between 2017 and 2024. The GROW program will lead to the implementation of yet to be defined GSI and I/I reduction projects that may play a role in any proposals to downsize grey infrastructure.

Municipal Source Reduction Studies/Plans
Regional advocacy for flow reduction has spawned many avenues for the development of municipal flow reduction plans and adaptive integration of these efforts into the regional WWP. They include, but are not limited to, the MSRS, flow targets, flow reduction agreements, and ALCOSAN's GROW flow reduction program and regional flow optimization strategy. As a result, adaptive milestones have been identified to evaluate the impact of these initiatives on the remainder of the WWP and provide flexibility for timely revision such that green opportunities can be fully leveraged as the region expands the role of flow reduction in controlling CSOs.

Impact of MSRS on Interim or Final Measures
During 2018, ALCOSAN will evaluate the impacts of flow reduction identified in the MSRS that were due to PaDEP or ACHD by December 2017. On or before December 31, 2018 ALCOSAN shall submit to the agencies for review and comment a report in which ALCOSAN states whether it recommends modifications to the Interim or Final Measures based upon the MSRS submitted by the municipalities. The report shall evaluate 1) the proposed municipal source reduction measures and 2) the regional implications of any proposed municipal source reduction measures on whether alternate or revised Interim or Final Measures can achieve the requirements of the CD. If ALCOSAN recommends modification to the IWWP, the report shall describe the nature of the anticipated modification, and the basis for ALCOSAN's belief that the anticipated modification will satisfy the requirements of the CD.

Annual Requests for Municipal Flow Reduction Information and Progress Report Submission
On an annual basis from 2019 through 2025, ALCOSAN shall request information from the Customer Municipalities from the previous 12 months on any newly collected flow data or mapping changes regarding municipal source reduction measures. By December 31st of each year, ALCOSAN shall submit an analysis of the information to determine if the Municipal Source Reduction Measures are reducing the volume or rate of flow to the Conveyance and Treatment System. In designing Phases 2 and 3 projects, ALCOSAN shall consider the impact of Municipal Source Reduction Measures that have been installed or that are subject to Municipal Source Reduction Agreements or Enforceable Source Reduction Documents. ALCOSAN may submit a proposed revision to the IWWP based on Municipal Source Reduction Agreements or Enforceable Source Reduction Documents.

Flow Targets
In June 2015, the USEPA issued ALCOSAN a CWA Section 308 information requirement to establish flow targets for each customer municipality by January 2017 in anticipation of ALCOSAN and the municipalities entering into legally binding source reduction agreements. The letter required the submission of estimates of flows not captured by IWWP projects by January 2016, which ALCOSAN complied with, as scheduled. The letter also required that ALCOSAN establish flow targets for each customer municipality by January 2017. ALCOSAN complied with this requirement in coordination with customer municipalities participating in a 3RWW Wet Weather Working Group Source Flow Reduction and Flow Targets Sub-committee.

Municipal Source Reduction Agreements
As a requirement of the modified CD, the agencies are requiring that ALCOSAN undertake good faith efforts to enter into legally binding agreements with each customer municipality by January 31, 2025. Since the design of the tunnel drain pump station and Ohio River tunnel

projects must begin before this 2025 milestone, an interim July 1, 2020 milestone exists for considering the impact of flow reduction on these Phase 2 projects. The agreements should establish flow targets and include a long-term plan that will achieve those flow targets. The long-term plan shall identify the activities and the schedule that will be undertaken by the Customer Municipality and provide for periodic revisions to incorporate technological developments, changes in ownership of whole or in part of the collection systems, and revisions to flow targets. This requirement does not apply to municipalities that are subject to similar requirements under enforcement orders with PaDEP, ACHD, or USEPA.

ALCOSAN's CD is clear that it must design and construct facilities consistent with estimates of future flows to be delivered from customer municipalities. Any flow reduction driven revisions must be based on legally binding agreements between ALCOSAN and the municipalities or the regulatory agencies and the municipalities. Therefore, such agreements represent a critical milestone and will serve as the basis for any revisions to the IWWP.

Regional Flow Optimization Strategy
Section 11.2.4 describes ALCOSAN's approach to working jointly with its customer municipalities to assess the effectiveness of flow reduction measures and to develop a Regional Flow Optimization Strategy. This strategy includes goals of (1) maximizing peak flows managed while controlling flows to be conveyed and treated, (2) minimizing the need for expanded local and regional storage and conveyance and (3) rehabilitation of the regional collection system. The Regional Flow Optimization Strategy will collectively assess the various adaptive implementation activities and identify flow management measures to be adaptively incorporated into Phases 2 and 3, including any identified revisions to these projects.

