STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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In the Matter of the Violations of Article 17 of the Environmental Conservation Law and Part 750, *et seq*., of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York:

ORDER ON CONSENT
(CSO Order Modification to CO2-20000107-8)

-by-

The City of New York and
The New York City Department of Environmental Protection,

DEC Case No.
CO 2-20230228-38
(Citywide Green Infrastructure)

Respondents.

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WHEREAS:

1. The Department of Environmental Conservation ("the Department") is a Department of the State of New York with jurisdiction to enforce the environmental laws of the State, pursuant to the Environmental Conservation Law ("ECL"), Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("6 NYCRR"), and Orders issued thereunder.

2. The Department has jurisdiction over the abatement and prevention of pollution to the waters of the State pursuant to Article 17 of the ECL and 6 NYCRR Part 750, *et seq*. This jurisdiction also authorizes the Department, as a State agency with an approved program per Sections 318, 402 and 405 of the federal Clean Water Act ("CWA"), 33 U.S.C. Section 1251, *et seq.*, to regulate the discharge of pollutants from point sources into waters of the State in conformity with the CWA.

3. Pursuant to its authority to protect the waters of the State, the Department administers the State Pollutant Discharge Elimination System ("SPDES") permit program, ECL §17-0801, *et seq*. In general, the SPDES program prohibits any discharge of pollutants to the waters of the State without a permit establishing pollutant limitations and treatment requirements. Thus, SPDES permits set certain effluent limitation parameters, determined according to ECL §17-0809 and 6 NYCRR Part 750-1.11, in order to avoid contravention of mandated water pollution control requirements and water quality standards ("WQS"). Those conditions address not only the allowable range of parameters for discharge of pollutants to waters of the State, but also the manner in which the permittee is to operate, maintain, monitor and report on its regulated facilities and activities.

4. Combined sewer overflows ("CSOs") are discharges of untreated domestic sewage from combined sewer systems, and industrial wastewaters, combined with stormwater. CSOs occur when wet weather flows are in excess of the capacity of combined sewer systems and/or the Water Pollution Control Plants they serve. CSO discharges can contribute to violations of state WQS. CSO outfalls are "point sources" subject to SPDES permit requirements, including both water quality-based and technology-based requirements of the CWA.

5. The New York City Department of Environmental Protection ("DEP"), a municipal agency, and the City of New York ("the City") (collectively referred to herein as "Respondents") own, operate and are responsible for the Respondent's 14 Wastewater Resource Recovery Facilities (collectively referred to as the "WRRFs"). Collectively, these WRRFs process approximately 1.3 billion gallons of sewage per day generated within New York City. Respondents discharge wastewater combined with stormwater from approximately 418 CSO outfalls within the City of New York.

6. Previously, the Department and Respondents entered into Orders on Consent to address CSO discharges dated June 26, 1992 (Case No. R2-3351-90-12) (the "1992 CSO Order"), September 19, 1996 (Case No. R2-3351-90-12) (the "1996 CSO Order"), January 14, 2005 (Case No. CO2-20000107-8) (the "2005 CSO Order"), April 14, 2008 (Case No. CO2-2007-0101-1), September 3, 2009 (Case No. CO2-20090318-30), March 8, 2012 (Case No. CO2-20110512-25) (the "2012 CSO Order"), March 26, 2015 (Case No. CO2-20140314-01) (the "2015 CSO Order"), May 19, 2017 (CO2-20140314-01), December 7, 2017 (CO2-20161013-375), May 25, 2021 (CO2-20190107-5), and September 2, 2022 (Case No. CO 2-20210608-136). The 2005 CSO Order was issued to address numerous violations of the 1992 and 1996 CSO Orders and superseded those two Orders. The 2005 CSO Order and all subsequent modifications are hereinafter referred to collectively as the "CSO Orders".

7. Pursuant to the CSO Orders as of December 2022, Respondents have completed construction of CSO storage facilities, parallel interceptors, improvements to pumping stations, regulators, and interceptors, and other engineered projects (projects that are conventionally referred to as "gray infrastructure"). These gray infrastructure projects have significantly reduced CSO discharges to the City's waterbodies with the overall goal of attaining applicable water quality standards. Under approved CSO Long-Term Control Plans, Respondents have committed to construct additional gray infrastructure projects to further improve attainment with applicable water quality standards. Overall, Respondents have expended or committed to expend approximately $9 billion for gray infrastructure projects.

8. In 2010, Respondents proposed under the NYC Green Infrastructure Plan the implementation of an ambitious and unprecedented citywide green infrastructure program to complement its gray infrastructure program to reduce CSOs. The citywide green infrastructure program was incorporated into the 2005 CSO Order under the 2012 CSO Order, which constituted a major modification to the 2005 CSO Order. Pursuant to the 2012 CSO Order, Respondents were required to construct green infrastructure to manage stormwater equivalent to one inch of rainfall on: 1.5% of impervious surfaces in the City's combined sewer areas ("1.5% application rate") by

2015, 4% of impervious surfaces in the City's combined sewer areas ("4% application rate") by 2020, 7% of impervious surfaces in the City's combined sewer areas ("7% application rate") by 2025, and 10% of impervious surfaces in the City's combined sewer areas ("10% application rate") by 2030. In addition to these application rates, pursuant to the 2012 CSO Order, Respondents were required to develop green infrastructure performance metrics in 2016 ("2016 Performance Metrics'). The 2016 Performance Metrics Report developed by Respondents consisted of a total citywide reduction in CSO volume of 507 million gallons per year (MGY) from managing stormwater equivalent to one inch of rainfall on 1.5% of available impervious surfaces in the City's combined sewer areas by 2015 for the average rainfall year of 2008 and a total citywide reduction in CSO volume of 1.67 billion gallons per year (BGY) from managing stormwater equivalent to one inch of rainfall on 10% of available impervious surfaces in the City's combined sewer areas by 2030 for the average rainfall year of 2008.

9. Each LTCP submitted and approved by the Department included estimated baseline conditions for CSO volume reductions attributable to the implementation of the Waterbody/Watershed Facility Plans and the estimated cumulative sum of the drainage basin-specific baseline CSO reduction credits, including for green infrastructure. The estimated baseline conditions for acreage or CSO volume reductions attributable to green infrastructure in each LTCP are superseded by the green infrastructure program established pursuant to this Order. This does not alleviate the need for the LTCPs to achieve the CSO requirements contained at Section 402(q)(1) of the federal CWA.

10. The performance metrics for green infrastructure from the 2016 Performance Metrics Report were subsequently approved by the Department in 2017 and incorporated into the CSO Orders, and thereafter, Respondents were required to attain both the application rates and CSO volume reductions under the 2012 CSO Order. Following the approval of the performance metrics, the Respondents proceeded with the volumetric reduction goal of 507 MGY using the citywide equivalency rate presented for the 1.5% in the Performance Metrics Report.

11. Pursuant to the 2012 CSO Order, Respondents were required to certify by December 2015 that they had implemented green infrastructure projects that achieved the 1.5% application rate and that these green infrastructure projects resulted in a reduction of 507 million gallons per year of CSOs for average rainfall year of 2008. Respondents were also required to certify that they had encumbered $187 million for green infrastructure projects by December 2015. Respondents timely certified the encumbrance of $187 million but failed to achieve the 1.5% application rate and 507 MGY of CSO volume reduction by December 2015. In accordance with provisions of the 2012 CSO Order, Respondents timely submitted a contingency plan ("1.5% Contingency Plan") that allowed an additional five years, to December 2020, to achieve the 1.5% application rate and 507 MGY of CSO volume reduction. Respondents made extensive efforts, but failed to achieve the 1.5% application rate and 507 MGY of CSO volume reduction by December 2020 due to delays including, but not limited to the lack of bidders for a portion of the green infrastructure work and the COVID pandemic and subsequently requested an extension for the milestone to achieve the 1.5% application rate and 507 MGY of CSO volume reduction to December 2021, which the Department approved. Respondents submitted a certification of achievement for the 1.5% application rate and 507 MGY of CSO volume reduction on December

30, 2021. The achievement of the 1.5% application rate only is accepted by the Department and the volume associated with the 1.5% application rate will be calculated using the equivalency ratios established by this Order.

12. Pursuant to the 2012 CSO Order, by December 2020, Respondents were required to certify that they had implemented green infrastructure projects that achieved the 4% application rate and provide a calculation of the equivalent CSO volume reduction associated with that green infrastructure application rate. Due to the challenges in attaining the 1.5% application rate and despite best efforts, Respondents failed to achieve the 4% application rate by December 2020. In accordance with provisions of the 2012 CSO Order, Respondents timely submitted a contingency plan ("4% Contingency Plan") that allowed an additional five years, to December 2025, to achieve a calculated 668 MGY of CSO reduction for average rainfall year of 2008. However, the 4% Contingency Plan did not include a commitment to achieve the 4% application rate by December 2025 but included a minimum of 668 million gallons per year by December 2025. In August 2021, the Department approved the 4% Contingency Plan and directed Respondents to achieve both the 4% application rate and a minimum of 668 million gallons per year of CSO reduction for average rainfall year of 2008 by December 2025.

