ENVELOPE

STORMWATER MANAGEMENT PLAN

77 AND 109 KAPITI ROAD AND 1 BRETT AMBLER WAY, PARAPARAUMU

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1.0 INTRODUCTION

New Central Park Limited (NCPL) is proposing the comprehensive development of land at 77 and 109 Kapiti Road and 1 Brett Ambler Way, Paraparaumu, together with associated works on adjoining land. The Project is a comprehensive, masterplanned mixed-use development providing for the expansion of the Paraparaumu Metropolitan Centre.

The Project comprises:

- Approximately 600 residential dwellings, including apartments, townhouses, duplexes, courtyard housing and standalone dwellings;
- Approximately 20,000 m² GFA of Large Format Retail (LFR);
- Approximately 3,800 m² of other retail and commercial activities, including specialty retail and drive-through activities;
- Subdivision to create residential, commercial, LFR and other development allotments, together with roads, reserves and infrastructure;
- A new internal transport network, including the Town Centre Link Road, local roads and JOALs, together with pedestrian and cycling connections and provision for public transport;
- Three waters infrastructure required to service the development;
- An extensive network of open space, landscaping and blue-green infrastructure; and
- Wetland reclamation and creation and ecological restoration and enhancement, including a constructed indigenous wetland primarily providing ecological offsetting and compensation, together with complementary flood-storage functions.

The development has been comprehensively masterplanned to integrate the residential, commercial, transport, infrastructure, ecological, landscape and open space components of the Project. It is intended to proceed progressively in stages as an integrated extension to the existing Paraparaumu town centre.

The Project has been referred for consideration under the Fast-track Approvals Act 2024. This report forms part of the technical documentation supporting the substantive application for the Project and covers stormwater management at the site, in particular:

- How hydraulic neutrality for the site will be achieved.
- The forms of low impact stormwater devices to be used.
- Providing a summary of flood modelling results.
- The integration of the development with stormwater management, flood storage and ecological offsetting areas.
- Conceptual design of stormwater conveyance systems.

This report should be read alongside other project documentation and reports submitted with the substantive application.

2.0 PROJECT BACKGROUND

A previous masterplan was prepared for the site and formed the basis of resource consent applications lodged with Kapiti Coast District Council (KCDC) and Greater Wellington Regional Council (GWRC) in 2024 for subdivision, bulk earthworks and associated infrastructure works. The previous proposal was subject to technical review and requests for further information from both Councils, including in relation to stormwater management.

The development has subsequently been redesigned, and the current proposal differs from the earlier masterplan in a number of respects, including the development layout, earthworks,

stormwater and flood management approach, and infrastructure requirements. The current engineering design has been developed having regard to the technical investigations, modelling and feedback obtained through the previous consent process, where these remain relevant to the revised proposal. A key difference between this application and the previous application is that this is a substantive application, considering land use in addition to subdivision as opposed to the previous "superlot" approach.

Where appropriate, previous technical work has been updated to reflect the current masterplan and development yield.

The previous application received Section 92 requests for information, which have been addressed through the design process. These are outlined in Table 1.

Table 1. Summary of KCDC/GWRC S92 requests and where these are addressed.

RFI issue / information requested	Where addressed in current application
Mana whenua engagement and cultural freshwater outcomes	The SMP references the Interim CIA and the Te Ātiawa Kaitiakitanga Plan (sections 4.2 and 6.1). Consultation and cultural effects are addressed in the application's Consultation Summary. There are some clear connections between the matters raised in the CIA and the proposed stormwater approach, including the importance of the Wharemauku Stream, freshwater health, wetland restoration and ongoing mana whenua involvement.
Receiving environment, environmental constraints and WSUD evaluation	The SMP identifies the key environmental and physical constraints affecting the Site, including shallow groundwater, variable ground conditions, existing freshwater features, flood hazards and the receiving environment of the Wharemauku Stream. These constraints have informed the proposed stormwater management approach, including the use of rain gardens and passive soakage where practicable, attenuation to achieve hydraulic neutrality, and the integration of flood storage with the proposed wetland compensation area. The design has also been informed by the hydrological and ecological assessments, particularly in relation to groundwater recharge, stream baseflows and the hydrological requirements of the proposed wetland. Refer to Sections 5–10 of the SMP and the supporting WWLA Hydrological Assessment and Flood Risk Assessment.
Water-sensitive design, road runoff and swales	The SMP describes rain gardens, treatment, retention and water-sensitive design measures (stormwater treatment and design objectives sections).
Superlots, future imperviousness and design certainty	The current proposal seeks land use consents for all proposed activities unlike the previous super lot subdivision. Therefore, this SMP is based on the full proposed development yield (section 3.3) and outlines conceptual servicing.
Ownership, maintenance and whole-of-life operation	The SMP addresses maintenance requirements at a conceptual level and the consent conditions set out future ownership and maintenance responsibilities.



RFI issue / information requested	Where addressed in current application
Flood storage, flood levels and proposed stream/wetland arrangement	Existing flood hazard and storage functions are discussed in sections 6.3 and 7–8, with flood modelling in the supporting Flood Risk Assessment.
Wharemauku hydraulics, open channels, geomorphology and wetland water levels	It is noted that unlike the previous proposal, the Wharemauku Stream will be retained within its existing alignment instead of a new channel through the new wetland complex. The SMP discusses catchment and conveyance design, including stream flow analysis and wetland bathymetry. Confirm cross/long sections, low-flow operation, sediment deposition, groundwater interactions and model outputs are supplied.
Attenuation device layout and interaction with wetland and groundwater	Hydraulic neutrality and attenuation design are addressed in the SMP, with supporting hydrology/flood assessments. Soakage devices are proposed instead of an attenuation pond as was in the previous design.
Hydrological modelling inputs, events and verification	The SMP identifies runoff calculations, design criteria and hydraulic neutrality, with calculations appended.
Stormwater pipe sizing, overland flow and adjoining properties	The SMP sets primary/secondary network design criteria and references flood modelling. Pipe sizing has been undertaken to a preliminary level and tested within the hydraulic model. Refined sizing including detailed calculations will be undertaken at the detailed design stage.
Wetland restoration and ecological interface	The proposed wetland compensation area incorporates both ecological restoration and flood storage functions. The SMP addresses water supply, groundwater interactions and stormwater discharges, with rain gardens, sediment forebays and scour protection proposed to manage water quality and erosion. The supporting ecological assessments and management plans address wetland establishment and monitoring. Further coordination at detailed design will ensure stormwater inflows and water levels support the intended ecological functions of the wetland.
Groundwater, peat, recharge, soakage and wetland hydrology	Sections 5.2–5.3 of the SMP summarise the geotechnical and groundwater investigations, including peat deposits, shallow groundwater and implications for soakage. The stormwater design incorporates passive soakage to support groundwater recharge and stream baseflows, with these measures assessed through WWLA's hydrological modelling. The proposed wetland hydrology considers groundwater levels and surface water inflows to maintain suitable wetland conditions. Site-specific soakage testing and final design parameters will be confirmed at detailed design.
Stormwater quality and protection of receiving waters	The SMP outlines existing water quality conditions within the Wharemauku Stream catchment, drawing on the Jacobs Stream Baseline Study prepared for KCDC. The proposed stormwater management approach incorporates rain gardens, passive soakage and other



RFI issue / information requested	Where addressed in current application
	treatment measures to manage contaminants before discharge to receiving waters. These measures are intended to minimise adverse effects on water quality and support the ecological health of the Wharemauku Stream and associated freshwater environments.
Construction runoff, erosion and sediment controls	Construction-phase sediment controls are principally addressed in the separate Earthworks and Construction Management Plan / ESCP.
Stream works, culverts, aquatic ecology and regional approvals	Watercourse and fish values are described in the SMP; ecological impacts, fish passage and approval requirements are addressed in the ecological and statutory assessments.
Wetland loss, hydrology, offset and compensation	The SMP outlines the proposed wetland compensation area, including its hydrological arrangements and flood storage functions. The extent of wetland loss, associated ecological effects and proposed compensation measures are addressed in the Ecological Impact Assessment and the Wetland Residual Effects Analysis Report. These assessments also address the proposed wetland restoration, management and monitoring requirements.
NRP, RPS, NPS-FM and integrated freshwater management	The SMP outlines the proposed stormwater management approach, including water quality treatment, passive soakage, groundwater recharge, hydraulic neutrality and flood storage, which collectively support freshwater management outcomes under the NPS-FM, RPS and NRP. A detailed assessment of the relevant objectives and policies is provided in the application's Statutory Assessment. The specific stormwater provisions introduced through NRP Plan Change 1 (PC1) for the Te Whanganui-a-Tara and Te Awarua-o-Porirua whaitua do not apply to the Kapiti Coast Whaitua, although the proposed design incorporates similar water-sensitive design principles.

3.0 SITE DESCRIPTION

3.1 SITE DESRCIPTION

The site is comprised of 7 lots – Section 3 and 4 SO 501569, Section 2 SO 570550, Lot 2 and 4 DP 470759, Lot 13 DP 361734 and Lot 7 DP 342714 which have an approximate area of 37.45 ha. The proposed development works will also be undertaken on portions of land owned by and in conjunction with external parties (e.g. Kapiti Coast District Council). The site development extents are shown in our drawings (Appendix 1) and in Figure 1



Figure 1. Site Extents Plan

The site is at an elevation of approximately RL 3 – 20 m and is comprised of two distinctive landforms:

- Sand dunes with steep sides in the centre of the site.
- Lowland areas to the north and south of the dunes.

There are several watercourses which run through the site including the Wharemauku Stream on the southern boundary, and various drainage channels which run through the site including a channel which conveys stormwater from the reticulated Council stormwater network discharging adjacent to Kapiti Road. Bioresearches have conducted a watercourse assessment of the site which provides further detail on the various drains and streams and assigns ecological values and classifications to these.

3.2 PROPOSED DEVELOPMENT

The proposed development will deliver approximately 600 residential units in a varied range of typologies, together with approximately 20,000 m² of large format retail and 3,800 m² of other commercial and retail activities. It also includes significant infrastructure works, including a new east–west link road ('the spine road') and Iver Trask extension, three waters servicing, and an integrated network of open space, wetland and flood management areas.

The Fast-track application seeks the land use and subdivision consents required to enable the comprehensive development of the site, including the residential, large format retail, commercial and retail development shown on the architectural plans. The application also seeks approval for the associated earthworks, roads, three waters infrastructure, stormwater and flood management works and other supporting infrastructure required to service the development.

The civil infrastructure described in this report has been designed to service the full development proposed as part of the Fast-track application, with infrastructure sizing and servicing requirements based on the anticipated residential and commercial development yield. Proposed engineering plans for the site are included in Appendix 1 and the Site Survey is included in Appendix 2.

3.3 PROPOSED DEVELOPMENT YIELD

The civil infrastructure design has been developed having regard to the proposed development yield and land uses across the site. The anticipated residential and commercial development summarised in **Table** 2. Proposed Development Yield.has been used to inform infrastructure sizing and demand estimates for the development. While detailed design and staging may result in minor changes to individual infrastructure requirements, the servicing assessment has been undertaken on the basis of the overall development proposed through the Fast-track application.

Table 2. Proposed Development Yield.

Usage type	Commercial GFA (m²)	Residential units	Comments
Apartments	–	219	Assessed at 2.5 persons/dwelling
Courtyard	–	21	Assessed at 2.5 persons/dwelling
Duplex	–	32	Assessed at 2.5 persons/dwelling
House	–	135	Assessed at 2.5 persons/dwelling
Townhouse	–	186	Assessed at 2.5 persons/dwelling
Residential total	–	**593**	
Commercial – Large Format Retail	20,000	–	Assessed as medium water use
Commercial – other retail and commercial activities	3,800	–	Low (nominal) water use
Commercial total	**23,800**	–	

4.0 BACKGROUND

4.1 PREVIOUS STUDIES AND REPORTS

Several previous studies have considered the site and surrounding areas. These include:

- Jacobs Wharemauku Catchment Integrated Modelling Reports (2021, 2022) provides an assessment of the effects of proposed developments, enhancements and stormwater upgrades on the catchment. This includes the area of the proposed development, with and without mitigation measures. The modelling shows that mitigation measures are required to minimise off site effects and that these can address flood hazard and offsite effects.
- Awa Environmental conducted a 2020 flood model and options assessment, to assess options to mitigate flood risk in the Amohia and Ruahine Street catchments, which discharge adjacent to the site in Iver Trask Place.
- The Wharemauku Stream Freshwater Ecological Baseline Study (Jacobs, 2016), prepared for KCDC, assessed the existing ecological condition of the Wharemauku Stream, including water quality, freshwater habitat, fish and macroinvertebrate communities. The study identified the effects of historic land use and flood management works on stream health, including modified

channels, limited riparian vegetation and degraded aquatic habitat. It also identified opportunities for improving water quality, riparian habitat and overall stream ecological values.

4.2 RELATIONSHIP TO OTHER PLANS

This report should be read in conjunction with the following plans and reports:

- Te Ātiawa ki Whakarongotai Kaitiakitanga Plan, which outlines kaupapa, huanga and tikanga relating to land development.
- Envelope Engineering Earthworks and Construction Management Plan (2026), which outlines construction management measures, including erosion and sediment control.
- Envelope Engineering Infrastructure Report (2026), which assesses the proposed infrastructure and servicing arrangements.
- Envelope Engineering Flood Risk Assessment (2026), which assesses flood hazards, flood storage requirements and effects on surrounding properties.
- Williamson Water & Land Advisory (WWLA), Hydrological Effects Assessment Report – Kapiti Road Development (October 2026), which assesses surface water, groundwater, recharge, stream flows and wetland hydrology.
- Bioresearches, 77–109 Kapiti Road and 1 Brett Ambler Way, Paraparaumu – Assessment of Ecological Effects (October 2026), which assesses freshwater and terrestrial ecological values and the effects of the proposed development.
- Bioresearches, 77–109 Kapiti Road and 1 Brett Ambler Way, Paraparaumu – Wetland Residual Effects Analysis Report (October 2026), which assesses residual wetland effects and the proposed compensation measures.
- Bioresearches, Ecological Management Plan – 77–109 Kapiti Road and 1 Brett Ambler Way, Paraparaumu (Draft, 2026), which outlines ecological management, restoration, monitoring and adaptive management measures.
- Torlesse, Geotechnical Assessment report (October 2026).
- Torlesse, Geotechnical Desktop Study – 77 Kapiti Road (September 2026), which identifies the site's geotechnical conditions and development constraints.
- Aquanet Consulting, Waikanae Water Quality and Ecological State Report (2023), which collates and assesses freshwater water quality and ecological information as part of the Kāpiti Whaitua process.

5.0 SITE EVALUATION

5.1 SITE DESCRIPTION

The site is located between State Highway 1 to the west and central Paraparaumu to the east. There are prominent dune features in the middle portion of the site with lower lying areas surrounding these.

The Wharemauku Stream flows through the southern portion of the site, with a stormwater drain connecting into this from the residential area to the northeast of the site.

5.2 GEOTECHNICAL CONSIDERATIONS

Geotechnical investigations have been undertaken by Torlesse to understand the underlying ground conditions at the site. Refer to Torlesse's Geotechnical Assessment Report submitted with the application. These have identified the following aspects which are considered to be relevant for the proposed stormwater strategy:



- The flatter portions of the site are underlain by peat (typically 1.0-1.5 m thickness) overlain by organic sands and sands. The dune is comprised of a shallow layer of topsoil, with underlying sands.
- There is a shallow groundwater table based on groundwater monitoring. This is comprised of a perched groundwater level at the interface of the peat and sand layers, and a deeper regional groundwater table.
- The peat and organic sands will be required to be removed for development, with competent materials placed back.

The removal and replacement of peat and organic soils will alter the existing subsurface conditions, with potential implications for infiltration, groundwater movement and the interaction between surface water and groundwater. These changes have been considered in the WWLA Hydrological Effects Assessment, alongside the proposed increase in impervious surfaces and the stormwater management measures intended to mitigate changes to the existing hydrological regime.

5.3 HYDROGEOLOGICAL CONSIDERATIONS

Williamson Water and Land Advisory (WWLA) have undertaken groundwater monitoring and modelling to understand groundwater regimes at the site and the potential effects of development on groundwater within the site and the surrounding area. Refer to WWLA's Hydrology Assessment Report submitted with the application. Key aspects of the report and analysis as they relate to the SMP are:

- The changes in underlying soil types will cause changes to hydrology that need to be assessed.
- There are also corresponding changes to land use, increasing the imperviousness which has potential effects on groundwater recharge.
- The groundwater table at the site is high in places and stormwater devices (particularly soakage devices) need to be suitably located to ensure they will be located above the groundwater table.
- Stormwater management measures e.g. passive soakage, needs to be accounted for within any analysis, as these provide mitigation for changes in soil type and land use.

These matters have been assessed in the WWLA Hydrological Effects Assessment Report (WWLA1533, October 2026), which considers the combined effects of changes to ground conditions, increased impervious surfaces and proposed stormwater management measures on groundwater levels, recharge and stream baseflows. The findings have informed the stormwater strategy, including the provision of passive soakage, the location of stormwater devices and the proposed hydrological arrangements for the wetland compensation area. Further details of the proposed stormwater controls are provided in the following sections of this SMP.

5.4 HYDROGEOLOGICAL CONSTRAINTS AND STORMWATER DESIGN RESPONSES

The geotechnical investigations and hydrological assessment have identified a number of site constraints relevant to the stormwater management strategy. Table 3 summarises how these have been considered in the proposed design. Further detail is provided in the WWLA Hydrological Effects Assessment Report (WWLA1533, 1 October 2026) and the following sections of this SMP.

Table 3. Stormwater design response to hydrogeological constraints.

Site Constraint	Stormwater Design Response
Shallow groundwater levels	Stormwater devices, particularly soakage measures, are to be located and designed with regard to groundwater levels and available separation distances. The conceptual design has avoided areas with anticipated high groundwater table. Final locations and soakage performance will be confirmed through detailed design.



Site Constraint	Stormwater Design Response
Peat and organic soil removal and ground replacement	The potential hydrological effects of altered subsurface conditions have been considered in the WWLA assessment, alongside the proposed stormwater management measures.
Increased impervious surfaces	Rain gardens and passive soakage are proposed to retain and infiltrate runoff where practicable, supporting groundwater recharge and reducing direct runoff. Soakage provides attenuation for larger events.
Groundwater contributions to stream baseflows	WWLA's hydrological modelling considers the effects of the development and proposed infiltration measures on groundwater recharge and stream baseflows.
Hydrological requirements of the proposed wetland compensation area	The wetland design considers surface water inflows, groundwater interactions and water levels, alongside its flood storage function. The detailed design will need to maintain conditions suitable for the intended wetland habitats.

5.5 EXISTING WATER FEATURES

The Wharemauku Stream runs through the southern part of the site. This stream and its catchment are outlined in detail in Section 0. There are several stormwater drains running through the site which ultimately discharge to the Wharemauku Stream. Additionally, there are a large number of wetlands that occupy the flatter areas of the site. The classification and extent of the streams and natural inland wetlands have been classified by the project ecologist and are shown in Figure 1

The existing wetlands and watercourses have been assessed by Bioresearches in the Assessment of Ecological Effects (October 2026), with the proposed wetland compensation measures addressed in the Wetland Residual Effects Analysis Report (October 2026). The proposed wetland compensation area will also provide flood storage, with its hydrological requirements considered through the WWLA assessment and the stormwater design. The integration of these functions is addressed further in Section 11 of this SMP.



Figure 2. Freshwater features at the site (Bioresearches).

5.6 EXISTING FAUNA

Targeted surveys were undertaken by Bioresearches using overnight trapping and eDNA sampling within Watercourse 1 and the adjoining Wharemauku Stream. These surveys confirmed the presence of several indigenous fish within and adjacent to the site, most of which have a "Threatened" or "At Risk" status.

The wider ecological condition of the Wharemauku Stream has also been documented in the Wharemauku Stream Freshwater Ecological Baseline Study (Jacobs, 2016), prepared for KCDC. This study identified existing pressures on stream health associated with historic land use and flood management, including modified channels, limited riparian vegetation and degraded aquatic habitat. These existing conditions provide context for the proposed stormwater treatment measures and the importance of managing water quality and discharges to the stream.

6.0 CATCHMENT EVALUATION

6.1 WHAREMAUKU STREAM

The Wharemauku Stream is a central feature in Paraparaumu. Historically, the stream was a source of shelter and sustenance[1] however the stream has been channelised and straightened through gradual development of the catchment. Previous monitoring has identified pressures on water quality and ecological health associated with urban and rural land use, including elevated nutrient concentrations, sedimentation, channel modification and limited riparian vegetation.

The Wharemauku Stream Freshwater Ecological Baseline Study (Jacobs, 2016), prepared for KCDC, assessed water quality, freshwater habitat, fish and macroinvertebrate communities across the catchment. The study identified elevated nutrient concentrations, localised water quality issues and reduced ecological values in the more heavily modified lower reaches. Stream Ecological Valuation (SEV) scores ranged from 0.37 at the Airport site to 0.68 at Kaitawa Reserve, reflecting the influence of channel modification, limited riparian vegetation and other land use pressures. The study also

[1] Atiawa Ki Whakarongotai Charitable Trust, Interim Cultural Impact Assessment.

confirmed the presence of indigenous freshwater fish and identified opportunities for improving riparian habitat, water quality and overall stream ecological function.

The Wharemauku Stream catchment covers central and southern Paraparaumu and the northern part of Raumati Beach on the Kāpiti Coast. The stream rises in the Maungakotukutuku valley in the foothills of the Tararua Range. It flows west across the coastal plain and reaches the Tasman Sea at Raumati Beach, just north of Raumati Marine Gardens. The total catchment is approximately 2,000 ha.

From the foothills, the stream passes through Kaitawa Reserve, under the North Island Main Trunk railway and the former State Highway 1, and past Coastlands. It then crosses under the Kāpiti Expressway, passes the southern edge of Kāpiti Coast Airport and Weka Park, and reaches the coast through a short, channelised estuary.

The upper catchment is steep to rolling hill country on greywacke with residual soils. The middle and lower catchment is low-lying, gently graded coastal plain on Holocene dune sands. The sands are typically 15 m thick inland and up to 40 m thick near the coast. Interdunal swales contain peat and organic deposits, and the sands also hold gravel lenses that follow old stream channels.

Most of the middle and lower catchment is urban, including:

- residential suburbs
- the Paraparaumu town centre and Coastlands commercial area
- transport corridors – North Island Main Trunk railway, the Expressway and Kapiti Road
- Kapiti Coast Airport

Through the urban area, the stream has been straightened into a uniform trapezoidal channel with little riparian vegetation. Stopbanks along the channel contain moderate floods, with spillover into surrounding areas in larger events. Piped stormwater outfalls discharge to the stream and its tributary drains.

The lower catchment overlies an unconfined sand aquifer with a shallow water table. In the Raumati area it is typically within 4 m of the ground surface, and shallower in low-lying swales.

6.2 WATER QUALITY

Aquanet Consulting conducted an information gathering exercise as part of the Kapiti Whaitua process. This included analysis of water quality data for the Wharemauku Stream. Earlier monitoring undertaken for KCDC, as reported in the Wharemauku Stream Freshwater Ecological Baseline Study (Jacobs, 2016), provides additional information on water quality conditions within the catchment. The Jacobs assessment draws on monthly dry-weather monitoring undertaken during 2014 at Weka Road and Hookway Grove. While this provides useful baseline information, the results do not necessarily reflect water quality during rainfall events, when stormwater runoff can increase contaminant concentrations.

- **Overall State:** The stream hasn't been given a formal overall grade. Water quality is rated poor[2] and macroinvertebrate health is in a generally poor state suggesting widespread degradation[2]. This mainly reflects urban land use in the lower catchment (about a third of it is urban) and the channelised, poorly shaded lower reaches. The receiving estuary is rated "moderate to poor" overall.
- **Bacterial Risk:** E. coli falls in the NPS-FM D–E bands across monitored sites. Monitoring from 2021 to 2024 gives median counts of about 180 cfu/100 mL at Hookway Grove (upper reach) and 300 cfu/100 mL at the stream mouth. At the mouth, 27% of samples exceeded 540 cfu/100 mL. Faecal source tracking points mainly to wildfowl and livestock, although wastewater overflows have occurred, including from Coastlands in 2018.[2]
- **Sediment & Clarity:** Baseflow suspended solids are low. However, the stream is subject to significant erosion pressures (forestry and rural) in the upper reaches and associated deposition in the lower reaches where velocities are low enough for sedimentation to occur. This is

[2] Beca (2011), *Technical Report 24 – Baseline Water and Sediment Quality Investigation*, MacKays to Peka Peka Expressway (NZTA)



significant enough for KCDC to undertake gravel and sand clearance works within the stream for flood management purposes (noting that there is no current consent for these works).

- **Dissolved Metals:** KCDC monitoring indicates generally low dry-weather copper and zinc concentrations, consistent with the findings of Jacobs (2016), which recorded concentrations below guideline trigger values on most sampling occasions. Higher concentrations may occur following rainfall, particularly from urban stormwater runoff.[2]
- **Nutrients:** The Wharemauku Stream Freshwater Ecological Baseline Study (Jacobs, 2016), prepared for KCDC, identified elevated nutrient concentrations in the stream. Monitoring undertaken at Weka Road and Hookway Grove recorded exceedances of guideline trigger values for total nitrogen, nitrate and dissolved reactive phosphorus. The study noted that elevated nutrient concentrations can encourage excessive aquatic plant and algal growth, affecting freshwater ecosystem health.

6.3 EXISTING FLOOD HAZARD

There is an identified current flood hazard across parts of the site. This has been studied previously and is represented by the current KCDC (GIS) hazard map shown in Figure 3.

KCDC are in the process of updating flood modelling for the Wharemauku catchment and this is not yet reflected in Figure 3. The modelling referenced in this report and covered within the Flood Risk Assessment submitted with the substantive application accounts for this new modelling.



Figure 3. KCDC flood hazard mapping (GIS).

A brief description of the relevant items in the legend is as follows:

- **Stream Corridor** – The areas identified on the hazard map as stream corridors are expected to function as streams during a 1% AEP event. They include natural streams and artificially formed drains. The extent shown on the map is the expected width of the stream during the storm event. The Wharemauku Stream is clearly visible near the bottom of the image. The stream corridors shown within the site are primarily open drains.
- **Overflow Path** – These act as channels for floodwaters. They can be natural or artificially formed.
- **Storage** - Areas adjacent to streams providing temporary storage of floodwater during storm events. Filling or development of these areas is likely to have a direct effect on flood levels elsewhere. There is a significant existing storage area identified on the site just to the north of the Wharemauku Stream.
- **Ponding** – These areas are similar in function to storage but not necessarily directly connected to a stream. Within the site they are typically low-lying open ground.

In addition to the site, there are significant existing flooding problems upstream and downstream of the site and any development of the site needs to include suitable mitigation measures to ensure that the flooding problems are not worsened.

7.0 SITE CONSTRAINTS AND STORMWATER MANAGEMENT OPPORTUNITIES

The site investigations and supporting technical assessments have identified a number of physical, hydrological and ecological constraints that have informed the proposed stormwater management approach. These include the existing flood hazard, shallow groundwater conditions, proposed modification of ground levels and underlying soils, existing freshwater features and the ecological condition of the Wharemauku Stream.

The principal constraints and associated stormwater management responses are summarised below.

Table 4. Site Constraints and Implications for design.

Site Constraint	Implication for Stormwater Management
Existing flood hazard	The site forms part of the wider Wharemauku Stream floodplain. Development must maintain flood conveyance and storage functions and avoid increasing flood risk on surrounding properties. The design incorporates flood storage and attenuation measures informed by catchment-wide hydraulic modelling.
Shallow groundwater	Groundwater levels constrain the location and effectiveness of soakage devices. The proposed stormwater strategy incorporates passive soakage where practicable, with groundwater interactions assessed through the WWLA hydrological modelling.
Peat removal and ground replacement	Changes to underlying soils and ground levels will alter existing infiltration and groundwater movement. These changes have been considered in the hydrological assessment alongside the proposed stormwater controls.
Increased impervious surfaces	The development will increase stormwater runoff and potentially reduce groundwater recharge. Rain gardens, passive soakage and attenuation measures are proposed to manage runoff and mitigate changes to the hydrological regime.
Existing wetlands and watercourses	The proposed development involves the reclamation of existing wetlands and modification of watercourses. The stormwater strategy must integrate with the proposed wetland compensation area and maintain suitable hydrological conditions for its establishment and ongoing functioning.
Wharemaukū Stream receiving environment	Previous investigations, including Jacobs (2016), identify existing pressures on water quality and ecological health. Stormwater treatment measures are proposed to manage

Site Constraint	Implication for Stormwater Management
	contaminants and minimise additional effects on receiving waters.
Flood storage and wetland integration	The proposed wetland compensation area also provides flood storage. The design must accommodate flood storage requirements while maintaining the water supply and hydrological conditions needed to support wetland habitats.
Staged development and future land uses	The development includes residential, commercial and large-format retail activities with different runoff and treatment requirements. Stormwater infrastructure must accommodate the proposed land uses and provide for appropriate treatment and management as development progresses.

The proposed stormwater management strategy has therefore been developed to address the combined requirements of flood management, water quality treatment, groundwater recharge and freshwater ecological outcomes. The following sections outline the applicable design criteria and the stormwater management measures proposed to respond to these requirements.

8.0 DESIGN CRITERIA

The stormwater design criteria have been established having regard to the site characteristics and constraints outlined in the preceding sections, together with the relevant KCDC and GWRC requirements. Particular considerations include the site's location within the Wharemauku Stream floodplain, shallow groundwater conditions, changes to ground levels and underlying soils, and the integration of stormwater management with the proposed wetland compensation area. The design criteria seek to ensure that the development achieves hydraulic neutrality, manages flood risk and stormwater quality, maintains groundwater recharge where practicable, and provides for the hydrological requirements of the proposed wetland habitats.

8.1 STORMWATER MANAGEMENT PERFORMANCE CRITERIA

The KCDC Land Development Minimum Requirements (2022), states that a stormwater management system for a development shall meet the following objectives:

- Meet the relevant standards and criteria of the district plan, the Council's Stormwater Management Strategy, the Greater Wellington Proposed Natural Resources Plan, Regional Freshwater Plan and the Regional Plan for Discharges to Land and other relevant RMA planning instruments.
- Provide for the collection and/or control of stormwater, allowing for ultimate future development within the catchment or adjoining catchments and for climate change.
- Achieve hydraulic neutrality so that peak flows into the receiving bodies for the 1 in 2- year, 1 in 5-year, 1 in 10-year, 1 in 50-year and 1 in 100-year design rainfall events shall not exceed the pre-development peak flows for the same design rainfall events.
- Provide for climate change predictions as advised by the Council Land Development Minimum Requirements.
- Meet the requirements of any stormwater management plans.
- Create a multifunctional landscape where the design integrates with other aspects of site planning and provides multiple benefits.
- Make use of available natural features and processes on site wherever possible.

- Result in minimal disturbance to the site and natural water systems.
- Preserve and/or recreate natural landscape features.
- Reduce impervious cover as far as practical.
- Facilitate detention and infiltration opportunities.
- Address flood events and preserve treatment systems through off-line storage and bypasses.
- Meet regional and district stormwater discharge quality requirements.
- Have stormwater treatment systems based on created natural systems (e.g. wetlands, lakes and detention ponds) that can mimic natural processes and function as entire ecosystems.
- Comprise simple, non-structural, low-tech and low-cost methods.
- identify opportunities for enhancement.

8.2 STORMWATER MANAGEMENT DESIGN CRITERIA

The stormwater management design criteria adopted for the proposed development are summarised in Table 5. These criteria have been informed by the KCDC Land Development Minimum Requirements (2022) and relevant regional stormwater design guidance, having regard to the site's flood hazard, groundwater conditions and receiving environment.

Table 5. Stormwater Management design criteria.

Design Criteria	Parameter	Reference
Primary Network	10% AEP	KCDC Land Development Minimum Requirements 2022.
Secondary Network	1% AEP	KCDC Land Development Minimum Requirements 2022.
Freeboard	Commercial Buildings – 0.3m Residential Buildings – 0.5m	KCDC Land Development Minimum Requirements 2022.
Attenuation	Hydraulic Neutrality of peak flows up to 1% AEP event	KCDC Land Development Minimum Requirements 2022.
Rainfall	SKM Rainfall Recurrence Isohyet Maps including allowance for climate change.	KCDC Land Development Minimum Requirements 2022.
Water Sensitive Design	To meet the objectives of the KCDC Land Development Minimum Requirements 2022.	KCDC Land Development Minimum Requirements 2022.
Stormwater Quality Flow	As defined by Wellington Water Design for Stormwater: Treatment Device Design Guide	As defined by Wellington Water Design for Stormwater: Treatment Device Design Guide. This has been chosen as it is a local and recent design guide. KCDC does not specify a standard to follow.
Groundwater Recharge and Infiltration	Incorporate infiltration and passive soakage where practicable, having regard to groundwater levels, soil conditions and the findings of	WWLA Hydrological Effects Assessment (2026); KCDC Land Development Minimum Requirements (2022).

	the Hydrological Effects Assessment.	
Wetland Hydrology and Flood Storage	Integrate stormwater management and flood storage with the proposed wetland compensation area, including provision for suitable water levels, inflows and hydrological conditions to support wetland establishment and ongoing functioning.	WWLA Hydrological Effects Assessment (2026); Bioresearches Ecological Effects Assessment (2026); Wetland Residual Effects Analysis Report (2026).

9.0 DESIGN OBJECTIVES

Based on the site characteristics, identified constraints and applicable design criteria outlined in the preceding sections, the key stormwater management objectives for the proposed development are:

1. Flood management: Maintain the effectiveness of existing flood conveyance and storage functions, while providing suitable development areas and ensuring that the proposed development does not exacerbate flood hazards within or beyond the Site. This includes integrating the proposed flood storage areas with the wider Wharemauku Stream flood management system.
2. Hydraulic neutrality: Achieve hydraulic neutrality for peak stormwater discharges from the developed Site across the relevant design rainfall events, recognising the potential for increased runoff from impervious surfaces to contribute to downstream flooding.
3. Stormwater quality: Provide appropriate treatment of stormwater runoff prior to discharge to the receiving environment. Existing water quality monitoring identifies pressures associated with nutrients, faecal contamination, sediment and urban stormwater contaminants. The proposed treatment system will focus on managing contaminants associated with the proposed development, particularly:
    a. Sediment and associated pollutants from roads, parking areas and other impervious surfaces associated with the development.
    b. Dissolved metals and other contaminants associated with urban stormwater runoff.
    c. Construction-related sediment arising from the development, which will be separately managed through the Earthworks and Construction Management Plan.
4. Hydrological management: Manage changes to runoff volumes and flow patterns, including frequent rainfall events, to minimise potential erosion and scour effects on receiving watercourses. Incorporate detention and infiltration measures where practicable, having regard to groundwater levels and underlying soil conditions.
5. Groundwater recharge: Maintain opportunities for groundwater recharge through passive soakage and infiltration measures where practicable, recognising the interaction between shallow groundwater, existing wetlands and the Wharemauku Stream.
6. Wetland integration: Integrate the stormwater management system with the proposed wetland compensation area, including its flood storage function, while providing for the water supply and hydrological conditions necessary to support the establishment and ongoing functioning of the proposed wetland habitats.
7. Water-sensitive design: Incorporate water-sensitive design principles and utilise natural features and processes where practicable, including rain gardens, passive soakage and landscaped stormwater management areas, to provide an integrated approach to stormwater management and site development.

The proposed stormwater management strategy has been developed to respond to these objectives, with the design and performance of the proposed infrastructure outlined in the following sections.

10.0 FLOOD RISK

Envelope Engineering have prepared a Flood Risk Assessment (FRA) for the proposed development. The FRA assesses the current flood risk at the site, and the post development flood risk at the site (inclusive of proposed mitigation measures).

The FRA includes hydraulic modelling of the existing and proposed development scenarios and identifies the following key findings:

- The Site is subject to flooding under existing conditions, with areas of inundation associated with the wider Wharemauku Stream floodplain.
- The proposed development incorporates a flood storage area and associated earthworks and stormwater infrastructure designed to manage flood risk within the Site and surrounding areas.
- The proposed development will provide approximately 26,000 m³ of additional flood storage capacity within the Site.
- The modelling indicates that the proposed development can be undertaken without exacerbating flood risk on surrounding properties, with reductions in flood levels predicted in areas to the south of the Site.
- The FRA therefore demonstrates that the proposed development can accommodate the identified flood hazards while maintaining and improving flood storage functions within the wider catchment.
- Selected modelling outputs from the FRA are provided in Figures 4–6. Further details, including the modelling methodology, assumptions and assessment of flood effects, are provided in the FRA submitted with the substantive application.

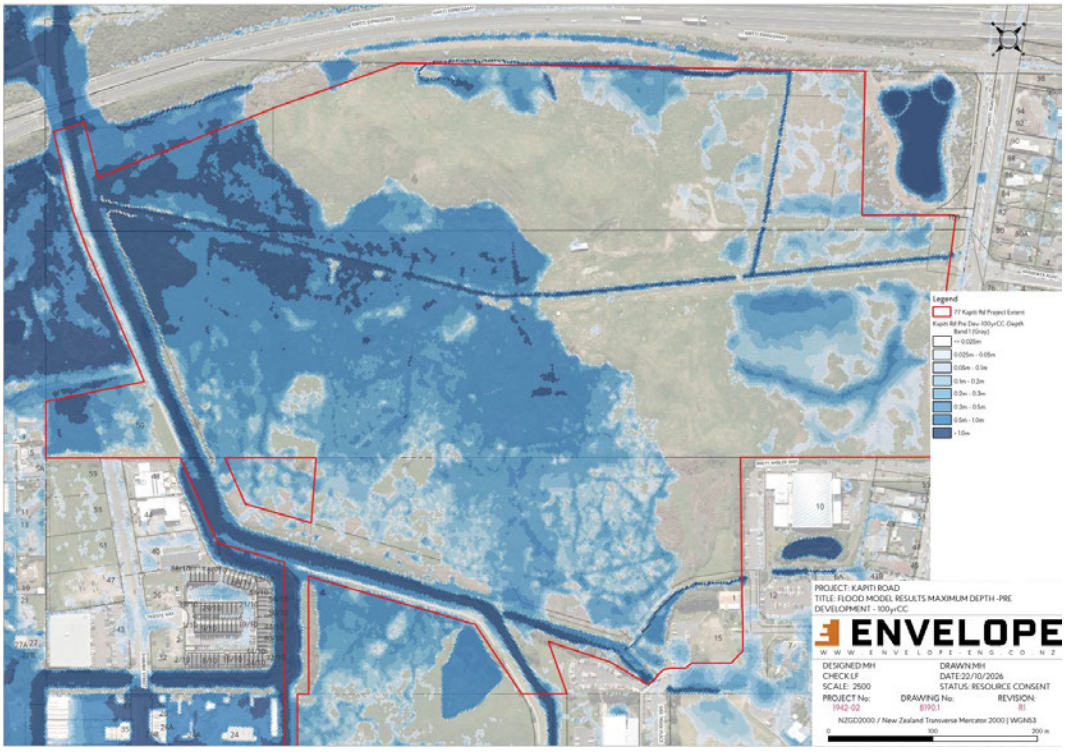


Figure 4. Existing modelled flood hazard (100-year ARI including climate change).

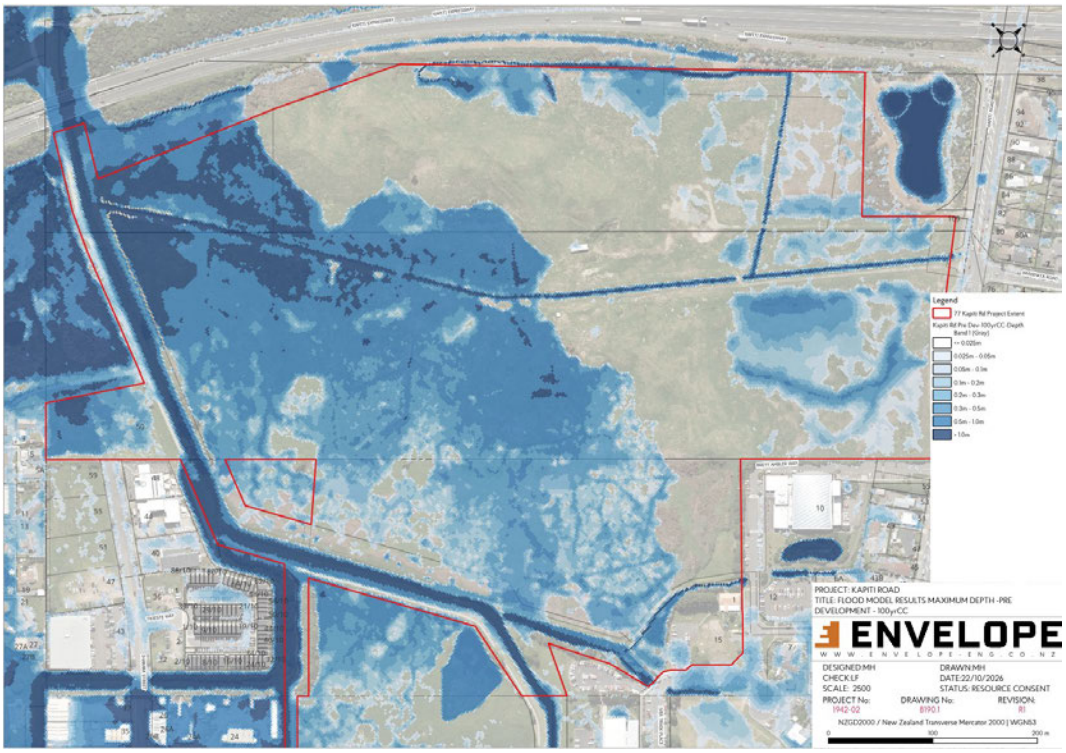


Figure 5. Post-development modelled flood hazard (100-year ARI including climate change).