11.3.7.2 Regionalization

The regionalization of inter-municipal trunk sewers is a critical element of the IWWP and is described in Section 11.2.2. When a municipality transfers ownership to ALCOSAN, it will also transfer responsibility for implementing projects necessary to control overflows along the transferred sewer(s). Since some municipal overflows exist along sewers that are not currently envisioned for transfer, those overflow control measures will remain the responsibility of the corresponding municipality.

The IWWP is premised on the municipal flow projections and planning information provided to ALCOSAN prior to the submission of their MFS and before comments on the Draft WWP increased the focus on flow reduction measures. Regionalization will change who is responsible for certain controls and the focus on flow reduction might change the selection and/or sizing of projects needed to control overflows along transferred sewers, as well as the Phase 2 and Phase 3 projects already identified.

As a result, regulatory flexibilities have been established to defer reconciling the controls necessary to address overflows along sewers currently owned and operated by customer municipalities until after the impacts of regionalization and flow reduction are better understood. By December 2017, ALCOSAN will provide a map to the regulatory agencies of the existing sewers and wet weather facilities identified for transfer from municipalities to ALCOSAN. ALCOSAN is required to undertake good faith efforts to take responsibility for the inter-municipal trunk sewers and associated facilities identified on the map by January 31, 2020.

By January 31, 2024 ALCOSAN must identify the projects necessary to eliminate SSOs on transferred portions of the collection system and submit a schedule for priority projects that will be completed as a part of the IWWP. The timing of this IWWP update is aligned with updates that may result from the flow reduction activities described in Section 11.3.7.1. Since, it is anticipated that some projects will need to be deferred as Final Measures projects due to affordability limitations, ALCOSAN is planning on conducting an optional financial capability update to inform the selection of priority projects that can be included in the IWWP. Section 11.3.7.4 discusses some of the information resource updates that would be incorporated into financial capability updates, including consideration of green and grey project commitments by customer municipalities.

11.3.7.3 Integrated Planning

USEPA has increasingly embraced integrated planning approaches to compliance with the myriad of wastewater and stormwater management regulations municipalities and wastewater authorities are faced with. Integrated planning concepts can assist in identifying implementation synergies and critical path priority projects needed to comply with the collective suite of distinct wastewater and stormwater programs. In some cases, municipalities are using integrated planning to facilitate the use of sustainable solutions, such as green stormwater infrastructure. This holistic approach is particularly useful when financial capability limitations are a concern and the selection and scheduling of priority investments becomes a critical element of the long-term path to compliance.

USEPA's Office of Water issued a memorandum in October of 2011 concerning the achievement of improved water quality through integrated municipal stormwater and wastewater planning. In May of 2012, USEPA finalized an Integrated Municipal Stormwater and Wastewater Planning Approach Framework that provides further guidance in developing and implementing effective integrated plans under the CWA.

ALCOSAN does not have NPDES Municipal Separate Storm Sewer System (MS4) compliance responsibilities, however a sub-set of its customer base does. This WWP was developed using integrated planning principles pertaining to CSO and SSO control, but it does not address municipal stormwater management responsibilities. ALCOSAN and its customer municipalities anticipate working with the USEPA and PaDEP in addressing all NPDES obligations in an orderly manner to identify cost-effective and proactive solutions that prioritize implementation of the most important projects first. As ALCOSAN and its customer municipalities continue evaluating the merits of flow reduction and the integrated planning relationships between sewer overflow control and other wastewater and stormwater management obligations, modifications to the scope, schedule and priorities of wet weather controls that are identified in this IWWP might materialize.

The adaptive management framework developed jointly by ALCOSAN and the regulatory agencies will provide the regulatory flexibilities needed to capitalize on these integrated planning opportunities if and when they come to light. In addition to the anticipated integrated planning factors already discussed, flow reduction and regionalization, the remainder of this sub-section describes other factors and uncertainties that may emerge and influence adaptive management proposals to revise the WWP, consistent with the provisions of the modified CD.