13. Pursuant to Article VII of the 2005 CSO Order, Respondents timely initiated dispute resolution in October 2021 challenging the Department's determination that Respondents were required to achieve the 4% application rate under the approved 4% Contingency Plan. The Department and Respondents conducted informal negotiations to resolve the dispute between October 2021 and February 2023. Upon the effect date of this Order Modification, the dispute initiated by the Respondents in October 2021 is hereby resolved. During this time period, the Department and Respondents acknowledged that the Respondents faced numerous challenges in implementing the citywide green infrastructure program to achieve the application rates and CSO volume reductions required under the 2012 CSO Order. As such, the negotiations encompassed a complete restructuring of the Respondents' green infrastructure obligations under the 2012 CSO Order. The major modification to the CSO Orders set forth herein reflects the restructuring of the citywide green infrastructure program and hereby replaces in its entirety Section IV of the 2012 CSO Order. Respondents submitted a Modification Request pursuant to Article XIII of the 2005 CSO Order on April 12, 2023 for the modifications documented herein.

14. As of December 2021, Respondents had encumbered or expended approximately $1 billion and were reporting construction of approximately 11,500 green infrastructure assets, including assets funded and constructed externally, for its citywide green infrastructure program under the 2012 CSO Order. The green infrastructure assets were constructed primarily on publicly-owned sites or rights-of-way, in combined sewered areas of the city. As of February 2022, Respondents had also established local laws to foster implementation of green infrastructure on public and privately-owned sites, including the 2012 Stormwater Rule and 2022 Unified Stormwater Rule on a citywide basis.

15. The Department recognizes the considerable investment and efforts undertaken by Respondents to implement the citywide green infrastructure program to date. In consideration of this investment, the Department and Respondents also acknowledge that proper maintenance of

green infrastructure assets is critical to ensure their long-term performance to achieve required CSO volume reductions. As such, Respondents commit to the appropriate maintenance for the useful life of the publicly owned assets, and the 2022 Unified Stormwater Rule provides for permitting and oversight of privately owned assets. The Department also commits to make all efforts to clarify provisions in the Respondents' 14 WRRF SPDES permits to establish the appropriate inspection and maintenance requirements as currently reflected in Section IV of the NYC Municipal Separate Storm Sewer System ("MS4") permit effective August 1, 2022.

16. The Department and Respondents have each consented to the making of this Order, which modifies the CSO Orders, without further action, litigation, hearing, or adjudication of any issues of law or fact, being duly advised, and it being in the public interest and advantageous to the State.

IT IS HEREBY ORDERED:

I. EFFECT ON PREVIOUS ORDERS

Respondents are bound by, and agree to follow and comply with the terms, provisions and requirements set forth in this Order modification, including the modified milestone dates in revised Appendix A, provisions set forth in new Appendix E, and the requirements as set forth below in Article II. This Order supersedes Section IV of the 2012 CSO Order. All other provisions of the CSO Orders shall remain in full force and effect.

II. CITYWIDE GREEN INFRASTRUCTURE PROGAM

A. Citywide Green Infrastructure Program. Respondents are permanently enjoined and directed to complete the tasks set forth herein and meet the milestones set forth in revised Appendix A, which are incorporated herein and attached hereto, for the Citywide Green Infrastructure Program. The implementation and enforcement of the activities required by these tasks and milestones shall be governed by the terms of the 2005 CSO Order. In conjunction with the milestones set forth in Appendix A, Respondents shall complete the requirements listed below and milestones established for each requirement shall be subject to stipulated penalties pursuant to Article V.B and V.C of the 2005 CSO Order, as applicable.

B. Green Infrastructure Definition. For purposes of this Order, "green infrastructure" shall be defined as follows: Within the context of stormwater management, the term green infrastructure includes a wide array of practices at multiple scales to manage and/or treat stormwater, maintain and restore natural hydrology (including restoration of historic stream beds and ravines associated with reconnecting previously existing stormwater hydrology) and ecological function by infiltration, evapotranspiration, capture and reuse of stormwater, filtration, and detention. On a larger scale, green infrastructure includes, but is not limited to, ecological systems, both natural and engineered, and protection and enhancement of riparian buffers and floodplains and daylighting, bluebelts, coupled with policies to regulate new development and re-development for stormwater management. On the local scale green infrastructure consists of site- and neighborhood-specific practices, including cloudburst management. Such practices essentially

result in runoff reduction, peak flow reduction through slow-release orifice controls where necessary, and/or establishment of habitat areas with significant utilization of soils, vegetation, and engineered media where feasible, rather than traditional centralized hardscape collection, conveyance and storage structures. Some examples include green roofs, trees and tree boxes, pervious pavement, rain gardens, vegetated swales, planters, stormwater harvesting and reuse systems, and surface and subsurface stormwater storage systems that either perform as retention or slow-release detention systems. Related sewer conveyance needed to connect a green infrastructure asset to sewer infrastructure is included as part of the "Green Infrastructure."

C. CSO Volume Reduction. Respondents shall implement green infrastructure projects on a citywide basis that will reduce CSOs by 1.67 BGY from its combined sewer systems (CSS) only for the average rainfall year of 2008 by December 2040. The CSO volume reduction associated with Respondents' achievement of the 1.5% application rate in December 2021 shall be calculated using the equivalency ratio established by this Order and that volume shall count toward the 1.67 BGY volume reduction metric. Respondents shall not receive any credit for stormwater volume managed in MS4 areas toward the 1.67 BGY CSO volume reduction metric. The citywide CSO volume reduction of 1.67 billion gallons per year may be achieved through resiliency projects comprised of green infrastructure in CSS areas of the City. Interim and final milestones for CSO volume reduction are hereby established to track and enforce progress citywide towards 1.67 BGY of CSO volume reduction, as set forth in revised Appendix A, Section XIV, attached herein. The interim CSO volume reduction milestones for 2025, 2030, 2035 and final CSO volume reduction milestone for 2040 shall be considered major milestones subject to penalties per Paragraph V.B of the 2005 CSO Order.

D. Tracking and Verification of CSO Volume Reduction. The Respondents shall track and certify the completion of the 2025, 2030, 2035, and 2040 milestones for CSO volume reductions set forth in revised Appendix A, Section XIV. The tracking and certification shall utilize green infrastructure practice specific stormwater ("SW") capture equivalency rates (SW MGY/unit) as set forth in Appendix E, Table 1, attached herein and waterbody drainage area specific stormwater capture to CSO volume reduction equivalency rates (SW MGY/CSO MGY) as set forth in Appendix E, Table 2, attached herein. For new green infrastructure practices to be added to Appendix E, Table 1, Respondents shall prepare equivalency rates and obtain the Department's approval of such equivalency rates prior to using for calculating stormwater capture and CSO volume reductions. Respondents submitted a Green Infrastructure Equivalency Rate Technical Memorandum (Tech Memo), dated March 28, 2023, which documents the technical basis for the practice and program specific stormwater equivalency rates. The Tech Memo was approved by the Department on April 12, 2023, and is attached herein as Appendix F.

1. Green Infrastructure Asset Tracking. Respondents shall track constructed green infrastructure assets in its New York City ***Green Hub*** database [or successor database]. As part of the certification of milestone completion, Respondents may be required to submit detailed lists of all green infrastructure assets completed from the database, including information on asset type, asset size, asset location, Greened Acres or tributary area (acres) managed as appropriate. The Department reserves the right to

request other relevant and verified information that the City has collected that will assist the Department in reviewing certifications of completion.

2. CSO Volume Reduction Calculation. Green infrastructure assets from ***Green Hub*** database [or successor database] shall be used to calculate CSO volume reduction by applying the green infrastructure practice class or program specific Stormwater Capture Equivalency Rates in Appendix E, Table 1 to each constructed asset to determine the amount of stormwater captured and then converting the calculated stormwater capture volume to CSO volume reduction utilizing the Waterbody Drainage Area Specific Equivalency Rates for stormwater capture to CSO volume reduction in Appendix E, Table 2, as illustrated by the formula below.

Formula for Calculating CSO Volume Reduction:

"A" = Greened Acre for Right-of-Way retention practices (rain gardens, infiltration basins, and stormwater green streets only) and tributary area (acres) for all other green infrastructure program areas.

"SW ER" = Green Infrastructure Practice or Program Specific Stormwater Capture Equivalency Rate, from Appendix E, Table 1

"SW / CSO ER" = Waterbody Drainage Area Specific Equivalency Rate, from Appendix E, Table 2

$$\text{CSO Volume Reduction (MGY CSO)} = \frac{\text{A (acres)} \times \text{SW ER (MGY SW / acre)}}{\text{SW / CSO ER (MGY SW / MGY CSO)}}$$

3. Model Update. By June 30, 2036, Respondents may update an InfoWorks model (or commercially available equivalent) to estimate the CSO volume reduction achieved up through 2035 and projected CSO volume to achieve 1.67 BGY and assess the accuracy of the Green Infrastructure Practice or Program Specific Stormwater Capture Equivalency Rates in Appendix E, Table 1 or Waterbody Drainage Area Specific Equivalency Rates in Appendix E, Table 2, or any Green Infrastructure Practice Specific Stormwater Capture Equivalency Rates subsequently developed by the Respondents and approved by the Department. If Respondents proceed with a model update, Respondents shall provide the scope of work for the model update to the Department for review and approval prior to completing the update. The baseline conditions for the modeling shall be as defined in the 2016 Performance Metrics Report that were used to develop the CSO volume reductions for the citywide green infrastructure program. These baseline conditions include the citywide impervious surface conditions as of January 1, 2010. The City may seek the Department's approval to modify the assumptions that were used to develop the baseline conditions, and may seek the Department's approval to develop other model runs to support the modification request. Any modification request must set forth any change to the baseline and any impacts on the model outcome. The updated modeling shall also use

the average rainfall year 2008. The modeling results can be used to adjust the equivalency factors Table 1 and Table 2 in Appendix E upon approval by the Department.