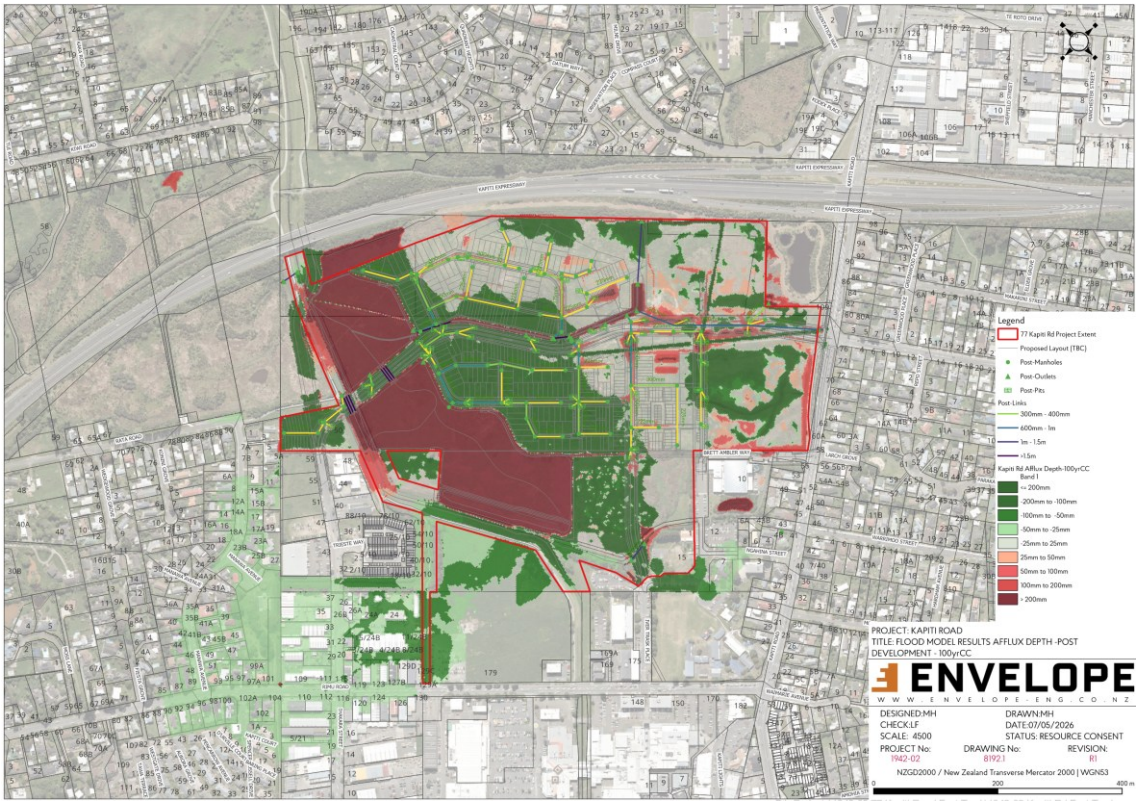


Figure 6. Flood depth difference

11.0 HYDRAULIC NEUTRALITY

11.1 RUNOFF CALCULATIONS

Future development of the site will result in an increase in impermeable surfaces, which has the potential to increase stormwater runoff to downstream properties. With no mitigation in place, future development would cause an increase in peak stormwater flows from the development, which has the potential for offsite effects, including erosion, scour, uncontrolled discharges, and flooding. To understand this, runoff calculations have been undertaken in accordance with Kapiti Coast District Council's Land Development Minimum Requirements using HEC-HMS software.

The catchment parameters for pre and post development are presented in Appendix 3 and the catchment extents are shown in Appendix 1.

It is important to note that the neutrality calculations do not allow for increased imperviousness associated with the Airport Link Road or potential development adjacent to the Aquatic Centre, which are all works to be undertaken by others.

Based on the geotechnical investigations and hydrogeological analysis undertaken on site, the site soils have two distinct classifications:

- For the lower portions of the site, class C – D, with a curve number of 86 chosen. This is due to the retention of water and ponding observed in these areas on site and limited infiltration of the peat materials.
- For the raised dunes, class B to C, with a curve number of 70 chosen.

As a result of the earthworks operations undercutting the unsuitable materials in the lower portions of the site and replacing these with higher permeability sand materials, the curve number for these areas of the site decreases creating a net reduction in flow (ignoring any increase associated with new impervious areas). This partially offsets the increase in flow caused by proposed impervious areas. This is supported by the analysis undertaken by WWLA.

Post development catchments have been split into discrete areas based on land use and the proposed stormwater network.

Initial calculations with no mitigation measures implemented suggest increases in peak flow in the order of 20%. Mitigation measures such as soakage devices will be required to meet hydraulic neutrality objectives. These have been implemented into the model and the design of these is covered in Section 11.1.

Model inputs and outputs are provided in Appendix 3, with selected outputs shown in Figure 7 and 8, and the model setup shown in Figure 9.

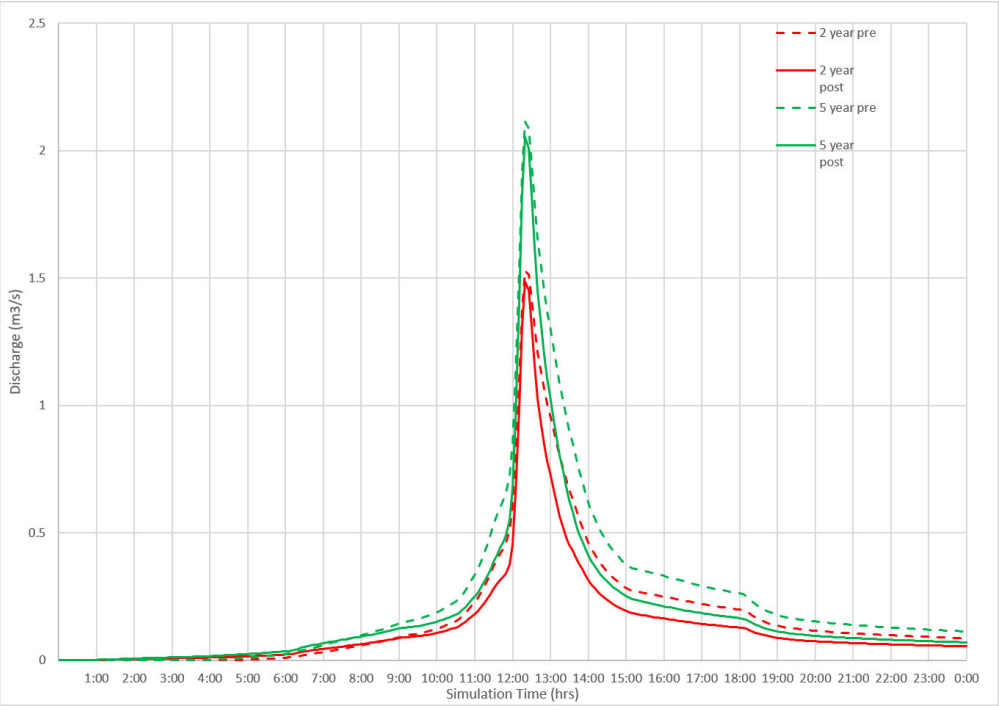


Figure 7. HEC-HMS Model outputs, 2 and 5-year events.

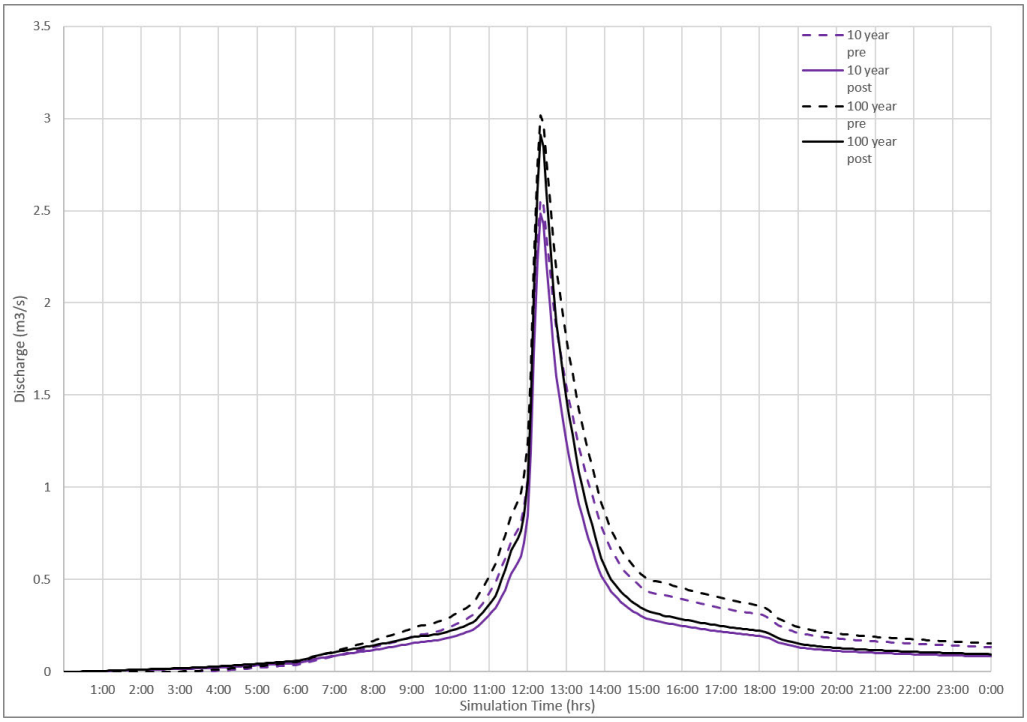


Figure 8. HEC-HMS Model outputs, 10 and 100-year events.

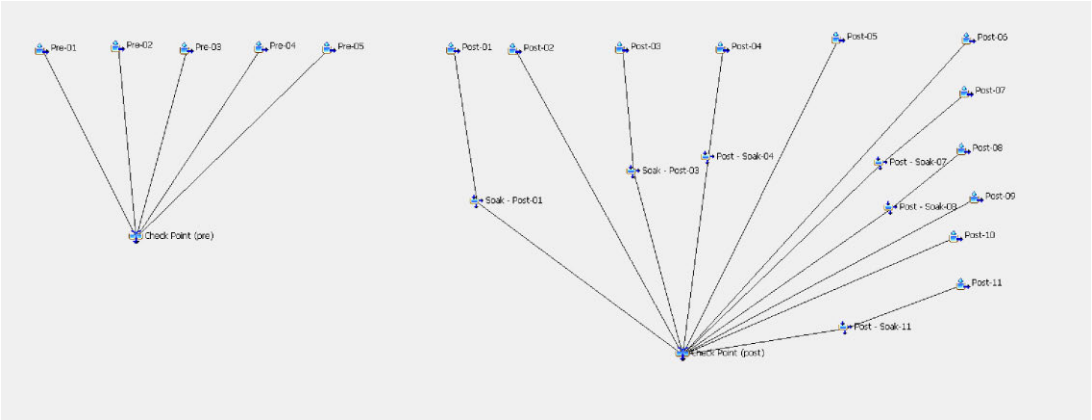


Figure 9. HEC-HMS Model setup.

11.2 ATTENUATION DESIGN

Soakage is considered a feasible design solution for stormwater attenuation. Soakage has been used as it contributes to groundwater recharge, which has beneficial effects on stormwater quality. However, other options will be suitable provided that they achieve neutrality of peak flows.

Soakage testing has not been undertaken at the site, as the existing soils are not representative of the soils that will be expected post-development. Based on Envelope's experience in projects in the surrounding areas, a factored soakage rate of 1,000 mm/hr has been used for conceptual soakage design for the site and implementation in the model. Ignoring the impact of storage within soakage devices (a conservative assumption), this gives a factored soakage rate of 0.278 L/s per square meter of soakage area. The adopted soakage rate will be verified through site-specific testing following ground improvement works, with the final sizing and configuration of soakage devices confirmed at detailed design to ensure hydraulic neutrality is achieved.

WWLA have assessed the groundwater levels in pre- and post-development states including the effects of climate change on groundwater. We have considered their post-development scenario as the design groundwater level due to the changes in groundwater levels anticipated from the landform modification. These are shown in Figure 10. Refer WWLA's Hydrology Report for further details. This shows that soakage is likely to be suitable for the southern and central catchments, and less suitable for the commercial catchments adjacent to Kapiti Road due to a higher groundwater table in these locations. The final location and design of soakage devices will also account for seasonal groundwater levels and the separation required between the base of the devices and the design groundwater level.

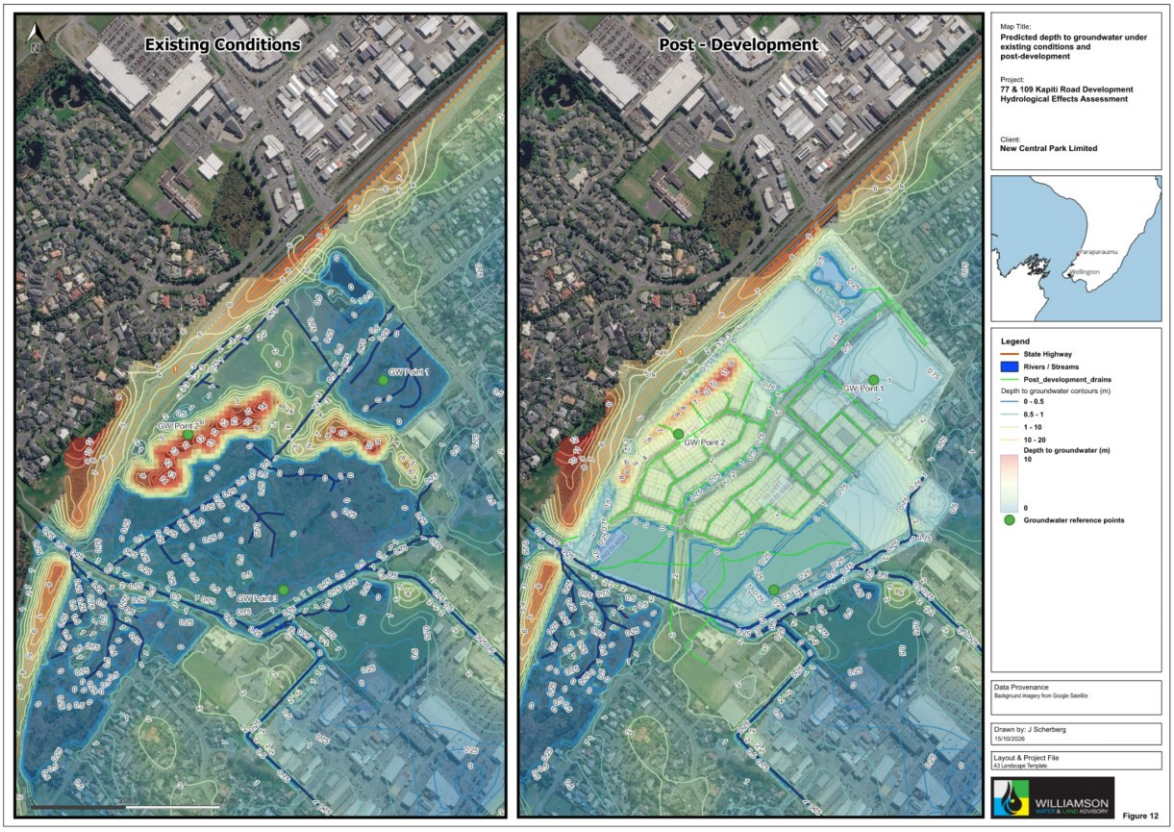


Figure 10. Depth to groundwater (WWLA).

The HEC-HMS model was used to compare the runoff from pre and post development catchments. Without any stormwater control, the development does not achieve hydraulic neutrality of peak flows. To achieve hydraulic neutrality, several stormwater controls measures have been implemented. The HEC-HMS model results show that hydraulic neutrality of peak flows can be achieved with stormwater control measures as shown on our plans (Appendix 1) and consisting of:

- Catchment Post-01 – Soak Pit(s) with total base area of 72 m^2.
- Catchment Post-02 – Mostly wetland, with no attenuation proposed for the road in this location. This area is offset by soakage in other areas of the site.
- Catchment Post-03 – Soak Pit(s) with total base area of 360 m^2.
- Catchment Post-04 – Soak Pit(s) with total base area of 216 m^2.
- Catchment Post-05 – No controls proposed. This area is offset by soakage in other areas of the site.
- Catchment Post-06 – Grassed area with no controls provided.
- Catchment Post-07 – Soak Pit(s) with total base area of 360 m^2.
- Catchment Post-08 – Soak Pit(s) with total base area of 180 m^2.
- Catchment Post-09 – Landscaped area with no controls provided.
- Catchment Post-10 – No controls proposed. This area is offset by soakage in other areas of the site.
- Catchment Post-11 – Soak Pit(s) with total base area of 180 m^2 on the southern portion of the Road section.

The measures above and as detailed on our plans are sufficient to attenuate peak flow for the range of 2 to 100-year events for the fully developed site, up to the allowances within Table 2. The The

exact configuration of these devices including detailed layouts and locations (device sizing and details etc.) will be confirmed at the detailed design stage.

Other measures will likely be acceptable and could be part of the solution to achieve hydraulic neutrality for the proposed development e.g. underground tanks, permeable paving etc. However, these have not been assessed at this stage. Alternative designs and configurations are acceptable provided that they achieve neutrality of peak flows in the 2-, 5-, 10- and 100-year events (these being the typical events that KCDC accept and covering a broad range of events between the 2- and 100-year events).

12.0 STORMWATER CONVEYANCE

12.1 PRIMARY NETWORK

As part of the future development, conveyance of events up to and including the 10% AEP event (1 In 10-year return period) will be by pipe to outlets within the constructed wetland and swales. Catchpits will be located at low points and regular intervals along roads to capture runoff. Each residential lot will be provided with a lateral connecting to the piped stormwater network.

At the detailed design stage, the design of the primary network will be finalised in terms of location and sizing. Detailed design calculations and drawings will be prepared and submitted to KCDC and, where required, GWRC for approval or certification in accordance with the relevant consent conditions.

12.2 SECONDARY NETWORK

The 1% AEP event will be conveyed through road corridors and designated overland flow paths to the proposed flood management areas. The capacity and performance of the secondary network have been considered in the Flood Risk Assessment (FRA), which demonstrates that suitable overland flow paths can be provided through the development, with some localised ponding within road corridors.

13.0 CULVERT DESIGN

As part of the proposed works, it is required to install culverts across two streams/channels to enable access to the site. The locations of these are shown on our plans (Appendix 1).

The proposed culverts have been considered against the relevant provisions of the Natural Resources Plan for the Wellington Region and the National Environmental Standards for Freshwater (NES-F). Based on the watercourse classifications identified in the Ecological Effects Assessment, Culverts A and J are located within watercourses subject to the relevant fish passage requirements. The remaining crossing is associated with a farm drain that has not been classified as a river under the RMA. The applicable regulatory requirements are addressed in the statutory assessment accompanying the application. An assessment of the culverts against the NRP permitted activity provisions is provided in Table 6.

The hydraulic performance of the proposed culverts has been implicitly considered within the flood modelling undertaken as part of the FRA.

The proposed culvert locations and preliminary sizing have been assessed to confirm their suitability from a flood management perspective. Detailed design will confirm the final culvert dimensions, inlet and outlet arrangements, erosion and scour protection, fish passage requirements where applicable, and final siting. The proposed consent conditions also include requirements to ensure that the detailed design and installation of the culverts comply with the relevant regulations of the National Environmental Standards for Freshwater (NES-F), including those relating to fish passage.

Table 6. Culvert assessment.

Metric	Culvert "A" Assessment	Culvert "J" Assessment

Length	32.5 m	34.0 m
Culvert Shape	Rectangular	Circular (twin barrel)
Size	4.0 x 1.5 m	2 x 1.35 m diameter
Inlet	Concrete Headwall	Concrete Headwall
Outlet	Concrete Headwall	Concrete Headwall
Embedment	Minimum 25%	Minimum 25%
Scour Protection	To be confirmed at detailed design.	To be confirmed at detailed design.

Table 6. Culvert assessment.

Clause		Requirement	Culvert "A" Assessment	Culvert "J" Assessment
(f)		The activity shall comply with the beds of lakes and rivers general conditions specified above in Section 5.4.4, except condition (l) (not altering the natural course of the river), and	Can Comply.	Can Comply.
(g)		the activity does not occur within a site identified in Schedule C (mana whenua), and	Does not Comply. Wharemauku Stream is listed under Schedule C.	Does not Comply. Wharemauku Stream is listed under Schedule C
(h)		where multiple culverts are placed side by side, the total capacity of the multiple culverts shall not be less than that of a single culvert which complies with this rule, and	Complies.	Complies.
(i)		the culvert, associated fill and culvert placement shall comply with the following dimensions:		
	(i)	a maximum culvert length of 20m (excluding any ancillary culvert structure), and	Does not comply. Length is too great under proposed road.	Does not comply. Length is too great under proposed road.
	(ii)	for circular culverts an external culvert diameter of 0.3m to 1.2m (inclusive), and	N.A.	Does not comply. Larger culvert required for conveyance purposes.
	(iii)	for non-circular culverts an external width and height of 0.3m to 1.2m each (inclusive), and	Does not comply. Larger culvert required for conveyance purposes.	N.A.

Clause		Requirement	Culvert "A" Assessment	Culvert "J" Assessment
	(iv)	the culvert's width where it intersects with the bed of the river or connected area must be more than 1.3 times the width of the bed at that location,	Complies.	Complies.
	(v)	a maximum fill height of 2m above the top of the culvert unless a spillway is constructed to enable the passage of a 5% annual exceedence probability (20 year return period) flood event without the fill being overtopped, and	May not comply. Flood flow and blockage assessed under the FRA.	May not comply. Flood flow and blockage assessed under the FRA.
(j)		a minimum culvert installation depth below the bed of 25% of the width of the culvert, or the culvert must be open bottomed, and	Can Comply.	Can Comply.
(k)		the bed substrate must be present over the full length of the culvert and stable at the flow rate at or below which the water flows for 80% of the time; and	Can Comply.	Can Comply.
(l)		the culvert shall be positioned so that its alignment and gradient are the same as the river, and	Complies.	Complies.
(m)		the mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river reaches; and	Complies. The culvert will not constrict water flow and therefore will not increase velocity compared to adjacent reaches in typical and low flow conditions.	Complies. The culvert will not constrict water flow and therefore will not increase velocity compared to adjacent reaches in typical and low flow conditions.
(n)		the culvert shall be constructed to allow:		
	(i)	the flow from a 5% annual exceedence probability (20 year return period) flood event without overtopping, unless the overtopping flows to a	Flood flow and blockage assessed under the FRA.	Flood flow and blockage assessed under the FRA.



Clause		Requirement	Culvert "A" Assessment	Culvert "J" Assessment
		specifically designed spillway, and		
	(ii)	the flow from a two year return period flood event without any flow impediment, and	Can Comply.	Can Comply.
(o)		the culvert inlet and outlet shall be protected against erosion, and	Can Comply.	Can Comply.
(p)		any ancillary culvert structure shall not occupy a total bed area of greater than 10m², and	Can Comply.	Can Comply.
(q)		all steps shall be taken to minimise the release of sediment during construction, and	Can Comply.	Can Comply.
(r)		the culvert shall be constructed and maintained to avoid any aggradation or erosion of the bed, including any erosion at the inlet and outlet of the culvert, and	Can Comply.	Can Comply.
(s)		the culvert shall be constructed and maintained to avoid causing any flooding on any neighbouring properties, and	Flood flow and blockage assessed under the FRA.	Flood flow and blockage assessed under the FRA.
(t)		the culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris); and	Can Comply.	Can Comply.
(u)		the information requirements of Regulations 62, 63 and 68 of the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 shall be provided as set out in the regulation.	Can Comply.	Can Comply.

14.0 WETLAND COMPENSATION COMPLEX

The proposed wetland compensation complex has been designed to provide a range of wetland habitats while also accommodating flood storage within the wider Wharemauku Stream catchment. The design has been informed by the ecological requirements identified by Bioresearches,

hydrological modelling undertaken by WWLA and hydraulic assessments undertaken by Envelope Engineering. The following sections outline the flow, groundwater and inundation assumptions used to inform the preliminary wetland design, together with the measures proposed to manage sedimentation and ongoing maintenance requirements.

14.1 WHAREMAUKU STREAM FLOW ANALYSIS

Data for the Wharemauku Stream flow at the Coastlands Site was sourced from GWRC for the period between February 1982 and June 2020, with maximum yearly values up to 2023. There was a gap in the recorded data between 1986 – 1995. The maximum yearly flood flow ranged between 1.0m^3/s – 19.8m^3/s, while the minimum recorded flow was 0.003m^3/s. The flow distribution over the recording period is shown in Figure 11, with typical flows at the monitoring site being between 0.13m^3/s – 0.33m^3/s.

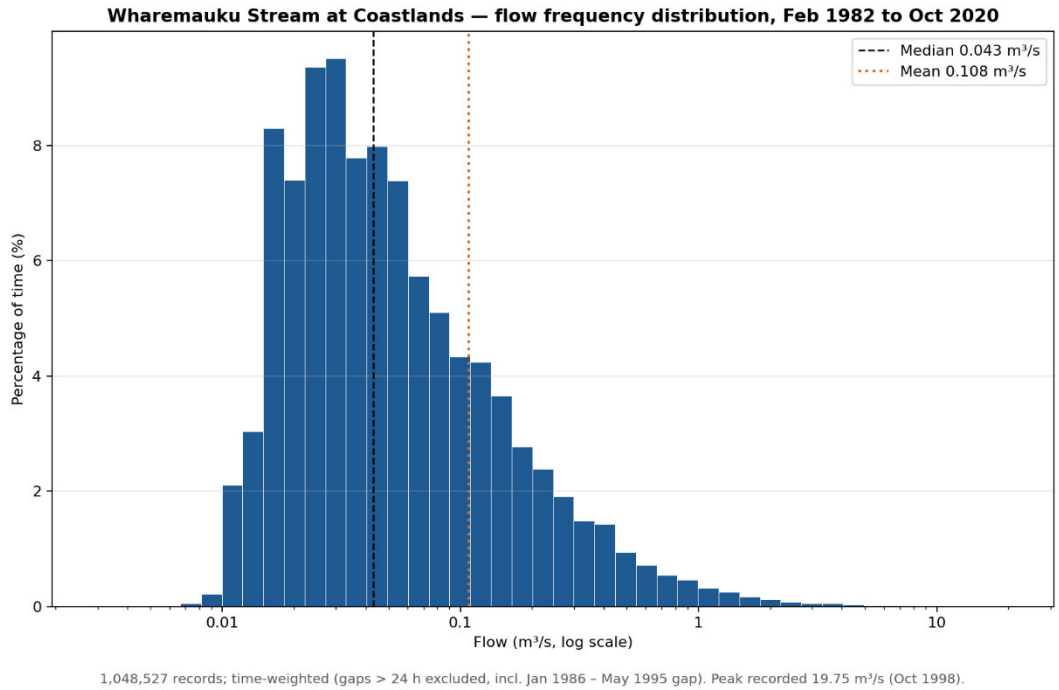


Figure 11. GWRC flow distribution at Coastlands Site for the Wharemauku Stream between 1982 – 2020.

A Log Pearson III analysis was performed for the peak yearly flood flow to understand the magnitude of flows for a range of Annual Exceedance Probabilities, especially higher frequency events. These higher frequency events are relevant to understanding the frequency and duration of inundation within the proposed wetland compensation complex.

The stream gauge is upstream from the development site and the flows have been matched to the flood model flows from the Envelope flood model for the 100-year event. This results in a 100% increase to the predicted flows which has been applied to the median predicted flood flow for each AEP. We note that some of this increase will be due to a climate change factor being applied to the rainfall within the Awa flood model, with the rest being the increased catchment area. The predicted flows at the Coastlands gauge site are shown in Figure 12 and the predicted flows at the development site shown in Figure 13.

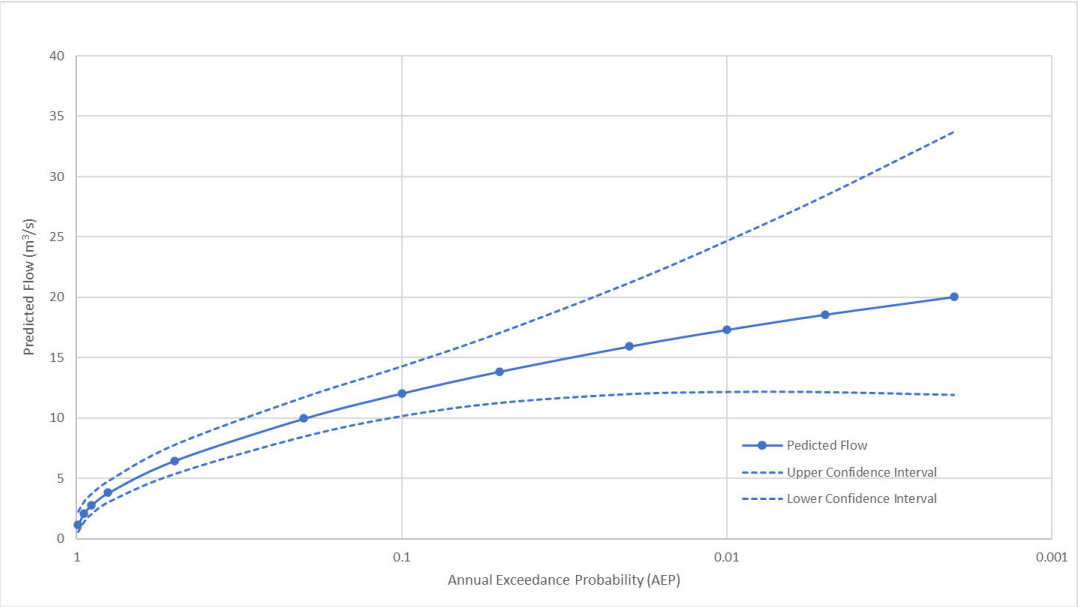


Figure 12. Log Pearson III analysis at Coastlands gauge site.

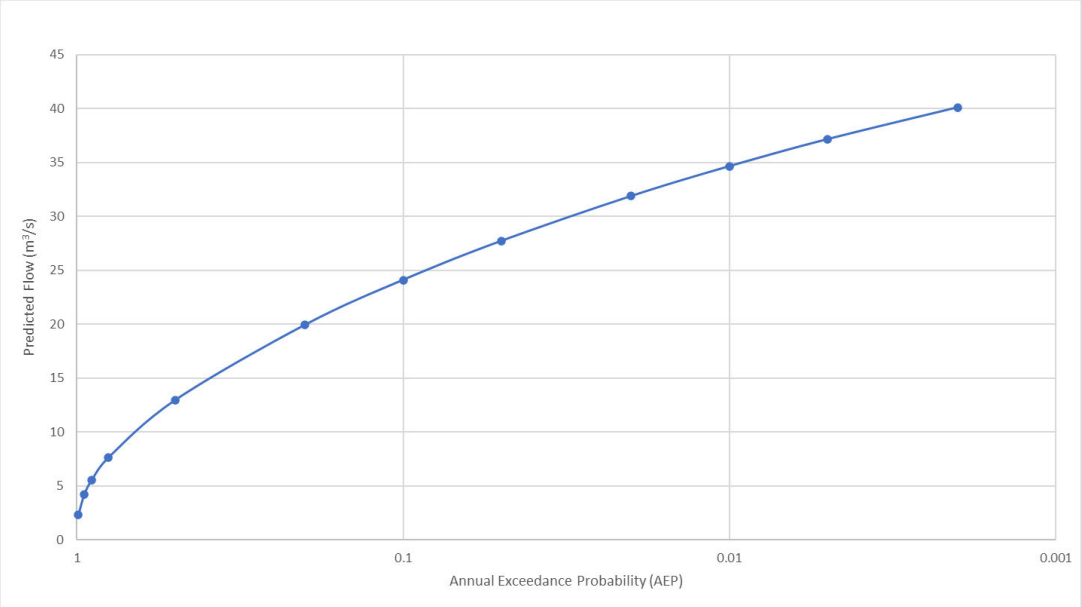


Figure 13. Factored flow estimates at the development site.

Low and normal flow conditions were also assessed to ensure that the proposed wetland will have sufficient water to sustain the proposed vegetation without drying out or becoming too wet. Data from GWRC was sorted to get percentile flows for the low and normal flow conditions. These are presented in Table 7. Flow data has been factored to account for the increased catchment area, with a 47% increase used. These percentiles should not be confused with Annual Exceedance Probabilities. Where possible, photos have been included showing the Wharemauku Stream at various flow levels observed during site visits by Envelope.

Table 7. Low and Normal flow estimates for the development site based on GWRC stream gauge data.

Percentile	Flow (m^3/s)	Indicative Photo matched to gauge flow (where available)
0.1%	0.013	
1%	0.018	
5%	0.022	
10%	0.026	
20%	0.032	
50%	0.063	
75%	0.147	
90%	0.332	

Percentile	Flow (m^3/s)	Indicative Photo matched to gauge flow (where available)
95%	0.587	

14.2 WETLAND BATHYMETRY DESIGN

The design levels of the wetland will be crucial to ensure that plants receive the correct amount of water and can tolerate periodic inundation.

Bioresearches have provided descriptive definitions around how frequently the different ecological tiers should be inundated, which have been matched to specified design flows which are checked against typical cross sections through the proposed wetland to ensure that the desired inundation is achieved. This is then used to inform the preliminary design levels for the wetland bathymetry. Table 8 provides a summary of the flow which can be related to the flow estimates in Table 4. These have then been run through the hydraulic model to show indicative depths at each of these flows.

It is important to note that Annual Exceedance Probabilities are a statistical measure and are not a guarantee that an event will occur. For example, it is possible to have two 100-year events in subsequent years or even the same year. For this reason, plants selected should be tolerable of a range of conditions – dry and wet.

The proposed wetland bathymetry and vegetation zones have been developed in consultation with Bioresearches to provide a range of hydrological conditions suitable for the proposed wetland habitats. The final wetland levels, vegetation zones and planting specifications will be confirmed through detailed design, having regard to the ecological requirements identified in the Ecological Effects Assessment and Ecological Management Plan.

Table 8. Wetland flow

Ecological Zone	Ecological Flow Description	Design Flow (m^3/s)
Channel	Permanent flowing water.	0.013 – 0.063
Obligate Plant Wetland	Wet most of the time, connected to the stream, inundation frequent.	0.063 – 0.147
Facultative Wetland	Damp most of the time, inundation common under high rainfall and usual storm events.	0.147 – 1.719
Facultative Vegetation	Damp Periodically, inundation occasionally in a year or two and then usually only for a short period. Flood	2.3 – 1-year event 12.9 – 2-year event 24.0 – 10-year event

Ecological Zone	Ecological Flow Description	Design Flow (m^3/s)
	zone rather than usual storm flow zone.	

14.3 GROUNDWATER INTERACTION

WWLA have assessed the post-development groundwater with the proposed finished ground contours, sourced directly from the civil design. These are assessed under current and future (climate change) conditions.

The WWLA modelling indicates that post-development groundwater levels will generally be at or within approximately 0.5 m of the proposed finished ground surface across the wetland compensation area. These conditions are expected to support the establishment and ongoing functioning of the proposed wetland habitats, alongside the surface water inflows provided through the wetland design. Figure 13 of the WWLA report (reproduced in part below) illustrates the predicted variation in groundwater levels across the wetland area.

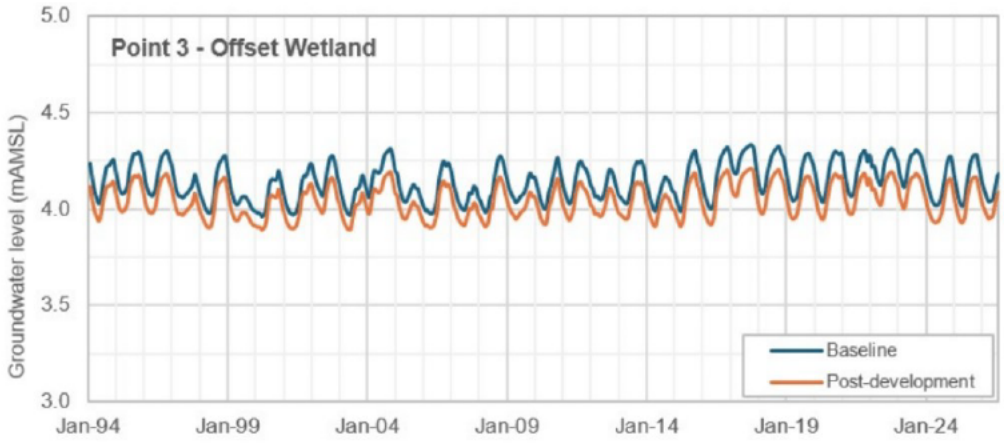


Figure 14. Variability of groundwater within the offset wetland (reproduced from WWLA).

14.4 WETLAND MAINTENANCE

The wetland compensation complex has been designed to minimise the need for intrusive maintenance activities that could disturb established wetland habitats. Ongoing ecological management, monitoring and maintenance will be undertaken in accordance with the Ecological Management Plan. The design also incorporates measures to manage sedimentation and maintain access to areas where periodic maintenance may be required.

The hydrological performance of the wetland compensation complex will be monitored following construction as part of the ecological management and monitoring programme. This will provide an opportunity to assess whether the intended wetland hydrological conditions are being achieved and identify any remedial or adaptive management measures required to support the establishment and ongoing functioning of the wetland habitats.

14.4.1 SEDIMENTATION

There is significant aggradation in the lower reaches of the Wharemauku Stream. This is caused by the deposition of sediment (mostly sands and gravels) caused by erosion in the upper catchment. KCDC have historically undertaken clearing work to remove accumulated material. However, the consents for this have lapsed and we understand that the last clearance works were in approximately 2016.

Sedimentation is a concern for the offset wetland as this will not be able to be manually cleared in the future if large amounts of sediment accumulate. This has been considered in the design using two methods.

The offset wetland is separated from the main channel of the Wharemauku with a bund. The sediment that accumulates within the Wharemauku Stream primarily comprises sands and gravels. The bund separating the wetland compensation area from the main stream channel is intended to limit the movement of coarser sediment into the wetland during higher flow events. A sediment forebay is also proposed to intercept and retain sediment before it enters the wetland compensation area. The forebay will provide an accessible location for periodic sediment removal of coarse sediments and gross pollutants, reducing the need for maintenance within the established wetland habitats. Finer sediments will be more readily flushed through the wetland system and are not targeted by the forebay.

Although KCDC does not have consent to clear sediment from the Wharemauku Stream, the design allows for this to occur in the future if consent was granted. Access has been maintained on the river left to enable future clearing works, with planting and restoration efforts strategically placed on the river right so that these are also not affected by future maintenance. This ensures a balance between ecological enhancement and future maintenance requirements.

14.4.2 STORMWATER OUTLETS

Stormwater outlets are proposed into the offset wetland. The extent of these has been limited to where it is required to avoid potential maintenance of these areas. Each outlet will be provided with outlet controls to reduce stormwater velocity and associated scour. The design of these will be provided at the detailed design stage.

15.0 STORMWATER TREATMENT

15.1 OBJECTIVES

The treatment objectives for the Site are to minimise the volume of stormwater runoff where practicable, manage contaminants associated with the proposed development and limit the discharge of untreated stormwater to the receiving environment. Stormwater treatment measures will also seek to protect the water quality and ecological functioning of the proposed wetland compensation complex and the Wharemauku Stream.

15.2 INTEGRATION OF WATER SENSITIVE URBAN DESIGN

Water Sensitive Urban Design, including the provision of stormwater treatment devices, is the recommended design approach for stormwater management to avoid adverse effects on receiving waterbodies (Wellington Water Regional Standard, 2021). Wellington Water further notes the Water Sensitive Urban Design (WSUD) *"combines the positive attributes of the natural water cycle and urban-engineered network to design systems that use vegetation, soils and natural processes to reduce the volume, rate and peak flows of stormwater runoff and improve the water quality of discharges"*.

An integrated Water Sensitive Urban Design approach is proposed to manage changes to the water cycle associated with the development and minimise adverse effects on downstream receiving environments. Water Sensitive Urban Design promotes an interdisciplinary and collaborative design approach. This approach has been followed to develop this SMP with a team of multiple different disciplines.

The WSUD Strategy has been developed based on Wellington Water's "Integrated WSUD System" design and development practices, highlighting best-practice measures at each stage of the water cycle. This has been used as KCDC do not have an equivalent design guide.

The WSUD strategy has been developed based on:

- Exploring suitability of various WSUD measures in the local site context, taking into account catchment characteristics and site constraints, and the need to protect and enhance the values and functions of natural ecosystems.
- Integrated, interdisciplinary and collaborate design approach comprising experts of different disciplines.



- Management at source where possible including treatment train approach and controls of contaminant sources (e.g. building materials).
- Developing preferred treatment trains based on the above and applying standard WSUD sizing and design requirements from the Water Sensitive Design for Stormwater: Treatment Device Design Guideline (Wellington Water, 2019).