Clean Water Act: Changes to the Clean Water Act or federal regulations promulgated pursuant thereto, the CSO Control Policy, The Pennsylvania Clean Streams Law and associated state administrative code, designated uses of the ALCOSAN receiving waters and associated water quality standards which would materially affect the scope, cost or schedule of ALCOSAN's WWP will result in a review and potential modification proposal, in coordination with the regulatory agencies.

Other Emergent Regulatory Requirements: There are a number of emergent Federal regulatory initiatives which could materially affect the operation and resources of municipalities and regional wastewater authorities such as ALCOSAN. Key examples of potential regulatory mandates which cannot be fully accounted for in the development of this WWP include the following:

Revised Water Quality Standards – In 2012, the USEPA issued revised recreational water quality criteria which incorporate the latest research and science linking illness and fecal contamination in recreational waters since USEPA's last issued recommended water quality criteria for recreation in 1986. In early 2017, PaDEP indicated their intent to revise water quality standards as a part of the regularly scheduled triennial review to better align with USEPA's latest recommendations. PADEP's current proposal is to revise the swimming season water contact sports use criteria, while leaving the existing non-swimming season and public water supply use criteria in place.

Revisions to applicable water quality standards impact the environmental endpoint for which this demonstration based WWP was developed. Therefore, it is important to monitor and evaluate whether revisions materially impact the controls necessary to comply with the CWA and CSO Policy, and warrant a revision to the WWP. The recently proposed modifications to the water contact sports recreational use criteria are not yet promulgated, so ALCOSAN will continue monitoring the triennial review process for potential impacts on the WWP. In addition, during implementation of the WWP, ALCOSAN will work with the regulatory agencies to evaluate whether a Use Attainability Analyses becomes an appropriate mechanism for reviewing water quality standards applicable to ALCOSAN receiving waters.

Total Maximum Daily Loads – Additional Total Maximum Daily Loads (TMDL) rulings applicable to ALCOSAN receiving waters could materially affect the scope, schedule and water quality compliance strategy of the Plan depending upon the allocation of the subject pollutant to combined sewer overflow and sanitary sewer overflow discharges in the respective TMDL.

Municipal Stormwater Regulations – Nationally, there is movement to utilize the Phase II municipal stormwater permits held by the sanitary sewered municipalities as a mechanism to implement TMDLs through the use of wasteload allocations to establish stormwater end-of-pipe effluent limits. The timing of municipal implementation of their respective SSO control Feasibility Studies might also be impacted if integrated stormwater and wastewater planning were to determine that addressing stormwater impacts had greater or timelier water quality benefits than the SSO controls. When applied to the ALCOSAN sanitary sewered municipalities, new stormwater regulatory requirements would affect the municipalities' financial capabilities if new stormwater infrastructure or capital-intensive best management practices were to be required.

Nutrient Limits – There is increased awareness of and concern about the hypoxic conditions within the Gulf of Mexico attributable to nutrient loadings from the Mississippi River watershed which could lead to additional nutrient discharge limitations on publicly owned treatment works (POTWs) or other forms of regulatory controls. For example, the Ohio River Valley Water Sanitary Commission (ORSANCO)'s Ohio River Sub Basin Committee for Reduction of Hypoxia in the Gulf of Mexico recommended that POTWs be upgraded to Biologic Nutrient Removal (BNR) or Enhanced Nutrient Removal (ENR) technologies. Paralleling this potential development, there is movement in some states towards numeric water quality criteria for nutrients. Such developments and corresponding upgrades to the ALCOSAN WWTP could constitute a significant capital investment that would erode affordability and financial capability available for wet weather controls.

Sewage Sludge Incineration Rule – On March 21, 2011 USEPA promulgated rules transferring the regulation of sewage sludge incineration (SSI) from Section 112 to Section 129 of the Clean Air Act. This change required the development of Maximum Achievable Control Threshold (MACT) standards for SSIs. The final rule set limits for nine pollutants under section 129 of the Clean Air Act: Cadmium, carbon monoxide, hydrogen chloride, lead, mercury, nitrogen oxides, particulate matter, polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, and sulfur dioxide. ALCOSAN is currently evaluating the technical and cost implications of the MACT standards on ALCOSAN's Resource Recovery Facility under its Biosolids Strategic Plan capital project (S-408). Pending completion of the evaluation, ALCOSAN anticipates that the MACT standards could require a significant capital investment that would erode affordability and financial capability available for wet weather controls**.**

POTW Greenhouse Gas Management – The USEPA currently regulates greenhouse gases (GHG) emissions from sewage sludge incineration facilities under their GHG mandatory reporting regulation for carbon monoxide (CO), carbon dioxide (CO_2), and nitrous oxide (NO_x). To date, EPA has considered aeration basin emissions as anthropogenic and are therefore exempt from GHG regulations. Should this exemption for aeration basins be changed in the future, ALCOSAN could face future capital and operation & maintenance costs which might erode affordability and financial capability available for wet weather controls.