4. 2037 Contingency Plan. If Respondents fail to meet the December 2035 CSO volume reduction milestone to reduce CSOs by a minimum of 850 million gallons with green infrastructure practices, in order to avoid stipulated penalties, Respondents shall, within 24 months, submit an approvable green and/or grey infrastructure implementation contingency plan ("2037 Contingency Plan"). The 2037 Contingency Plan shall clearly identify the projects and timelines for reducing CSO volumes to meet the CSO volume reduction target of 1.67 BGY by December 2045. The 2037 Contingency Plan projects may include green and/or gray projects as needed. Failure to achieve the required 1.67 BGY of CSO volume reduction by December 2045 shall be considered a violation of the December 2040 final CSO volume reduction milestone and subject to stipulated penalties per Paragraph V.B of the 2005 CSO Order, retroactive to December 2040.

E. Encumbrances and Expenditure of Funds. The Respondents shall encumber and expend $3.5 billion on green infrastructure practices in accordance with the milestones set forth in Article II, Table 1. Respondents may include funds allocated and spent since inception of the Green Infrastructure program in 2010 to fulfill this funding requirement. However, for all funds used to meet the expenditure obligation, Respondents must be able to provide specific information on the green infrastructure practices completed and associated CSO volume reduction as applicable. The $3.5 billion funding commitment shall only apply to green infrastructure practices, as defined in Paragraph II.B, and cannot be used for any grey infrastructure projects proposed under the 2037 Contingency Plan, if required. For clarity, funds expended by Respondents to construct green infrastructure assets in both MS4 and CSO areas may be credited towards the $3.5 billion expenditure obligation. Respondents shall not count the expenditure of funds by private third parties towards the $3.5 billion funding commitment.

Table 1. Cumulative Green Infrastructure Funding Encumbrances and Expenditures

Milestone	Fund Encumbered or Expended (billion dollars, value in year of expenditure)
December 2025	$1.4 billion encumbered
December 2030	$1.8 billion encumbered
December 2035	$2.8 billion encumbered
December 2040	$3.5 billion encumbered
December 2045	$3.5 billion expended

1. Certification of Encumbrance and Expenditures. For each certification required in Article II, Table 1, Respondents shall provide a list of major expenditure items (e.g., area-wide green infrastructure contracts, design contracts, land acquisitions) and associated monetary value. The list shall be validated and attested by the DEP Commissioner, or their authorized delegate for this purpose.

2. Qualifying Expenditures. Expenditures that are eligible for meeting the $3.5 billion funding obligation include expenditures on project design, construction, land acquisition (including easements), and other related expenditures for implementation of green infrastructure practices, including resiliency projects comprised of green infrastructure in both CSO and MS4 areas. Other related expenditures shall be subject to approval by the Department. To the maximum extent practicable, Respondents should strive to construct green infrastructure in environmental justice areas.
   i. Any green infrastructure practices, including resiliency projects comprised of green infrastructure, in MS4 areas by New York City government agencies, including the DEP, constructed under this CSO Order, can be used to comply with NYC MS4 SPDES permit requirements, as applicable.
   ii. Respondents may take credit for expenditures associated with green infrastructure practices installed to comply with the 2022 Unified Stormwater Rule or the 2012 Stormwater rule that would not otherwise be required by the New York State (NYS) State Pollution Discharge Elimination Systems (SPDES) General Permit for Stormwater Discharges from Construction Activity (Construction General Permit), GP-0-20-001, effective date January 29, 2020. Expenditures on green infrastructure required under the NYS SPDES Construction General Permit, for any land disturbance of one acre or more, cannot be counted towards the $3.5 billion obligation in this CSO Order.
   iii. Any funds obtained by DEP or the City from any federal, state or other source to construct green infrastructure capital projects can be credited towards the $3.5B expenditure obligation.
   iv. Expenditures for completion of the Tibbetts Brook daylighting project, Paragraph II.F (infra) may be credited towards the $3.5B expenditure obligation.
   v. Expenditures for High Level Storm Sewer construction not connected to a green infrastructure practice may not be credited towards the $3.5B expenditure obligation unless approved by the Department.

F. Tibbetts Brook Daylighting Project. Respondents shall complete the Tibbetts Brook daylighting project in accordance with the milestones set forth in revised Appendix A, Section XIV, attached herein.

G. Reporting Requirements.

1. Respondents will report on the progress of the green infrastructure program in the CSO Quarterly reports and at the regularly scheduled CSO Quarterly meetings. Program status updates will be included beginning the first reporting quarter for the Quarterly Reports after the effective date of the CSO Order modification. DEP will provide the Department updates on the Tibbetts Brook project in CSO Order Quarterly Report and meetings, beginning the first quarter after the effective date of the CSO Order modification.

2. By April 30th of each calendar year, Respondents will submit an Annual Green Infrastructure Report on measures taken to implement the GI obligations under this Order, including: institutional steps taken; results from monitoring demonstration projects; material design changes and plans; planned and built green infrastructure installations; Greened Acres or tributary area (acres) managed as appropriate in combined sewer areas, and an action plan for the following year. The Annual Green Infrastructure Report will also include the most recent approved 10-year Capital Improvement Program Budget for the green infrastructure program. DEP shall track cumulative CSO volume reduction achieved and costs encumbered for the Green Infrastructure Program as part of the Annual Green Infrastructure Report. This will start in the next annual submittal for the Annual Report after the effective date of the CSO modification.
3. The Department and Respondents will meet annually to review the Annual Report and progress made in the preceding year and discuss the action plan for the upcoming year.

H. Carryover Provisions from 2012 CSO Order. Appendix B and Appendix D are hereby incorporated into this CSO Order modification to preserve provisions from the 2012 CSO Order that remain in effect. Appendix B consists of the "LTCP Introductory Goal Statement" and Appendix D consists of the "Long Term Control Plan Outline". Respondents shall develop LTCPs in accordance with Appendices B and D of this Order and submit approvable LTCPs pursuant to the milestone dates in Appendix A of this Order.

I. Upon the effective date of this Order modification, Appendix A of the CSO Orders shall be modified by the pages set forth in the revised Appendix A of this Order and the pages of revised Appendix A shall be substituted for the corresponding pages of Appendix A of the CSO Orders as appropriate. Appendix B, Appendix D, Appendix E, and Appendix F shall also be incorporated upon effective date of this Order modification.

III. EFFECTIVE DATE

The effective date of this Order modification shall be the date it is executed by the Department's Commissioner or his designee.

DATED: June 29, 2023
Albany, New York

Basil Seggos, Commissioner
New York State Department of
Environmental Conservation

By: James M. Tierney
James M. Tierney
Deputy Commissioner

CONSENT BY RESPONDENTS

The New York City Department of Environmental Protection hereby consents to the issuance and entry of the foregoing Order, waives its right to a hearing herein as provided by law, and agrees to be bound by the provisions, terms and conditions contained herein.

Rohit Aggarwala, Commissioner
New York City Department of
Environmental Protection

April 26, 2023
Date

ACKNOWLEDGMENT

State of New York)
County of Queens) ss.:

On the 26th day of April, 2023 before me personally came Rohit Aggarwala to me known, who being by me duly sworn did depose and say that s/he was duly authorized to execute the foregoing instrument and did so on behalf of the Respondents of New York.

Diana Cuozzo
Notary Public

DIANA CUOZZO
STATE OF NEW YORK
NOTARY PUBLIC
Qualified in Queens County
01CU6415007
MY COMMISSION EXPIRES 03/08/2025

CONSENT BY RESPONDENTS

The New York City Corporation Counsel hereby consents to the issuance and entry of the foregoing Order without further notice, waives its right to a hearing herein, and agrees to be bound by the terms, conditions and provisions hereof.

Sylvia Hinds-Radix
Corporation Counsel of the
City of New York

By: _____
Title: ASSISTANT CORPORATION COUNSEL

May 2, 2023
Date

ACKNOWLEDGMENT

State of New York)
County of New York) s.:

On this 2nd day of May, 2023, before me personally came William Placito, to me known, who being duly sworn, deposed and stated that s/he maintains an office at 100 Church Street, New York, New York, that s/he is an Assistant Corporation Counsel, Environmental Law Section of the New York City Corporation Counsel, and that s/he was authorized by said Department to execute the foregoing instrument.

_____
Notary Public

HILARY MELTZER
Notary Public, State of New York
No. 02ME5010465
Qualified in New York County
Commission Expires ~~June 5~~ March 29, 20 27

XIV. Citywide Green Infrastructure Program	Milestone Date
A. Cumulative Citywide CSO Volume Reduction[1]	
1 668 million gallons per year	December 2025
2 700 to 800 million gallons per year	December 2030
3 850 to 1,220 million gallons per year	December 2035
4 1,670 million gallons per year	December 2040
B. Tibbetts Brook Daylighting	
1 Notice to Proceed to Construction	24 months after the later of: 1) completion of all necessary site acquisition / access for greenway and daylighting or 2) design completion
2 Construction Completion*	36 months after Notice to Proceed to Construction, but no later than December 2035

*In the event that the final plantings required by this project would be completed during a non-growing season, the City may request an extension to complete the plantings until the next growing season. Such an extension would apply only to the plantings.

1 CSO volume reductions are based on average rainfall year of 2008

APPENDIX B
DEC Case No. CO2-20000107-8

LTCP Introductory Goal Statement[1]

The New York City Department of Environmental Protection submits this Long Term Control Plan (LTCP) in furtherance of the water quality goals of the federal Clean Water Act and the state Environmental Conservation Law. We recognize the importance of working with our local, state, and federal partners to improve water quality within all city-wide drainage basins and remain committed to this goal.