15.3 CHANGES IN CATCHMENT CHARACTERISTICS

The imperviousness of the site will increase as a result of the proposed development. The pre-development imperviousness (largely access tracks, open water/channels and isolated buildings) is approximately 3,500 m^2 with ~350,000 m^2 of pervious surface. The proposed development will result in increases to road, roof and footpath areas to various extents with imperviousness of approximately 179,000 m^2 and pervious area of approximately 175,000 m^2.

Without appropriate controls, there will be corresponding increases in contaminants associated with development such as heavy metals and gross pollutants as well as other water quality metrics such as temperature (caused by rainfall hitting hot surfaces such as asphalt) and water volume in low-flow events.

This increase in impervious area will result in changes to stormwater runoff volumes and the potential generation of contaminants from roofs, roads, parking areas and other hard surfaces. These changes have informed the selection and design of the proposed stormwater treatment measures outlined in the following sections.

15.4 RECEIVING ENVIRONMENT

The ultimate receiving environment is the Tasman Sea, via the Wharemauku Stream. As discussed in Section 6.0, the stream is subject to existing pressures on water quality and ecological health. The proposed stormwater treatment strategy has been developed having regard to these conditions, with the objective of managing contaminants generated by the development and minimising further degradation of the receiving environment.

15.5 MANA WHENUA ENGAGEMENT

The project team has been meeting and engaging with representatives from Te Atiawa Ki Whakarongotai Charitable Trust. These meetings have been used to engage on all aspects of the design and get feedback on whether the proposed design aligns with the aspirations of mana whenua. The applicant is committed to ongoing kōrero through the consenting and design process. Further details of mana whenua engagement is provided in the substantive application.

15.6 FEASIBILITY OF RETAINING EXISTING FEATURES

Retaining existing natural features is an important consideration in water-sensitive design. However, the practicability of retaining the existing dunes and wetlands has been assessed having regard to the site's physical constraints, infrastructure requirements and the comprehensive development anticipated by the Metropolitan Centre Zone.

From a civil engineering perspective, the existing dunes and natural inland wetlands cannot practicably be retained in their current form without compromising the integrated development of the site that the Metropolitan Centre Zone provides for. The reasons are interrelated:

- Earthworks balance – the peat and organic sands beneath the low-lying parts of the site need to be removed from beneath building platforms and roads, and the land needs to be raised by approximately 2 m on average to achieve flood-free levels. The dune sand provides the principal on-site source of engineered fill, and the dune footprint provides the area in which the unsuitable material can be placed. Exporting the surplus and importing replacement fill is technically possible but is not practicable.
- Development layout – the alignment, cross-section and levels of the Town Centre Link Road, and the external connections at Kāpiti Road, Ihakara Street and Iver Trask Place, are constrained by KCDC requirements and the existing network. These roads cross both the dune system and the wetlands, and they set the levels and servicing corridors for the adjoining development. Approximately 4.1 ha of wetland is affected by the required road connections alone.



- Fragmentation of the wetlands – the wetlands are dispersed across most of the flat land rather than concentrated in one area. Retaining them would require the road and development network to weave between isolated remnants, and the surrounding filling and drainage would be likely to degrade any remnants retained.
- Flood management – the flood storage required to provide flood-free building platforms must be located in the south of the site, where it is hydraulically connected to the Wharemauku Stream. This location is anticipated by the Metropolitan Centre Structure Plan and coincides with existing wetlands.

For these reasons, retaining the existing dunes and wetlands in their current form is not considered practicable having regard to the engineering constraints of the Site and the comprehensive development anticipated by the Metropolitan Centre Zone. The proposed earthworks strategy, road network and wetland compensation complex represent an integrated response to these constraints, while providing for the management of unsuitable material, ecological compensation and flood storage.

15.7 OPTIONS ASSESSMENT

Various options were considered as part of the collaborative master planning design process, which are outlined in Table 9.

Table 9. WSUD options assessment.

WSUD System	Design Assessment	Suitable For Site
Wetland (Treatment) (i.e a dedicated stormwater treatment wetland)	Large footprint required to achieve target performance. Which reduces yield and compromises a key development objective. Additional treatment required to achieve equivalent contaminant load reductions required by the NRP. Wetlands would need to be located on lower parts of the site to convey stormwater to them and this would require them to be within the flood zone.	No
Bioretention (central)	Compact footprint required to achieve target reductions. Centralised structure requires less overall maintenance. Centralised raingardens would need to be located on lower parts of the site to convey stormwater to them and this would require them to be within the flood zone.	No
Bioretention (streetscape)	Compact footprint required to achieve target reductions. Can be easily integrated into landscaping features and road streetscape.	Yes
Swale	Could be used as a treatment device for larger road corridors. Reduced efficiency of maintenance and construction with using mixed treatment typologies across the site.	Yes (not proposed as a solution)



WSUD System	Design Assessment	Suitable For Site
	Additional treatment required to achieve equivalent contaminant load reductions required by the NRP.	
Infiltration (on Lot)	Could be used in parts of the site. However, the development density and use of townhouses makes this difficult to achieve based on spatial requirements.	No (possibly suitable in parts)
Infiltration (Central)	Allows soakage to be used in centralised places where better soaking materials are found. Soakage can still be achieved for most of the site, by conveying stormwater to centralised areas with good soakage. Centralised devices do not rely on individual owners to keep them maintained.	Yes
Rainwater Harvesting (on Lot)	Volumetric control is better achieved using soakage. Could be used in parts across the site, where soakage is not available.	Yes (not proposed as a solution).
Rainwater Harvesting (Central)	Volumetric control is better achieved using soakage. Requires significant additional infrastructure to store and transfer water. No suitable ownership mechanism is expected to exist for combined rainwater harvesting.	No
Permeable Paving	Could be used in smaller areas where raingardens are not feasible. Limitations on use due to Council acceptance as a paving solution for vested roads.	Yes (not currently proposed as a solution).
Building and roof materials	The applicant has confirmed acceptance with restrictions on the use on untreated or unsealed copper and zinc and these restrictions have been incorporated into the draft consent conditions	Yes

15.8 PEAK FLOW ATTENUATION

Attenuation of peak flows to at or below pre-development levels is achieved through the use of proposed soakage devices.

Where soakage devices are not reasonably practicable e.g. due to space or other considerations, specific attenuation devices will need to be designed. As set out in the criteria, these will be designed to reduce the post-development peak flow to at or below pre-development levels in the 2-, 5-, 10- and 100-year events for each specific catchment or portion of development.

15.9 BIORETENTION RAIN GARDENS

Bioretention rain gardens are proposed for future road areas. These will be designed in accordance with Wellington Water Guidelines. Filterra units are proposed for these devices, which can achieve the required treatment efficiency within a more confined filter media area. Where a standard



bioretention device is used, this will be designed at 2% media area of the contributing impervious road area.

Based on the design and construction of a bioretention rain garden in accordance with Wellington Water design guidelines it is estimated that removal performance of the following can be achieved (as per WWL Technical design Guidelines):

- Total Zinc 90%
- Total Copper 90%
- Total Suspended Solids 90%
- Total Nitrogen 40%
- Total Phosphorous 60%

Passive soakage through the base of the rain gardens will be used to achieve hydrological control outcomes.

15.10 MATERIAL RESTRICTIONS

The applicant has confirmed acceptance with restrictions on the use of untreated or unsealed copper and zinc products (flashings, downpipes, roofing elements etc.) which have the potential to leach these contaminants into stormwater.

15.11 RETENTION

While not relevant to this site as it is located within the Kapiti Coast Whaitua, Plan Change 1 (PC1) to the Natural Resources Plan recommends capture of 85% of the mean annual rainfall runoff as an acceptable solution for retention, which is approximated as one third of the 24-hour rainfall depth in a 2-year event. The GWRC Hydrological Control Guidance Note approximates this as 20-25 mm of retention depth for the soils anticipated on site.

Retention of the first 20 mm of rainfall from road areas has been replicated within the WWLA modelling and analysis as a recharge to the underlying ground based on the design raingarden locations. This reflects the contribution that passive soakage will have towards groundwater recharge, and baseflow within the Wharemauku Stream. The WWLA analysis shows that the passive raingardens allow the development to closely match base flow conditions which is an important outcome for hydrological control. Conversely, previous analysis prior to this recharge being included in the model, showed differences between pre and post-development base flow, which is not considered a good water sensitive urban design outcome.

Soakage is anticipated to be feasible across the majority of the site and will achieve retention outcomes where this is used including for management of stormwater from the road areas. Where full soakage is not feasible, passive soakage will be used under raingardens to ensure hydrological control depths are achieved.

The final design of the rain gardens and passive soakage arrangements will be confirmed through detailed design, including verification of infiltration performance and consideration of groundwater levels, to ensure that the hydrological outcomes assumed in the WWLA assessment can be achieved.

As the WWLA modelling suggests that baseflows are matched closely with passive soakage from the raingardens, rainwater collection and re-use is not considered a necessary requirement for water design purposes. Collection may still be used to satisfy KCDC requirements fro potable water reduction (refer Envelope Engineering Infrastructure Report).

15.12 MAINTENANCE AND OWNERSHIP CONSIDERATIONS

15.12.1 OWNERSHIP

It is anticipated that the majority of stormwater infrastructure, including pipes, treatment devices and soakage devices within public areas, will vest in KCDC, subject to Council approval. Maintenance responsibilities for vested assets will transfer to KCDC following formal acceptance and handover.



Stormwater devices serving private developments, including apartment and commercial lots, will remain privately owned and maintained.

15.12.2 DURING CONSTRUCTION

It is expected that the proposed contractor will prepare a site-specific management plan for works at the site. This will need to include measures to ensure that the proposed treatment devices are protected during construction works, which could include:

- Isolation of the treatment device offline until the catchment is stabilised.
- Controls during the works to ensure that silt does not enter the treatment device.
- Suitable bedding-in period for planting prior to commissioning of the treatment device.

15.12.3 POST CONSTRUCTION

As set out in the draft consent conditions accompanying the application, a draft Stormwater Operation and Maintenance Manual will be prepared at the Engineering Approval stage, setting out the inspection, maintenance and operational requirements for the proposed stormwater infrastructure.

The maintenance of vested devices will be undertaken by KCDC. The maintenance of private devices will be undertaken by the maintenance structure (such as Easement Instruments and Consent Notices registered on new Titles) formed as part of the future subdivision resource consent.

16.0 OBJECTIVES ASSESSMENT

The proposed stormwater network solution for the site has been assessed for compliance with the objectives of the KCDC Land Development Minimum Requirements (2022) within Table 10.

Table 10. Land Development Minimum Requirements assessment.

Design Requirement	Design Response
Meet the relevant standards and criteria of the district plan, the Council's Stormwater Management Strategy, the Greater Wellington Proposed Natural Resources Plan, Regional Freshwater Plan and the Regional Plan for Discharges to Land and other relevant RMA planning instruments.	The stormwater management strategy has been developed having regard to the relevant district and regional planning requirements. A detailed assessment against the applicable statutory provisions is provided in the Statutory Assessment accompanying the substantive application.
Provide for the collection and/or control of stormwater, allowing for ultimate future development within the catchment or adjoining catchments and for climate change.	The design makes allowance for future development up to specified levels of imperviousness and with allowance for climate change predictions in accordance with KCDC Land Development Minimum Requirements (2022).
Achieve hydraulic neutrality so that peak flows into the receiving bodies for the 1 in 2- year, 1 in 5-year, 1 in 10-year, 1 in 50-year and 1 in 100-year design rainfall events shall not exceed the pre-development peak flows for the same design rainfall events.	The hydraulic modelling demonstrates that hydraulic neutrality can be achieved for the assessed design events, subject to implementation of the proposed attenuation measures and confirmation of their performance through detailed design.
Provide for climate change predictions as advised by the Council Land Development Minimum Requirements.	Climate Change allowances have been made in accordance with the KCDC Land Development Minimum Requirements (2022).
Meet the requirements of any stormwater management plans.	There are no current Stormwater Management Plans for the Wharemauku Stream.

Design Requirement	Design Response
Create a multifunctional landscape where the design integrates with other aspects of site planning and provides multiple benefits.	The proposed wetland compensation complex integrates ecological compensation, flood storage and landscape functions, alongside the wider network of open spaces and water-sensitive stormwater management measures.
Make use of available natural features and processes on site wherever possible.	The proposed stormwater management strategy incorporates water-sensitive design measures, including rain gardens, passive soakage and a wetland compensation complex that also provides flood storage. The practicability of retaining existing natural features has been considered in the context of the site's engineering and development constraints, as outlined in this SMP and the supporting avoidance assessments.
Result in minimal disturbance to the site and natural water systems.	The proposed development requires substantial earthworks and modification of existing natural features. The practicability of avoiding these modifications has been considered through the integrated design process, with measures incorporated to manage associated effects, including stormwater treatment, hydrological controls, flood management and the proposed wetland compensation complex.
Preserve and/or recreate natural landscape features.	The Wharemauku Stream will be returned to a more natural alignment and form, including significant ecological enhancement areas. The design has been undertaken with close involvement from the project Ecologist.
Reduce impervious cover as far as practical.	Road widths and extents have been reduced as far as possible while maintaining a functional road corridor.
Facilitate detention and infiltration opportunities.	Infiltration is proposed for small and large flow events.
Address flood events and preserve treatment systems through off-line storage and bypasses.	Flood flows are managed through the proposed flood storage area and designated conveyance routes. The design of stormwater treatment devices will also provide for appropriate bypass arrangements and protection during larger storm events, as confirmed through detailed design.
Meet regional and district stormwater discharge quality requirements.	The proposed stormwater treatment strategy incorporates streetscape bioretention rain gardens, passive soakage and restrictions on untreated copper and zinc building materials. These measures have been selected to manage contaminants generated by the development and minimise adverse effects on the receiving environment.



Design Requirement	Design Response
Have stormwater treatment systems based on created natural systems (e.g. wetlands, lakes and detention ponds) that can mimic natural processes and function as entire ecosystems.	The proposed stormwater system has been designed in a way that mimics and is sympathetic to natural ecological systems. The design has been undertaken with close involvement from the project Ecologist.
Comprise simple, non-structural, low-tech and low-cost methods.	Low cost and maintenance solutions have been used where possible. The size of the site makes a combined treatment area not practical.
Identify opportunities for enhancement.	The proposed stormwater system has been designed in a way that mimics and is sympathetic to natural ecological systems. The design has been undertaken with close involvement from the project Ecologist. There is an overall enhancement of ecological values from the proposed development.

Overall, the proposed stormwater management strategy has been developed to respond to the identified site constraints and the relevant KCDC design objectives. The combination of stormwater treatment, attenuation, passive soakage and flood storage measures provides an integrated approach to managing runoff from the proposed development, while also supporting the hydrological requirements of the wetland compensation complex. The detailed design of the stormwater infrastructure will be undertaken in accordance with the relevant consent conditions and applicable engineering requirements.

17.0 CONCLUSION

This Stormwater Management Plan (SMP) has been prepared in support of the substantive application for the New Central Park development under the Fast-track Approvals Act 2024. It sets out the proposed stormwater management strategy for the Site, having regard to the existing catchment characteristics, flood hazard, groundwater conditions, proposed changes to landform and the requirements of the KCDC Land Development Minimum Requirements (2022).

The proposed stormwater management strategy has been developed through an integrated design process involving civil engineering, flood modelling, hydrology, ecology and urban design. The strategy incorporates a combination of stormwater attenuation, soakage, bioretention rain gardens, overland flow management and flood storage to manage the effects of the proposed development on the surrounding environment.

The Flood Risk Assessment demonstrates that the proposed earthworks and provision of approximately 26,000 m^3 of additional flood storage can accommodate the changes associated with the development while managing flood risk within the wider Wharemauku Stream floodplain. Hydraulic modelling also demonstrates that peak stormwater flows can be attenuated to pre-development levels through the proposed soakage and attenuation measures, subject to the design assumptions and implementation requirements outlined in this report.

Stormwater quality will be managed through a water-sensitive design approach, incorporating streetscape rain gardens, infiltration and restrictions on contaminant-generating building materials. The proposed passive soakage measures have also been incorporated into the WWLA hydrological assessment, which indicates that groundwater recharge and stream baseflow conditions can be maintained close to existing conditions.

An important component of the overall design is the integration of stormwater management and flood storage with the proposed wetland compensation complex. The wetland has been designed to provide ecological compensation while also accommodating flood storage and establishing the hydrological conditions required to support the proposed wetland habitats. The design reflects the

relationship between stormwater management, groundwater, freshwater environments and the wider Wharemauku Stream catchment.

While the development involves substantial changes to the existing landform and drainage characteristics, the proposed stormwater management strategy responds to these constraints through an integrated approach to flood management, hydraulic neutrality, water quality treatment and freshwater hydrology. Further verification of soakage performance, detailed design of stormwater infrastructure and ongoing management requirements will be addressed through the Engineering Approval process and relevant consent conditions.

Overall, the assessments undertaken demonstrate that the proposed stormwater management strategy can achieve the key stormwater design objectives for the development and provide an appropriate basis for the detailed design, construction and ongoing operation of the stormwater infrastructure.

18.0 LIMITATIONS

This report is for the use of New Central Park Limited only and should not be used or relied upon by any other person or entity or for any other project.

This report has been prepared for the project described to us and its extent is limited to the scope of work agreed between the client and Envelope Engineering Limited. No responsibility is accepted by Envelope Engineering Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.



APPENDICES

APPENDIX 1 ENGINEERING PLANS

(Refer plans with substantive application)

APPENDIX 2 TOPOGRAPHICAL SURVEY



LEGEND

- WATER — G S WATER MA N
- SS — G S SEWER MA N
- SW — SW — G S STORMWATER MA N
- EDGE OF SEAL
- GUTTER FLOW
- FENCE
- TOP OF KERB
- EDGE OF CONCRETE
- WALL BOTTOM
- EDGE OF VEGETAT ON
- BU LD NG OUTL NE
- BU LD NG DECK
- UNDERLY NG XML BDY
- CONTOUR MAJOR
- CONTOUR M NOR
- BU LD NG EAVE
- TOPO BREAKL NE
- TOPO BOTTOM OF BANK
- TOPO TOP OF BANK
- GATE
- E — O/H POWER L NE
- POST
- D — BU LD NG DOWN P PE
- SUMP
- T — COMMS PL NTH
- POWER POLE
- WATER VALVE
- W — WATER TOBY
- H — HYDRANT
- TREE
- MH — MANHOLE
- UNKNOWN L D
- S TE BENCHMARK
- GULLY TRAP
- STORMWATER OUTLET
- G — GAS VALVE
- STREET L GHT
- BU LD NG FLOOR LEVEL

NOTES

1. LEVELS ARE N TERMS OF NZ VERT CAL DATUM 2016
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   RL 9.01m

2. COORD NATES ARE N TERMS NZ GEODET C DATUM 2000 WANGANU C RCU T
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3. CONTOURS ARE AT 1.00m NTERVALS. CONTOURS SHOWN ON TH S PLAN HAVE BEEN ELECTRON CALLY COMPUTED FROM SPOT HE GHT DETERM NAT ONS AND MAY NOT REPRESENT THE TRUE GROUND LEVELS. ANY CR T CAL HE GHTS SHOULD BE CHECKED ON S TE PR OR TO DES GN AND CONSTRUCT ON COMMENC NG. CONTOURS SHOWN UNDER ANY BU LD NG FOOTPR NT HAVE BEEN NTERPOLATED AND MAY NOT REFLECT THE TRUE GROUND SURFACE N THESE AREAS.

4. TH S PLAN HAS BEEN CARR ED OUT BY UAV DRONE SURVEY, EST MATED TO ACCURACY STANDARDS OF /-50MM ON HARD STAND AND /-100MM ON SOFT SURFACES. ALL LEVELS SHOWN ARE CORRECT AT T ME OF SURVEY. CR T CAL D MENS ONS AND LEVELS SHOULD BE VER F ED. ANY GROUND SURFACE UNDER HEAVY VEGETAT ON HAS NOT BEEN ACCURATELY CAPTURED BY THE UAV SURVEY AND THEREFORE MAY NOT RELFECT THE ACCURACY TOLERANCES OUTL NED ABOVE.

5. GROUND BASED SURVEY SPOT CHECKS HAVE BEEN UNDERTAKEN TO COMPARE W TH SURFACE. PURODUCED BY UAV. VAR ANCES WERE FOUND BETWEEN LEVELS N THE V NC TY 50MM TO 500MM /-. THE AREAS W TH THE LARGEST D FFERENCES WERE FOUND TO BE WHERE THE GRASS AND VEGETAT ON COVERAGE WAS SUBSTANT AL.

6. T S THE NTENT ON OF TH S SURVEY TO BE READ N CONJUCT ON W TH ELECTRON C DWG F LE. SEE DRAW NG 1942-01-050.DWG FOR FULL SURFACE NFORMAT ON.

7. BOUNDAR ES SHOWN ON TH S PLAN HAVE BEEN EXTRACTED FROM THE LATEST XML NFORMAT ON HELD BY LANDONL NE AND HAVE NOT BEEN SURVEYED. A BOUNDARY DEF N T ON SURVEY SHOULD BE CARR ED OUT TO ESTABL SH EXACT BOUNDARY POS T ONS ON S TE.

8. ALL EASEMENTS, COVENANTS AND OTHER LEGAL NSTRUMENTS ASSOC ATED W TH TH S S TE MAY NOT BE SHOWN ON TH S PLAN. AN NVEST GAT ON OF THE MOST CURRENT LEGAL RECORDS SHOULD BE UNDERTAKEN PR OR TO DES GN AND CONSTRUCT ON COMMENC NG.

9. SERV CES POS T ONS AND AL GNMENT MAY HAVE BEEN OBTA NED FROM TH RD PARTY RECORDS AND SHOULD BE VER F ED ON S TE PR OR TO CONSTRUCT ON COMMENC NG. ENVELOPE SURVEY NG DOES NOT N ANY WAY GUARANTEE THE ACCURACY OF ANY UNDERGROUND SERV CE SHOWN ON TH S PLAN.

10. TH S PLAN MAY NOT PROV DE ENOUGH NFORMAT ON FOR HE GHT TO BOUNDARY CALCULAT ONS. WHERE ANY PROPOSED BU LD NG OR PART THEREOF S REQU RED TO MEET COUNC L S HE GHT N RELAT ON TO BOUNDARY CONTROLS, ENVELOPE SURVEY NG SHOULD BE CONSULTED.

11. THESE NOTES ARE AN NTEGRAL PART OF TH S PLAN.

12. TH S PLAN S SSUED FOR A SPEC F C PROJECT AND MAY NOT BE ALTERED OR USED FOR ANY OTHER PURPOSE W THOUT THE PR OR WR TTEN CONSENT OF ENVELOPE SURVEY NG.

13. LEGAL DESCR PT ONS

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REV S ONS:

REV	NOTES	BY	DATE
A	FOR NFORMAT ON	SGR	16.05.23

PROJECT
THE WELLINGTON COMPANY ASSET MANAGEMENT LIMITED
KAPITI ROAD, PARAPARAUMU

T TLE
SITE SURVEY

ENVELOPE SURVEYING
W W W E N V E L O P E - E N G C O N Z

SURVEYED	KMP (17.04.23)	DRAWN	SGR
CHECKED	ELC	DATE	17-May-2023
SCALE A1	1:1500		A3 Scale 1:3000
STATUS	CLIENT ISSUE		

PROJECT No	DRAW NG No	REV S ON
1942-01-SV	050	A

- Wed May 17 12 31 50 2023



LEGEND

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- SS — G S SEWER MA N
- SW — SW — G S STORMWATER MA N
- EDGE OF SEAL
- GUTTER FLOW
- FENCE
- TOP OF KERB
- EDGE OF CONCRETE
- WALL BOTTOM
- EDGE OF VEGETAT ON
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- E — O/H POWER L NE
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- D — BU LD NG DOWN P PE
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- T — COMMS PL NTH
- POWER POLE
- WATER VALVE
- W — WATER TOBY
- H — HYDRANT
- TREE
- MH — MANHOLE
- UNKNOWN L D
- S TE BENCHMARK
- GULLY TRAP
- STORMWATER OUTLET
- G — GAS VALVE
- STREET L GHT
- BU LD NG FLOOR LEVEL

NOTES

1. LEVELS ARE N TERMS OF NZ VERT CAL DATUM 2016
   OR G N OF LEVELS
   SP 4 SO 400686 (CUKD)
   RL 9.01m

2. COORD NATES ARE N TERMS NZ GEODET C DATUM 2000 WANGANU C RCU T
   OR G N OF COORD NATES
   SP 4 SO 400686 (CUKD)
   725013.25 mN 359142.38 mE

3. CONTOURS ARE AT 1.00m NTERVALS. CONTOURS SHOWN ON TH S PLAN HAVE BEEN ELECTRON CALLY COMPUTED FROM SPOT HE GHT DETERM NAT ONS AND MAY NOT REPRESENT THE TRUE GROUND LEVELS. ANY CR T CAL HE GHTS SHOULD BE CHECKED ON S TE PR OR TO DES GN AND CONSTRUCT ON COMMENC NG. CONTOURS SHOWN UNDER ANY BU LD NG FOOTPR NT HAVE BEEN NTERPOLATED AND MAY NOT REFLECT THE TRUE GROUND SURFACE N THESE AREAS.

4. TH S PLAN HAS BEEN CARR ED OUT BY UAV DRONE SURVEY. EST MATED TO ACCURACY STANDARDS OF /-50MM ON HARD STAND AND /-100MM ON SOFT SURFACES. ALL LEVELS SHOWN ARE CORRECT AT T ME OF SURVEY. CR T CAL D MENS ONS AND LEVELS SHOULD BE VER F ED. ANY GROUND SURFACE UNDER HEAVY VEGETAT ON HAS NOT BEEN ACCURATELY CAPTURED BY THE UAV SURVEY AND THEREFORE MAY NOT RELFECT THE ACCURACY TOLERANCES OUTL NED ABOVE.

5. GROUND BASED SURVEY SPOT CHECKS HAVE BEEN UNDERTAKEN TO COMPARE W TH SURFACE. PURODUCED BY UAV. VAR ANCES WERE FOUND BETWEEN LEVELS N THE V NC TY 50MM TO 500MM /-. THE AREAS W TH THE LARGEST D FFERENCES WERE FOUND TO BE WHERE THE GRASS AND VEGETAT ON COVERAGE WAS SUBSTANT AL.

6. T S THE NTENT ON OF TH S SURVEY TO BE READ N CONJUCT ON W TH ELECTRON C DWG F LE. SEE DRAW NG 1942-01-050.DWG FOR FULL SURFACE NFORMAT ON.

7. BOUNDAR ES SHOWN ON TH S PLAN HAVE BEEN EXTRACTED FROM THE LATEST XML NFORMAT ON HELD BY LANDONL NE AND HAVE NOT BEEN SURVEYED. A BOUNDARY DEF N T ON SURVEY SHOULD BE CARR ED OUT TO ESTABL SH EXACT BOUNDARY POS T ONS ON S TE.

8. ALL EASEMENTS, COVENANTS AND OTHER LEGAL NSTRUMENTS ASSOC ATED W TH TH S S TE MAY NOT BE SHOWN ON TH S PLAN. AN NVEST GAT ON OF THE MOST CURRENT LEGAL RECORDS SHOULD BE UNDERTAKEN PR OR TO DES GN AND CONSTRUCT ON COMMENC NG.

9. SERV CES POS T ONS AND AL GNMENT MAY HAVE BEEN OBTA NED FROM TH RD PARTY RECORDS AND SHOULD BE VER F ED ON S TE PR OR TO CONSTRUCT ON COMMENC NG. ENVELOPE SURVEY NG DOES NOT N ANY WAY GUARANTEE THE ACCURACY OF ANY UNDERGROUND SERV CE SHOWN ON TH S PLAN.

10. TH S PLAN MAY NOT PROV DE ENOUGH NFORMAT ON FOR HE GHT TO BOUNDARY CALCULAT ONS. WHERE ANY PROPOSED BU LD NG OR PART THEREOF S REQU RED TO MEET COUNC L S HE GHT N RELAT ON TO BOUNDARY CONTROLS, ENVELOPE SURVEY NG SHOULD BE CONSULTED.

11. THESE NOTES ARE AN NTEGRAL PART OF TH S PLAN.

12. TH S PLAN S SSUED FOR A SPEC F C PROJECT AND MAY NOT BE ALTERED OR USED FOR ANY OTHER PURPOSE W THOUT THE PR OR WR TTEN CONSENT OF ENVELOPE SURVEY NG.

13. LEGAL DESCR PT ONS

SECT ON 3 & 4 SO 501569
COMPR SED N RT 822686 & 822629
TOTAL AREA 28.0269 Ha

Th s des gn and draw ng shall only be used for the purpose for wh ch t was suppl ed and shall not be altered or reproduced w thout the perm ss on of Envelope Eng neer ng L m ted. No l ab l ty shall be accepted for unauthor sed use of th s des gn and draw ng.

REV S ONS:

REV	NOTES	BY	DATE
A	FOR NFORMAT ON	SGR	16.05.23

PROJECT
THE WELLINGTON COMPANY ASSET MANAGEMENT LIMITED
KAPITI ROAD, PARAPARAUMU

T TLE
SITE SURVEY
WITH AERIAL IMAGE

ENVELOPE SURVEYING

W W W E N V E L O P E - E N G C O N Z

SURVEYED	KMP (17.04.23)	DRAWN	SGR
CHECKED	ELC	DATE	17-May-2023
SCALE A1	1:1500		A3 Scale 1:3000
STATUS	CLIENT ISSUE		

PROJECT No	DRAW NG No	REV S ON
1942-01-SV	050	A

- Wed May 17 12 32 01 2023

APPENDIX 3 STORMWATER CALCULATIONS

Kapiti Road

HEC-HMS Model Inputs

DATE: 4 October 2026

PROJECT NUMBER: 942-02

ENVELOPE ENGINEERING
LAND
STRUCTURE
MANAGE

Pre

Catchment	Area (m2)	Area (km2	Imp %	CN	Ia (mm)	tc (mins)	tc (hr)	lag time (hrs)	Storage Coeffecient	Storage Value	Perv ous m2	Imperv ous m2
Pre - 01	7,263	0.00726	1.0%	86.1	5.0	20	0.33	0.200	0.500	0.333	7,190	73
Pre - 02 (FUTURE WETLAND AREA)	125,586	0.12559	1.0%	86.1	5.0	20	0.33	0.200	0.500	0.333	124,330	1,256
Pre - 03	62,988	0.06299	1.0%	86.1	5.0	20	0.33	0.200	0.500	0.333	62,358	630
Pre - 04 (EXISTING DUNE AREA)	64,489	0.06449	1.0%	70.3	5.0	20	0.33	0.200	0.400	0.222	63,844	645
Pre - 05	93,910	0.09391	1.0%	86.1	5.0	20	0.33	0.200	0.500	0.333	92,971	939
	354,236										**350,694**	**3,542**

Note: Imperviousness has been assessed at ~1% across the total site area and applied to all catchments equally

Post

Catchment		Area (m2)	Area (km2	Imp %	CN	Ia (mm)	tc (mins)	tc (hr)	lag time (hrs)	Storage Coeffecient	Storage Value	Perv ous m2	Imperv ous m2
Post - 01													
	Road / Reserve	2,968	0.00297	60.0%									
	Residential	4,295	0.0043	65.0%									
	Total	7,263	0.00726	63.0%	87.6	1.9	20	0.33	0.200	0.350	0.179	2,690	4,573
Post - 02												-	-
	Road	4,910	0.00491	70.0%									
	Wetland	120,676	0.12068	2.0%									
	Total	125,586	0.12559	4.7%	86.6	4.8	20	0.33	0.200	0.600	0.500	119,735	5,851
Post - 03												-	-
	Road / Reserve	14,427	0.01443	80.0%									
	Residential	28,002	0.028	65.0%									
	Total	42,429	0.04243	70.1%	89.6	1.5	20	0.33	0.200	0.350	0.179	12,686	29,743
Post - 04												-	-
	Road / Reserve	14,234	0.01423	80.0%									
	Residential	10,665	0.01067	65.0%									
	Total	24,899	0.0249	73.6%	90.6	1.3	20	0.33	0.200	0.350	0.179	6,580	18,319
Post - 05													
	Commercial Lot	30,186	0.03019	95.0%									
	Total	30,186	0.03019	95.0%	96.6	0.3	20	0.33	0.200	0.350	0.179	1,509	28,677
Post - 06		4,990	0.00499	0.0%	70.0	5.0	20	0.33	0.200	0.400	0.222	4,990	-
Post - 07													
	Road / Reserve	8,910	0.00891	80.0%									
	Residential	23,220	0.02322	65.0%									
	Total	32,130	0.03213	69.2%	89.4	1.5	20	0.33	0.200	0.350	0.179	9,909	22,221
Post - 08													
	Road / Reserve	5,231	0.00523	80.0%									
	Residential	15,070	0.01507	65.0%									
	Total	20,301	0.0203	68.9%	89.3	1.6	20	0.33	0.200	0.350	0.179	6,321	13,980
Post - 09		13,290	0.01329	0.0%	86.0	5.0	20	0.33	0.200	0.600	0.500	13,290	-
Post - 10													
	Commercial Lot	31,984	0.03198	95.0%									
	Total	31,984	0.03198	95.0%	96.6	0.3	20	0.33	0.200	0.350	0.179	1,599	30,385
Post - 11		21.176	0.02118	80.0%	95.6	1.0	20	0.33	0.200	0.350	0.179	4.235	16.941
		354,234										**183,545**	**170,689**

Project: 1942_02_HEC_Model

Simulation Run: Run 1

Simulation Start: 31 December 2021, 24:00

Simulation End: 2 January 2022, 12:00

HMS Version: 4.13

Executed: 22 October 2026, 03:58

Global Parameter Summary - Subbasin

Area (KM2)

Element Name	Area (KM2)
Pre - 01	0.01
Pre - 02	0.13
Pre - 03	0.06
Pre - 04	0.06
Pre - 05	0.09
Post - 01	0.01
Post - 02	0.13
Post - 03	0.04
Post - 04	0.02
Post - 05	0.03
Post - 06	0
Post - 07	0
Post - 08	0.02
Post - 09	0.01
Post - 10	0.03
Post - 11	0.02
Check Only (Road Pre)	0.03

Downstream

Element Name	Downstream
Pre - 01	Check Point (pre)
Pre - 02	Check Point (pre)
Pre - 03	Check Point (pre)
Pre - 04	Check Point (pre)
Pre - 05	Check Point (pre)
Post - 01	Soak - Post - 01
Post - 02	Check Point (post)
Post - 03	Soak - Post - 03
Post - 04	Post - Soak - 04
Post - 05	Check Point (post)
Post - 06	Check Point (post)
Post - 07	Post - Soak - 07
Post - 08	Post - Soak - 08
Post - 09	Check Point (post)
Post - 10	Check Point (post)
Post - 11	Post - Soak - 11

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
Pre - 01	0	86.1	5
Pre - 02	0	86.1	5
Pre - 03	0	86.1	5
Pre - 04	0	70.3	5
Pre - 05	0	86.1	5
Post - 01	0	89.3	1.6
Post - 02	0	86.6	4.8
Post - 03	0	91.5	1.2

Post - 04	0	91.8	1.1
Post - 05	0	96.6	0.3
Post - 06	0	70	5
Post - 07	0	91.4	1.2
Post - 08	0	91.4	1.2
Post - 09	0	86	5
Post - 10	0	96.6	0.3
Post - 11	0	95.6	1
Check Only (Road Pre)	0	86.1	5

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method
Pre - 01	Specified	0.33	0.5	Default
Pre - 02	Specified	0.33	0.5	Default
Pre - 03	Specified	0.33	0.5	Default
Pre - 04	Specified	0.22	0.4	Default
Pre - 05	Specified	0.33	0.4	Default
Post - 01	Specified	0.33	0.35	Default
Post - 02	Specified	0.33	0.6	Default
Post - 03	Specified	0.33	0.35	Default
Post - 04	Specified	0.33	0.35	Default
Post - 05	Specified	0.33	0.35	Default
Post - 06	Specified	0.33	0.35	Default
Post - 07	Specified	0.33	0.25	Default
Post - 08	Specified	0.33	0.35	Default
Post - 09	Specified	0.33	0.4	Default
Post - 10	Specified	0.33	0.35	Default
Post - 11	Specified	0.33	0.35	Default
Check Only (Road Pre)	Specified	0.2	0.33	Default

Global Results Summary

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pre - 01	0.01	0.03	01Jan2022, 12:25	48.49
Pre - 02	0.13	0.56	01Jan2022, 12:25	48.49
Pre - 03	0.06	0.28	01Jan2022, 12:25	48.49
Pre - 04	0.06	0.2	01Jan2022, 12:20	30.85
Pre - 05	0.09	0.46	01Jan2022, 12:20	48.49
Post - 01	0.01	0.04	01Jan2022, 12:20	56.48
Post - 02	0.13	0.53	01Jan2022, 12:25	49.39
Post - 03	0.04	0.27	01Jan2022, 12:20	60.64
Post - 04	0.02	0.16	01Jan2022, 12:20	61.28
Post - 05	0.03	0.22	01Jan2022, 12:20	71.66
Post - 06	0	0.02	01Jan2022, 12:20	30.59
Post - 07	0	0.02	01Jan2022, 12:20	60.46
Post - 08	0.02	0.13	01Jan2022, 12:20	60.46
Post - 09	0.01	0.07	01Jan2022, 12:20	48.35
Post - 10	0.03	0.23	01Jan2022, 12:20	71.66
Post - 11	0.02	0.15	01Jan2022, 12:20	68.82
Check Point (pre)	0.35	1.53	01Jan2022, 12:20	45.28
Check Point (post)	0.33	1.49	01Jan2022, 12:20	37.95
Check Only (Road Pre)	0.03	0.17	01Jan2022, 12:15	48.49
Attenuation Pond	0	0	31Dec2021, 24:00	Not specified
Road Attenuation (lumped)	0	0	31Dec2021, 24:00	Not specified

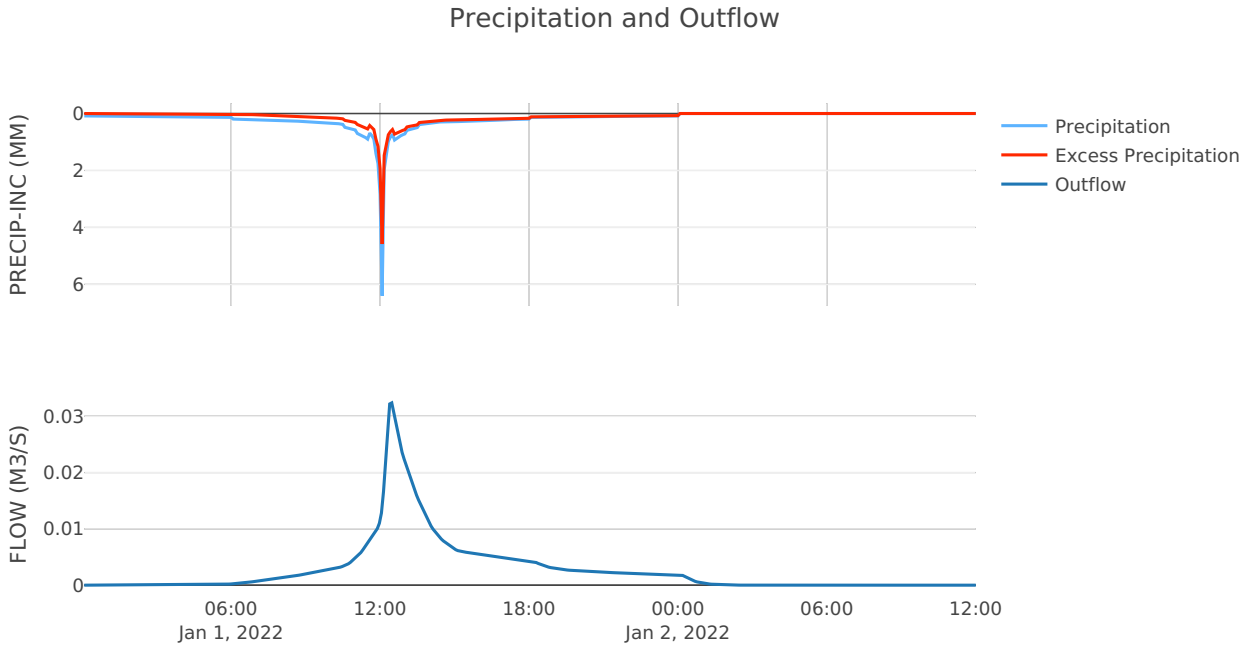
Subbasin: Pre-01

Area (KM2) : 0.01
Downstream : Check Point (pre)

Loss Rate: Scs

Percent Impervious Area	0
Curve Number	86.1

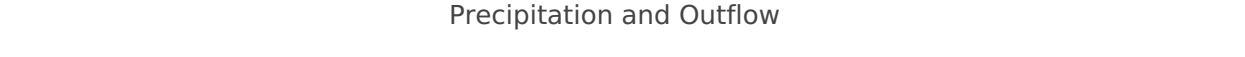
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-01	
Peak Discharge (M3/S)	0.03
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	48.49
Precipitation Volume (M3)	580.8
Loss Volume (M3)	228.77
Excess Volume (M3)	352.03
Direct Runoff Volume (M3)	352.03
Baseflow Volume (M3)	0