Climate Change: Water resource impacts of climate change have been increasingly documented in various governmental, industry and academic institution research. Western Pennsylvania lies at the interface between the Northeastern and Midwestern regions of the United States, and the potential effects are a combination of the two regions. Among the most significant impacts directly applicable to wet weather discharge controls that have been projected for Northeastern and Midwestern US in next century include:

- Increases in precipitation and changes to seasonal variation of precipitation;
- Increases in frequency and intensity of extreme precipitation events;
- Increased air temperature leading to greater evaporation rates and earlier snowmelt;
- Changes in soil moisture and surface runoff; and
- Greater in-stream flow uncertainty.

The magnitude and cumulative effects of these climatologic changes to the currently foreseeable range of conditions through the planning period (2046) is uncertain.

11.3.7.4 Financial Capability

In addition to the factors and uncertainties already described in this section, several other economic variables could materially affect ALCOSAN's ability to implement the WWP. To accommodate this concern, the adaptive implementation framework anticipates periodic financial capability assessment updates that incorporate new and updated information, both anticipated and unanticipated. ALCOSAN anticipates financial capability updates will precede and inform the following adaptive implementation milestone requirements.

- The submission of a schedule identifying additional IWWP projects to control SSOs along transferred inter-municipal trunk sewers. This update would likely occur in 2022 or 2023.
- The potential request for a schedule extension on or before January 2026. Since the modified CD allows for only one such request of up to five additional years to complete IWWP projects, a financial capability update in the 2024-2025 timeframe is anticipated.
- The completion of all IWWP projects and the submission of a FMP and schedule one year after the completion of post construction monitoring. To accommodate both these milestones, this financial capability update will likely occur within the 2038 timeframe.

In addition to any developments related to flow reduction, regionalization, and other integrated planning activities, each financial capability update will also consider the following economic and demographic variables.

Municipal Compliance Costs: The Affordability Assessment for this IWWP does not include municipal costs for compliance with sewer overflow control regulations and orders, since they are unknown at this time. Although regionalization will transfer responsibility for controlling some of the current municipal overflows to ALCOSAN, some may remain the municipalities' responsibly. In addition, ALCOSAN anticipates that municipalities will commit to the implementation of flow reduction projects as a part of their MSRS and legally binding flow reduction agreements. Once defined, the costs associated with these municipal projects will be incorporated into financial capability updates.

ALCOSAN IWWP Project Costs - The cost estimates for the controls which serve as the basis for the IWWP were based on concepts developed to a level of detail appropriate for the selection of wet weather controls in conformance with the CSO Policy, related guidance (e.g. CSO Guidance for Long-Term Control Plan EPA 832-B-95-002 (Sept. 95)) and ALCOSAN's CD. The Association for the Advancement of Cost Engineering International would consider such estimates as Class 4 estimates, with an expected accuracy within plus 50 percent to minus 30 percent of the estimated cost. As ALCOSAN moves from wet weather planning into preliminary and final design phases, the uncertainty ranges for the cost estimates will narrow. Ultimately, the actual cost of projects will be determined based on bids received and change orders resulting from construction. Each financial capability update will incorporate actual and more refined cost estimates as they become available.

Capital Cost Inflation – In Section 7.3.1 of the Draft WWP, future costs related to the construction of the recommended control facilities were inflated from the base year at an annual rate of 3.1%. For this updated analysis, a construction inflator of 2.2% was used, reflecting a twenty-year (1995 – 2015) Engineering News Record Construction Cost Index (CCI) for Pittsburgh. The Engineering News Record's *Construction Cost Index* shows an average annual increase of 4.9% for the fifty-year period of 1962 through 2011 (inclusive). The standard deviation for the period was 3%; therefore, an inflation rate one standard deviation higher than the fifty-year average would be 8%. Construction inflation rates at the fifty-year rather than the more recent twenty-year average would materially impact the implementation schedule of the WWP in conformance with Section II(c)(8) of the CSO Control Policy. For example, under the current 2.2% construction inflation factor, a $2 billion (current dollar) investment in wet weather controls would result in a regional residential indicator of approximately 2% of the median household income in 2037. If inflation were to run at the fifty-year average, the same current dollar investment would result in a residential indicator of 2.6%. If inflation were to run at one standard deviation higher than the fifty-year average, the residential indicator would be approximately 3.5% of median household income in 2037.