After undertaking a robust public process, the enclosed LTCP contains water quality improvement projects, consisting of both grey and green infrastructure, which will build upon the implementation of the U.S. Environmental Protection Agency's (EPA) Nine Minimum Controls and the existing Waterbody/Watershed Facility Plan projects. As per EPA's CSO Control Policy, communities with combined sewer systems are expected to develop and implement LTCPs that provide for attainment of water quality standards and compliance with other Clean Water Act requirements. The goal of this LTCP is to identify appropriate CSO controls necessary to achieve waterbody- specific water quality standards, consistent with EPA's 1994 CSO Policy and subsequent guidance. Where existing water quality standards do not meet the Section 101(a)(2) goals of the Clean Water Act, or where the proposed alternative set forth in the LTCP will not achieve existing water quality standards or the Section 101(a)(2) goals, the LTCP will include a Use Attainability Analysis examining whether applicable waterbody classifications, criteria, or standards should be adjusted by the State.

The Use Attainability Analysis will assess the waterbody's highest attainable use, which the State will consider in adjusting water quality standards, classifications, or criteria and developing waterbody-specific criteria. Any alternative selected by a LTCP will be developed with public input to meet the goals listed above. On January 14, 2005, the NYC Department of Environmental Protection and the NYS Department of Environmental Conservation entered into a Memorandum of Understanding (MOU), which is a companion document to the 2005 CSO Order also executed by the parties and the City of New York. The MOU outlines a framework for coordinating CSO long-term planning with water quality standards reviews. We remain committed to this process outlined in the MOU and understand that approval of this LTCP is contingent upon our state and federal partners' satisfaction with the progress made in achieving water quality standards, reducing CSO impacts, and meeting our obligations under the CSO Orders on Consent.

[1] This LTCP introductory goal statement is generic in nature, so waterbody specific LTCPs will take into account, as appropriate, the fact that certain waterbodies or waterbody segments may be affected by the City's concentrated urban environment, human intervention, and current waterbody uses, among other things. DEP will identify appropriate water quality outcomes based on site-specific evaluations in the drainage basin specific LTCP, consistent with the requirements of the CSO Control Policy and the Clean Water Act.

APPENDIX D
DEC Case No. CO2-20000107-8

LONG TERM CONTROL PLAN OUTLINE

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1. Goal Statement

1.2. Regulatory Requirements (federal, state, local)

1.3. LTCP Planning approach
- 1.3.a. Integrate Current CSO Controls from Waterbody/Watershed Facility Plans (Facility Plans)
- 1.3.b. Coordination with DEC
- 1.3.c. Watershed Planning
- 1.3.d. Public Participation Efforts

2. WATERSHED/WATERBODY CHARACTERISTICS

2.1. Watershed Characteristics
- 2.1.a. Description of Watershed
  - 2.1.a.1. Existing and Future Land Use and Zoning
  - 2.1.a.2. Permitted Discharges
  - 2.1.a.3. Impervious Cover Analysis
  - 2.1.a.4. Population growth and projected flows
  - 2.1.a.5. Update landside modeling
- 2.1.b. Review and Confirm Adequacy of Design Rainfall Year
- 2.1.c. Description of Sewer System
  - 2.1.c.1. Overview of Drainage Area and Sewer System
  - 2.1.c.2. Stormwater and Wastewater Characteristics
  - 2.1.c.3. Hydraulic Analysis of Sewer System
  - 2.1.c.4. Identification of Sewer System Bottlenecks, Areas Prone to Flooding and History of Sewer Backups
  - 2.1.c.5. Findings from Interceptor Inspections
  - 2.1.c.6. Status of Receiving Wastewater Treatment Plants (WWTPs)

2.2. Waterbody Characteristics
- 2.2.a. Description of Waterbody
  - 2.2.a.1. Current Waterbody Classification(s) and Water Quality Standards
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APPENDIX E
DEC Case No. CO2-20000107-8

Table 1. Green Infrastructure Practice or Program Specific Stormwater Capture Equivalency Rates

Green Infrastructure Practice Class or Program	Retention or Detention	Equivalency Rate[1] (SW MGY/unit[2])
Right-of-Way Rain Gardens and Stormwater Green Streets	Retention	0.86
Right-of-Way Infiltration Basins	Retention	0.91
Right-of-Way Porous Pavement	Retention	0.96
Public/Private/External Onsite and Large-Scale Median Projects	Retention	0.95
Public/Private/External Onsite and Large-Scale Median Projects	Detention	0.68
Green Roofs without Orifice Control	Detention	0.35
2012 Stormwater Rule	Detention	0.13
2022 Unified Stormwater Rule[3]	Retention	0.97
2022 Unified Stormwater Rule	Detention	0.68
Green Roofs with Orifice Control	Detention	0.68
Cloudburst Practices		SW Equivalency Rates will be selected from Right-of-Way and Public Onsite program areas based on assets implemented
Special Projects Not Specified Elsewhere		Modeled

1. The technical basis for these equivalency rates is documented in a Green Infrastructure Equivalency Rate Technical Memorandum, per Appendix F.
2. For purposes of these Equivalency Rates, "Unit" shall be defined as Greened Acre for Right-of-Way retention practices (rain gardens, infiltration basins, and stormwater green streets only) and tributary area (acres) for all other green infrastructure program areas. "Greened Acre" is an area equivalent to one acre of impervious surface covered by one-inch of stormwater.
3. The 2022 Unified Stormwater Rule or other city legislation/rule or regulation can be used to fulfill the 1.67 BGY CSO volume reduction milestone.

Table 2. Waterbody Drainage Area Specific Stormwater Capture to CSO Volume Reduction Equivalency Rates

Waterbody Drainage Area	Equivalency Rate[1] (SW MGY/CSO MGY)
Alley Creek	2.75
Jamaica Bay and Tributaries	3.67
Bronx River	2.35
Coney Island Creek	2.75
Hutchinson River	1.73
East River / Open Waters	1.87
Flushing Bay	1.25
Flushing Creek	1.91
Gowanus Canal	2.75
Newtown Creek	1.72
Westchester Creek	5

1. The Department calculated equivalency rates based on data provided by DEP on June 14, 2016 for the 2016 Performance Metric Report. Equivalency rates for Alley Creek and Coney Island Creek drainage areas were selected by the Department to represent a value closest to the mid-point of the range of calculated equivalency rates for the other drainage areas.

APPENDIX F
DEC Case No. CO2-20000107-8

TECHNICAL MEMO
GREEN INFRASTRUCTURE PRACTICE OR PROGRAM SPECIFIC STORMWATER CAPTURE EQUIVALENCY RATES

PURPOSE

The purpose of this technical memorandum is to present the methodology for Appendix E - Green Infrastructure Practice or Program Specific Stormwater Capture Equivalency Rates to the 2023 Combined Sewer Overflow (CSO) Order Modification for Citywide Green Infrastructure.

1.0 BACKGROUND AND INTRODUCTION

The New York City Department of Environmental Protection (DEP) has been implementing green infrastructure practices in areas served by the combined sewer system (CSS) since 2012 under the New York City Green Infrastructure Program (GI Program) to meet the requirements of the CSO Consent Order (CSO Order) between DEP and New York State Department of Environmental Conservation (NYS DEC). The GI Program uses multiple strategies to meet the requirements including phased area-wide construction of standardized practices in the right-of-way (ROW), retrofits of large medians, installation of larger practices on public properties, incentives for private properties, as well as regulatory requirements to incorporate green infrastructure technologies to manage stormwater in new development and redevelopment on both public and private properties. The modeling work described in this memo were undertaken as part of a larger research and development effort including academics and private sector experts to estimate the impact of these green infrastructure practices on stormwater runoff and ultimately CSO reduction.

DEP has been conducting various studies since the implementation of the GI Program to enhance understanding of the benefits of green infrastructure on water quality and water quantity, site planning and design optimization, cost, and long-term maintenance needs. To meet this wide spectrum of objectives, DEP has undertaken various data collection methodologies including sensors installed in place capturing real-time data, simulated runoff testing at constructed green infrastructure locations, small scale laboratory-type setups in semi-controlled environments, and modeling studies at various spatial scales calibrated with field data wherever possible. DEP has incorporated the data collected from these various studies to estimate stormwater runoff and the resulting CSO reduction impacts of the differing green infrastructure typologies. The following sections detail the methodologies and assumptions underlying the various

approaches taken to establish equivalency rates for stormwater capture volume for different green infrastructure practice types.

As the GI program continues evolving to adapt to changing climatic conditions and stormwater management needs by implementing the principles of adaptive management, there will be new green infrastructure designs and storm sizes that may or may not have been explicitly monitored and/or modeled, which may require additional evaluations in the future to supplement the work described in this memo.

2.0 ASSET-SCALE STORMWATER MODELING

Asset-scale models were developed for all green infrastructure practices, also referred to as assets, in DEP's current implementation portfolio using InfoWorks ICM (except for green roofs, which were modeled using the United States Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) Version 5.1 Low Impact Development (LID) as described below). The model hydrology was based on the previously developed DEP Long Term Control Plan (LTCP) models and like previous modeling efforts, the models were run with the 2008 typical year rainfall on tributary areas with a runoff coefficient of 0.95. The annual stormwater managed metrics (million gallons of stormwater per year, or MG of SW/YR) were derived from the different asset-scale models developed for each asset type. Relevant references underlying the basis of the assumptions, where applicable, are summarized in Table 1 and further details on other selected parameters are provided in the following subsections.