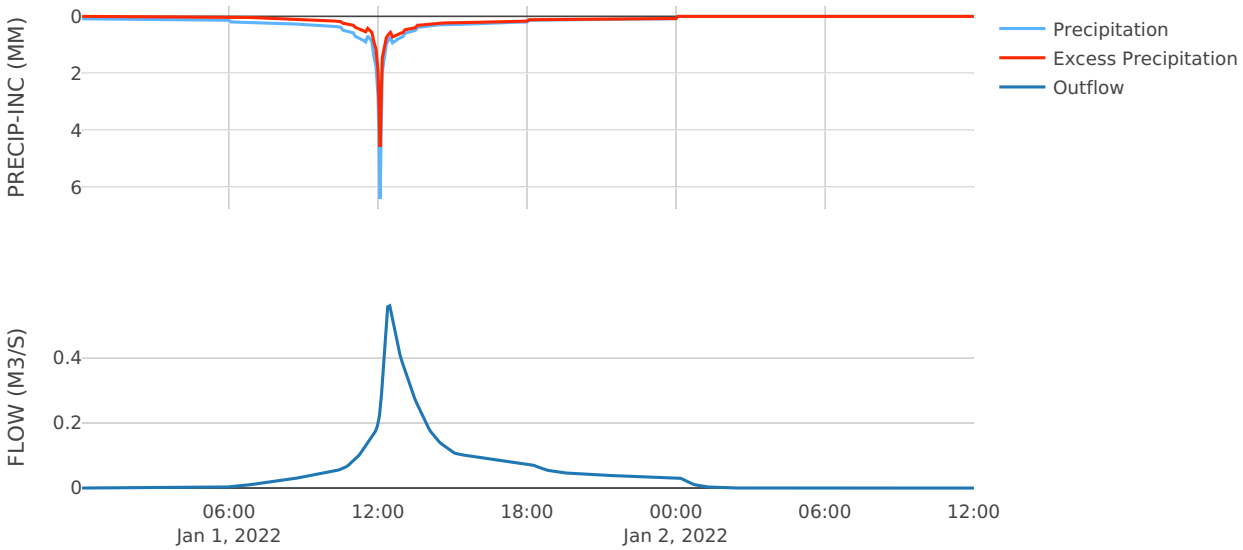


Subbasin: Pre-02

Area (KM2) : 0.13
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-02	
Peak Discharge (M3/S)	0.56
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	48.49
Precipitation Volume (M3)	10047.2
Loss Volume (M3)	3957.47
Excess Volume (M3)	6089.73
Direct Runoff Volume (M3)	6089.73
Baseflow Volume (M3)	0





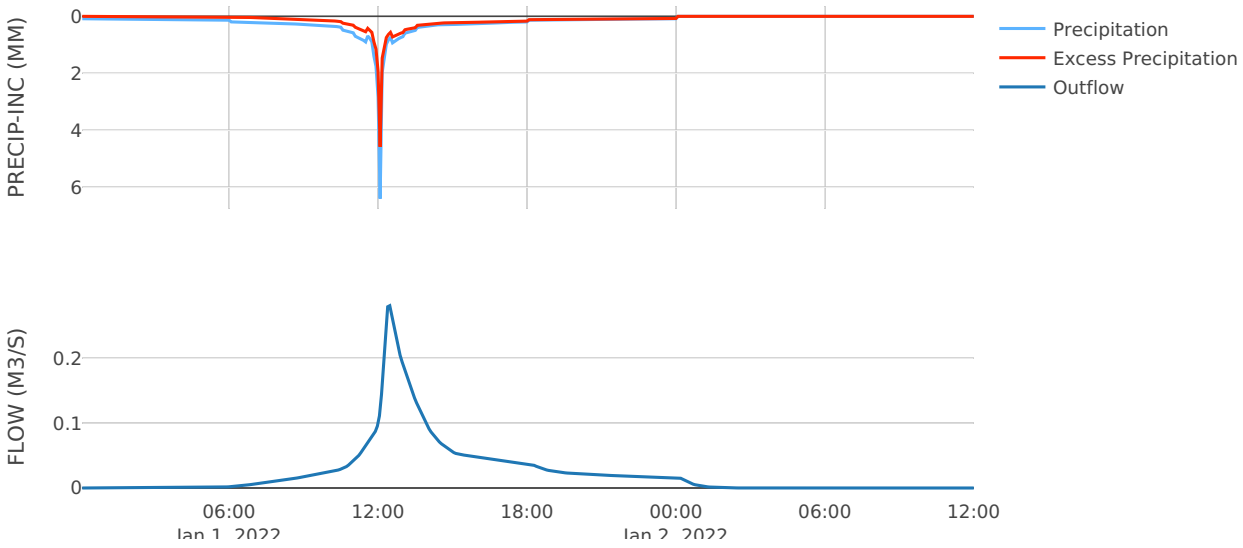
Subbasin: Pre-03

Area (KM2) : 0.06
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default

Results: Pre-03	
Peak Discharge (M3/S)	0.28
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	48.49
Precipitation Volume (M3)	5039.04
Loss Volume (M3)	1984.82
Excess Volume (M3)	3054.22
Direct Runoff Volume (M3)	3054.22
Baseflow Volume (M3)	0

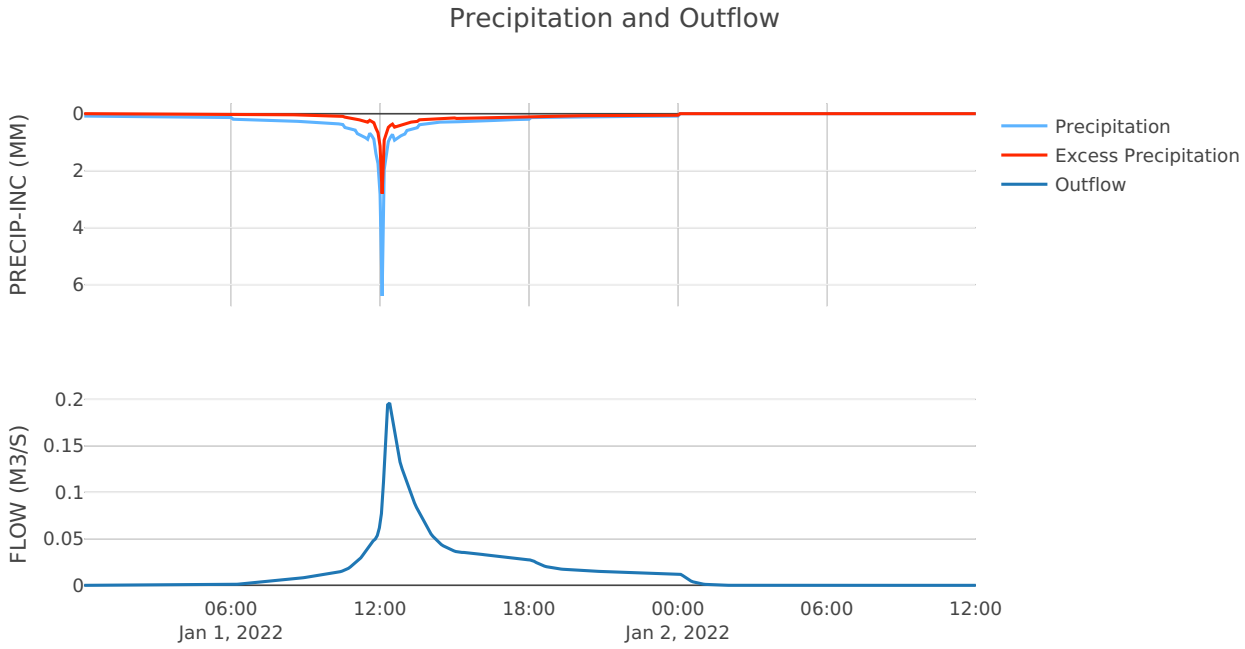
Precipitation and Outflow



Subbasin: Pre-04

Area (KM2) : 0.06
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70.3
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.22
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-04	
Peak Discharge (M3/S)	0.2
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	30.85
Precipitation Volume (M3)	5158.32
Loss Volume (M3)	3168.87
Excess Volume (M3)	1989.45
Direct Runoff Volume (M3)	1989.45
Baseflow Volume (M3)	0

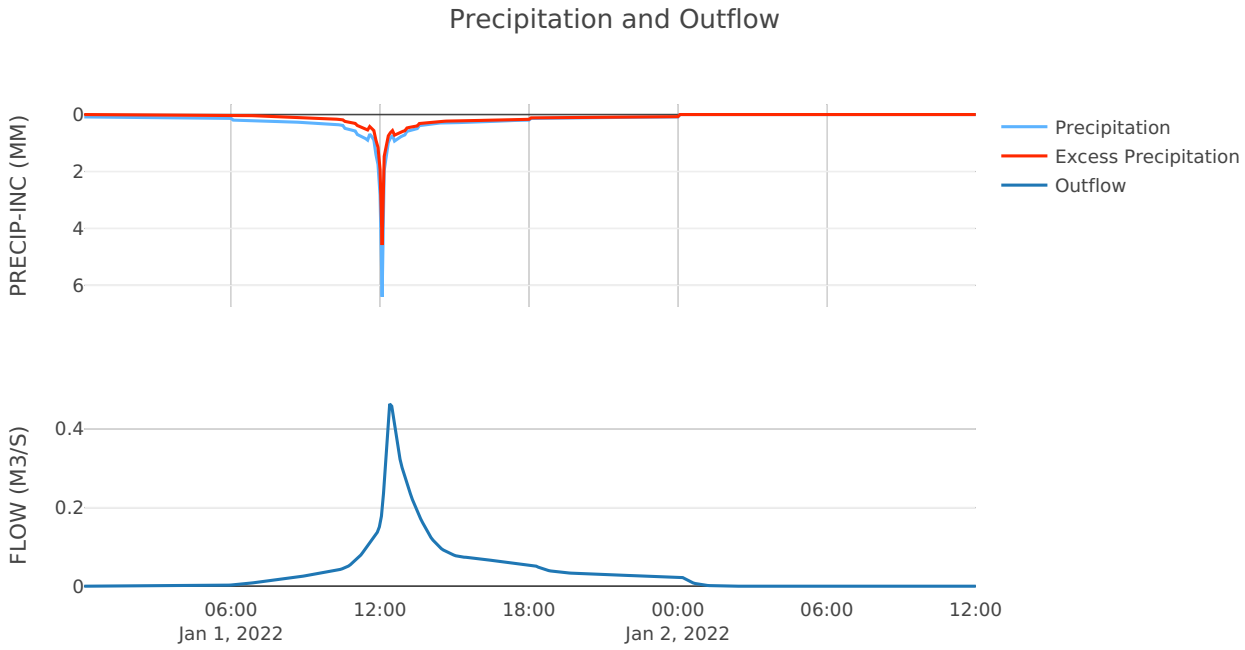


Subbasin: Pre-05

Area (KM2) : 0.09
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-05	

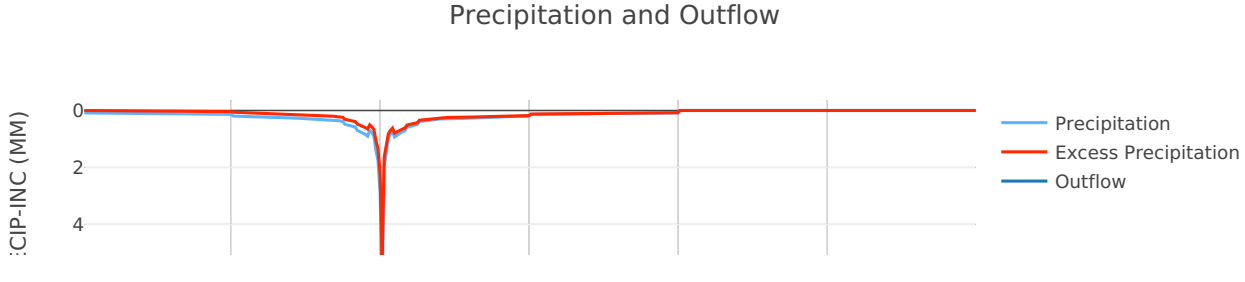
Peak Discharge (M3/S)	0.46
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	48.49
Precipitation Volume (M3)	7512.8
Loss Volume (M3)	2959.2
Excess Volume (M3)	4553.6
Direct Runoff Volume (M3)	4553.6
Baseflow Volume (M3)	0

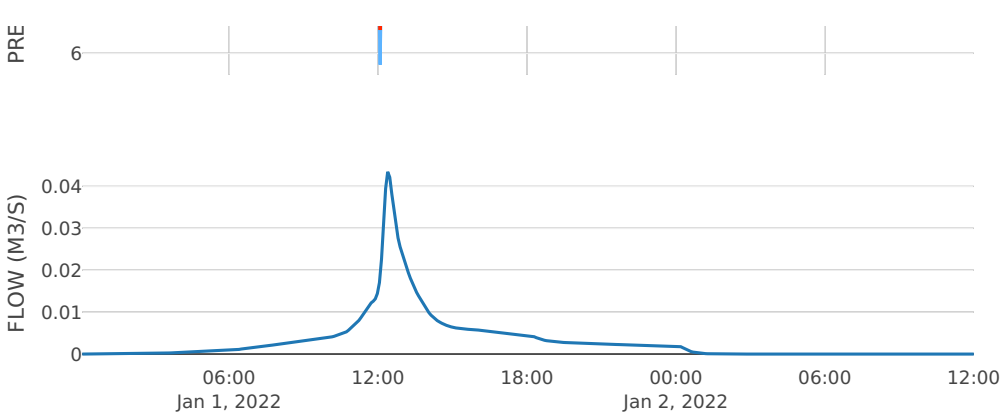


Subbasin: Post-01

Area (KM2) : 0.01
Downstream : Soak - Post - 01

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	89.3
Initial Abstraction	1.6
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-01	
Peak Discharge (M3/S)	0.04
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	56.48
Precipitation Volume (M3)	580.8
Loss Volume (M3)	170.78
Excess Volume (M3)	410.02
Direct Runoff Volume (M3)	410.02
Baseflow Volume (M3)	0

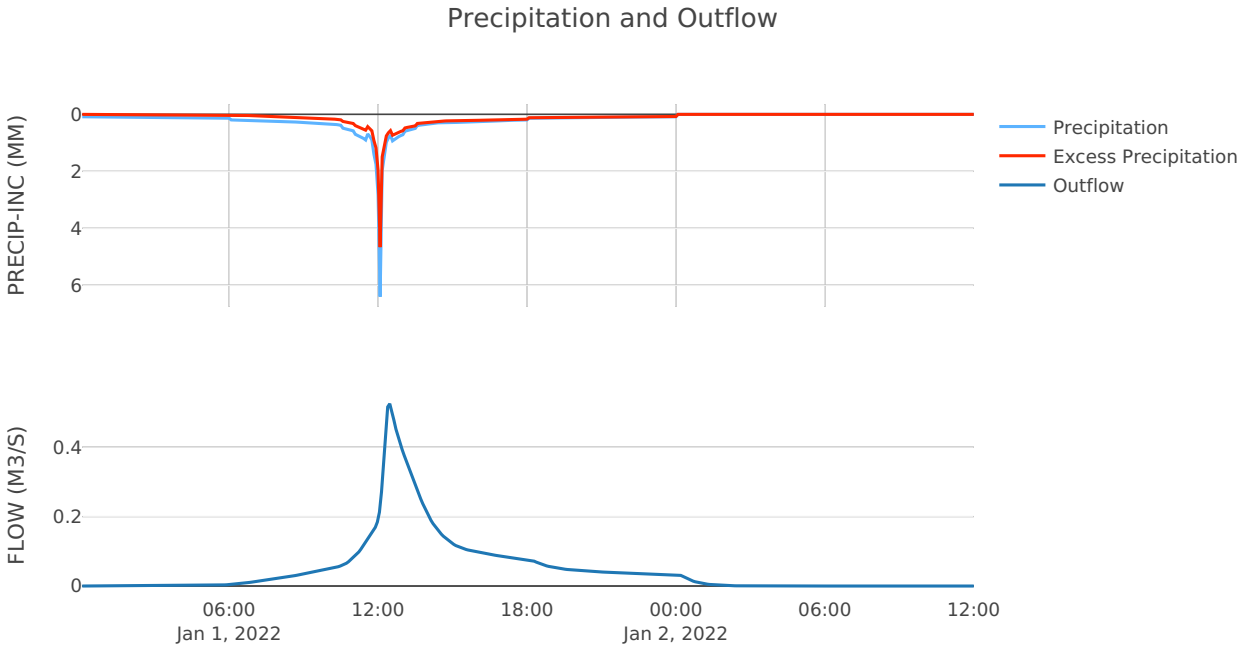




Subbasin: Post-02

Area (KM2) : 0.13
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.6
Initial Abstraction	4.8
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.6
Time Area Method	Default
Results: Post-02	
Peak Discharge (M3/S)	0.53
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	49.39
Precipitation Volume (M3)	10047.2
Loss Volume (M3)	3844.57
Excess Volume (M3)	6202.63
Direct Runoff Volume (M3)	6202.63
Baseflow Volume (M3)	0

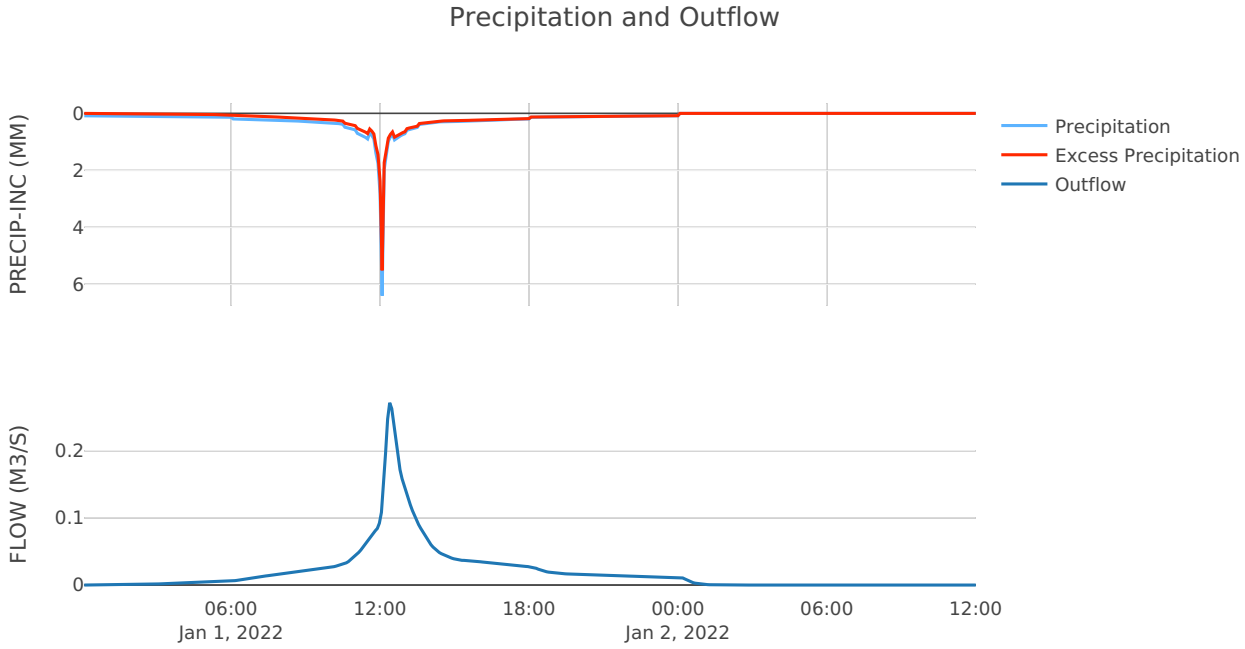


Subbasin: Post-03

Area (KM2) : 0.04

Downstream : Soak - Post - 03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.5
Initial Abstraction	1.2
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-03	
Peak Discharge (M3/S)	0.27
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	60.64
Precipitation Volume (M3)	3394.4
Loss Volume (M3)	821.37
Excess Volume (M3)	2573.03
Direct Runoff Volume (M3)	2573.03
Baseflow Volume (M3)	0

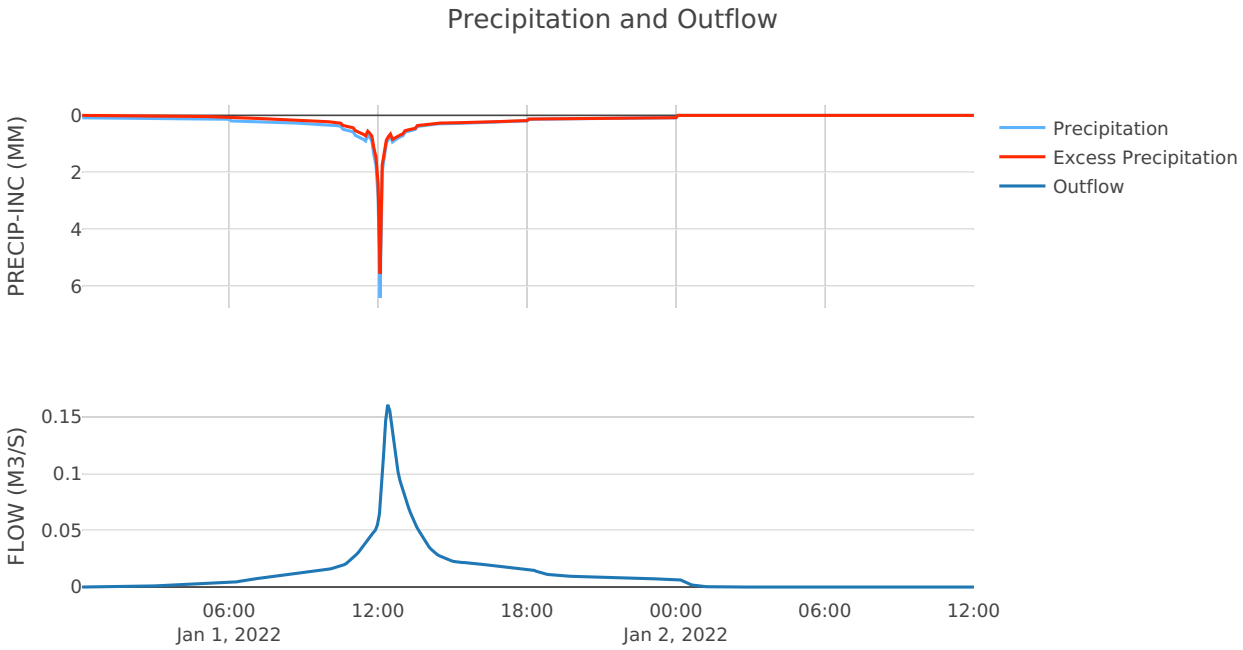


Subbasin: Post-04

Area (KM2) : 0.02
Downstream : Post - Soak - 04

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.8
Initial Abstraction	1.1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-04	
Peak Discharge (M3/S)	0.16
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	61.28
Precipitation Volume (M3)	1992
Loss Volume (M3)	466.16

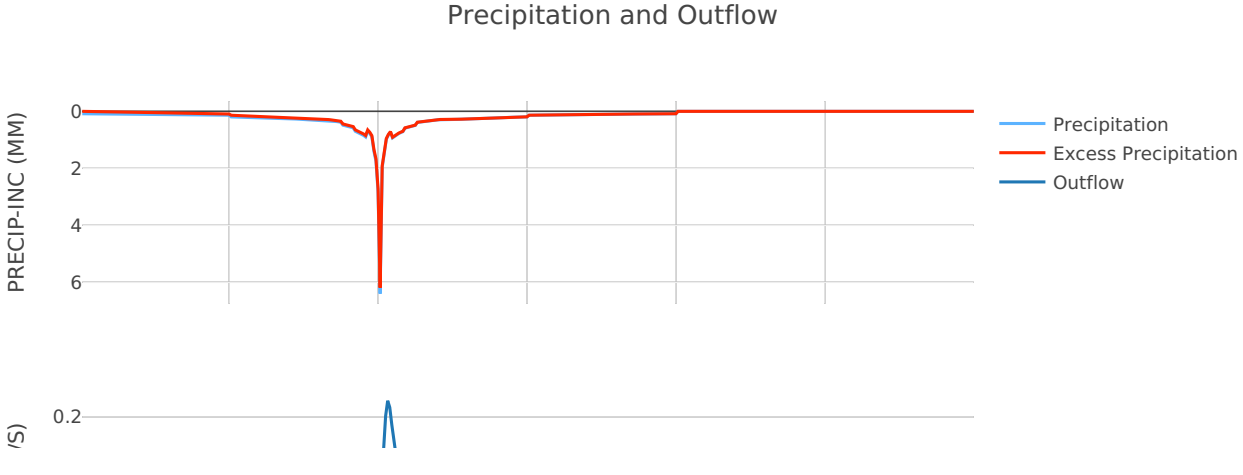
Excess Volume (M3)	1525.84
Direct Runoff Volume (M3)	1525.84
Baseflow Volume (M3)	0

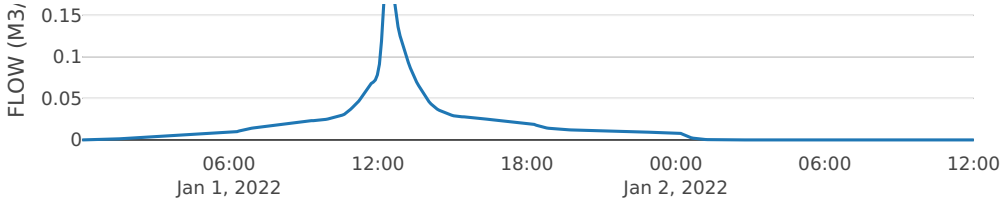


Subbasin: Post-05

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-05	
Peak Discharge (M3/S)	0.22
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	71.66
Precipitation Volume (M3)	2415.2
Loss Volume (M3)	251.73
Excess Volume (M3)	2163.47
Direct Runoff Volume (M3)	2163.47
Baseflow Volume (M3)	0





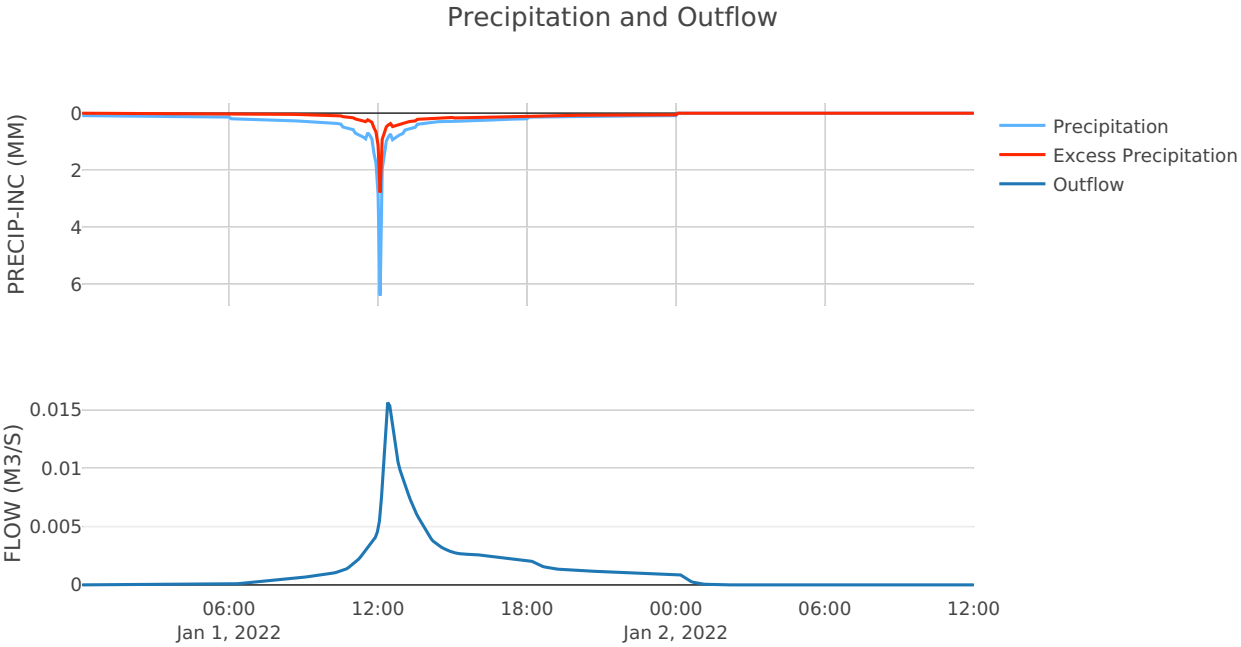
Subbasin: Post-06

Area (KM2) : 0
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70
Initial Abstraction	5

Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-06	
Peak Discharge (M3/S)	0.02
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	30.59
Precipitation Volume (M3)	399.2
Loss Volume (M3)	246.53
Excess Volume (M3)	152.67
Direct Runoff Volume (M3)	152.67
Baseflow Volume (M3)	0



Subbasin: Post-07

Area (KM2) : 0
Downstream : Post - Soak - 07

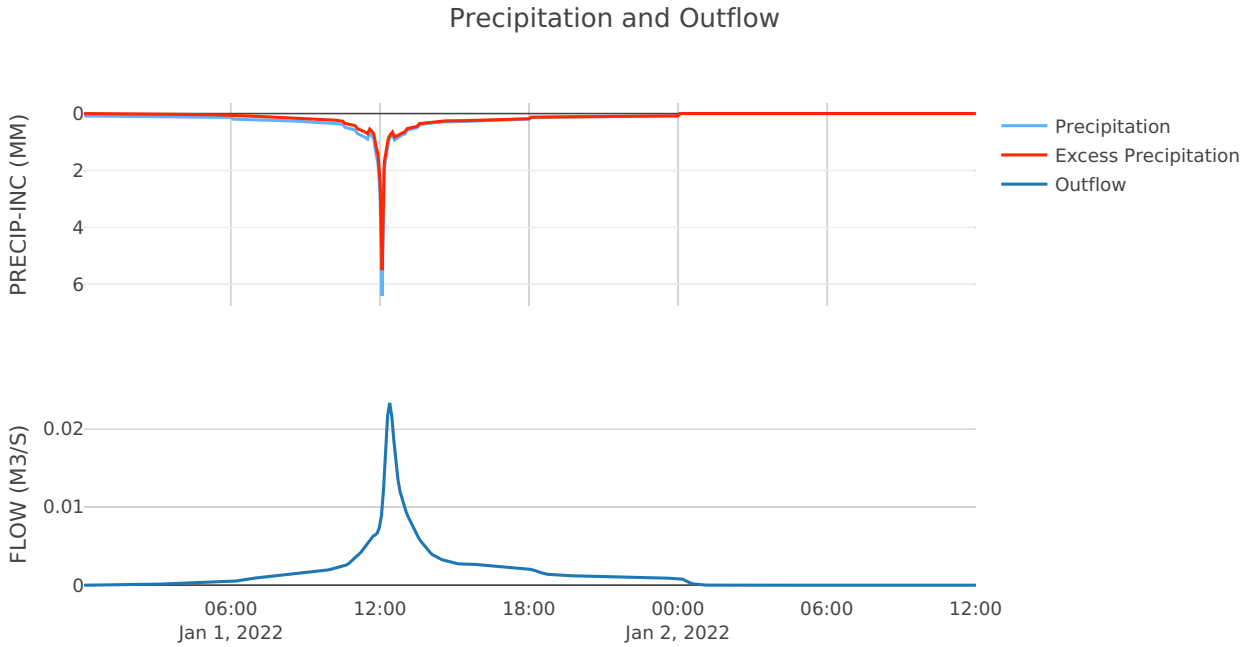
Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.25
Time Area Method	Default

Results: Post-07

Peak Discharge (M3/S)	0.02
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	60.46
Precipitation Volume (M3)	257.04
Loss Volume (M3)	62.77
Excess Volume (M3)	194.27
Direct Runoff Volume (M3)	194.27
Baseflow Volume (M3)	0



Subbasin: Post-08

Area (KM2) : 0.02
Downstream : Post - Soak - 08

Loss Rate: Scs

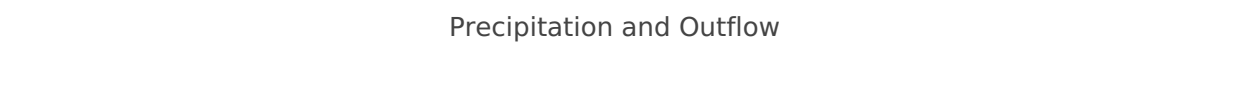
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

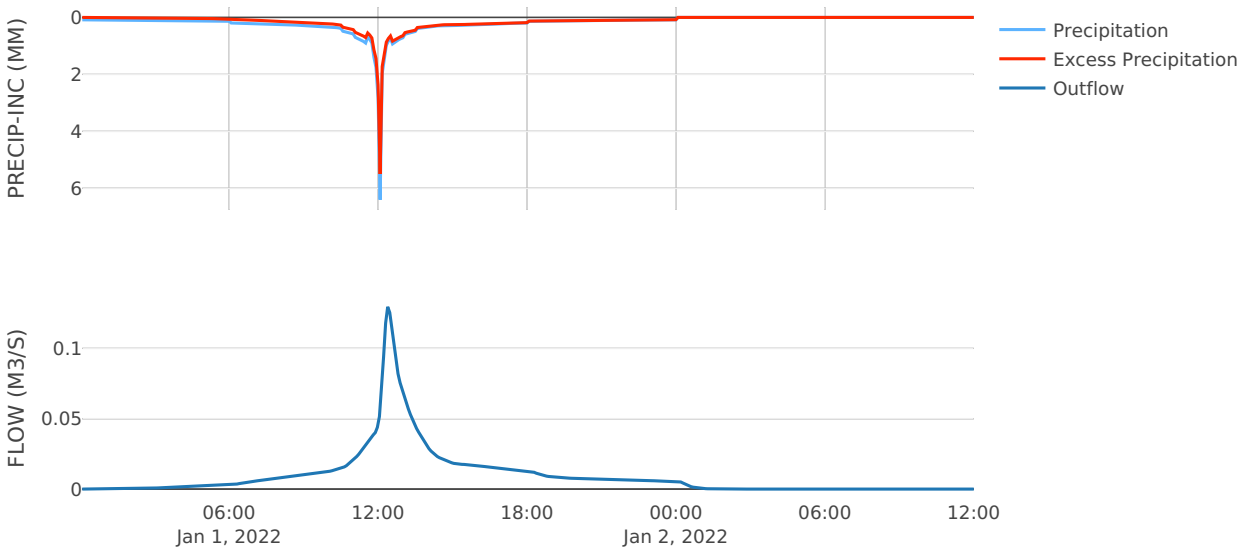
Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-08

Peak Discharge (M3/S)	0.13
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	60.46
Precipitation Volume (M3)	1624
Loss Volume (M3)	396.62
Excess Volume (M3)	1227.38
Direct Runoff Volume (M3)	1227.38
Baseflow Volume (M3)	0



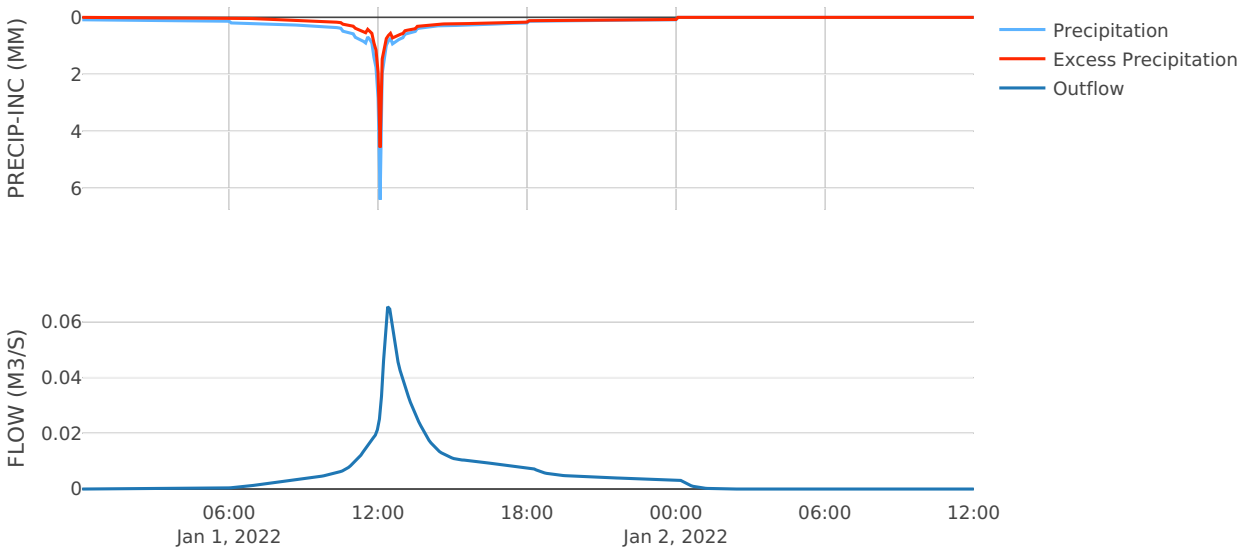


Subbasin: Post-09

Area (KM2) : 0.01
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Post-09	
Peak Discharge (M3/S)	0.07
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	48.35
Precipitation Volume (M3)	1063.2
Loss Volume (M3)	420.68
Excess Volume (M3)	642.52
Direct Runoff Volume (M3)	642.52
Baseflow Volume (M3)	0

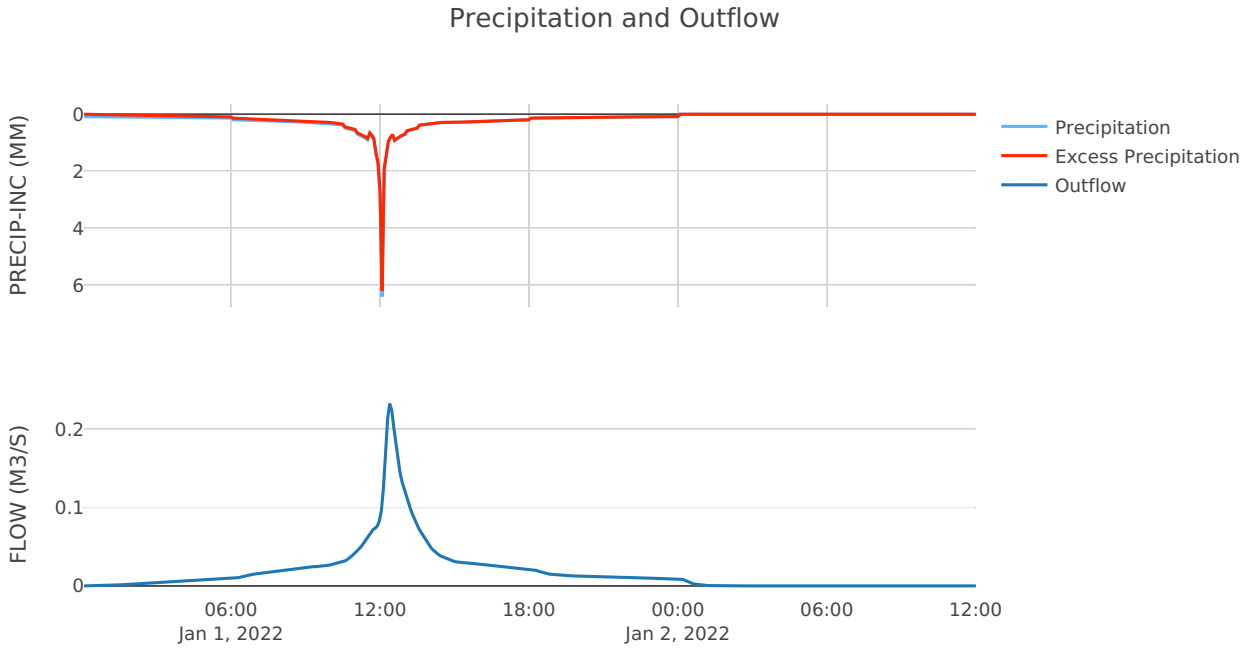
Precipitation and Outflow



Subbasin: Post-10

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-10	
Peak Discharge (M3/S)	0.23
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	71.66
Precipitation Volume (M3)	2558.4
Loss Volume (M3)	266.66
Excess Volume (M3)	2291.74
Direct Runoff Volume (M3)	2291.74
Baseflow Volume (M3)	0