Construction and Engineering Resource Availability - A preliminary review of construction and engineering resource availability provided input into the IWWP implementation schedule. This review was intended to inform ALCOSAN and the regulatory agencies as to potential issues that could affect timely program delivery. It is anticipated that the national and local engineering resources in the region can support this additional engineering demand with some growth. Certain specialty design services, such as for TBM tunneling and microtunneling, will be needed to supplement the local engineering resources. Similar conclusions were reached regarding resource availability and magnitude of cost for the construction management components of the plan implementation.

The sequential approach to TBM tunnel construction is an important element of this analysis in that it provides a relatively even distribution of annual capital costs; maintains a more stable demand for specialized and non-specialized labor forces; and promotes competitive bidding from tunnel construction contractors. The plan elements for construction of consolidation conduits and connections to the regional tunnel may be one of the more challenging demands on the local construction industry. Microtunneling, traditional open trench pipeline construction and regulator structure modifications work could result in a potential shortage of utility contractors. As the program continues and the municipal program compliance commitments develop it will be necessary to further evaluate the impacts of these potential limitations on program schedule and affordability.

Debt Interest Rates and Other Financing Variables – As also documented in Section 7.3.1 of the Draft WWP, an assumed interest rate of 6% was used as the base case for future debt service payments for the Affordability and Financial Capability Assessment related to the recommended wet weather controls. For this updated (2016) analysis, the assumed interest rate was reduced slightly to 5.82% based on a thirty-year rolling average interest rates for the Bond Buyer 20 bond revenue bond rates for the period of 1986 through 2015. The 5.82% used in the updated analysis and the original 6.0% rates closely matched the forty-one-year (1971 – 2011) average for the Bond Buyer 20 Bond Index of municipal bonds which was 6.24%. The standard deviation of interest rates for the period was 1.8%, therefore an interest rate one standard

deviation higher than the average would be around 8%. Using an 8% interest rate for a $2 billion (current dollar) program would result in a regional residential indicator of 2.3% compared to 2.0%. The peak for municipal bonds during the period occurred in 1982 when the average interest rate was 11.5%. A $2 billion (current $) program financed through 11.5% bonds would result in a regional residential indicator of around 2.7%. Material changes to the financial factors impacting the affordability of the program such as ALCOSAN's bond rating could also require refinement to the Plan.

Demographic Changes – As noted in Sections 6.5 and 7.3 of this document, ALCOSAN's service population, typical household size and water consumption have all declined over the past twenty years. Should these trends continue or accelerate during the planning period, the overall rate base to pay for the wet weather controls will erode and, regardless of the cost allocation or rate structure, the costs per household will increase. This could result in a Residential Indicator that is significantly higher than the 2% rate presented in Section 11.3 of this report both upon the first year of full implementation (2037) and beyond as the impacts of the demographic trends compound in the future. Conversely, should the service population, household size and water consumption increase in a sustained pattern, the resultant affordability improvements will be evaluated towards increasing ALCOSAN's wet weather control efforts. Future municipal flows will be dependent on actual population growth and actual expansion of the area served by the sewers. These flows may be higher or lower than what was assumed for the sizing of wet weather controls. As a result, design flows for some ALCOSAN facilities may need to be revised if growth projections are revised at a future date.

Changes to Billable Flow Composition – As detailed in Section 7.3, the quantity of billable flow received by ALCOSAN has declined by more than 26% over the past twenty years and percentage of billable flow that is attributable to residential users has increased from 65% in the mid-1990s to around 73% currently. The Affordability and Financial Capability analyses presented in Section 11.3.5 were premised on the residential class' share of billable flow and the volume of billable flow stabilizing. Should the flow contributions from major industrial, institutional or commercial users decline significantly, the resultant shift of costs to the residential class could materially affect the affordability of the IWWP.