Table 1: Asset-Scale Model Parameters and References

Practice/Program Type	Parameter and Value	References
Right-of-Way Rain Gardens and Stormwater Greenstreets, Right-of-Way Infiltration Basins	Design storm: 1 inch (in)	Report for Post-Construction Monitoring Green Infrastructure Neighborhood Demonstration Areas
	Asset size: 5 feet (ft) wide, 20 ft long	Standard Designs and Guidelines for Green Infrastructure Practices
Right-of-Way Porous Pavement	Asset size: 4-ft wide	Standard Designs and Guidelines for Green Infrastructure Practices
Green Roofs	Media layer depth: 4 in C value: 0.7	New York City Stormwater Manual
Public/Private/External Onsite and Large-Scale Median Projects Retention (Onsite Retention)	Design storm: 1.25 in	NYC Green Infrastructure On-site Design Manual

Onsite Retention, USWR Retention	Tributary area: 21,545 square feet (sf)	Lot Size Soil Disturbance Threshold Study for Construction and Post-Construction Stormwater Management
USWR Retention, Public/Private/External Onsite and 2022 USWR Detention (Onsite and USWR Detention)	Design storm: 1.85 in per Vv requirements	New York City Stormwater Manual
Onsite and USWR Detention, Green Roof with Orifice Control	0.1 cubic feet per second (cfs) release rate	New York City Stormwater Manual
2012 Rule Detention	Citywide CSO Equivalency Rate: 0.43 million gallons per year (MGY)/acre	Green Infrastructure Performance Metrics Report

ROW assets were separated into two categories for these analyses due to different design and siting approaches. For the ROW Rain Gardens, Stormwater Greenstreets, and Infiltration Basins which have widely varying tributary areas, a sensitivity analysis for tributary area was run to determine the impact of the tributary area on the equivalency rates. It was determined that the impact was not significant, as further explained in Sections 2.1 and 2.2. The remaining analyses for ROW assets focused on impact of native soil infiltration rates. For ROW Porous Pavement assets with less varying tributary areas, the evaluations focused on impact of native soil infiltration rates. For non-ROW retention assets, where tributary areas are fixed but the asset sizing may vary based on the design storm according to program area, evaluations were focused on impacts of design storm sizing and native soil infiltration rates. As detention assets do not rely on infiltration, they were evaluated on impacts of design storm sizing only. While varying green roof media depths were considered as part of DEP's research and development activities, only the minimum depth was conservatively considered for the purposes of equivalency rate development. These asset-scale modeling and evaluation results are summarized below.

2.1 Right-of-way Rain Gardens and Stormwater Greenstreets

As detailed in the Report for Post-Construction Monitoring Green Infrastructure Neighborhood Demonstration Areas, Right-of-Way Rain Gardens (ROWRG) are designed and sited in the ROW to manage a 1-in design storm through storage and infiltration. Accordingly, these were modeled in ICM as a storage retention node with an infiltrating bottom. The assets were modeled as one 5 ft wide by 20 ft long footprint based on the Standard Designs and Guidelines for Green Infrastructure Practices. A sensitivity analysis of the tributary area size was run by fixing the infiltration rate at 1.0 inches per hour (in/hr) and starting at a representative value of 8,000 sf then varying the tributary area by +/- 50%. 8,000 sf was selected as the mid-point area from a range of tributary areas evaluated based on a geospatial analysis of tributary areas for ROW practices that had been completed during development of the Green Infrastructure

Performance Metrics Report (Section 4.4). With the resulting variance in the equivalency rate of approximately 10%, it was determined that the variations in the equivalency rates were not significant and therefore an average tributary area of 8,000 sf was selected for further analysis. The native soil infiltration rates were then varied from 0.125 in/hr to 5 in/hr based on the range of infiltration rates observed for actual constructed ROWRG practices to test the sensitivity of the results. The total volume managed was calculated as a volume of the infiltration loss at the storage retention node in ICM. The model representation of the ROWRG is shown below in Figure 1.

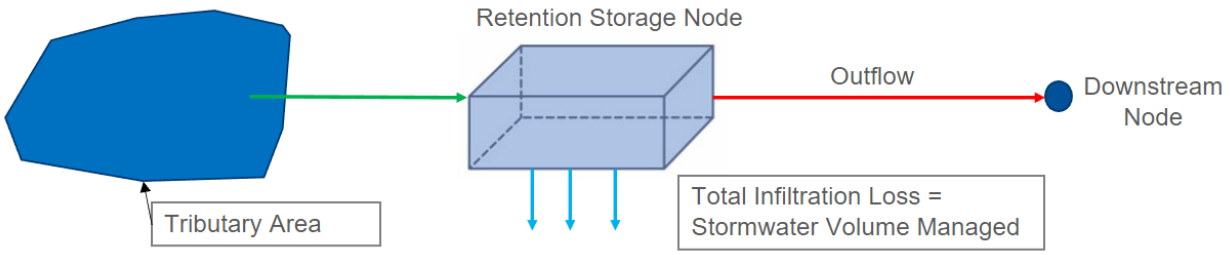

Figure 1: ROWRG Model Representation

The total volume managed was then normalized by Greened Acres to obtain the equivalency rate. A Greened Acre is an area equivalent to one acre of impervious surface covered by one inch of stormwater. For ROW practices, this is calculated following the methodology to estimate stormwater capacity for ROW practices as described in the Report for Post-Construction Monitoring Green Infrastructure Neighborhood Demonstration Areas which is then converted to Greened Acres as presented in Exhibit E of the 2021 Green Infrastructure Annual Report.

The selected equivalency rate for the ROWRG and Right of Way Stormwater Greenstreets (ROWSGS) represents the weighted average of the range of values that were produced by varying native soil infiltration rates within the model, weighted based on the number of actual ROW assets within different infiltration rate

bins as illustrated in Figure 2 below. The range of values along with the selected equivalency rate is shown in Table 2.

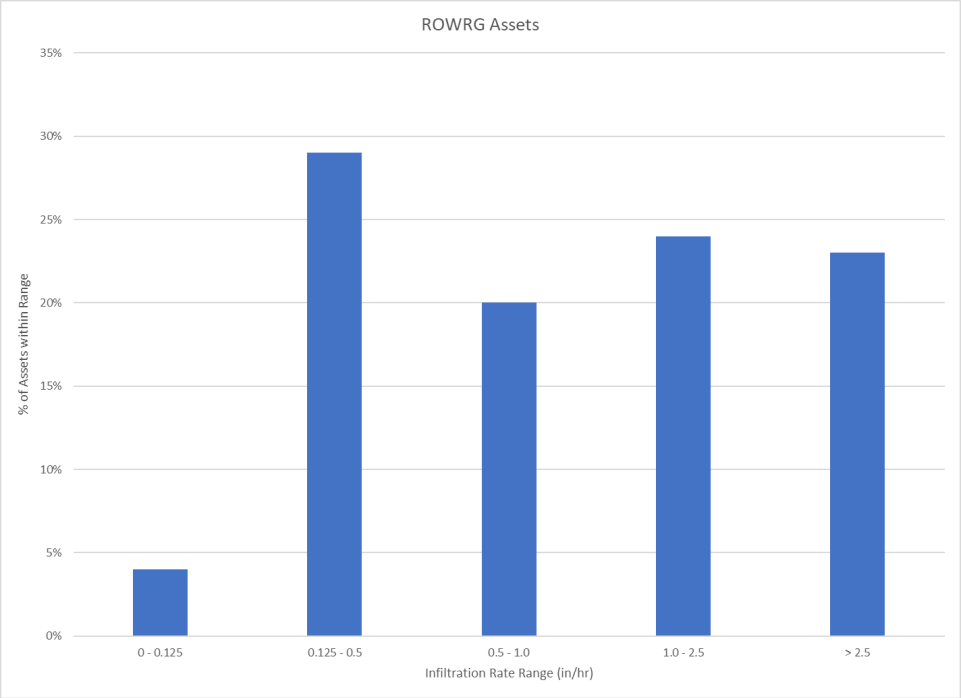

Figure 2: Summary of ROWRG Infiltration Rates

ROWSGS were not modeled explicitly but consist of similar design features including depression storage area, engineered soil depth, and open-graded stone base depth, with tributary areas similar to ROWRG as shown in the Standard Designs and Guidelines for Green Infrastructure Practices, and are therefore expected to perform similarly to ROWRG. They are larger in size compared to typical ROWRG, but similar equivalency rates are conservatively assumed for these assets.

Table 2: ROWRG and ROWSGS Equivalency Rate

Results	Units	Value
Equivalency Rate, MG of SW per Greened Acre	MG/acre/year	0.70 – 0.97
Selected Equivalency Rate, MG of SW per Greened Acre	MG/acre/year	0.86

2.2 Right-of-way Infiltration Basins

Similar to ROWRG, Right-of-Way Infiltration Basins (ROWIB) are designed and sited to manage the 1-in design storm through storage and infiltration, and were modeled in ICM as a storage retention node with an infiltrating bottom. The main difference between the ROWRGs and ROWIBs in the model was higher storage volume used for ROWIBs, as stone has a higher void ratio than engineered soil. The assets were modeled as 5 ft wide by 20 ft long based on the Standard Designs and Guidelines for Green Infrastructure Practices. A sensitivity analysis of the tributary area size was run by fixing the infiltration rate at 1.0 in/hr and varying the average tributary area of 8,000 sf by +/- 50%, similar to ROWRG. With the resulting variance in the equivalency rate of approximately 10%, it was determined that the variations in the equivalency rates were not significant and therefore an average area of 8,000 sf was selected for further analysis. The native soil infiltration rates were then varied from 0.125 in/hr to 5 in/hr based on the range of infiltration rates for actual constructed ROW practices, to test the sensitivity of the results. The total volume managed was calculated as a volume of the infiltration loss at the storage retention node in ICM. The model representation of the ROWIB is shown below in Figure 3.