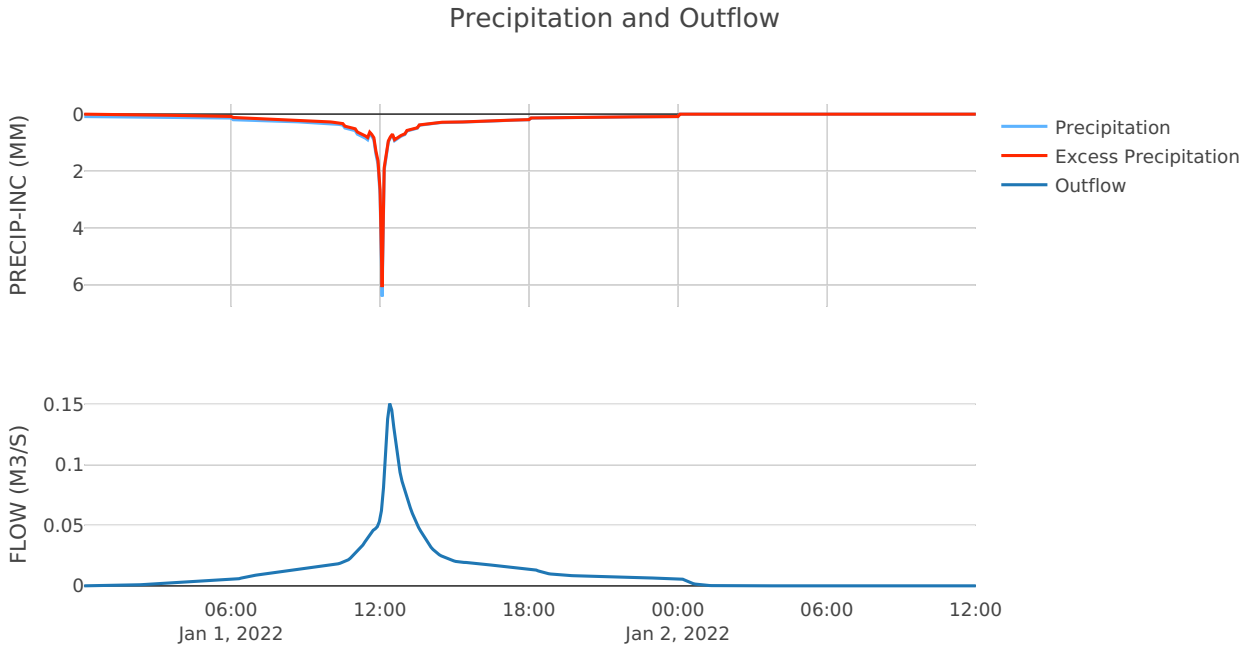


Subbasin: Post-11

Area (KM2) : 0.02
Downstream : Post - Soak - 11

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	95.6
Initial Abstraction	1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-11	

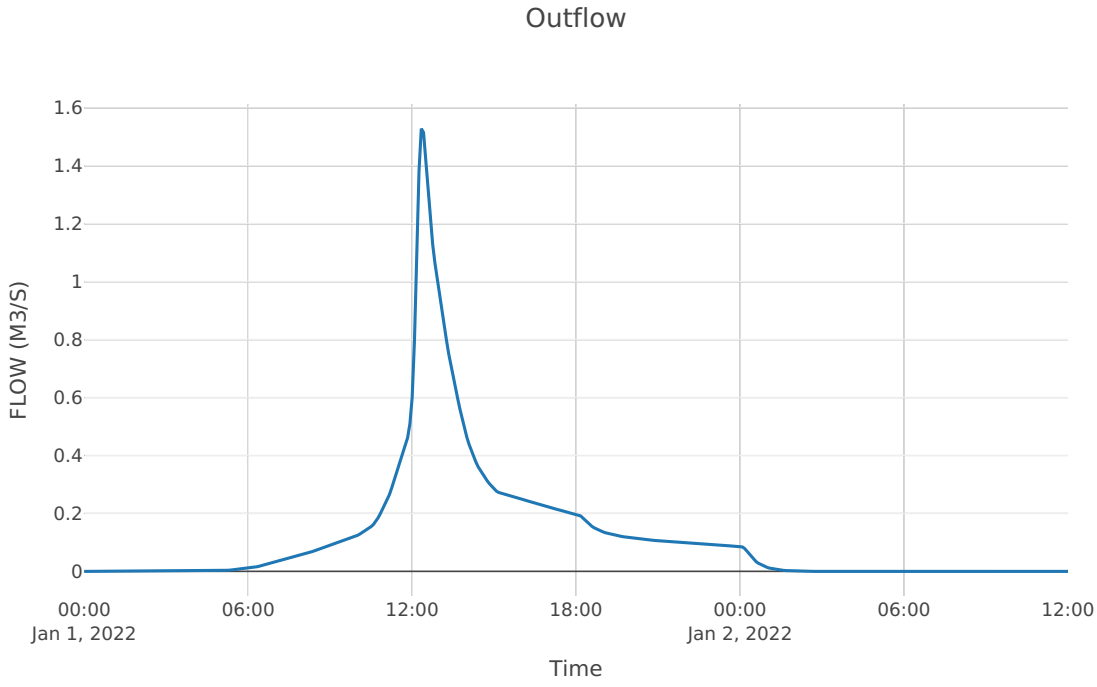
Peak Discharge (M3/S)	0.15
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	68.82
Precipitation Volume (M3)	1694.08
Loss Volume (M3)	236.82
Excess Volume (M3)	1457.26
Direct Runoff Volume (M3)	1457.26
Baseflow Volume (M3)	0



Junction: Check Point (pre)

Results: Check Point (pre)

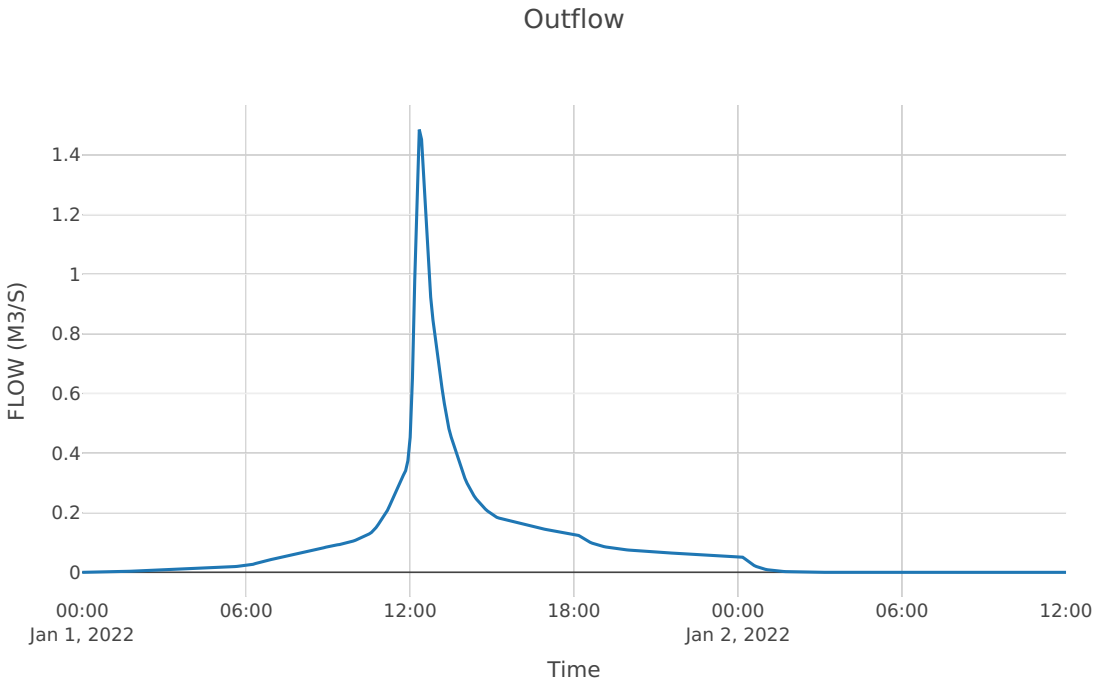
Peak Discharge (M3/S)	1.53
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	45.28



Junction: Check Point (post)

Results: Check Point (post)

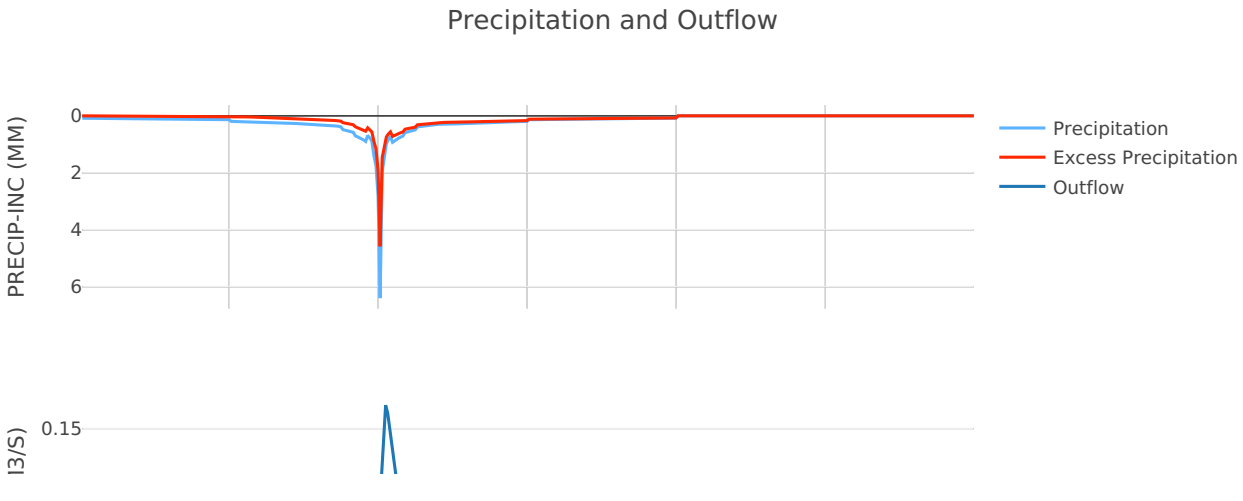
Peak Discharge (M3/S)	1.49
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	37.95

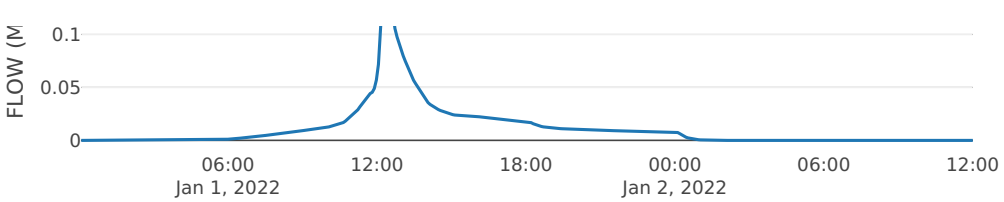


Subbasin: Check Only (Road Pre)

Area (KM2) : 0.03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.2
Storage Coefficient	0.33
Time Area Method	Default
Results: Check Only (Road Pre)	
Peak Discharge (M3/S)	0.17
Time of Peak Discharge	01Jan2022, 12:15
Volume (MM)	48.49
Precipitation Volume (M3)	2468.8
Loss Volume (M3)	972.43
Excess Volume (M3)	1496.37
Direct Runoff Volume (M3)	1496.37
Baseflow Volume (M3)	0

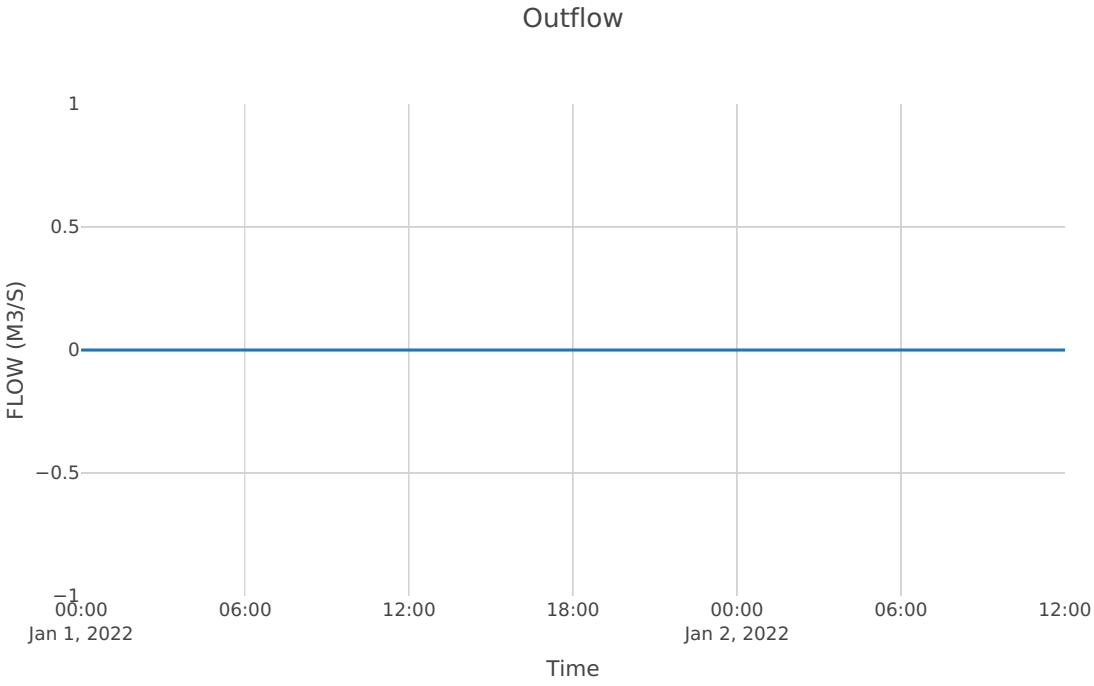




Reservoir: Attenuation Pond

Results: Attenuation Pond

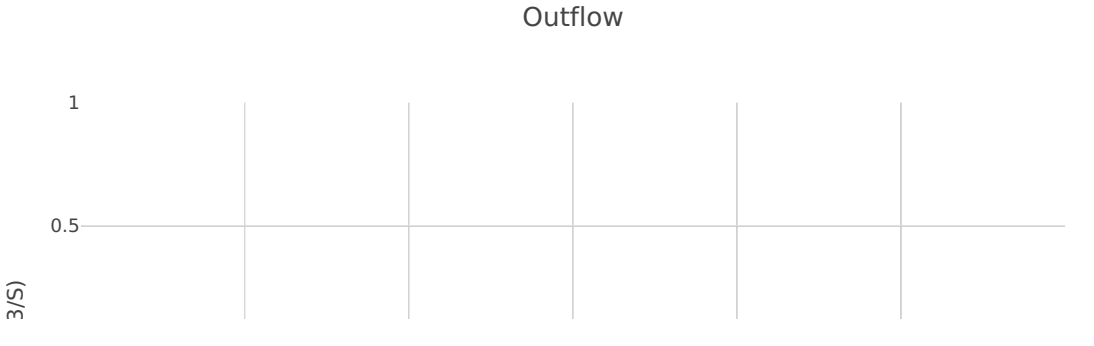
Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	451.59
Discharge Volume (M3)	0

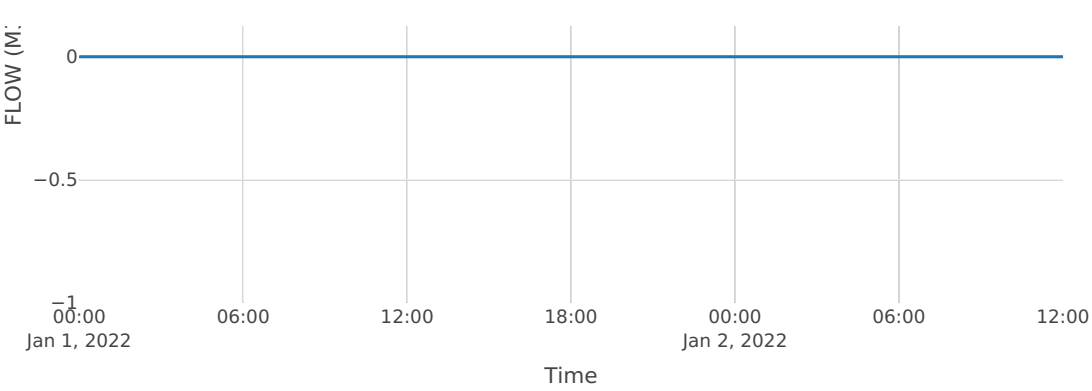


Reservoir: Road Attenuation (lumped)

Results: Road Attenuation (lumped)

Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	5.5
Peak Elevation (M)	0.01
Discharge Volume (M3)	0




FLOW (M
0
−0.5
−1
00:00
Jan 1, 2022
06:00
12:00
18:00
00:00
Jan 2, 2022
06:00
12:00
Time

Project: 1942_02_HEC_Model

Simulation Run: Run 2

Simulation Start: 31 December 2021, 24:00

Simulation End: 2 January 2022, 12:00

HMS Version: 4.13

Executed: 22 October 2026, 03:58

Global Parameter Summary - Subbasin

Area (KM2)

Element Name	Area (KM2)
Pre - 01	0.01
Pre - 02	0.13
Pre - 03	0.06
Pre - 04	0.06
Pre - 05	0.09
Post - 01	0.01
Post - 02	0.13
Post - 03	0.04
Post - 04	0.02
Post - 05	0.03
Post - 06	0
Post - 07	0
Post - 08	0.02
Post - 09	0.01
Post - 10	0.03
Post - 11	0.02
Check Only (Road Pre)	0.03

Downstream

Element Name	Downstream
Pre - 01	Check Point (pre)
Pre - 02	Check Point (pre)
Pre - 03	Check Point (pre)
Pre - 04	Check Point (pre)
Pre - 05	Check Point (pre)
Post - 01	Soak - Post - 01
Post - 02	Check Point (post)
Post - 03	Soak - Post - 03
Post - 04	Post - Soak - 04
Post - 05	Check Point (post)
Post - 06	Check Point (post)
Post - 07	Post - Soak - 07
Post - 08	Post - Soak - 08
Post - 09	Check Point (post)
Post - 10	Check Point (post)
Post - 11	Post - Soak - 11

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
Pre - 01	0	86.1	5
Pre - 02	0	86.1	5
Pre - 03	0	86.1	5
Pre - 04	0	70.3	5
Pre - 05	0	86.1	5
Post - 01	0	89.3	1.6
Post - 02	0	86.6	4.8
Post - 03	0	91.5	1.2

Post - 04	0	91.8	1.1
Post - 05	0	96.6	0.3
Post - 06	0	70	5
Post - 07	0	91.4	1.2
Post - 08	0	91.4	1.2
Post - 09	0	86	5
Post - 10	0	96.6	0.3
Post - 11	0	95.6	1
Check Only (Road Pre)	0	86.1	5

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method
Pre - 01	Specified	0.33	0.5	Default
Pre - 02	Specified	0.33	0.5	Default
Pre - 03	Specified	0.33	0.5	Default
Pre - 04	Specified	0.22	0.4	Default
Pre - 05	Specified	0.33	0.4	Default
Post - 01	Specified	0.33	0.35	Default
Post - 02	Specified	0.33	0.6	Default
Post - 03	Specified	0.33	0.35	Default
Post - 04	Specified	0.33	0.35	Default
Post - 05	Specified	0.33	0.35	Default
Post - 06	Specified	0.33	0.35	Default
Post - 07	Specified	0.33	0.25	Default
Post - 08	Specified	0.33	0.35	Default
Post - 09	Specified	0.33	0.4	Default
Post - 10	Specified	0.33	0.35	Default
Post - 11	Specified	0.33	0.35	Default
Check Only (Road Pre)	Specified	0.2	0.33	Default

Global Results Summary

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pre - 01	0.01	0.04	01Jan2022, 12:25	66.36
Pre - 02	0.13	0.77	01Jan2022, 12:25	66.36
Pre - 03	0.06	0.38	01Jan2022, 12:25	66.36
Pre - 04	0.06	0.29	01Jan2022, 12:20	44.61
Pre - 05	0.09	0.63	01Jan2022, 12:20	66.36
Post - 01	0.01	0.06	01Jan2022, 12:20	75.16
Post - 02	0.13	0.72	01Jan2022, 12:25	67.38
Post - 03	0.04	0.35	01Jan2022, 12:20	79.75
Post - 04	0.02	0.21	01Jan2022, 12:20	80.45
Post - 05	0.03	0.28	01Jan2022, 12:20	91.5
Post - 06	0	0.02	01Jan2022, 12:20	44.27
Post - 07	0	0.03	01Jan2022, 12:20	79.56
Post - 08	0.02	0.17	01Jan2022, 12:20	79.56
Post - 09	0.01	0.09	01Jan2022, 12:20	66.19
Post - 10	0.03	0.29	01Jan2022, 12:20	91.5
Post - 11	0.02	0.19	01Jan2022, 12:20	88.54
Check Point (pre)	0.35	2.11	01Jan2022, 12:20	62.4
Check Point (post)	0.33	2.05	01Jan2022, 12:20	51.92
Check Only (Road Pre)	0.03	0.24	01Jan2022, 12:15	66.36
Attenuation Pond	0	0	31Dec2021, 24:00	Not specified
Road Attenuation (lumped)	0	0	31Dec2021, 24:00	Not specified

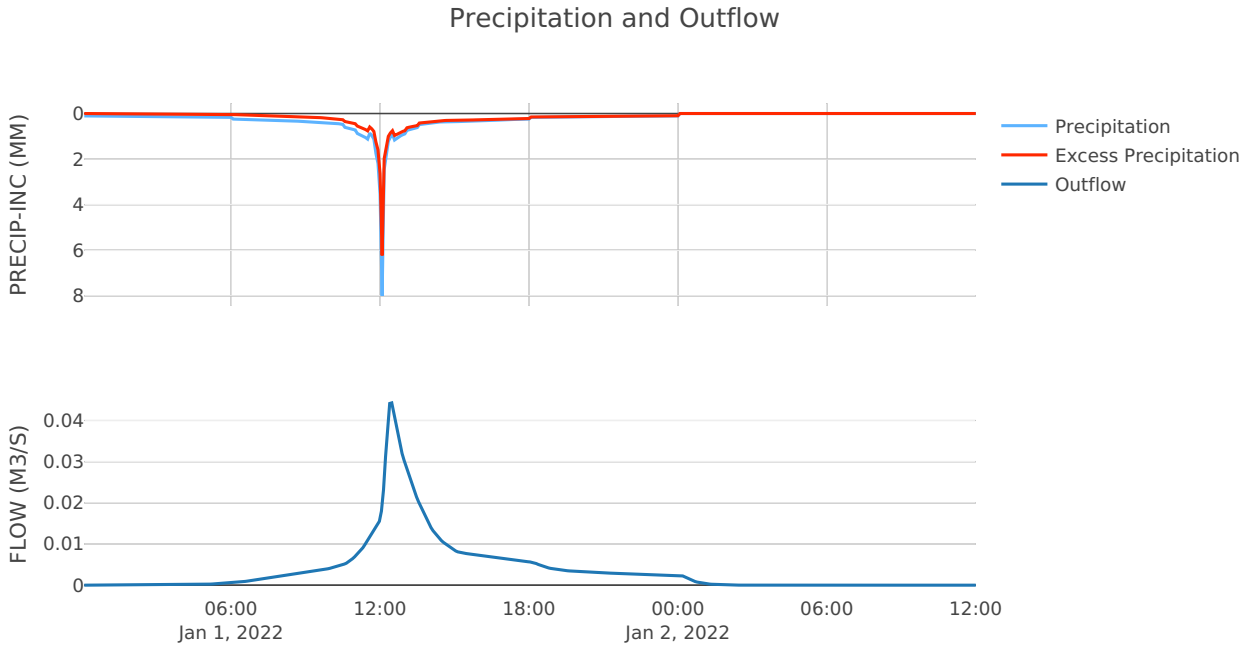
Subbasin: Pre-01

Area (KM2) : 0.01
Downstream : Check Point (pre)

Loss Rate: Scs

Percent Impervious Area	0
Curve Number	86.1

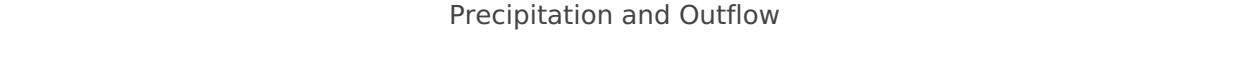
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-01	
Peak Discharge (M3/S)	0.04
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	66.36
Precipitation Volume (M3)	726
Loss Volume (M3)	244.24
Excess Volume (M3)	481.76
Direct Runoff Volume (M3)	481.76
Baseflow Volume (M3)	0

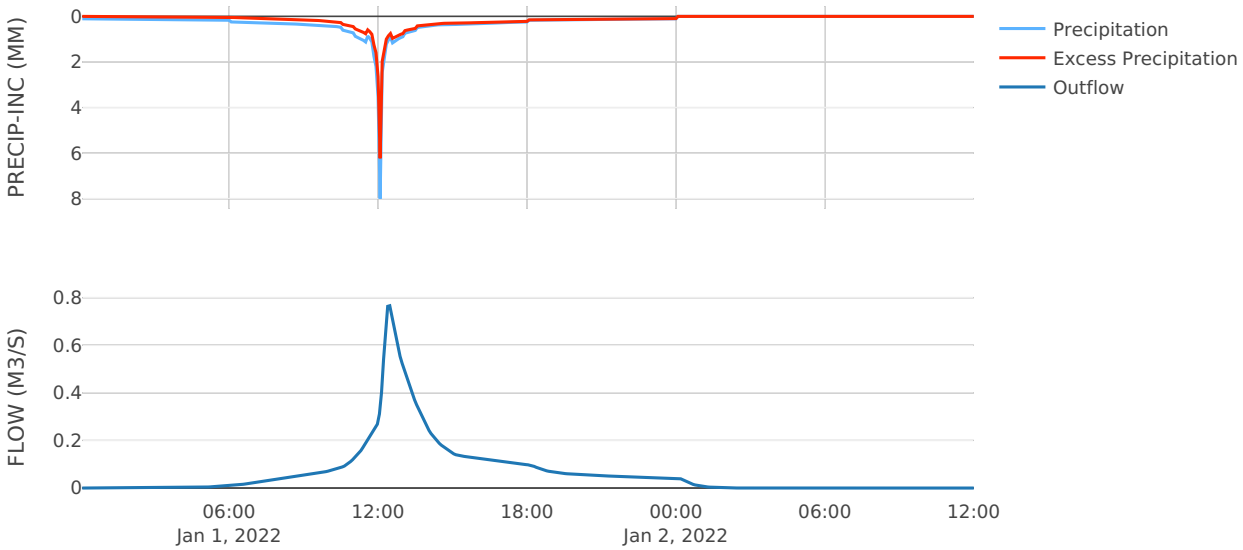


Subbasin: Pre-02

Area (KM2) : 0.13
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-02	
Peak Discharge (M3/S)	0.77
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	66.36
Precipitation Volume (M3)	12559
Loss Volume (M3)	4225.17
Excess Volume (M3)	8333.83
Direct Runoff Volume (M3)	8333.83
Baseflow Volume (M3)	0

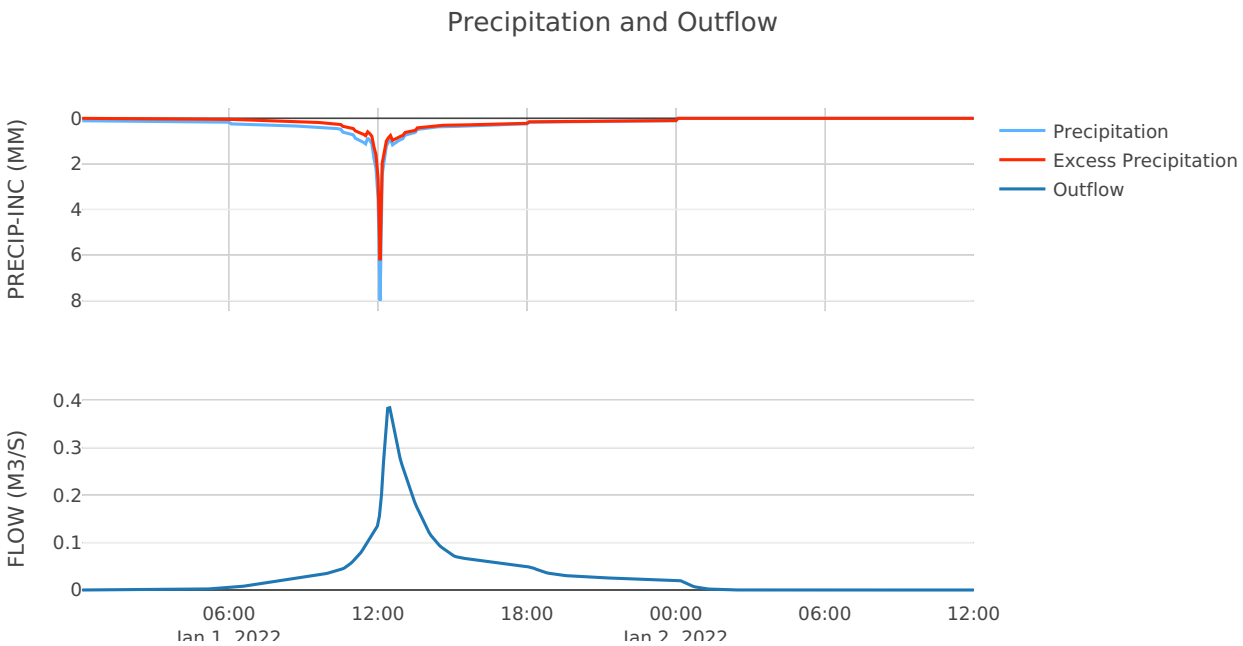




Subbasin: Pre-03

Area (KM2) : 0.06
Downstream : Check Point (pre)

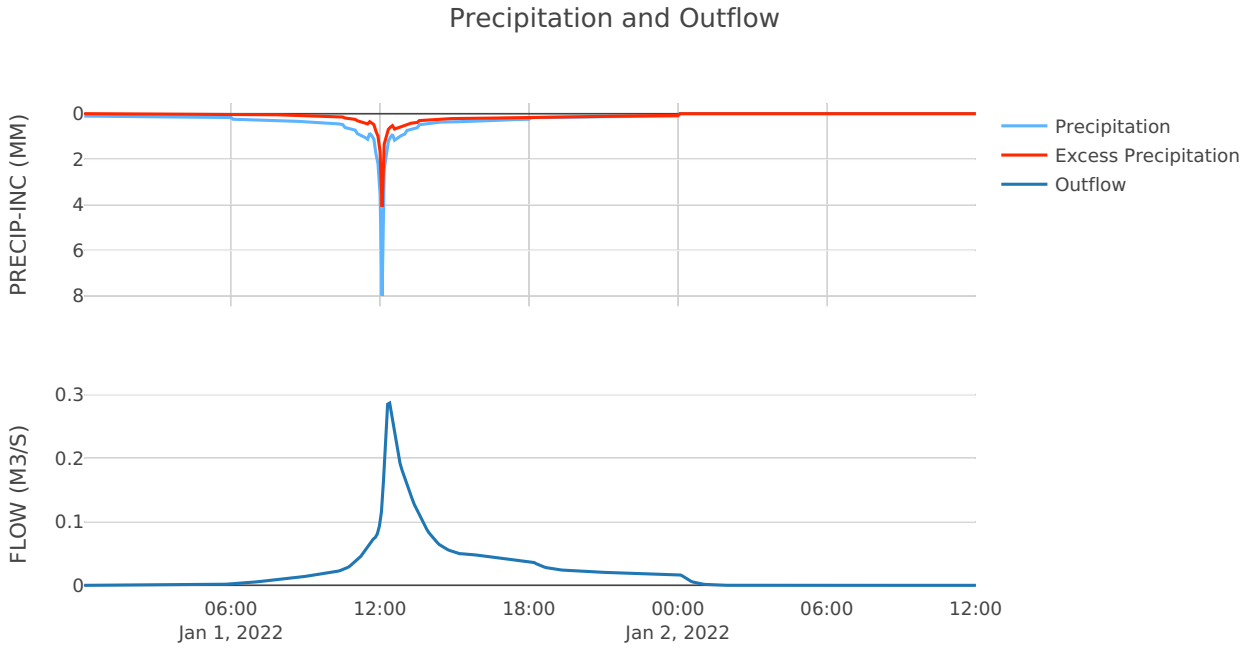
Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-03	
Peak Discharge (M3/S)	0.38
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	66.36
Precipitation Volume (M3)	6298.8
Loss Volume (M3)	2119.08
Excess Volume (M3)	4179.72
Direct Runoff Volume (M3)	4179.72
Baseflow Volume (M3)	0



Subbasin: Pre-04

Area (KM2) : 0.06
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70.3
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.22
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-04	
Peak Discharge (M3/S)	0.29
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	44.61
Precipitation Volume (M3)	6447.9
Loss Volume (M3)	3571.49
Excess Volume (M3)	2876.41
Direct Runoff Volume (M3)	2876.41
Baseflow Volume (M3)	0



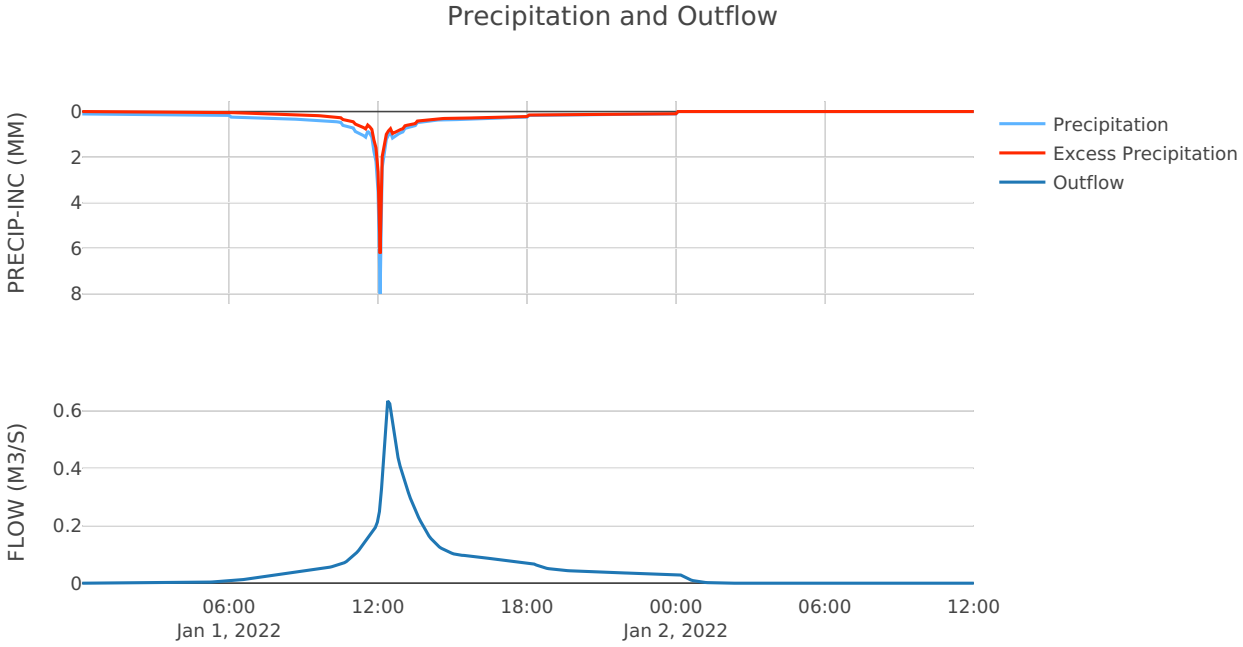
Subbasin: Pre-05

Area (KM2) : 0.09
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-05	

Results: Pre 03

Peak Discharge (M3/S)	0.63
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	66.36
Precipitation Volume (M3)	9391
Loss Volume (M3)	3159.37
Excess Volume (M3)	6231.63
Direct Runoff Volume (M3)	6231.63
Baseflow Volume (M3)	0



Subbasin: Post-01

Area (KM2) : 0.01
Downstream : Soak - Post - 01

Loss Rate: Scs

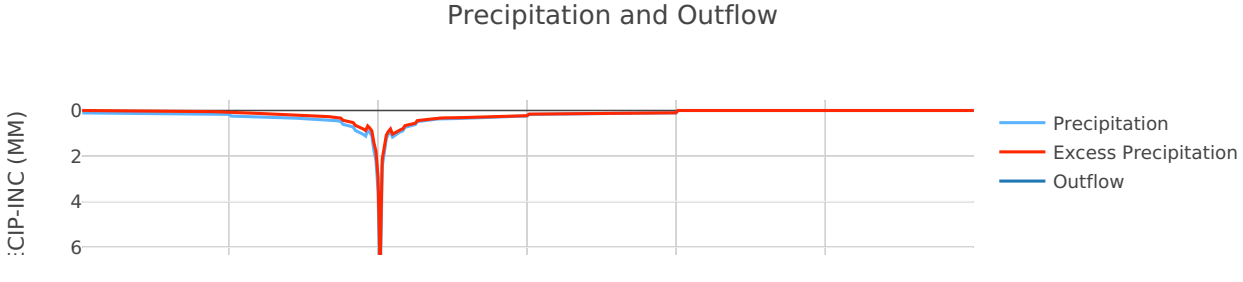
Percent Impervious Area	0
Curve Number	89.3
Initial Abstraction	1.6

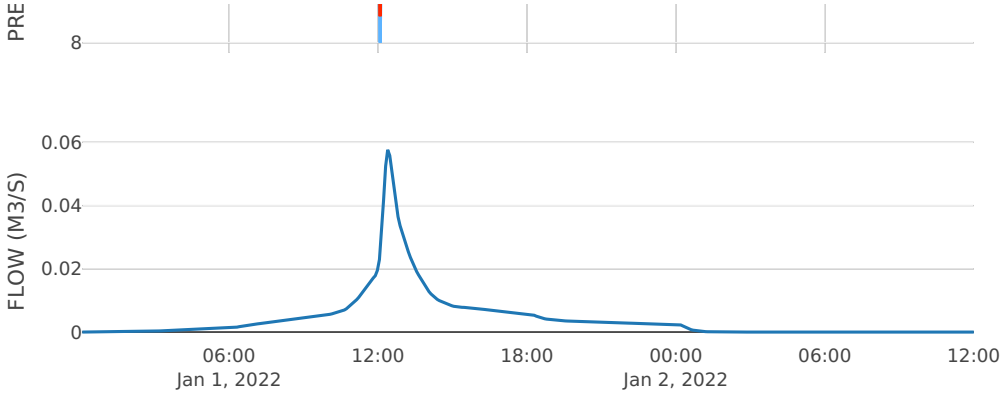
Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-01

Peak Discharge (M3/S)	0.06
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	75.16
Precipitation Volume (M3)	726
Loss Volume (M3)	180.37
Excess Volume (M3)	545.63
Direct Runoff Volume (M3)	545.63
Baseflow Volume (M3)	0

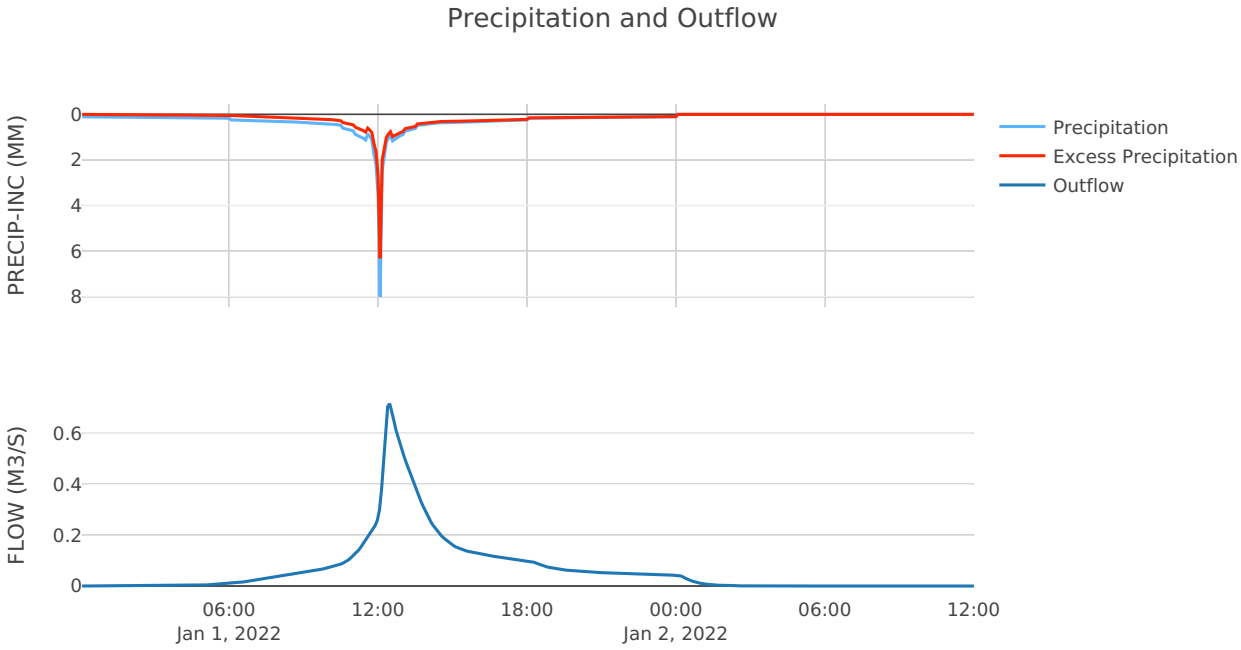




Subbasin: Post-02

Area (KM2) : 0.13
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.6
Initial Abstraction	4.8
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.6
Time Area Method	Default
Results: Post-02	
Peak Discharge (M3/S)	0.72
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	67.38
Precipitation Volume (M3)	12559
Loss Volume (M3)	4096.5
Excess Volume (M3)	8462.5
Direct Runoff Volume (M3)	8462.5
Baseflow Volume (M3)	0