Changes to Household Income – The Affordability Analysis presented in Section 11.3.5 was premised on the ALCOSAN service-area-wide median household income growing at an annual rate of 2.4% through (and beyond) 2037, the first full year of operation of the facilities constructed under the IWWP. This income growth rate was based on the weighted average income change within the eleven largest ALCOSAN customer municipalities for the period of 1989 – 2014. This 2.4% growth rate is higher than the 1.8% used in the 2012 analysis, and reflects modest income growth after the 2008 economic recession. Using the 1.8% growth rate, the projected residential indicator for the IWWP would be 2.3% rather than 2.0%. Based on future Census data or other economic data that become available moving forward will be utilized to periodically update the affordability analysis.

11.3.7.5 Wet Weather Plan Revisions

The adaptive management framework provides the regulatory flexibility to propose revisions to the IWWP or FMP at any time during implementation of the associated program phase. Any

revision that alters the IWWP or FMP CSO or SSO controls must achieve the same or better system-wide typical year performance as the previously approved IWWP or FMP, respectively. IWWP performance estimates are provided in Section 11.2.11: *Interim Measures Wet Weather Plan Performance*. For the IWWP, ALCOSAN and the agencies have established the following performance criteria for evaluating whether potential IWWP revisions achieve the same or better system-wide typical year performance.

1. Reduction of untreated ALCOSAN CSO volume to 2,700 MG/year in a typical year
2. Control the following ALCOSAN CSOs near Sensitive Areas to zero overflows in a typical year, with the exception of one overflow in a typical year at A-67

Lower Ohio – Girty's Run

A-62, A-63, A-64, A-65, A-67

Main Rivers

A-47, M-18, M-20, M-21, M-22, O-40, O-41, O-43

Upper Monongahela

M-43

Technologies utilized in WWP revisions may include, without limitation, GSI and I/I reduction that ALCOSAN will install or that are subject to legally binding agreements with customer municipalities. In addition, revision proposals must include the following:

1. A description of the specific technology to be applied
2. The locations where the technology will be used
3. The design limits of the proposed use of the technology
4. The costs of installation and maintenance and who will bear those costs
5. The impact of the alternate technology on the schedule for implementing the IWWP or FMP
6. Reliable computer modeling and/or other evidence sufficient to demonstrate that the proposed modification of the IWWP or FMP will achieve the same or better performance as the previously approved IWWP or FMP, respectively
7. And updated schedule for the revised portion of the WWP that is as expeditious as practicable
8. Information showing that there has been an opportunity for public participation with respect to the proposed modification, including one or more public meetings

Although ALCOSAN may submit WWP revision proposals at any time, revisions are required and/or anticipated in response to key milestones as identified in Figure 11-26 and summarized below.

Integration of Municipal Source Reduction – By December 31, 2018, ALCOSAN will submit a report evaluating the impacts the MSRS will have on the Interim or Final Measures projects. As a part of this report, ALCOSAN must indicate if it plans to recommend modifications to these projects. If ALCOSAN recommends modifications to the Interim Measures, the report must include a description of the anticipated revisions and the basis for ALCOSAN's belief that the modification will satisfy the requirements of the CD.

Integration of Regionalization – By January 31, 2024, ALCOSAN must amend the WWP to include the identification of projects designed to control sanitary sewer overflows along sewers transferred to ALCOSAN, and include a schedule for each project proposed for completion during the IWWP timeframe.

Regional Flow Optimization Strategy and Preliminary Planning
The Regional Flow Optimization Strategy and Preliminary Planning elements of the IWWP will collectively assess the impact of municipal source reduction and regional flow optimization measures on Phase 2 and Phase 3 IWWP overflow control facilities. These efforts will be summarized in a Basis of Design report for the Phase 2 and 3 IWWP projects. This report will be submitted to the regulatory agencies in October 2020 and may include revisions to the WWP.

Financial Capability Assessment Update – If ALCOSAN experiences significant adverse changes to its financial circumstances and requires more time to complete the IWWP, it must submit a request by January 1, 2026, for no more than a five-year extension, accompanied by an updated financial capability assessment.

Post Construction Monitoring and Identification of Final Measures Plan - Upon completion of the IWWP, ALCOSAN will conduct post construction monitoring and modeling to assess additional controls necessary to meet the requirements of the CD. Unless post construction monitoring and modeling shows that ALCOSAN has met the objectives of the CD, within one year following the conclusion of post construction monitoring and modeling, ALCOSAN shall submit a Final Measures Plan and schedule that is as expeditious as practicable.