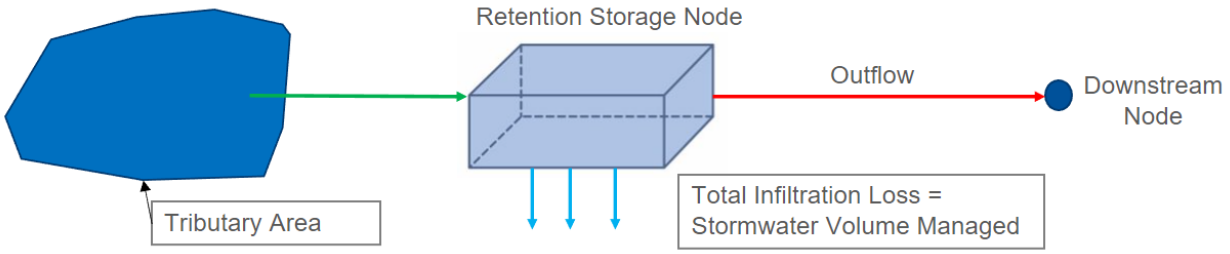

Figure 3: ROWIB Model Representation

Similar to ROWRG and ROWSGS assets, the total volume managed was then normalized by Greened Acre to obtain equivalency rates. The selected equivalency rate for the ROWIB represents the weighted average of the range of values that were produced by varying native soil infiltration rates within the model and weighted based on the number of constructed ROWIBs within different infiltration rate bins as illustrated in Figure 4. The range of values along with the selected equivalency rate is shown in Table 3.

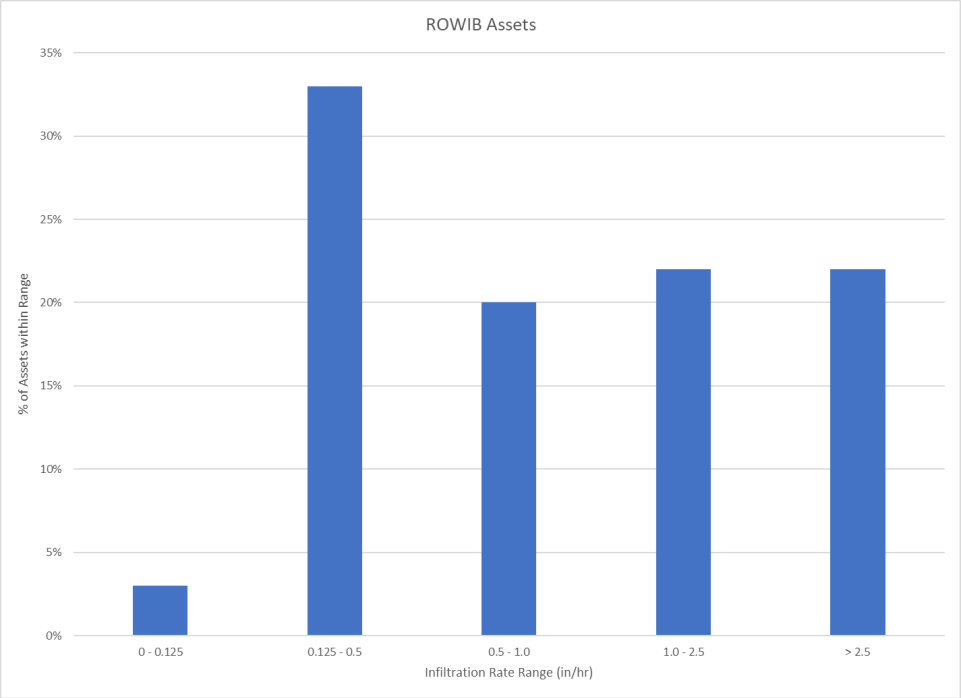

Figure 4: Summary of ROWIB Infiltration Rates

Table 3: ROWIB Equivalency Rate

Results	Units	Value
Equivalency Rates, MG of SW per Greened Acre	MG/acre/year	0.74 – 1.03
Selected Equivalency Rate, MG of SW per Greened Acre	MG/acre/year	0.91

2.3 Right-of-way Porous Pavement Retention

As part of DEP's research and development efforts, DEP had modeled Right-of-Way Porous Pavement (ROWPP) Retention assets in ICM using the Sustainable Urban Drainage System (SUDS)/Low Impact Development (LID) model representation for a constructed ROWPP pilot project as shown below in Figure 5.

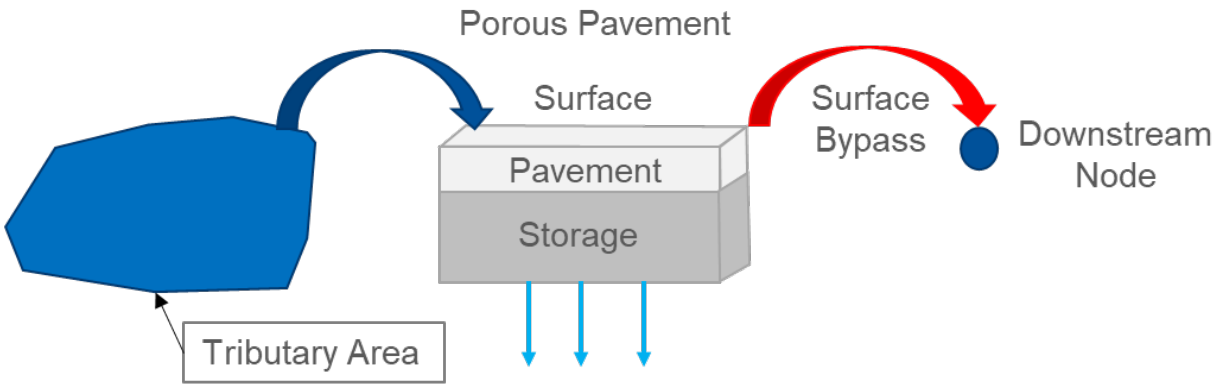

Figure 5: Porous Pavement LID Model Representation

To develop an equivalency rate, one ROWPP asset was modeled for one side of one street block with 4-ft-wide panels, 693 linear feet long, with a tributary area of 13,987 sf which includes half of the street and the sidewalk, as modeled in the pilot study for which the current ROWPP standard designs are based on (Standard Designs and Guidelines for Green Infrastructure Practices). The ROWPP was modeled with a 5-in-deep pavement layer and an 18-in-deep storage layer per as-built drawings from the constructed pilot installation. The pavement layer was modeled with a permeability of 100 in/hr based on the Standard Green Infrastructure Specifications. The infiltration rate from the storage layer into the underlying soil was varied from 0.125 in/hr to 5 in/hr, based on the range of infiltration rates observed in the ROW for ROWRG and ROWIBs to test the sensitivity of the results. The ROWPP model assumed only vertical infiltration and was modeled without an underdrain, which is consistent with the current ROWPP standard designs referenced earlier. The bypass represents flow that is not able to be stored and infiltrated and would flow on the surface to a catch basin down the street.

The selected equivalency rate is the median of a range of values that were produced by varying native soil infiltration rates within the model. The median value was used rather than a weighted average because very few ROWPP have been installed, limiting the number of actual constructed data. The range of values along with the selected equivalency rate for ROWPP is shown in Table 4.

Table 4: ROWPP Equivalency Rate

Results	Units	Value
Equivalency Rates, MG of SW per tributary area	MG/acre/year	0.87 – 1.04
Selected Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.96

2.4 Green Roofs

As part of DEP's research and development efforts, DEP had modeled green roofs using the EPA SWMM V5.1 LID toolset as represented in Figure 6.

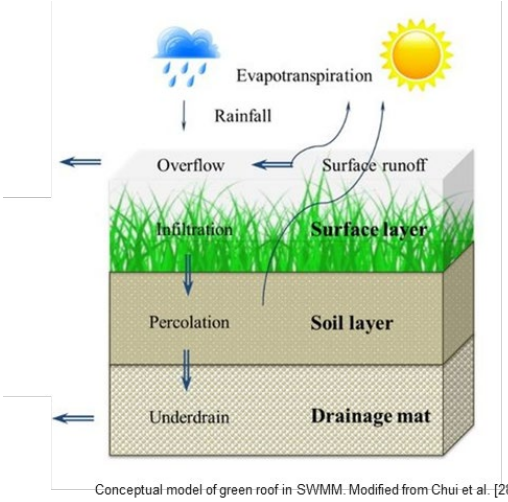

Figure 6: Green Roof Conceptual Representation

To develop an equivalency rate, the tributary area was assumed to be equal to the asset area, which was set to 1,000 sf for simplicity purposes (since the asset area is equivalent to the tributary area for green roofs, the equivalency rate approach already accounts for varying asset sizes). A C-factor of 0.7 was assumed based on the C value established for green roofs with 4 inches or more of growing media in the New York City Stormwater Manual (Chapter 2) and the green roof was modeled for a variety of substrate depths. Evapotranspiration (ET) was considered in the model and the daily ET rates were calculated using 7-day average temperature data during the modeling period (2008 typical year). The managed volume is retained volume. The results of the modeled green roof performance over varying depths are shown in Figure 7.