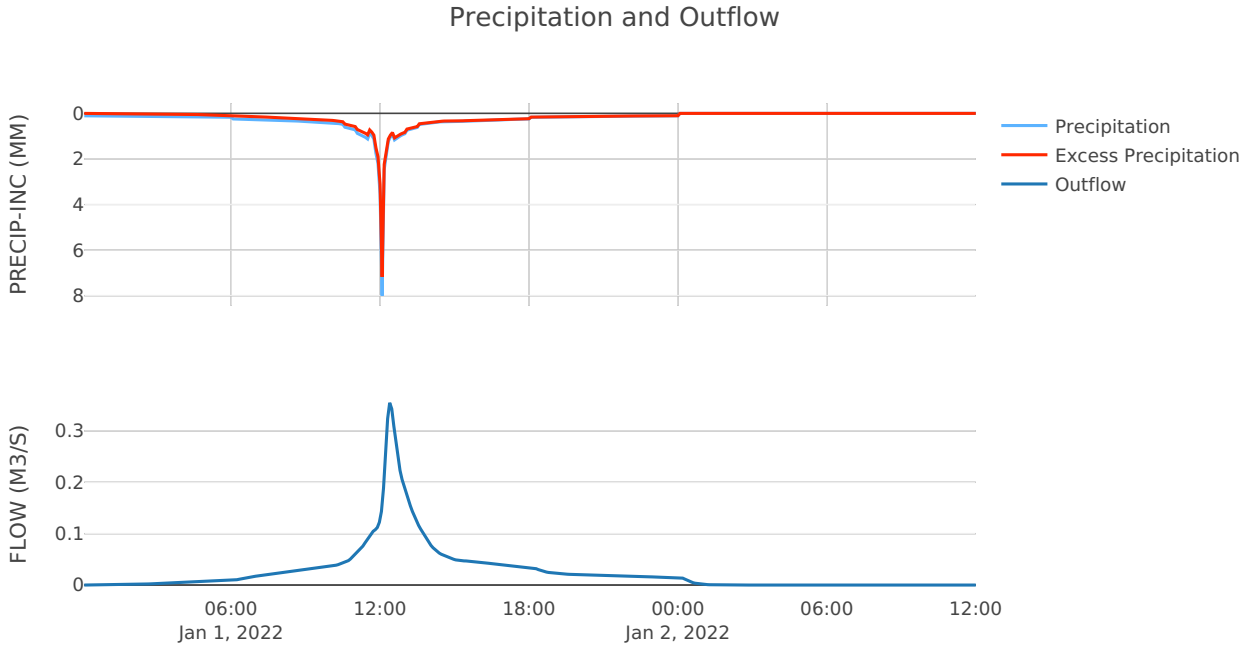


Subbasin: Post-03

Area (KM2) : 0.04

Downstream : Soak - Post - 03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.5
Initial Abstraction	1.2
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-03	
Peak Discharge (M3/S)	0.35
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	79.75
Precipitation Volume (M3)	4243
Loss Volume (M3)	859.07
Excess Volume (M3)	3383.93
Direct Runoff Volume (M3)	3383.93
Baseflow Volume (M3)	0

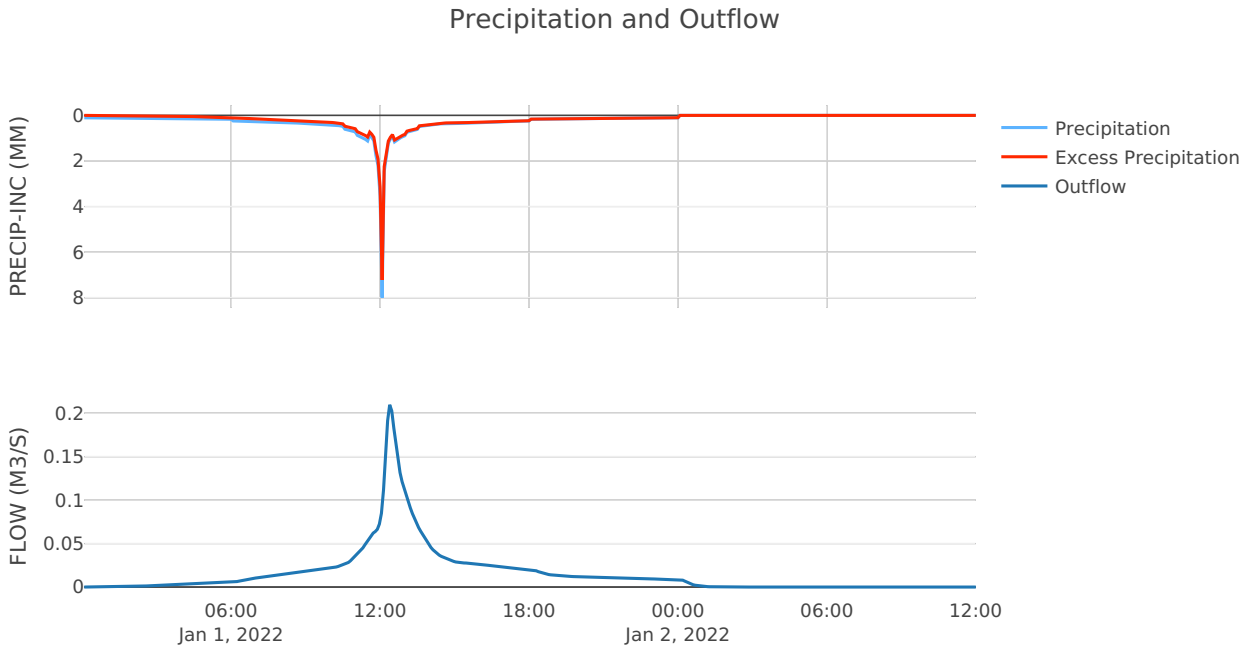


Subbasin: Post-04

Area (KM2) : 0.02
Downstream : Post - Soak - 04

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.8
Initial Abstraction	1.1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-04	
Peak Discharge (M3/S)	0.21
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	80.45
Precipitation Volume (M3)	2490
Loss Volume (M3)	486.91

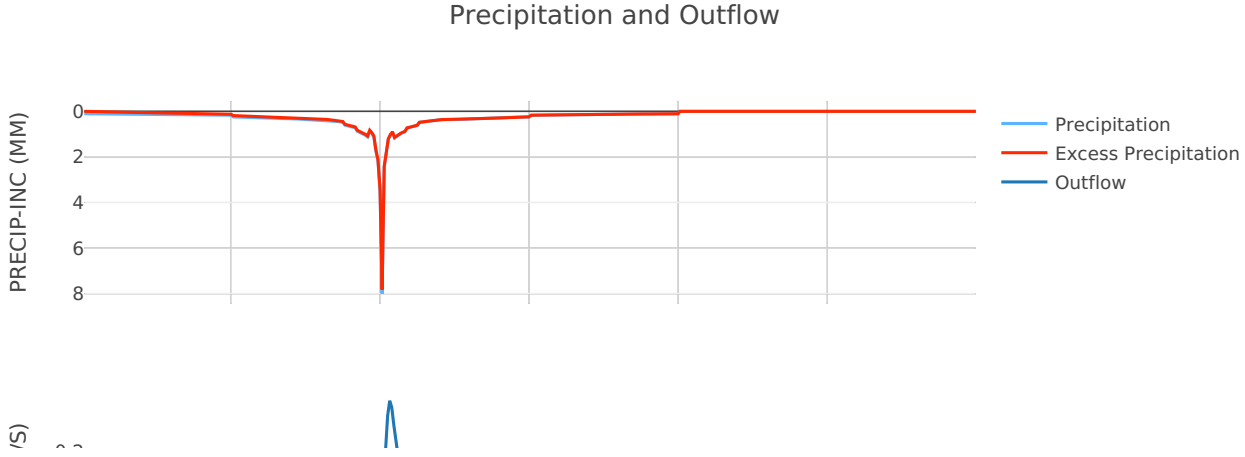
Excess Volume (M3)	2003.09
Direct Runoff Volume (M3)	2003.09
Baseflow Volume (M3)	0

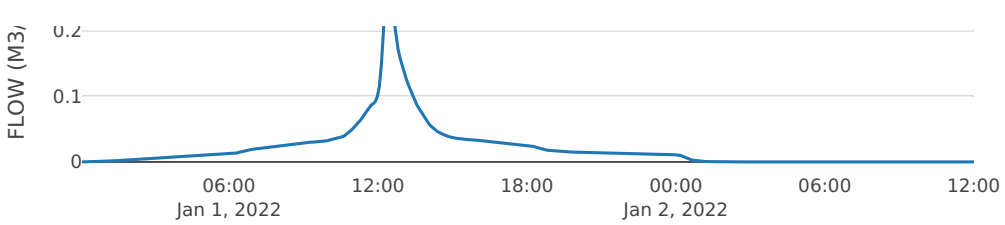


Subbasin: Post-05

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-05	
Peak Discharge (M3/S)	0.28
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	91.5
Precipitation Volume (M3)	3019
Loss Volume (M3)	256.74
Excess Volume (M3)	2762.26
Direct Runoff Volume (M3)	2762.26
Baseflow Volume (M3)	0



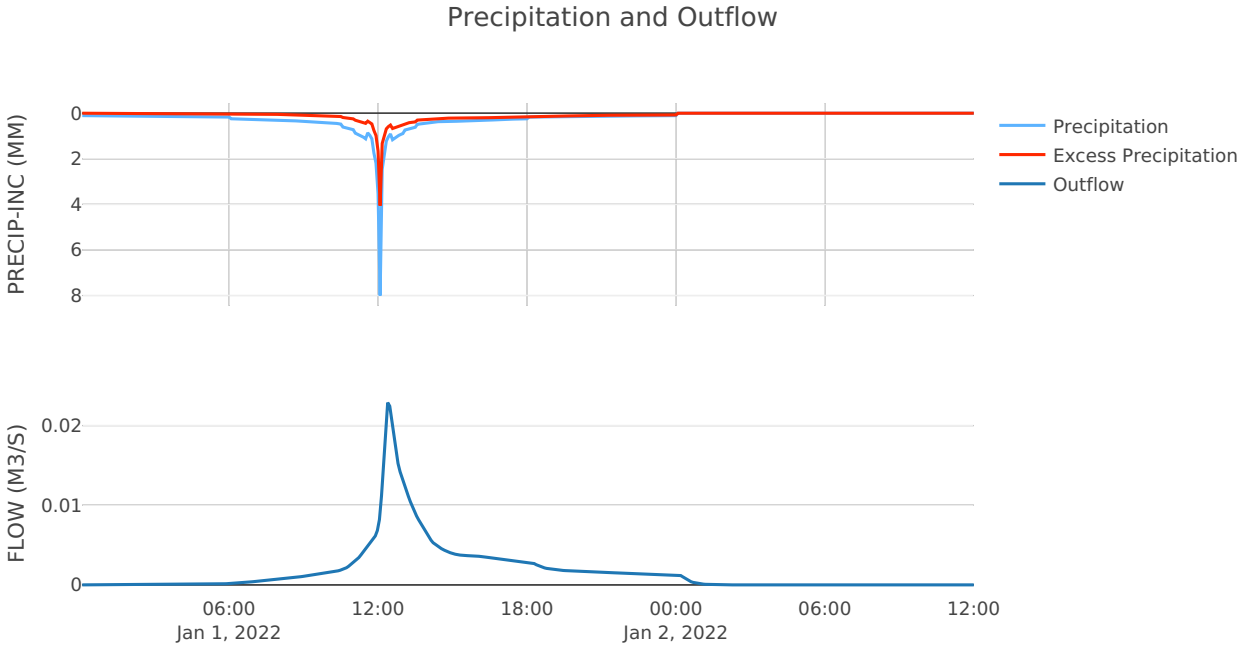


Subbasin: Post-06

Area (KM2) : 0
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-06	
Peak Discharge (M3/S)	0.02
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	44.27
Precipitation Volume (M3)	499
Loss Volume (M3)	278.09
Excess Volume (M3)	220.91
Direct Runoff Volume (M3)	220.91
Baseflow Volume (M3)	0



Subbasin: Post-07

Area (KM2) : 0
Downstream : Post - Soak - 07

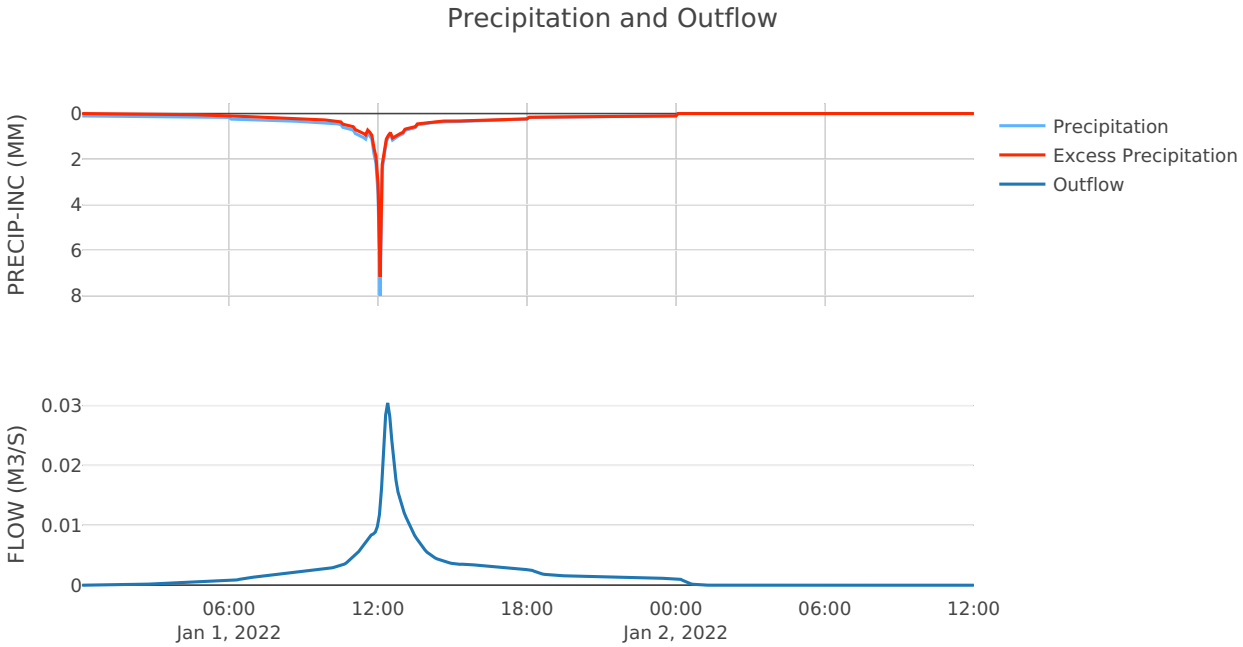
Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.25
Time Area Method	Default

Results: Post-07

Peak Discharge (M3/S)	0.03
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	79.56
Precipitation Volume (M3)	321.3
Loss Volume (M3)	65.69
Excess Volume (M3)	255.61
Direct Runoff Volume (M3)	255.61
Baseflow Volume (M3)	0



Subbasin: Post-08

Area (KM2) : 0.02
Downstream : Post - Soak - 08

Loss Rate: Scs

Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

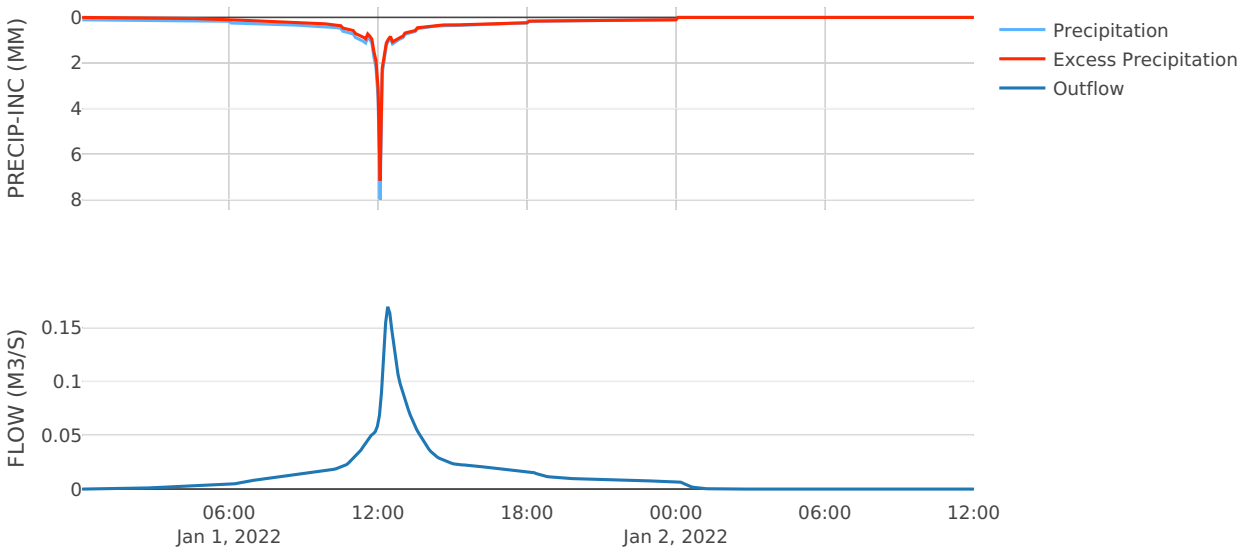
Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-08

Peak Discharge (M3/S)	0.17
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	79.56
Precipitation Volume (M3)	2030
Loss Volume (M3)	415.02
Excess Volume (M3)	1614.98
Direct Runoff Volume (M3)	1614.98
Baseflow Volume (M3)	0



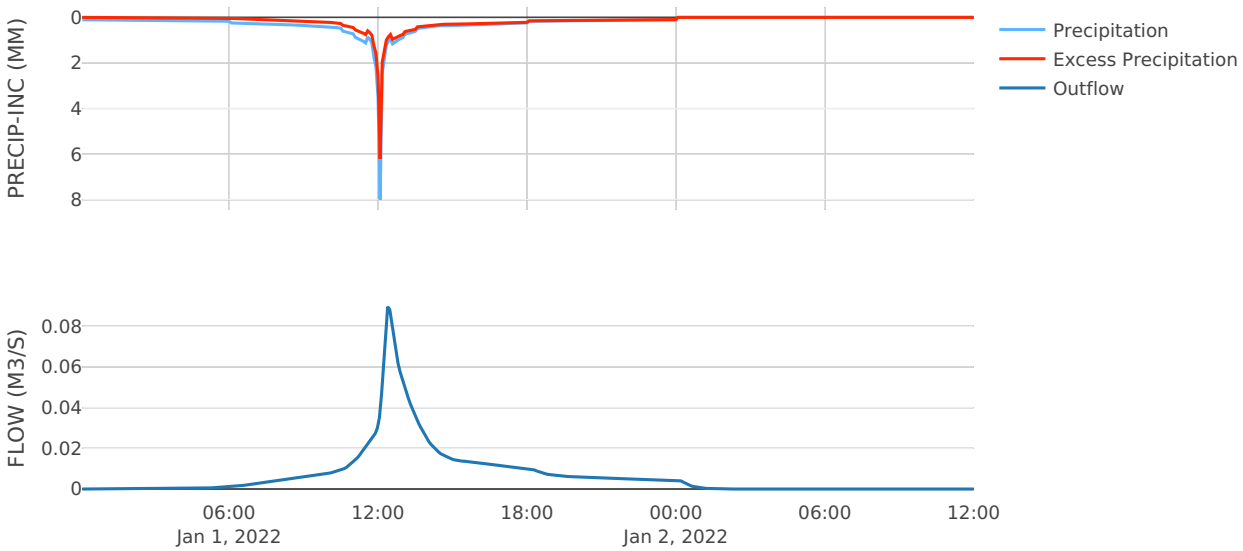


Subbasin: Post-09

Area (KM2) : 0.01
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Post-09	
Peak Discharge (M3/S)	0.09
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	66.19
Precipitation Volume (M3)	1329
Loss Volume (M3)	449.33
Excess Volume (M3)	879.67
Direct Runoff Volume (M3)	879.67
Baseflow Volume (M3)	0

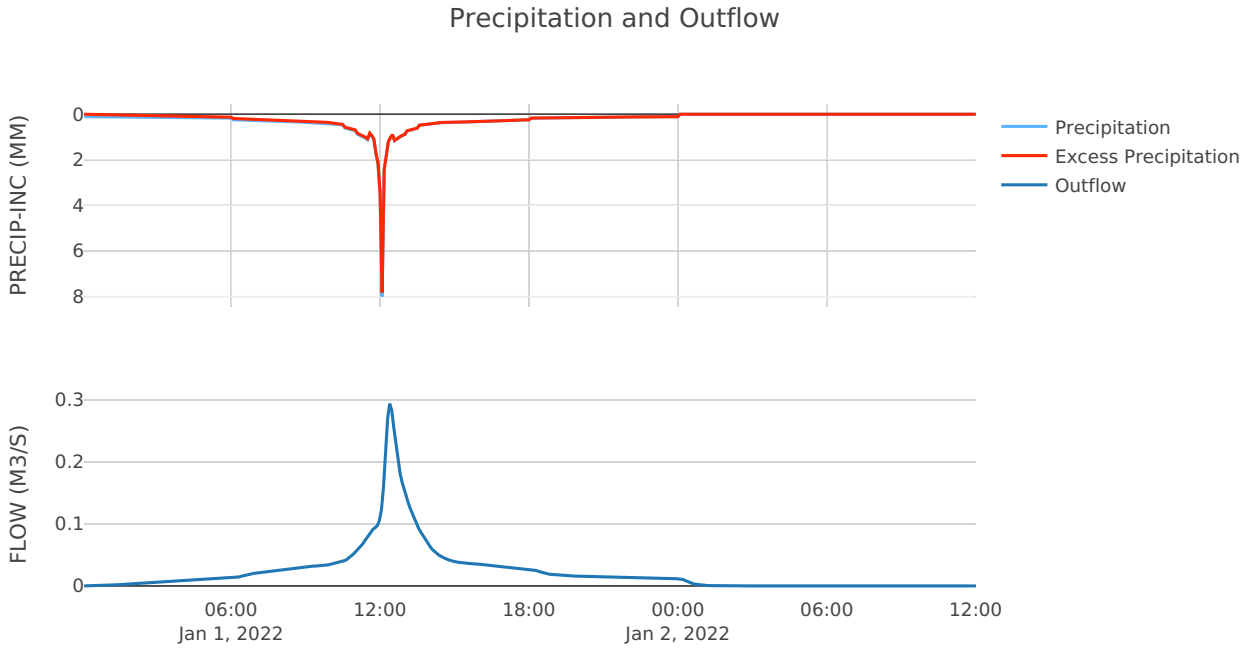
Precipitation and Outflow



Subbasin: Post-10

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-10	
Peak Discharge (M3/S)	0.29
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	91.5
Precipitation Volume (M3)	3198
Loss Volume (M3)	271.97
Excess Volume (M3)	2926.03
Direct Runoff Volume (M3)	2926.03
Baseflow Volume (M3)	0

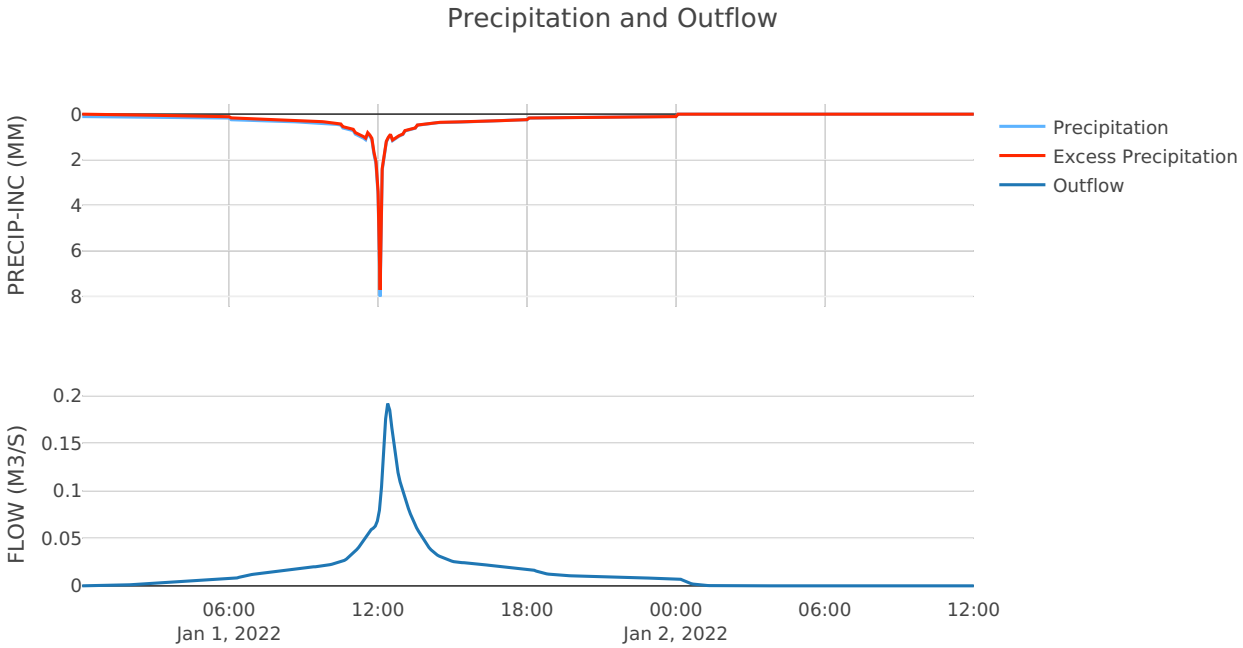


Subbasin: Post-11

Area (KM2) : 0.02
Downstream : Post - Soak - 11

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	95.6
Initial Abstraction	1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-11	

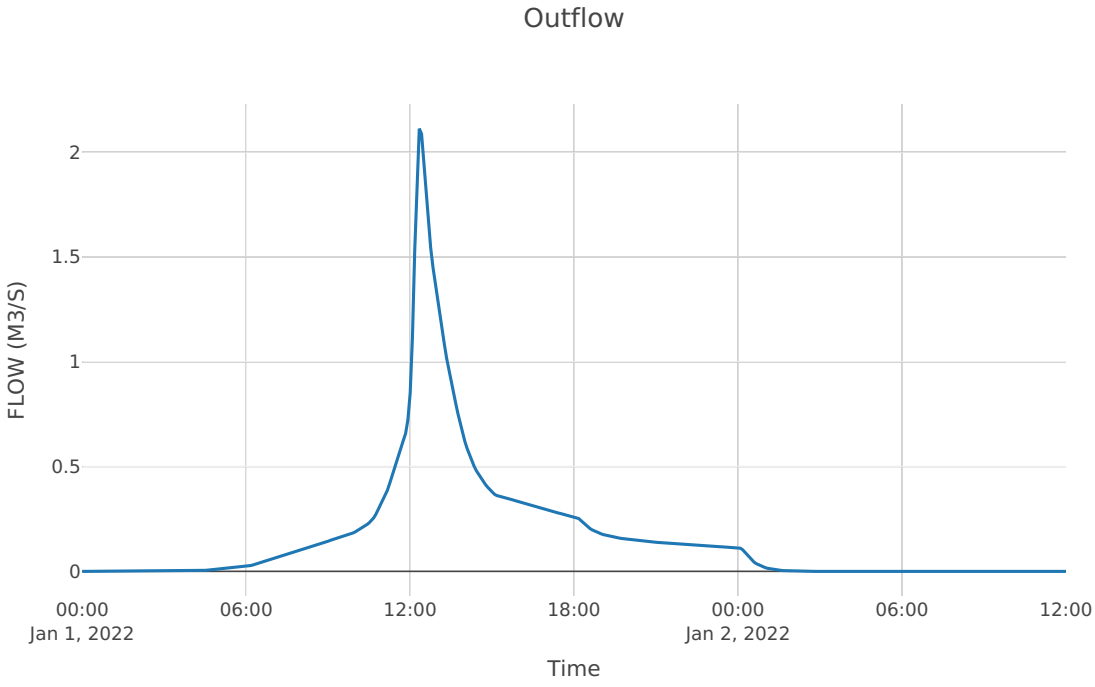
Peak Discharge (M3/S)	0.19
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	88.54
Precipitation Volume (M3)	2117.6
Loss Volume (M3)	242.59
Excess Volume (M3)	1875.01
Direct Runoff Volume (M3)	1875.01
Baseflow Volume (M3)	0



Junction: Check Point (pre)

Results: Check Point (pre)

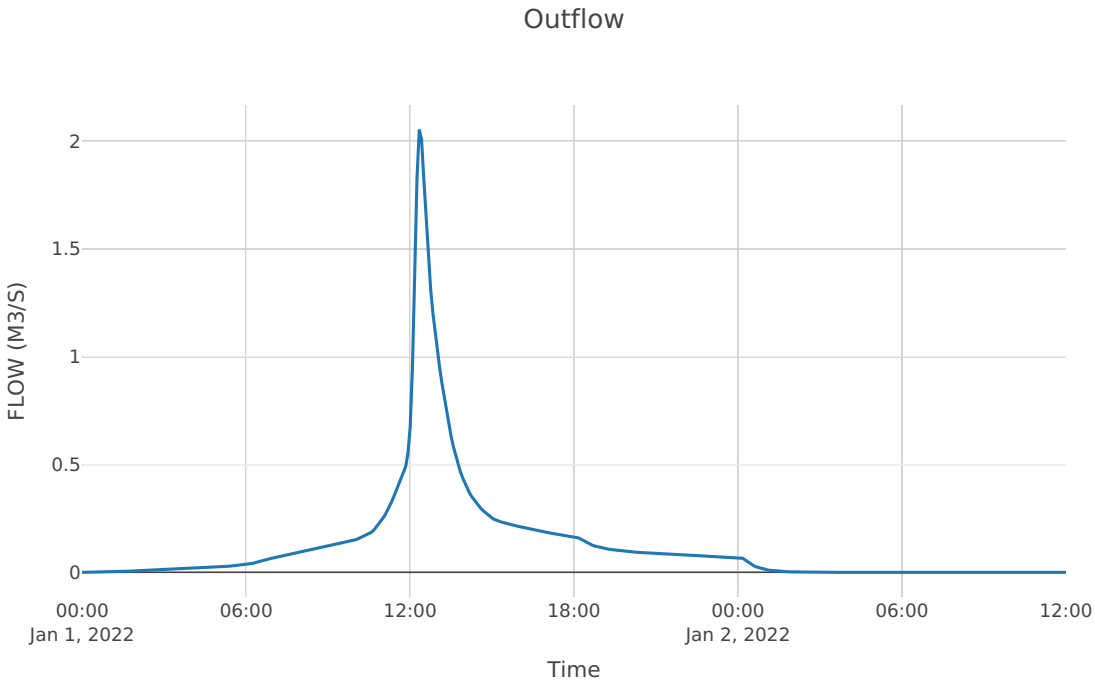
Peak Discharge (M3/S)	2.11
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	62.4



Junction: Check Point (post)

Results: Check Point (post)

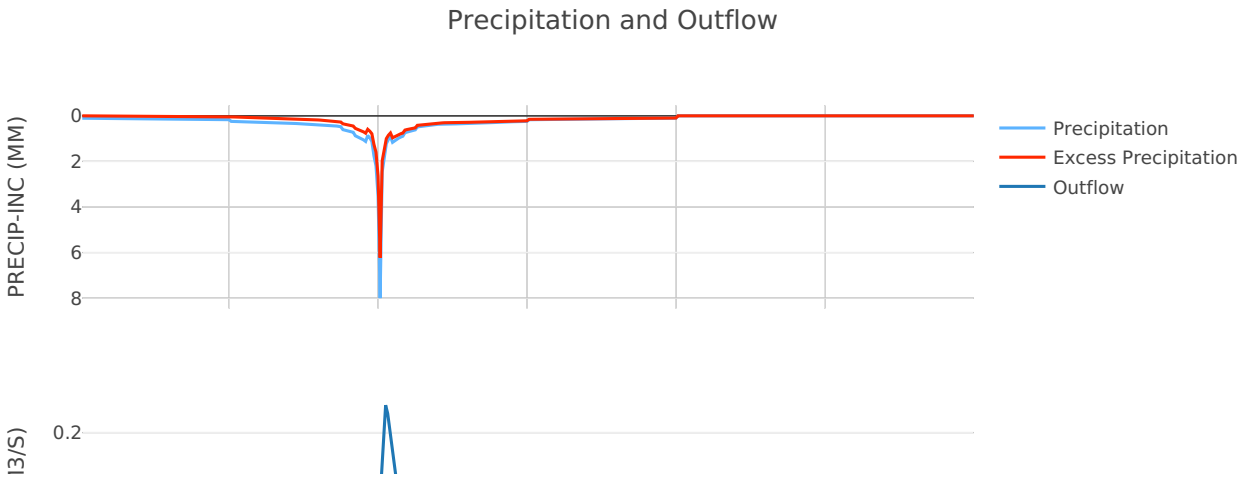
Peak Discharge (M3/S)	2.05
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	51.92

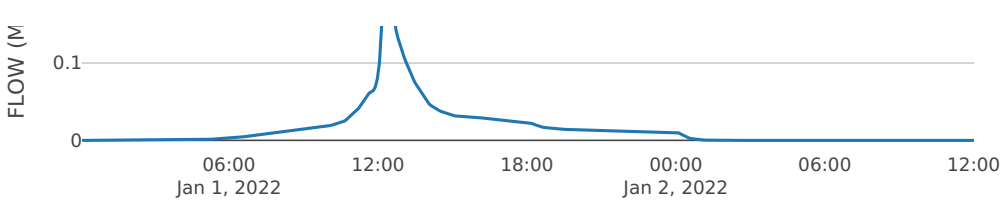


Subbasin: Check Only (Road Pre)

Area (KM2) : 0.03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.2
Storage Coefficient	0.33
Time Area Method	Default
Results: Check Only (Road Pre)	
Peak Discharge (M3/S)	0.24
Time of Peak Discharge	01Jan2022, 12:15
Volume (MM)	66.36
Precipitation Volume (M3)	3086
Loss Volume (M3)	1038.21
Excess Volume (M3)	2047.79
Direct Runoff Volume (M3)	2047.79
Baseflow Volume (M3)	0

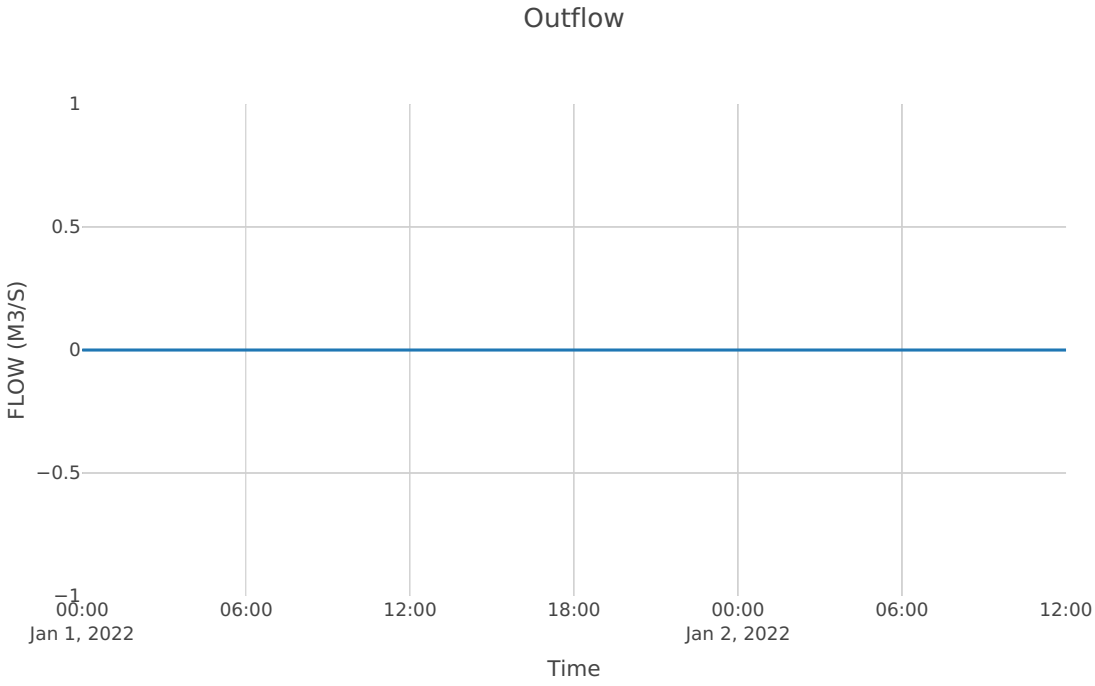




Reservoir: Attenuation Pond

Results: Attenuation Pond

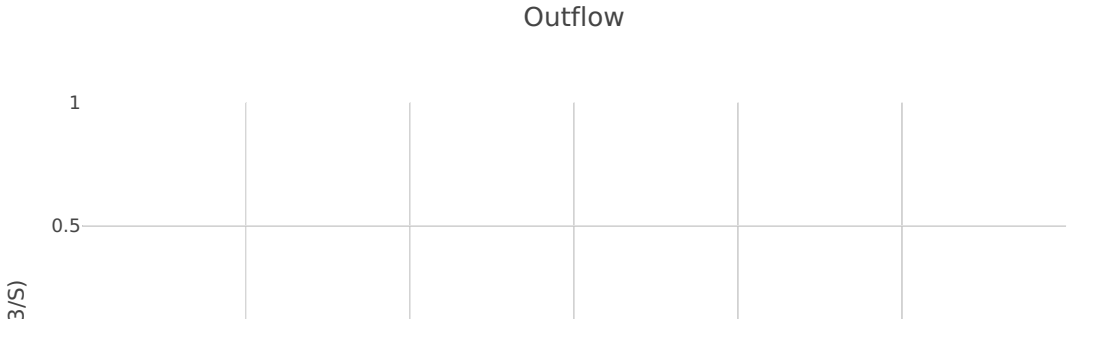
Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	723.39
Discharge Volume (M3)	0

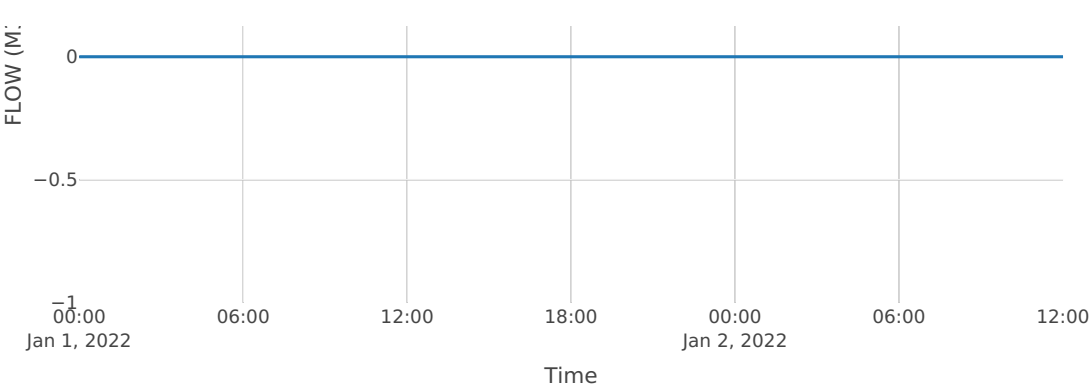


Reservoir: Road Attenuation (lumped)

Results: Road Attenuation (lumped)

Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	5.5
Peak Elevation (M)	0.01
Discharge Volume (M3)	0




FLOW (M
0
−0.5
−1
00:00
Jan 1, 2022
06:00
12:00
18:00
00:00
Jan 2, 2022
06:00
12:00
Time

Project: 1942_02_HEC_Model

Simulation Run: Run 3

Simulation Start: 31 December 2021, 24:00

Simulation End: 2 January 2022, 12:00

HMS Version: 4.13

Executed: 22 October 2026, 03:58

Global Parameter Summary - Subbasin

Area (KM2)

Element Name	Area (KM2)
Pre - 01	0.01
Pre - 02	0.13
Pre - 03	0.06
Pre - 04	0.06
Pre - 05	0.09
Post - 01	0.01
Post - 02	0.13
Post - 03	0.04
Post - 04	0.02
Post - 05	0.03
Post - 06	0
Post - 07	0
Post - 08	0.02
Post - 09	0.01
Post - 10	0.03
Post - 11	0.02
Check Only (Road Pre)	0.03

Downstream

Element Name	Downstream
Pre - 01	Check Point (pre)
Pre - 02	Check Point (pre)
Pre - 03	Check Point (pre)
Pre - 04	Check Point (pre)
Pre - 05	Check Point (pre)
Post - 01	Soak - Post - 01
Post - 02	Check Point (post)
Post - 03	Soak - Post - 03
Post - 04	Post - Soak - 04
Post - 05	Check Point (post)
Post - 06	Check Point (post)
Post - 07	Post - Soak - 07
Post - 08	Post - Soak - 08
Post - 09	Check Point (post)
Post - 10	Check Point (post)
Post - 11	Post - Soak - 11

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
Pre - 01	0	86.1	5
Pre - 02	0	86.1	5
Pre - 03	0	86.1	5
Pre - 04	0	70.3	5
Pre - 05	0	86.1	5
Post - 01	0	89.3	1.6
Post - 02	0	86.6	4.8
Post - 03	0	91.5	1.2

Post - 04	0	91.8	1.1
Post - 05	0	96.6	0.3
Post - 06	0	70	5
Post - 07	0	91.4	1.2
Post - 08	0	91.4	1.2
Post - 09	0	86	5
Post - 10	0	96.6	0.3
Post - 11	0	95.6	1
Check Only (Road Pre)	0	86.1	5

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method
Pre - 01	Specified	0.33	0.5	Default
Pre - 02	Specified	0.33	0.5	Default
Pre - 03	Specified	0.33	0.5	Default
Pre - 04	Specified	0.22	0.4	Default
Pre - 05	Specified	0.33	0.4	Default
Post - 01	Specified	0.33	0.35	Default
Post - 02	Specified	0.33	0.6	Default
Post - 03	Specified	0.33	0.35	Default
Post - 04	Specified	0.33	0.35	Default
Post - 05	Specified	0.33	0.35	Default
Post - 06	Specified	0.33	0.35	Default
Post - 07	Specified	0.33	0.25	Default
Post - 08	Specified	0.33	0.35	Default
Post - 09	Specified	0.33	0.4	Default
Post - 10	Specified	0.33	0.35	Default
Post - 11	Specified	0.33	0.35	Default
Check Only (Road Pre)	Specified	0.2	0.33	Default