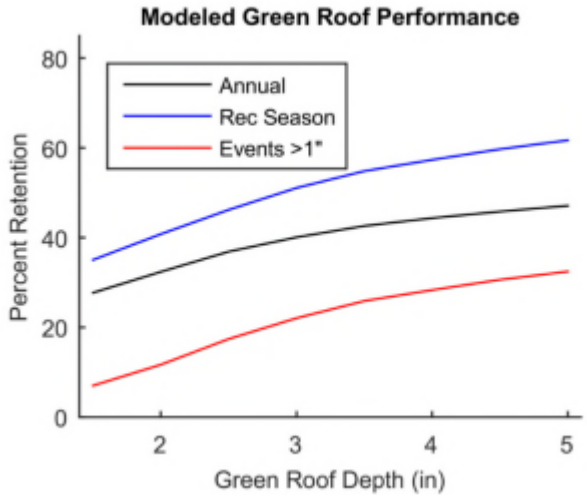

Figure 7: Stormwater Benefits for a Range of Green Roof Substrate Depths

A conservative equivalency rate for a 4-in-deep media, based on the NYC Green Infrastructure On-site Design Manual, was developed using the typical year modeling results which indicated about 40% of the runoff was retained on an annual basis with green roofs utilizing thicker substrates which were able to retain more. This was converted to a stormwater volume metric using the total annual stormwater volume generated from the roof area, and the equivalency rate is shown below in Table 5.

Table 5: Green Roof without Orifice Control Equivalency Rate

Results	Units	Value
Selected Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.35

Note that these modeling efforts did not account for additional stormwater detention benefits by controlling the roof drain valve, which is expected to become a common practice to meet the 2022 Unified Stormwater Rule (USWR) requirements. With the roof drain release rates of 0.1 cfs/acre, the stormwater managed by green roofs is expected to be very similar to those of slow-release orifice detention practices further described in Section 2.7. The equivalency rate for the green roof with orifice control is shown below in Table 6.

Table 6: Green Roof with Orifice Control Equivalency Rate

Results	Units	Values
Selected Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.68

2.5 Public/Private/External Onsite and Large-Scale Median Projects Retention

Over the years, the DEP sizing criteria for Onsite Retention and Large-Scale Median practices have evolved from earlier practices sized for a 1-in design storm to current practices sized for a 1.25- or 1.5-in design storm, depending on program area. Asset scale modeling evaluations were performed for all 3 design storm sizes. Retention practices capture stormwater through storage and infiltration, including storage within stone layers, stormwater chambers, etc. Practices are categorized as retention when the underlying soil has sufficient infiltration properties. The Onsite Retention and Large-Scale Median practices were modeled as a retention storage node in ICM with an infiltrating bottom. A tributary area of 21,545 sf was assumed with one asset per tributary area based on a conceptual design from an applicable case study conducted as part of the Lot Size Soil Disturbance Threshold study described in Appendix 6.1 of the NYC Stormwater Management Plan. This tributary area is slightly greater than the 20,000 sf of soil disturbance needed to trigger a stormwater construction permit under the USWR. Due to limited existing data for Onsite and Large-Scale Median practices, a tighter range of infiltration rates of 0.5, 1.0 and 1.5 inches per hour were modeled for infiltration from the practice into the underlying soil with no underdrain/orifice. The lower end of the infiltration rate range of 0.5 inches per hour was selected based on the minimum allowable infiltration rate for Onsite Retention practices according to the NYC Green Infrastructure Onsite Design Manual. As shown in Figure 8, the stormwater volume managed was assumed to be the total volume infiltrated into the soil from the practice, with an overflow weir allowing any additional stormwater to route to a downstream node.

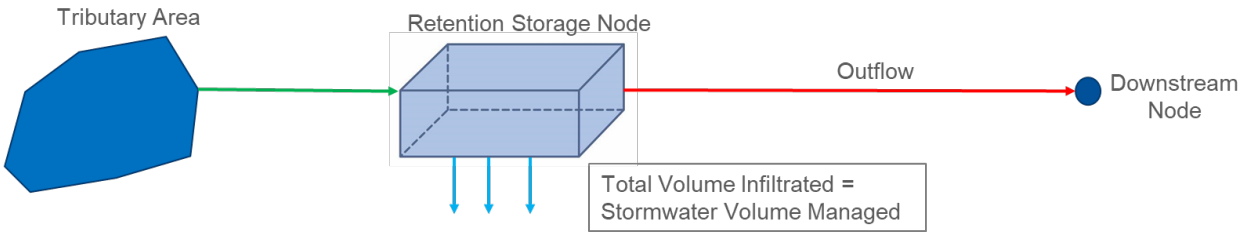

Figure 8: Onsite Retention Representation

The selected equivalency rate for the Onsite Retention practices represents the median of a range of values that were produced by varying native soil infiltration rates for a practice sized for a 1.25-in design storm based on the minimum allowable according to the NYC Green Infrastructure On-site Design Manual. The weighted average approach was not utilized because not as many projects have been constructed as compared to ROW assets for a statistical evaluation, but these existing projects provided sufficient data to observe variations in the infiltration rates to select the median infiltration rate value as a representative equivalency rate. The range of values of equivalency rates for the modeled soil infiltration rates along with the selected equivalency rate is shown in Table 7.

Table 7: Public Onsite Retention Equivalency Rate

Results	Units	Value
Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.87 – 0.98
Selected Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.95

2.6 2022 USWR Retention

The USWR was implemented in 2022, changing requirements for how stormwater is managed on all new and redevelopment sites that discharge to City sewers including CSS and Municipal Separate Storm Sewer (MS4) areas. The New York City Stormwater Manual was published with the USWR to provide guidance to permit applicants and designers for selecting and designing stormwater management practices. The USWR includes specific design and sizing requirements for water quality volume (WQv) and for sewer operations volume (Vv) (see Chapter 2 of NYC Stormwater Manual). Asset-scale modeling was completed for onsite retention practices and sizing consistent with the USWR requirements. Applicants are required to retain the WQv and can opt to retain the additional Vv requirement as follows:

- WQv for 1.5” rainfall depth
- Vv for 1.85” rainfall depth (CSS areas)

USWR Retention practices are expected to have similar design features as Onsite Retention practices and were modeled as a retention storage node in ICM with an infiltrating bottom to meet both WQv and Vv requirements. A tributary area of 21,545 sf was assumed with one asset per tributary area. As discussed earlier in Section 2.5, this tributary area is slightly greater than the 20,000 sf of soil disturbance needed to trigger a stormwater construction permit under the USWR. 0.5, 1.0, and 1.5 in/hr were modeled for infiltration from the practice into the underlying soil with no underdrain/orifice. As shown in Figure 9 the

stormwater volume managed was assumed to be the total volume infiltrated into the soil from the practice, with an overflow weir allowing any additional stormwater to route to a downstream node.

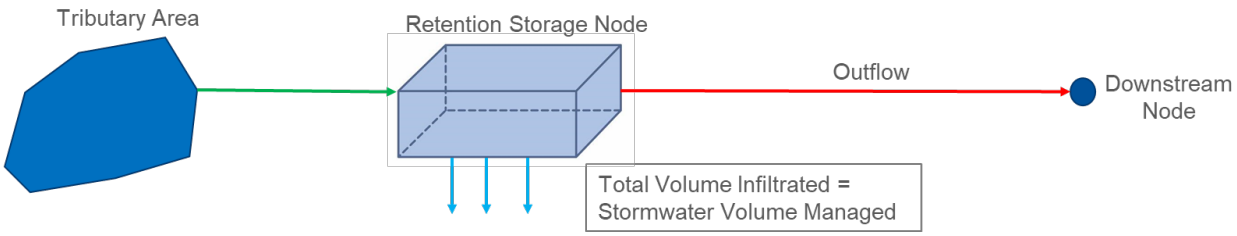

Figure 9: USWR Retention Representation

The equivalency rate for the USWR Retention practices was selected for the 0.5 in/hr infiltration rate, representing the conservative minimum allowable infiltration rate for retention under the regulations. The range of equivalency rates from the modeled scenarios and the selected equivalency rate are shown in Table 8.

Table 8: 2022 USWR Retention Equivalency Rate

Results	Units	Value
Equivalency Rates, MG of SW per tributary area	MG/acre /year	0.97 – 0.99
Selected Equivalency Rate, MG of SW per tributary area	MG/acre /year	0.97

2.7 Public/Private/External Onsite and 2022 USWR Detention

While practices are categorized as retention when the underlying soil has sufficient infiltration properties, where inadequate soils require utilization of the slow-release orifice for water quality benefit, practices are categorized as detention. Similar to the modeling described in the 2022 USWR Retention section, Onsite and 2022 USWR Detention was modeled as a storage node, however without an infiltrating bottom. The detention storage was sized for the same Vv requirement as stated in Section 2.6. Similar to USWR Retention practices, a tributary area of 21,545 sf was assumed with one asset per tributary area for the reasons discussed in Section 2.5. The outlet of the detention storage node was an orifice which was sized

to meet the 0.1 cfs per the New York City Stormwater Manual. Figure 10 shows the overall representation of the Onsite and USWR Detention as modeled in ICM.

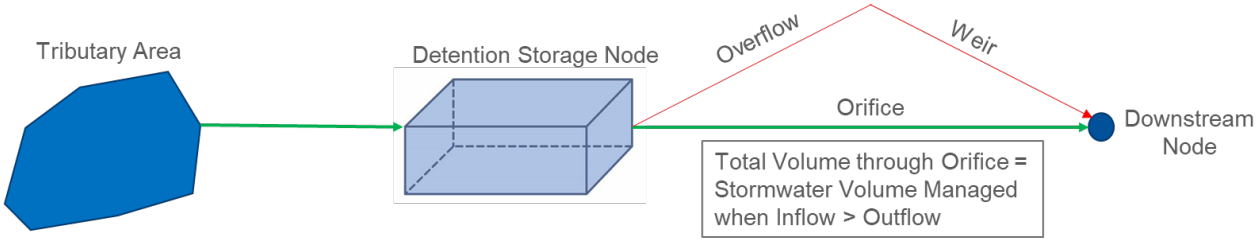

Figure 10: Onsite and USWR Detention Representation

The equivalency rate for Onsite and USWR Detention is calculated using the active flow control approach. Slow-release detention assets provide CSO benefit by delaying the stormwater entering the sewer system thereby reducing the peak flow. The total volume through the orifice that is actively managed is considered only time steps when the outflow from the tank is less than the inflow or when the inflow is zero and the tank is emptying after the event. This approach only considers the stormwater that is actively managed by the slow-release orifice during and after the event when unmanaged stormwater runoff can contribute to CSOs, which is why the timesteps following the end of rainfall were included in order to account for the full rainfall event. Figure 11 illustrates hydrographs for detention tank inflow and outflow from the June 14, 2008 rainfall event from the 2008 typical year rainfall data. The managed volume for this event is shown in the shaded area below the Outflow line. Similar calculations were done for all other events from the 2008 typical year rainfall to develop the equivalency rate shown in Table 9.

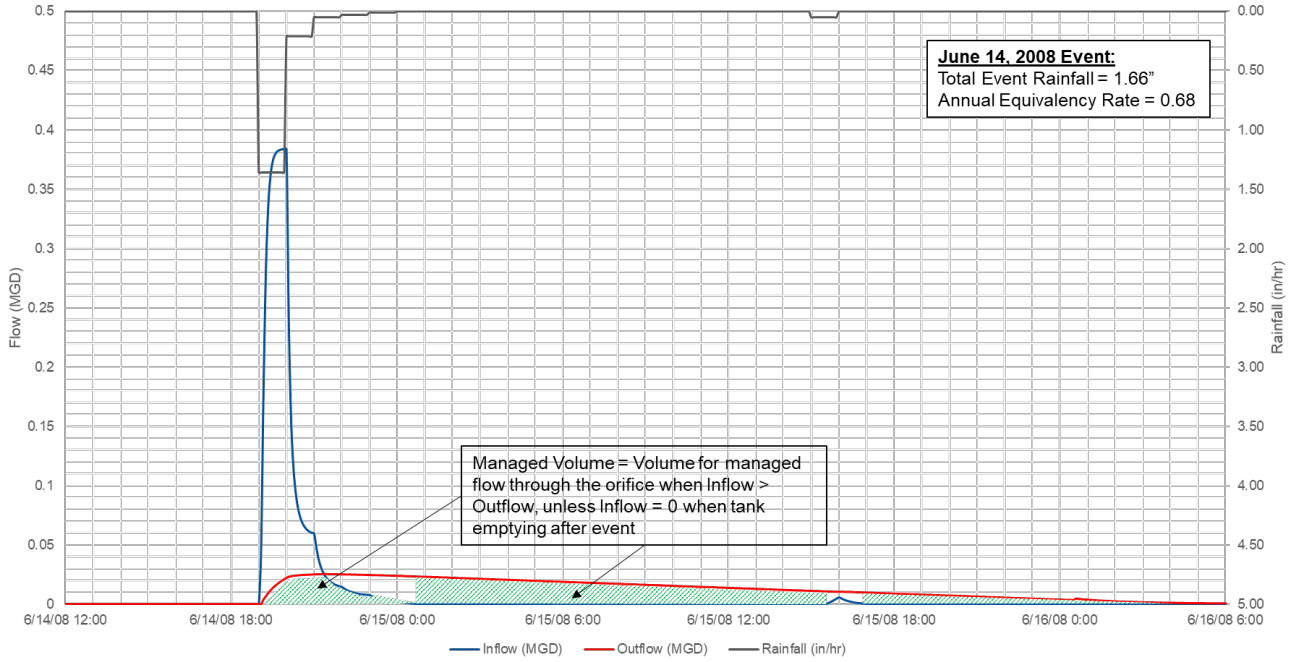

Figure 11: Onsite and USWR Detention, Sample Rainfall Event Hydrograph

Table 9: Onsite and USWR Detention Equivalency Rate

Results	Units	Value
Selected Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.68

2.8 2012 Stormwater Rule Detention

No asset-scale modeling was performed for detention assets following the requirements of the 2012 Guidelines for Stormwater Management Systems (referred to as 2012 Stormwater Rule Detention assets). The stormwater managed equivalency rate for the 2012 Rule Detention assets was derived from CSO reduction equivalency rates from previously completed watershed scale modeling results, as detailed below.

The Green Infrastructure Performance Metrics Report was prepared in 2016 and approved by DEC in 2017 in accordance with the CSO Order. The report presented performance metrics for the 1.5% green

infrastructure implementation rate, consisting of predominantly right-of-way retention assets, resulting in an annual citywide equivalency rate of 0.43 MG of CSO reduction per acre managed by green infrastructure.

Subsequent modeling was conducted to better define CSO reduction for 2012 Stormwater Rule detention assets. The analysis was conducted with the Jamaica Bay – 26th Ward LTCP InfoWorks CS model. In the model, the 2012 Stormwater Rule detention requirements were applied to a mix of lot sizes and redevelopment rates to represent onsite practices resulting in 128 impervious acres modeled within the Jamaica Bay-26th Ward Wastewater Resource Recovery Facilities drainage area. The model was run using the 2008 typical year rainfall. Based on this analysis, the 2012 Stormwater Rule detention assets result in an annual CSO reduction equivalency rate of 0.06 MG/acre.

To use these two results to develop an appropriate stormwater equivalency rate, it was assumed that stormwater capture performance scales proportionately with CSO reduction performance. Comparing the difference in CSO reduction between the 2012 Stormwater Rule Detention assets and the predominantly retention-based 1.5% green infrastructure implementation, a reduction factor of 0.06/0.43 = 0.14 was established.

Accordingly, to calculate the stormwater equivalency rates, this reduction factor of 0.14 was applied to the Onsite Retention stormwater equivalency rate of 0.95 MG/acre (refer to Section 2.5) to derive 0.95*0.14 = 0.13 MG/acre for stormwater managed by detention practices designed in accordance with the 2012 Stormwater Rule. The equivalency rate for the 2012 Stormwater Rule Detention assets is shown in Table 10.

Table 10: 2012 Stormwater Rule Detention Equivalency Rate

Results	Units	Value
Selected Equivalency Rate, MG of SW per tributary area	MG/acre/year	0.13

2.9 Cloudburst

Cloudburst practices retain (CSS & MS4), detain (CSS), and/or treat (MS4) at a minimum the first 1 inch of rainfall for water quality benefits; and are co-located in areas vulnerable to flooding and include additional features to reduce flood risk to the extent possible under larger “cloudburst” precipitation events. These practices can incorporate multiple green infrastructure technologies and be installed in public ROW or onsite locations. Water quality related components of these practices are designed in accordance with the existing design guidelines and standard details for ROW and public onsite green infrastructure, with Cloudburst projects designed to manage larger storm events than the traditional green infrastructure

projects. However, the stormwater and CSO reduction performance of Cloudburst practices will be conservatively determined from the ROW and onsite components with similar functions.

3.0 SUMMARY OF EQUIVALENCY RATES

Based on the modeling and evaluation results described above, equivalency rates have been established for estimating annual stormwater capture benefits of the NYC GI Program.

As DEP continues expansion of green infrastructure implementation citywide beyond the current portfolio of public projects, it is likely that new types of green infrastructure designs will become more prevalent. In the cases where the function of the green infrastructure design is substantially different than those listed in this memo, DEP will use the best available tools and information at the time to establish the corresponding citywide equivalency rate for such designs.

References

New York City Department of Environmental Protection. (2012, rev. July 2013, October 2013, August 2014, March 2016, June 2016, July 2017, June 2020, May 2022). Standard Designs and Guidelines for Green Infrastructure Practices. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/green-infrastructure-standard-designs.pdf

New York City Department of Environmental Protection. (2021, April). Green Infrastructure Annual Report. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/gi-annual-report-2021.pdf

New York City Department of Environmental Protection. (2016, June 30). Green Infrastructure Performance Metrics Report. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/gi-performance-metrics-report-2016.pdf

New York City Department of Environmental Protection. (2022, February 15). New York City Stormwater Manual. https://www.nyc.gov/site/dep/water/unified-stormwater-rule.page?question=faq1

New York City Department of Environmental Protection. (2019, rev July 2021). New York City Onsite Design Manual. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/nyc-green-infrastructure-onsite-design-manual-v2.pdf

New York City Department of Environmental Protection. (2021, April). NYC Green Infrastructure 2021 Annual Report. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/gi-annual-report-2021.pdf

New York City Department of Environmental Protection. (2014, Dec). Report for Post-Construction Monitoring Green Infrastructure Neighborhood Demonstration Areas. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/post-construction-monitoring-report-gi-neighborhood-demonstration-areas.pdf

New York City Department of Environmental Protection. Standard Green Infrastructure Specifications. (Available upon request).

New York City Department of Environmental Protection. (2018, rev. February 2022). New York City Stormwater Management Plan. https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/ms4/nyc-swmp-plan-full.pdf