Global Results Summary

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pre - 01	0.01	0.05	01Jan2022, 12:25	80.13
Pre - 02	0.13	0.92	01Jan2022, 12:25	80.13
Pre - 03	0.06	0.46	01Jan2022, 12:25	80.13
Pre - 04	0.06	0.36	01Jan2022, 12:20	55.68
Pre - 05	0.09	0.77	01Jan2022, 12:20	80.13
Post - 01	0.01	0.07	01Jan2022, 12:20	89.41
Post - 02	0.13	0.86	01Jan2022, 12:25	81.23
Post - 03	0.04	0.42	01Jan2022, 12:20	94.26
Post - 04	0.02	0.25	01Jan2022, 12:20	94.98
Post - 05	0.03	0.32	01Jan2022, 12:20	106.41
Post - 06	0	0.03	01Jan2022, 12:20	55.29
Post - 07	0	0.04	01Jan2022, 12:20	94.05
Post - 08	0.02	0.2	01Jan2022, 12:20	94.05
Post - 09	0.01	0.11	01Jan2022, 12:20	79.95
Post - 10	0.03	0.34	01Jan2022, 12:20	106.41
Post - 11	0.02	0.22	01Jan2022, 12:20	103.4
Check Point (pre)	0.35	2.56	01Jan2022, 12:20	75.68
Check Point (post)	0.33	2.48	01Jan2022, 12:20	62.88
Check Only (Road Pre)	0.03	0.28	01Jan2022, 12:15	80.13
Attenuation Pond	0	0	31Dec2021, 24:00	Not specified
Road Attenuation (lumped)	0	0	31Dec2021, 24:00	Not specified

Subbasin: Pre-01

Area (KM2) : 0.01
Downstream : Check Point (pre)

Loss Rate: Scs

Percent Impervious Area	0
Curve Number	86.1

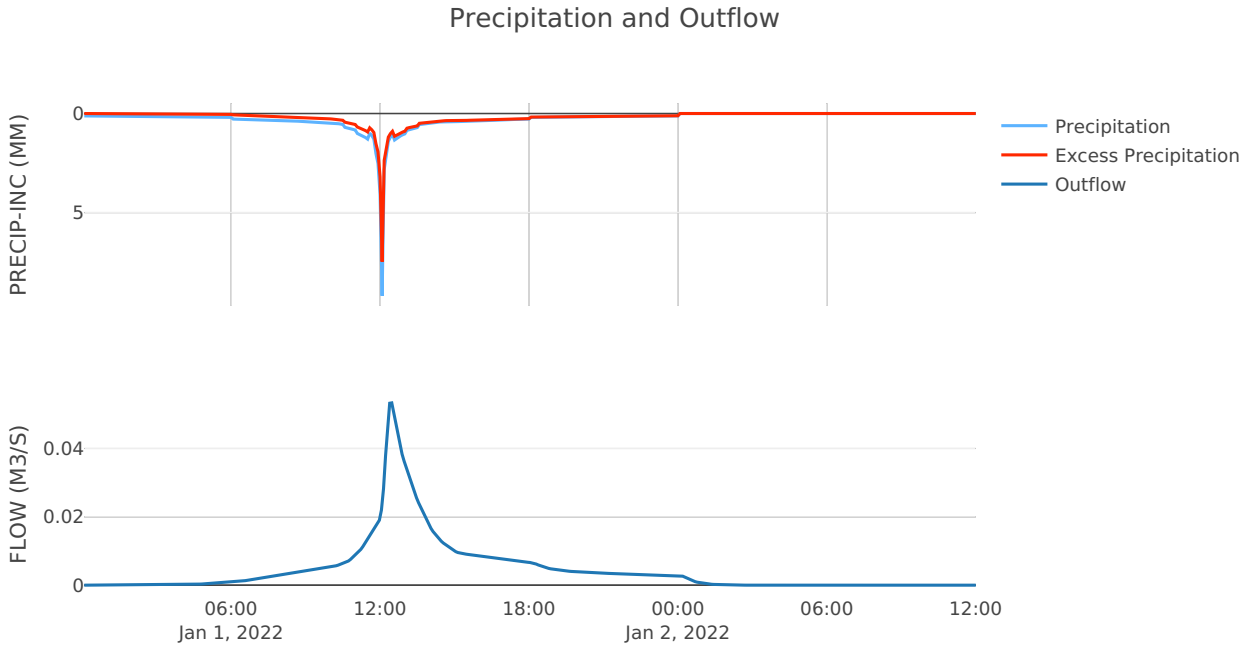
Initial Abstraction	5

Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default

Results: Pre-01

Peak Discharge (M3/S)	0.05
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	80.13
Precipitation Volume (M3)	834.9
Loss Volume (M3)	253.16
Excess Volume (M3)	581.74
Direct Runoff Volume (M3)	581.74
Baseflow Volume (M3)	0



Subbasin: Pre-02

Area (KM2) : 0.13
Downstream : Check Point (pre)

Loss Rate: Scs

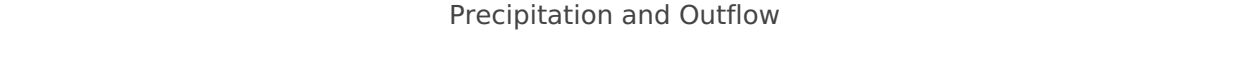
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5

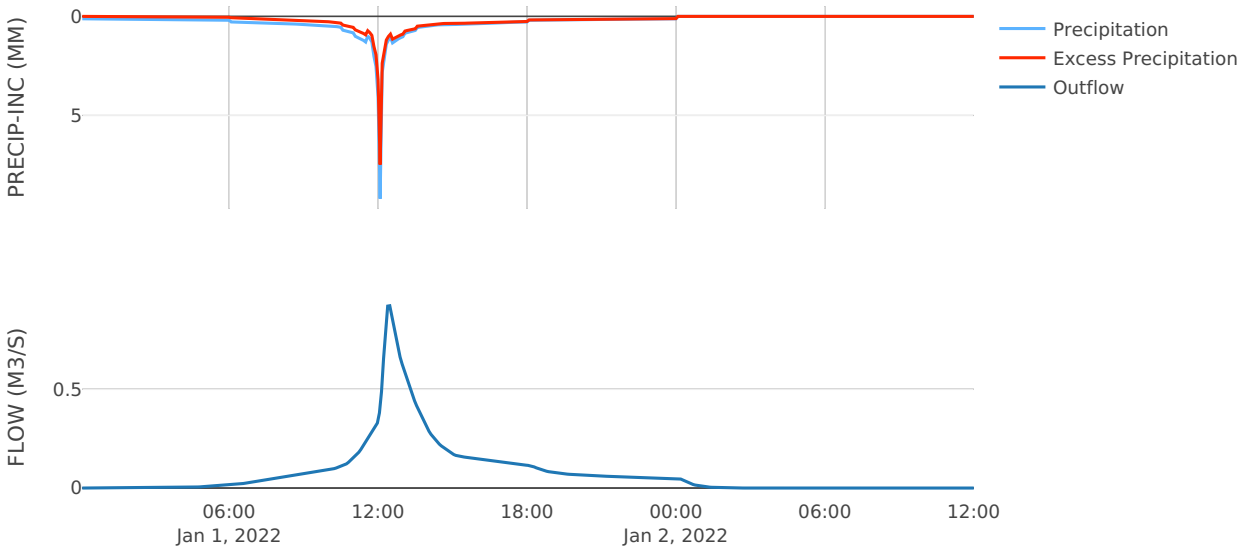
Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default

Results: Pre-02

Peak Discharge (M3/S)	0.92
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	80.13
Precipitation Volume (M3)	14442.85
Loss Volume (M3)	4379.4
Excess Volume (M3)	10063.45
Direct Runoff Volume (M3)	10063.45
Baseflow Volume (M3)	0





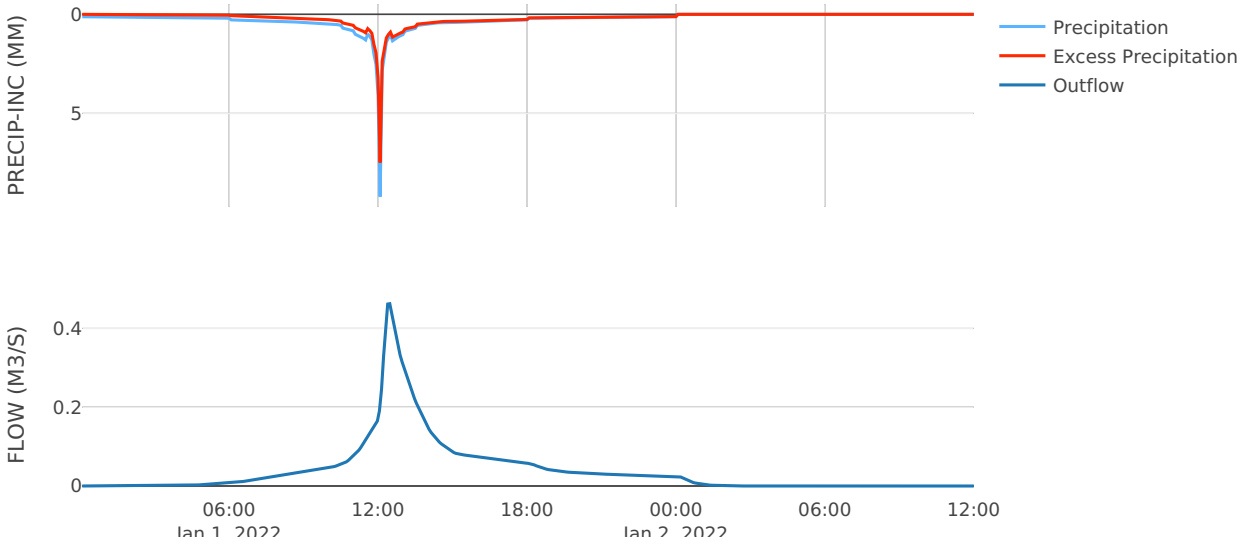
Subbasin: Pre-03

Area (KM2) : 0.06
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default

Results: Pre-03	
Peak Discharge (M3/S)	0.46
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	80.13
Precipitation Volume (M3)	7243.62
Loss Volume (M3)	2196.43
Excess Volume (M3)	5047.19
Direct Runoff Volume (M3)	5047.19
Baseflow Volume (M3)	0

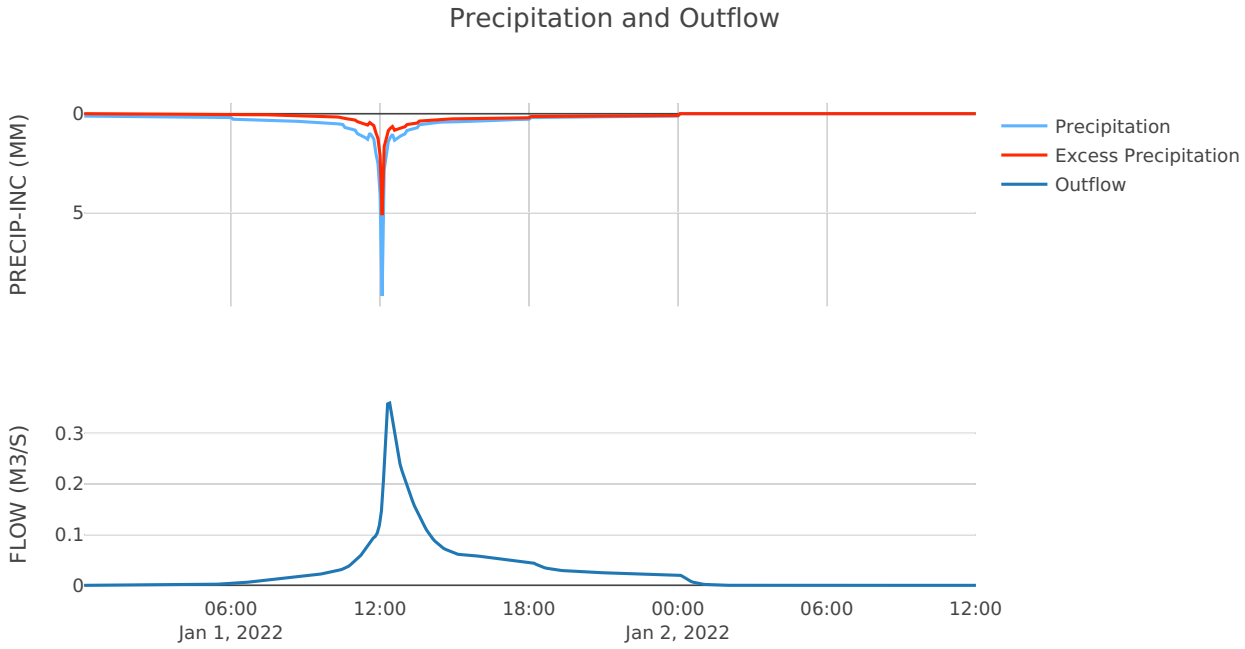
Precipitation and Outflow



Subbasin: Pre-04

Area (KM2) : 0.06
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70.3
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.22
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-04	
Peak Discharge (M3/S)	0.36
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	55.68
Precipitation Volume (M3)	7415.09
Loss Volume (M3)	3824.82
Excess Volume (M3)	3590.27
Direct Runoff Volume (M3)	3590.27
Baseflow Volume (M3)	0

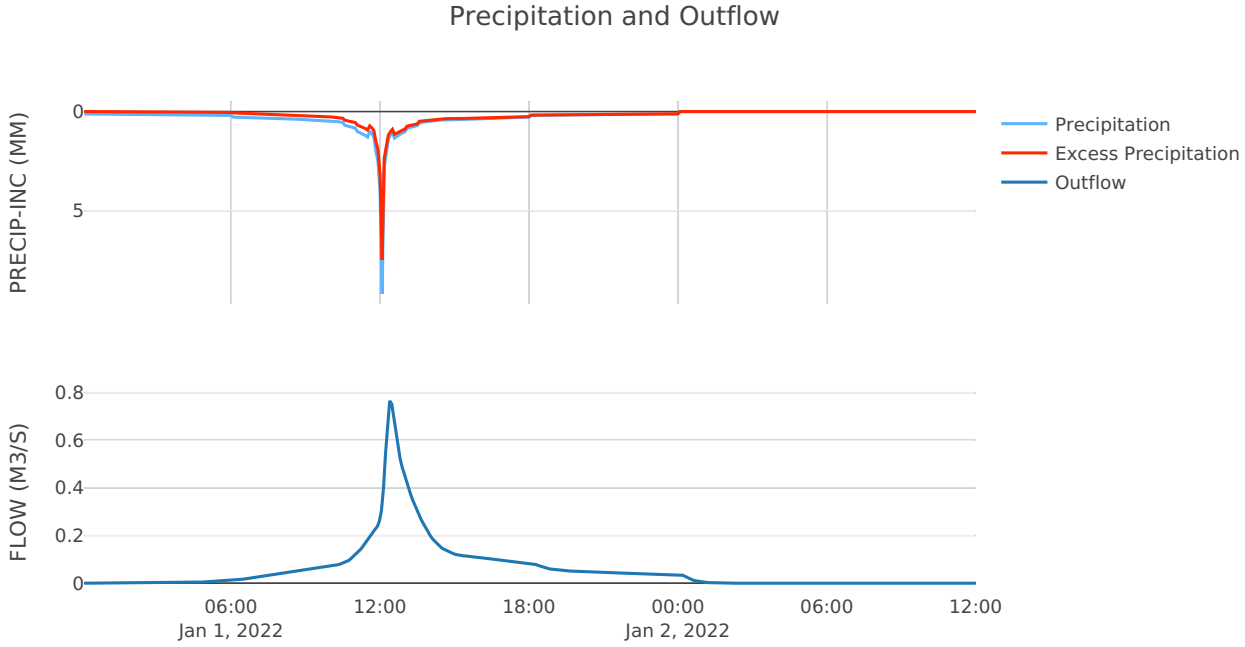


Subbasin: Pre-05

Area (KM2) : 0.09
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-05	

Peak Discharge (M3/S)	0.77
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	80.13
Precipitation Volume (M3)	10799.65
Loss Volume (M3)	3274.7
Excess Volume (M3)	7524.95
Direct Runoff Volume (M3)	7524.95
Baseflow Volume (M3)	0

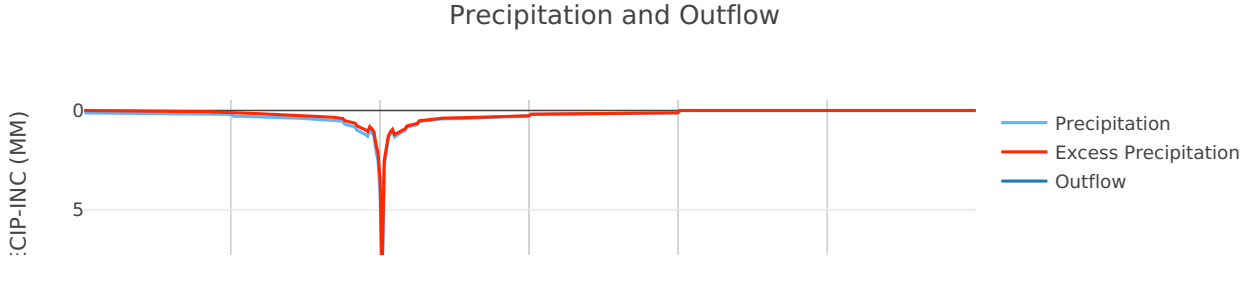


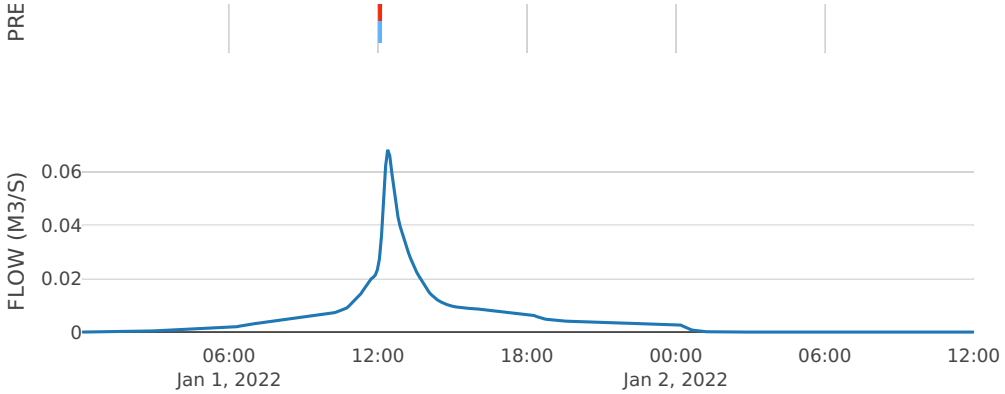
Subbasin: Post-01

Area (KM2) : 0.01
Downstream : Soak - Post - 01

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	89.3
Initial Abstraction	1.6
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-01	
Peak Discharge (M3/S)	0.07
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	89.41
Precipitation Volume (M3)	834.9
Loss Volume (M3)	185.82
Excess Volume (M3)	649.08
Direct Runoff Volume (M3)	649.08
Baseflow Volume (M3)	0

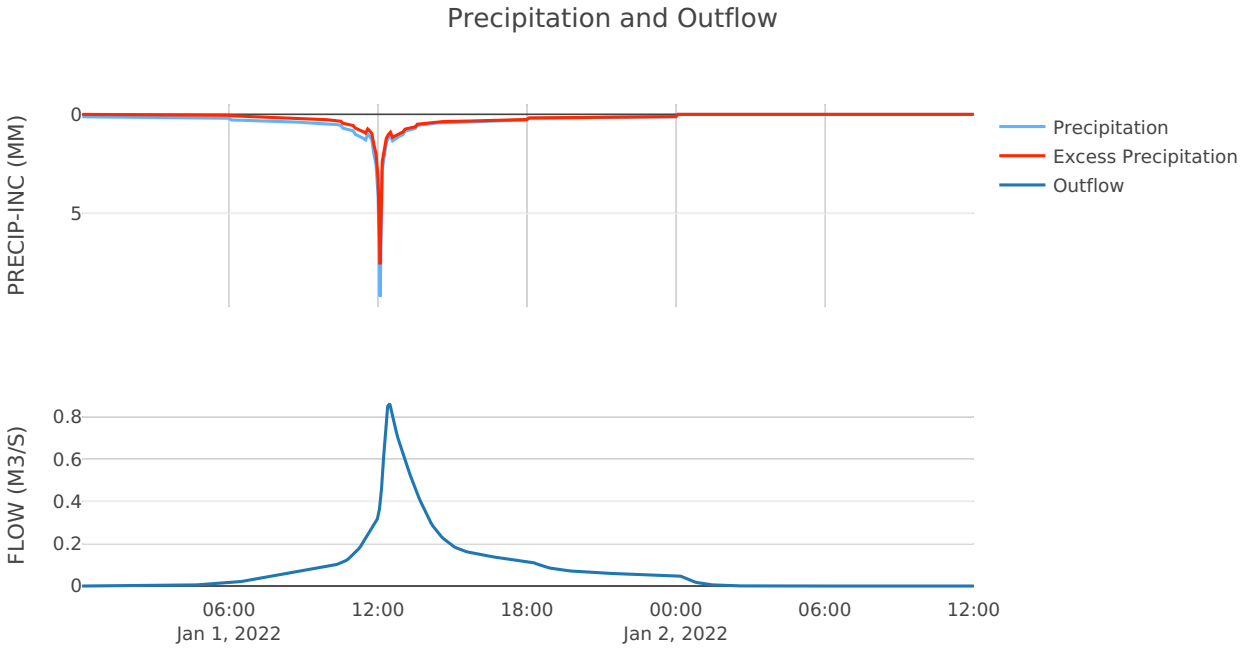




Subbasin: Post-02

Area (KM2) : 0.13
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.6
Initial Abstraction	4.8
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.6
Time Area Method	Default
Results: Post-02	
Peak Discharge (M3/S)	0.86
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	81.23
Precipitation Volume (M3)	14442.85
Loss Volume (M3)	4241.22
Excess Volume (M3)	10201.63
Direct Runoff Volume (M3)	10201.63
Baseflow Volume (M3)	0

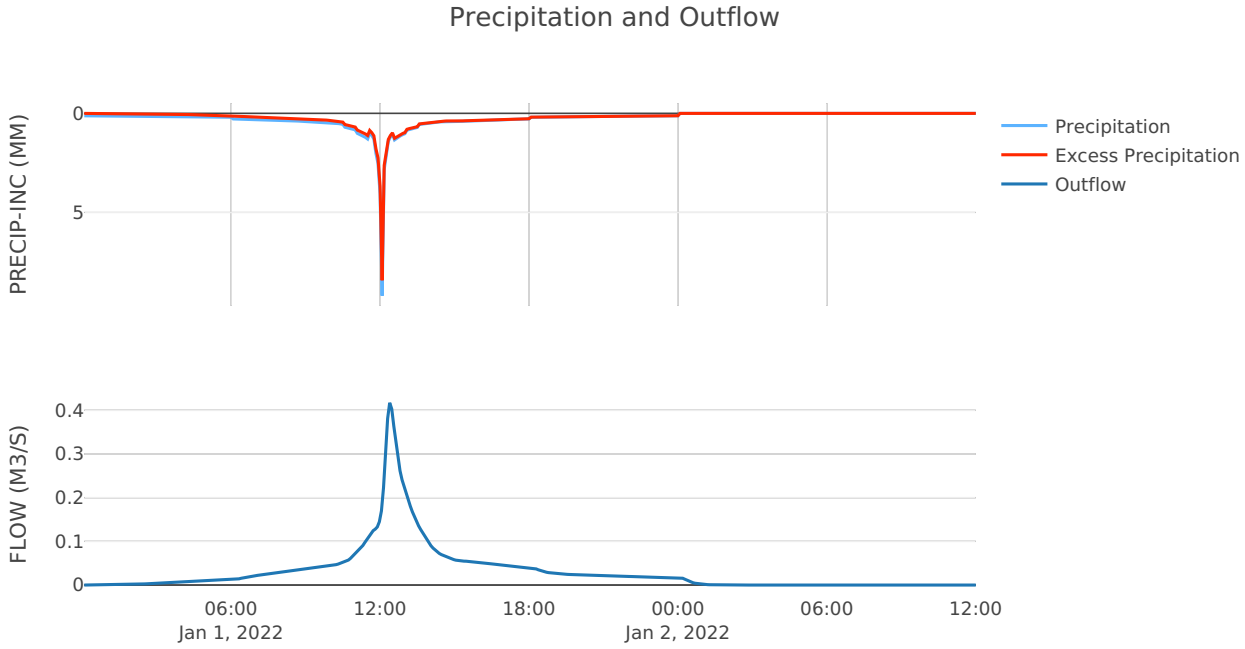


Subbasin: Post-03

Area (KM2) : 0.04

Downstream : Soak - Post - 03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.5
Initial Abstraction	1.2
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-03	
Peak Discharge (M3/S)	0.42
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	94.26
Precipitation Volume (M3)	4879.45
Loss Volume (M3)	880.14
Excess Volume (M3)	3999.31
Direct Runoff Volume (M3)	3999.31
Baseflow Volume (M3)	0

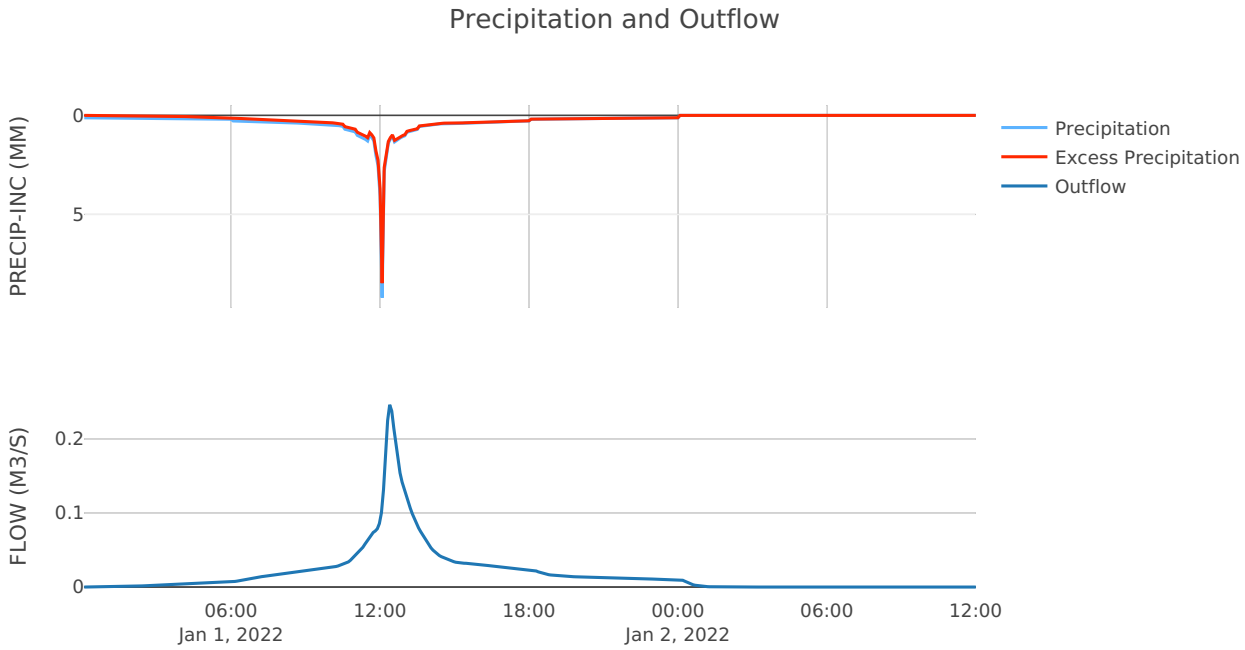


Subbasin: Post-04

Area (KM2) : 0.02
Downstream : Post - Soak - 04

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.8
Initial Abstraction	1.1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-04	
Peak Discharge (M3/S)	0.25
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	94.98
Precipitation Volume (M3)	2863.5
Loss Volume (M3)	498.49

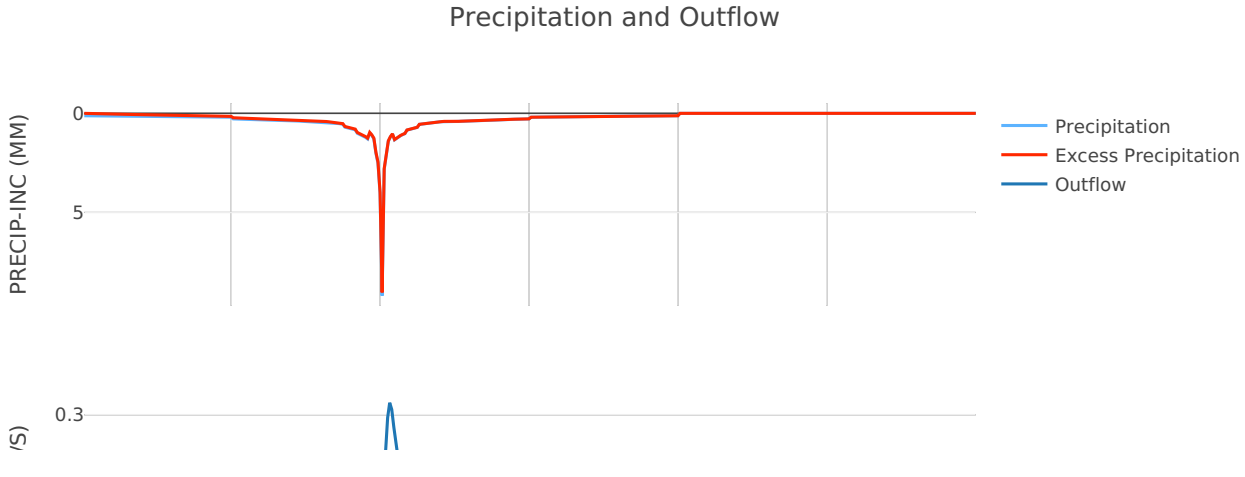
Excess Volume (M3)	2365.01
Direct Runoff Volume (M3)	2365.01
Baseflow Volume (M3)	0

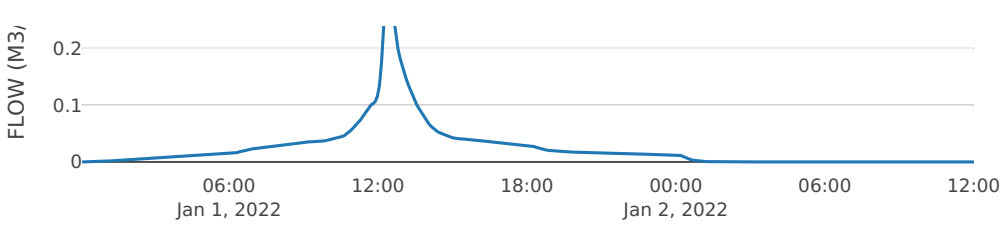


Subbasin: Post-05

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-05	
Peak Discharge (M3/S)	0.32
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	106.41
Precipitation Volume (M3)	3471.85
Loss Volume (M3)	259.44
Excess Volume (M3)	3212.41
Direct Runoff Volume (M3)	3212.41
Baseflow Volume (M3)	0





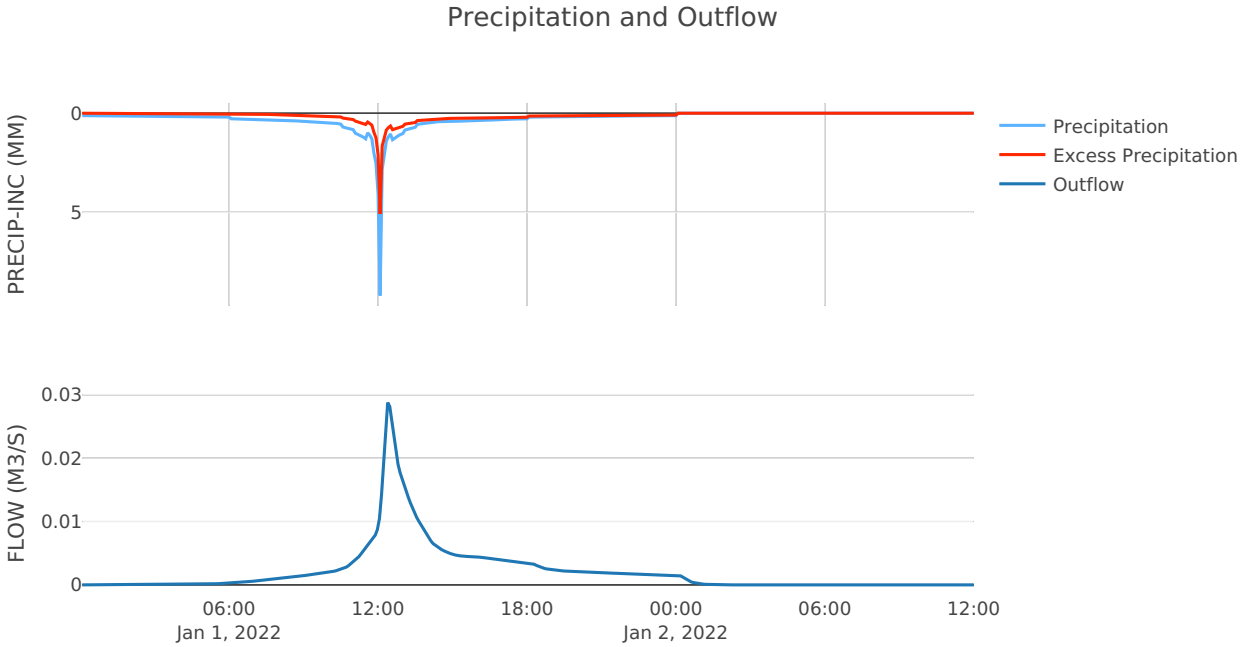
Subbasin: Post-06

Area (KM2) : 0
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70
Initial Abstraction	5

Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-06	
Peak Discharge (M3/S)	0.03
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	55.29
Precipitation Volume (M3)	573.85
Loss Volume (M3)	297.97
Excess Volume (M3)	275.88
Direct Runoff Volume (M3)	275.88
Baseflow Volume (M3)	0



Subbasin: Post-07

Area (KM2) : 0
Downstream : Post - Soak - 07

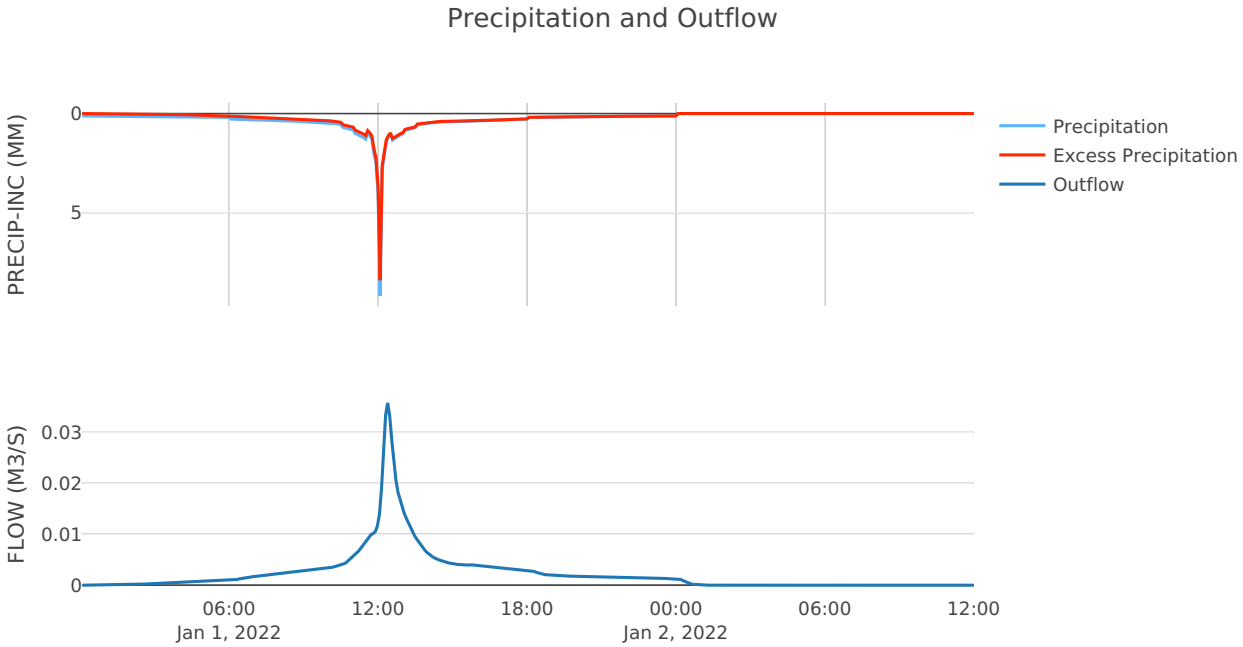
Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.25
Time Area Method	Default

Results: Post-07

Peak Discharge (M3/S)	0.04
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	94.05
Precipitation Volume (M3)	369.5
Loss Volume (M3)	67.32
Excess Volume (M3)	302.18
Direct Runoff Volume (M3)	302.18
Baseflow Volume (M3)	0



Subbasin: Post-08

Area (KM2) : 0.02
Downstream : Post - Soak - 08

Loss Rate: Scs

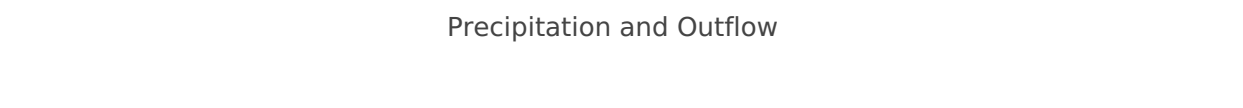
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

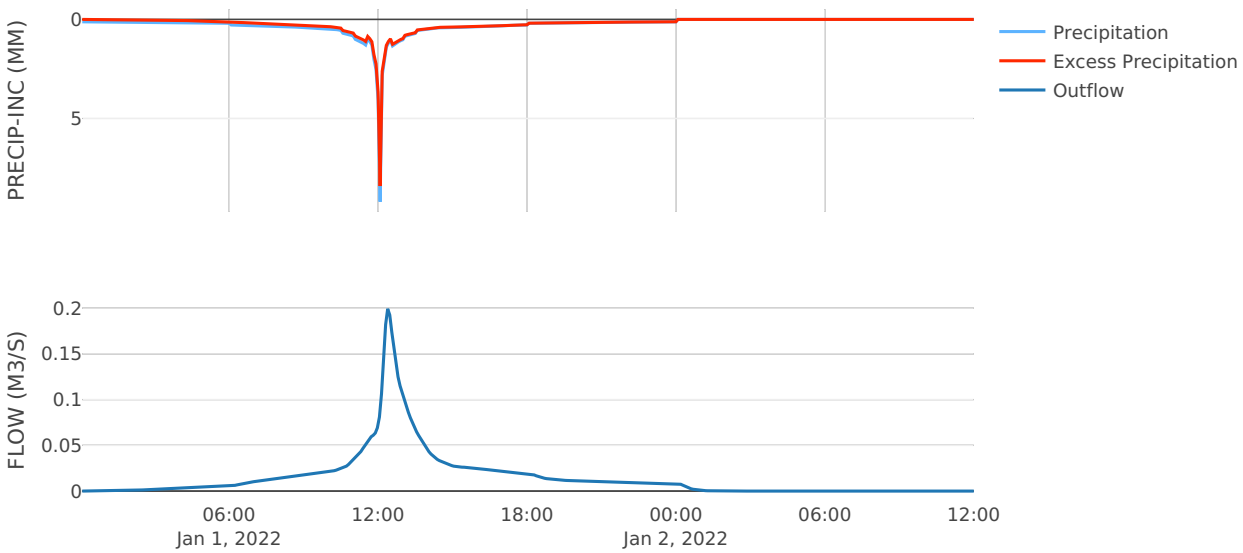
Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-08

Peak Discharge (M3/S)	0.2
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	94.05
Precipitation Volume (M3)	2334.5
Loss Volume (M3)	425.31
Excess Volume (M3)	1909.19
Direct Runoff Volume (M3)	1909.19
Baseflow Volume (M3)	0



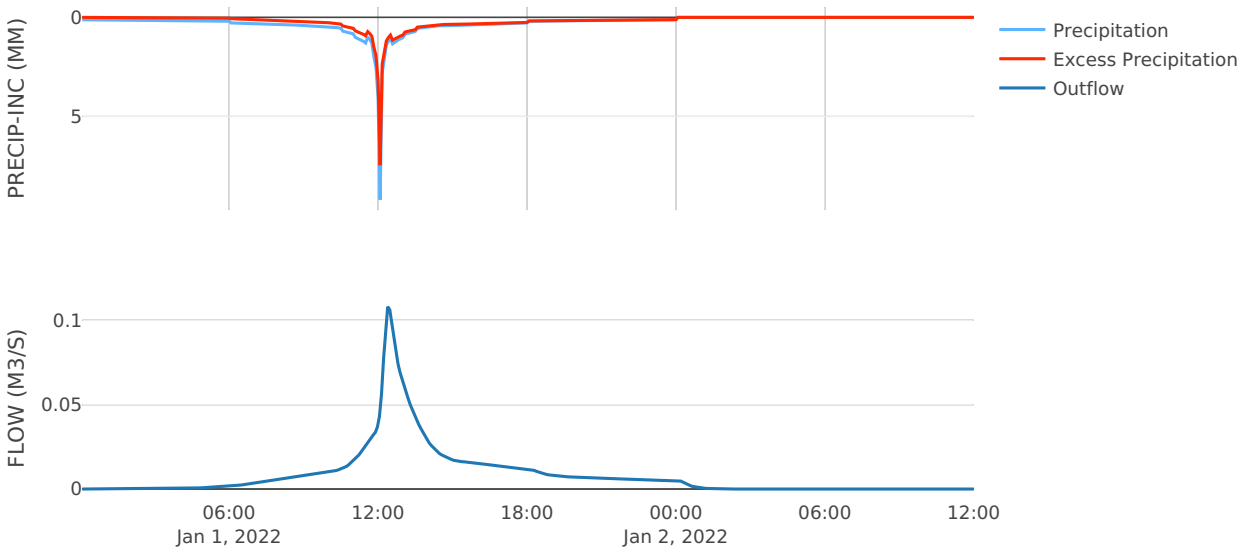


Subbasin: Post-09

Area (KM2) : 0.01
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Post-09	
Peak Discharge (M3/S)	0.11
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	79.95
Precipitation Volume (M3)	1528.35
Loss Volume (M3)	465.84
Excess Volume (M3)	1062.51
Direct Runoff Volume (M3)	1062.51
Baseflow Volume (M3)	0

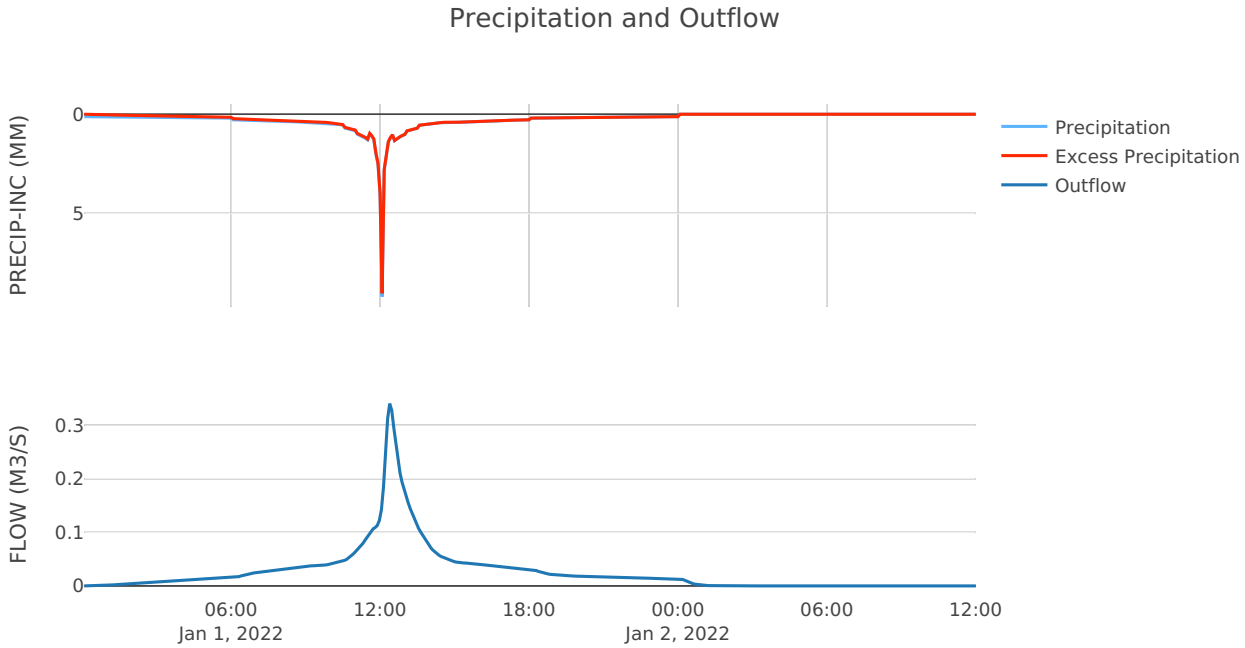
Precipitation and Outflow



Subbasin: Post-10

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-10	
Peak Discharge (M3/S)	0.34
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	106.41
Precipitation Volume (M3)	3677.7
Loss Volume (M3)	274.82
Excess Volume (M3)	3402.88
Direct Runoff Volume (M3)	3402.88
Baseflow Volume (M3)	0

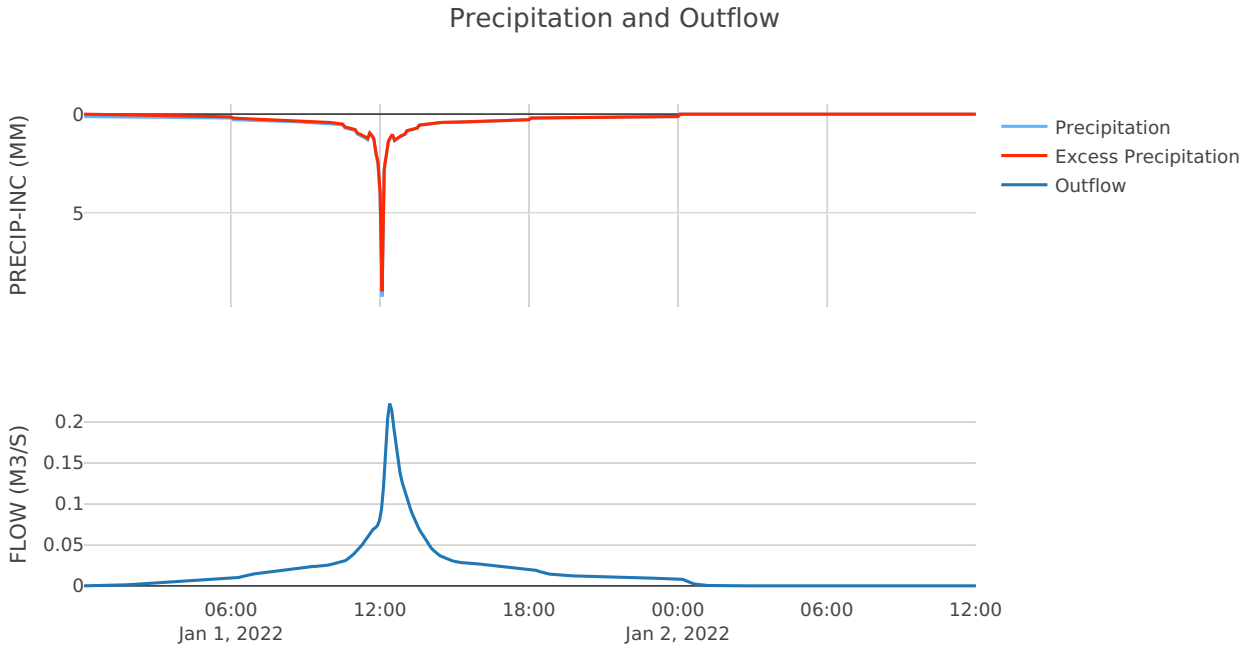


Subbasin: Post-11

Area (KM2) : 0.02
Downstream : Post - Soak - 11

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	95.6
Initial Abstraction	1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-11	

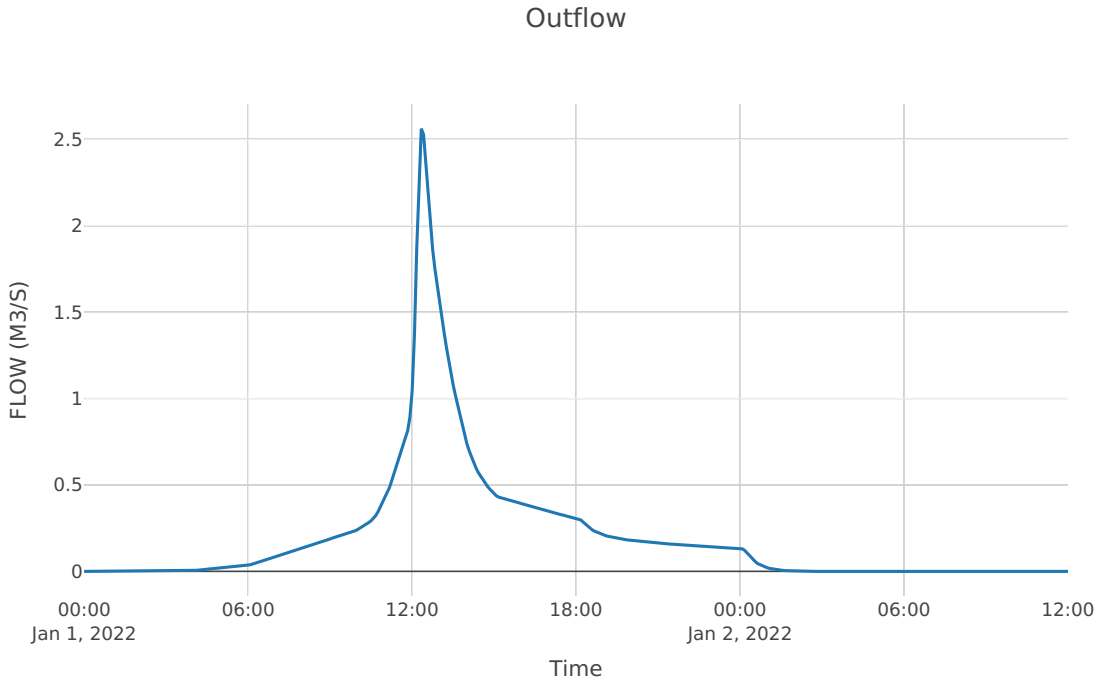
Peak Discharge (M3/S)	0.22
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	103.4
Precipitation Volume (M3)	2435.24
Loss Volume (M3)	245.71
Excess Volume (M3)	2189.53
Direct Runoff Volume (M3)	2189.53
Baseflow Volume (M3)	0



Junction: Check Point (pre)

Results: Check Point (pre)

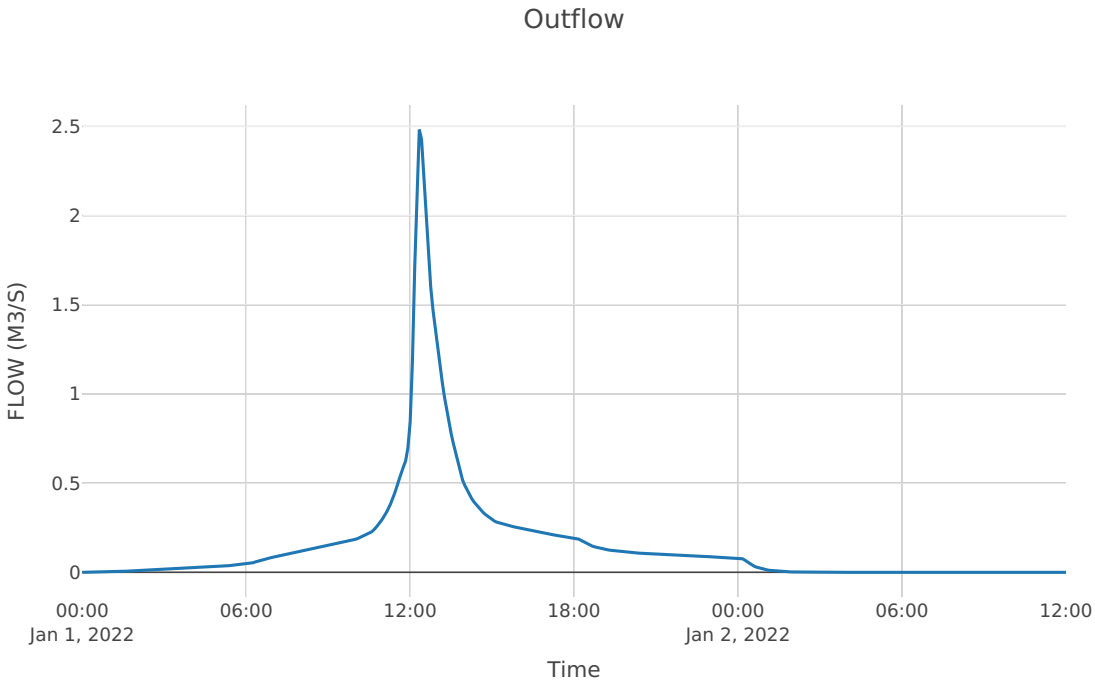
Peak Discharge (M3/S)	2.56
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	75.68



Junction: Check Point (post)

Results: Check Point (post)

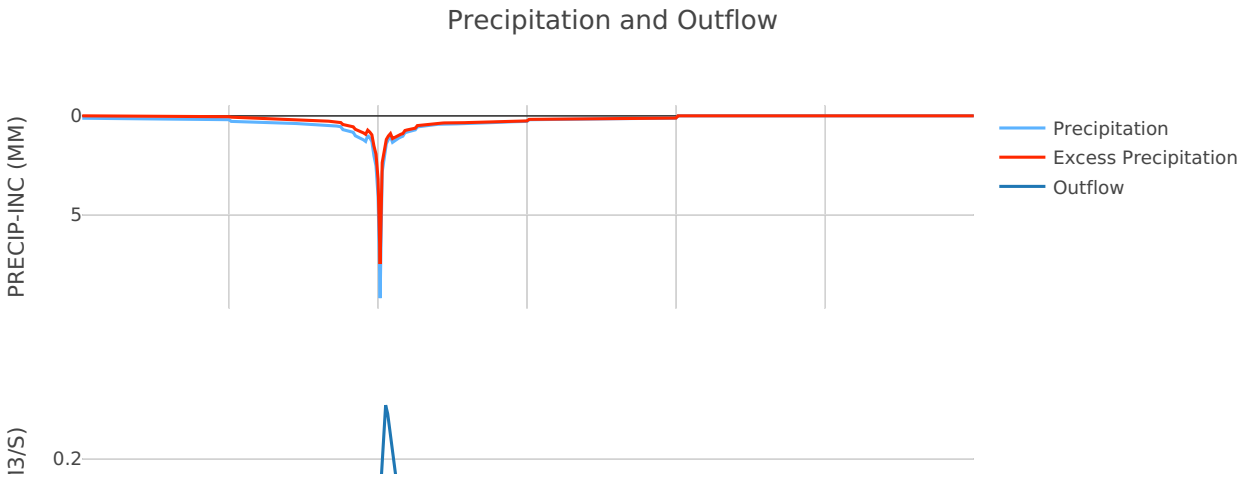
Peak Discharge (M3/S)	2.48
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	62.88

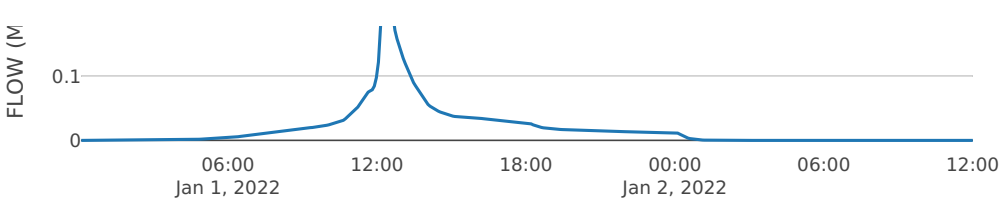


Subbasin: Check Only (Road Pre)

Area (KM2) : 0.03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.2
Storage Coefficient	0.33
Time Area Method	Default
Results: Check Only (Road Pre)	
Peak Discharge (M3/S)	0.28
Time of Peak Discharge	01Jan2022, 12:15
Volume (MM)	80.13
Precipitation Volume (M3)	3548.9
Loss Volume (M3)	1076.11
Excess Volume (M3)	2472.79
Direct Runoff Volume (M3)	2472.79
Baseflow Volume (M3)	0

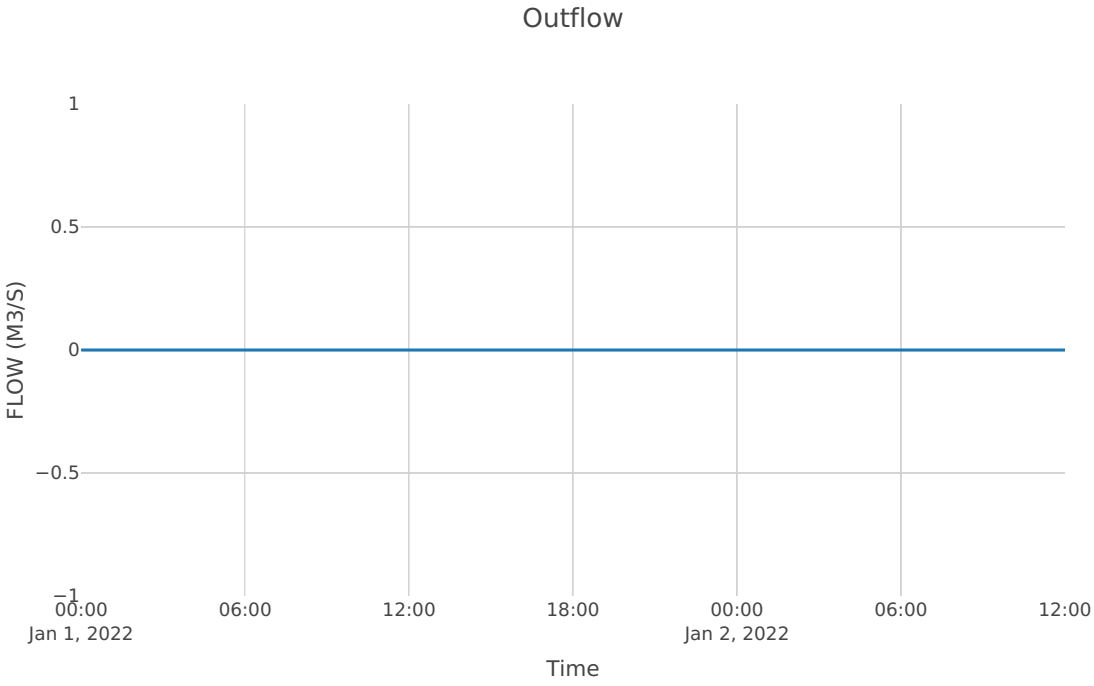




Reservoir: Attenuation Pond

Results: Attenuation Pond

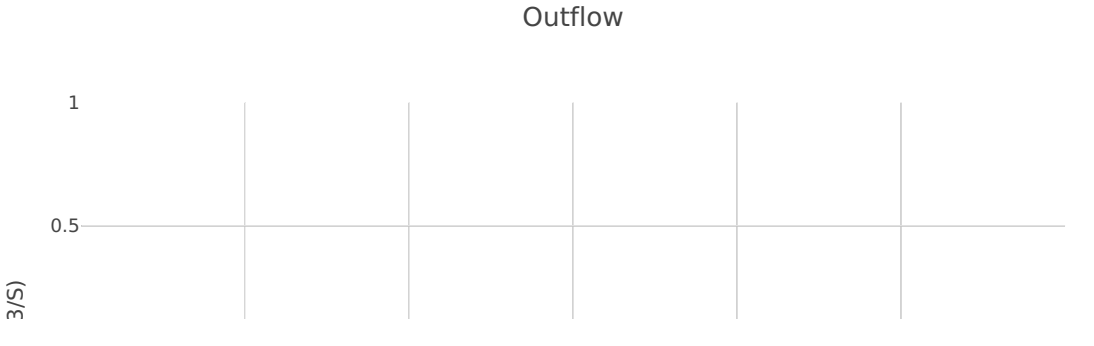
Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	866.69
Discharge Volume (M3)	0

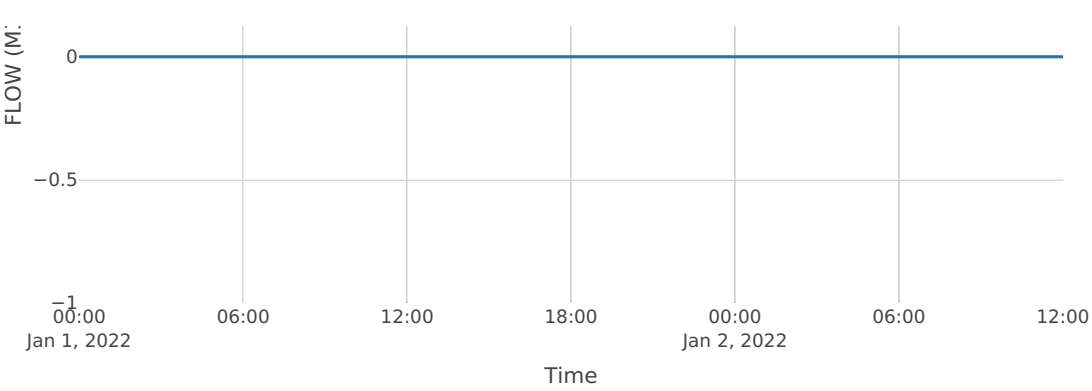


Reservoir: Road Attenuation (lumped)

Results: Road Attenuation (lumped)

Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	5.5
Peak Elevation (M)	0.01
Discharge Volume (M3)	0




FLOW (M
0
−0.5
−1
00:00
Jan 1, 2022
06:00
12:00
18:00
00:00
Jan 2, 2022
06:00
12:00
Time

Project: 1942_02_HEC_Model

Simulation Run: Run 4

Simulation Start: 31 December 2021, 24:00

Simulation End: 2 January 2022, 12:00

HMS Version: 4.13

Executed: 22 October 2026, 03:58

Global Parameter Summary - Subbasin

Area (KM2)

Element Name	Area (KM2)
Pre - 01	0.01
Pre - 02	0.13
Pre - 03	0.06
Pre - 04	0.06
Pre - 05	0.09
Post - 01	0.01
Post - 02	0.13
Post - 03	0.04
Post - 04	0.02
Post - 05	0.03
Post - 06	0
Post - 07	0
Post - 08	0.02
Post - 09	0.01
Post - 10	0.03
Post - 11	0.02
Check Only (Road Pre)	0.03

Downstream

Element Name	Downstream
Pre - 01	Check Point (pre)
Pre - 02	Check Point (pre)
Pre - 03	Check Point (pre)
Pre - 04	Check Point (pre)
Pre - 05	Check Point (pre)
Post - 01	Soak - Post - 01
Post - 02	Check Point (post)
Post - 03	Soak - Post - 03
Post - 04	Post - Soak - 04
Post - 05	Check Point (post)
Post - 06	Check Point (post)
Post - 07	Post - Soak - 07
Post - 08	Post - Soak - 08
Post - 09	Check Point (post)
Post - 10	Check Point (post)
Post - 11	Post - Soak - 11

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
Pre - 01	0	86.1	5
Pre - 02	0	86.1	5
Pre - 03	0	86.1	5
Pre - 04	0	70.3	5
Pre - 05	0	86.1	5
Post - 01	0	89.3	1.6
Post - 02	0	86.6	4.8
Post - 03	0	91.5	1.2

Post - 04	0	91.8	1.1
Post - 05	0	96.6	0.3
Post - 06	0	70	5
Post - 07	0	91.4	1.2
Post - 08	0	91.4	1.2
Post - 09	0	86	5
Post - 10	0	96.6	0.3
Post - 11	0	95.6	1
Check Only (Road Pre)	0	86.1	5

Transform: Clark

Element Name	Clark Method	Time of Concentration	Storage Coefficient	Time Area Method
Pre - 01	Specified	0.33	0.5	Default
Pre - 02	Specified	0.33	0.5	Default
Pre - 03	Specified	0.33	0.5	Default
Pre - 04	Specified	0.22	0.4	Default
Pre - 05	Specified	0.33	0.4	Default
Post - 01	Specified	0.33	0.35	Default
Post - 02	Specified	0.33	0.6	Default
Post - 03	Specified	0.33	0.35	Default
Post - 04	Specified	0.33	0.35	Default
Post - 05	Specified	0.33	0.35	Default
Post - 06	Specified	0.33	0.35	Default
Post - 07	Specified	0.33	0.25	Default
Post - 08	Specified	0.33	0.35	Default
Post - 09	Specified	0.33	0.4	Default
Post - 10	Specified	0.33	0.35	Default
Post - 11	Specified	0.33	0.35	Default
Check Only (Road Pre)	Specified	0.2	0.33	Default

Global Results Summary

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Pre - 01	0.01	0.06	01Jan2022, 12:25	94.12
Pre - 02	0.13	1.08	01Jan2022, 12:25	94.12
Pre - 03	0.06	0.54	01Jan2022, 12:25	94.12
Pre - 04	0.06	0.44	01Jan2022, 12:20	67.26
Pre - 05	0.09	0.9	01Jan2022, 12:20	94.12
Post - 01	0.01	0.08	01Jan2022, 12:20	103.8
Post - 02	0.13	1.01	01Jan2022, 12:25	95.29
Post - 03	0.04	0.48	01Jan2022, 12:20	108.86
Post - 04	0.02	0.28	01Jan2022, 12:20	109.61
Post - 05	0.03	0.36	01Jan2022, 12:20	121.34
Post - 06	0	0.03	01Jan2022, 12:20	66.81
Post - 07	0	0.04	01Jan2022, 12:20	108.64
Post - 08	0.02	0.23	01Jan2022, 12:20	108.64
Post - 09	0.01	0.13	01Jan2022, 12:20	93.93
Post - 10	0.03	0.39	01Jan2022, 12:20	121.34
Post - 11	0.02	0.25	01Jan2022, 12:20	118.28
Check Point (pre)	0.35	3.02	01Jan2022, 12:20	89.23
Check Point (post)	0.33	2.91	01Jan2022, 12:20	74.11
Check Only (Road Pre)	0.03	0.33	01Jan2022, 12:15	94.12
Attenuation Pond	0	0	31Dec2021, 24:00	Not specified
Road Attenuation (lumped)	0	0	31Dec2021, 24:00	Not specified

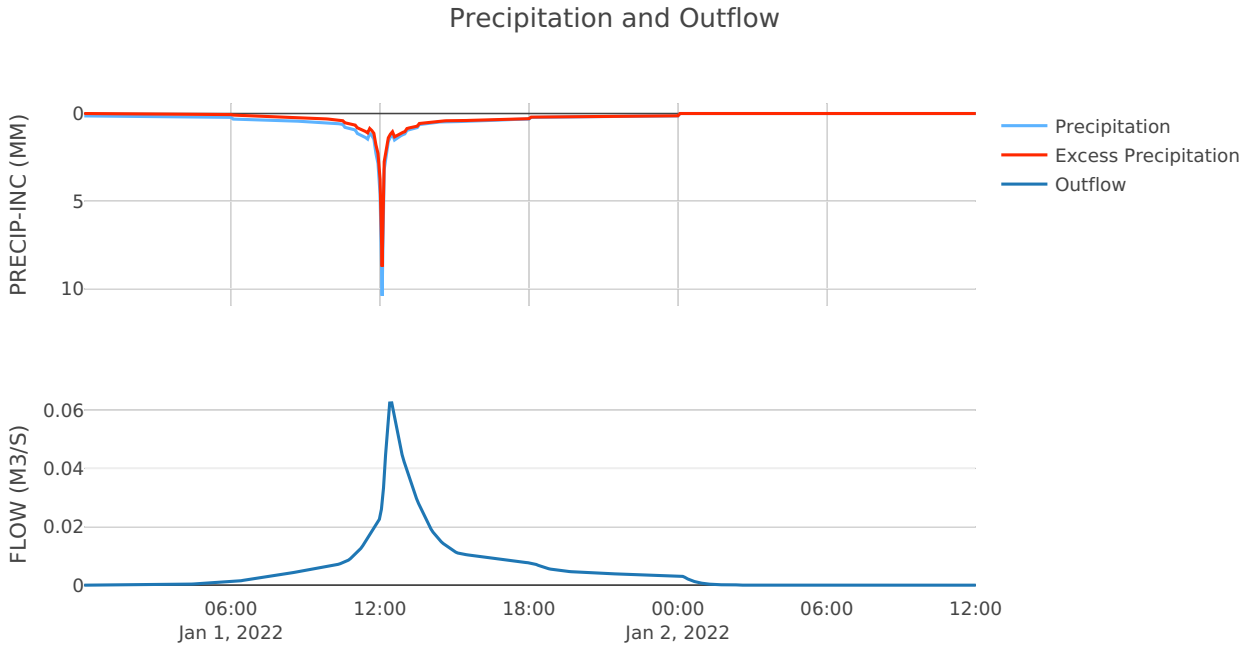
Subbasin: Pre-01

Area (KM2) : 0.01
Downstream : Check Point (pre)

Loss Rate: Scs

Percent Impervious Area	0
Curve Number	86.1

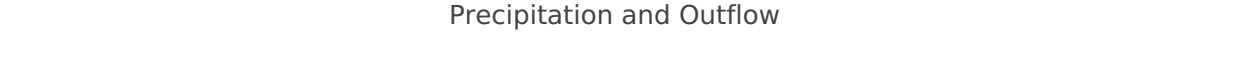
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-01	
Peak Discharge (M3/S)	0.06
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	94.12
Precipitation Volume (M3)	943.8
Loss Volume (M3)	260.47
Excess Volume (M3)	683.33
Direct Runoff Volume (M3)	683.33
Baseflow Volume (M3)	0

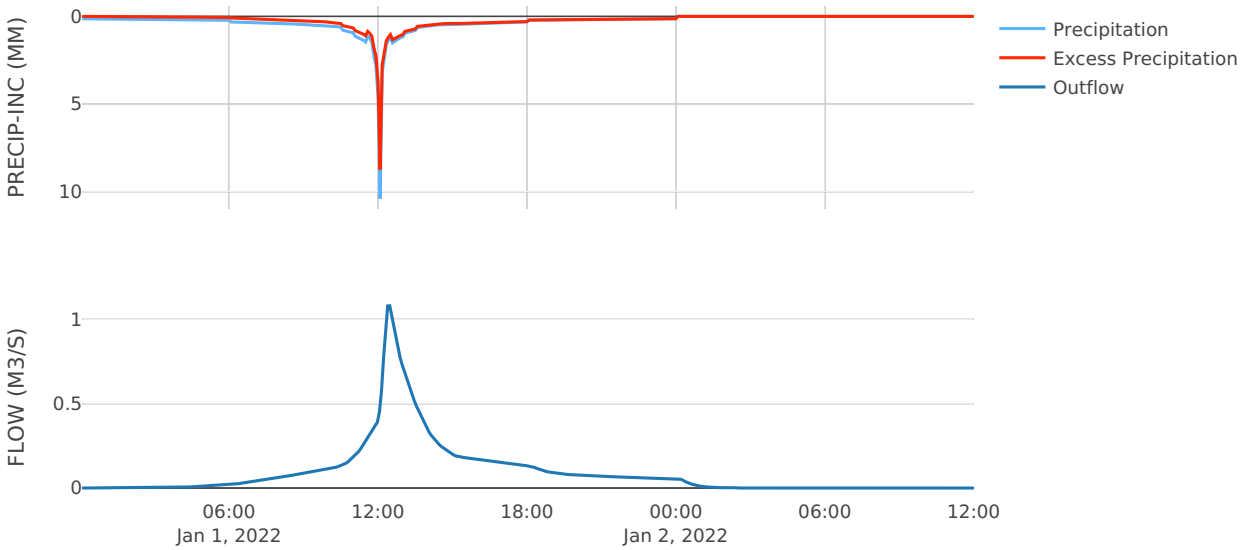


Subbasin: Pre-02

Area (KM2) : 0.13
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-02	
Peak Discharge (M3/S)	1.08
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	94.12
Precipitation Volume (M3)	16326.7
Loss Volume (M3)	4505.77
Excess Volume (M3)	11820.93
Direct Runoff Volume (M3)	11820.93
Baseflow Volume (M3)	0

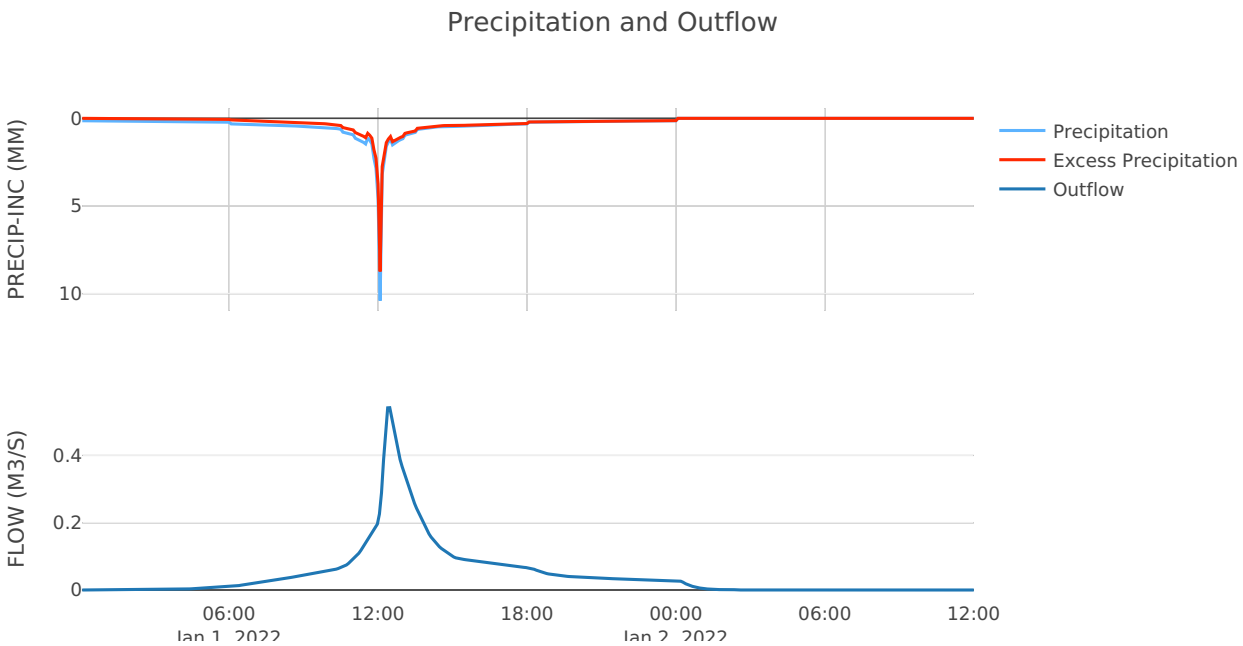




Subbasin: Pre-03

Area (KM2) : 0.06
Downstream : Check Point (pre)

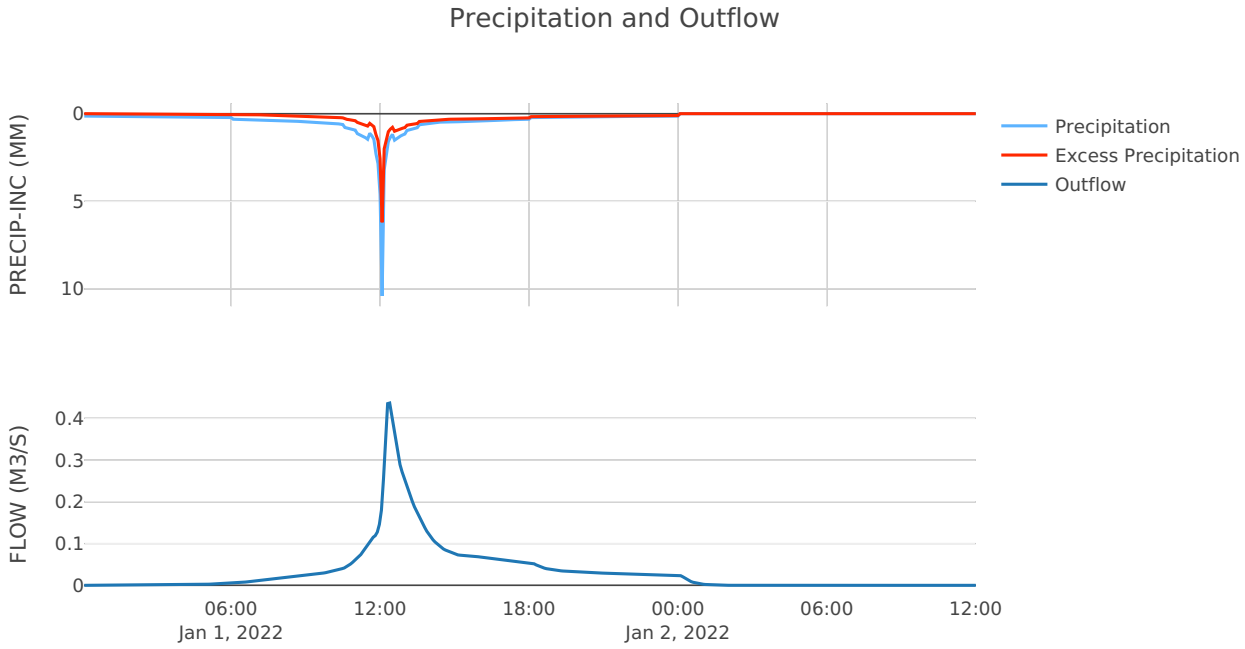
Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.5
Time Area Method	Default
Results: Pre-03	
Peak Discharge (M3/S)	0.54
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	94.12
Precipitation Volume (M3)	8188.44
Loss Volume (M3)	2259.81
Excess Volume (M3)	5928.63
Direct Runoff Volume (M3)	5928.63
Baseflow Volume (M3)	0



Subbasin: Pre-04

Area (KM2) : 0.06
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70.3
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.22
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-04	
Peak Discharge (M3/S)	0.44
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	67.26
Precipitation Volume (M3)	8382.27
Loss Volume (M3)	4045.44
Excess Volume (M3)	4336.83
Direct Runoff Volume (M3)	4336.83
Baseflow Volume (M3)	0

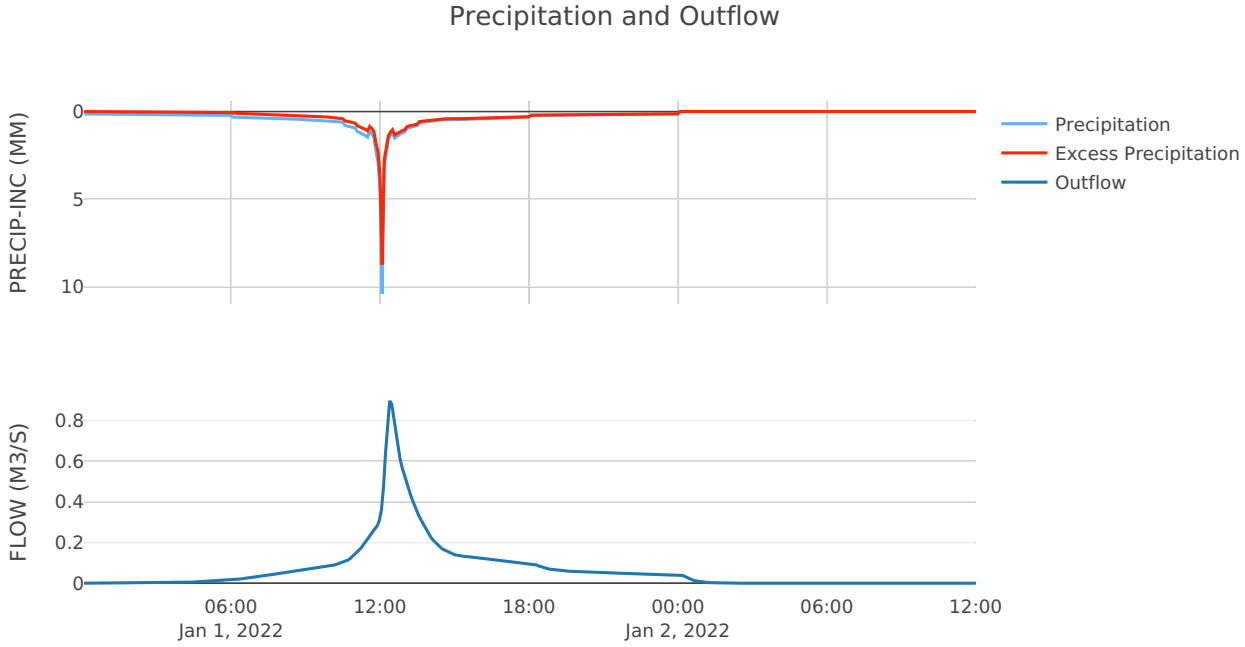


Subbasin: Pre-05

Area (KM2) : 0.09
Downstream : Check Point (pre)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Pre-05	

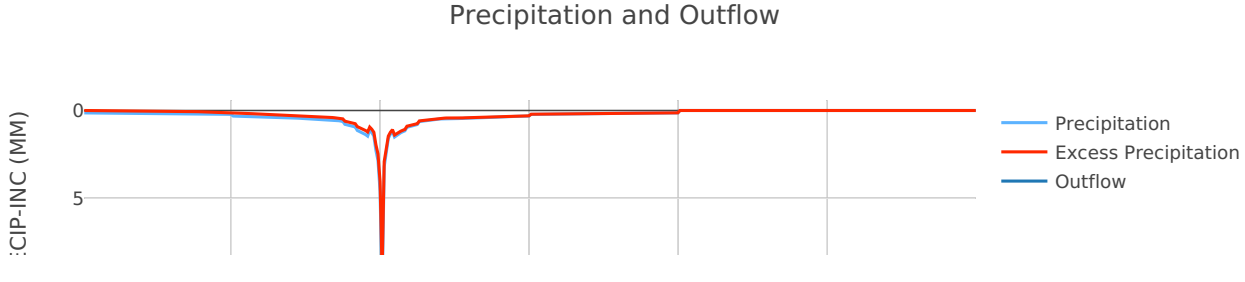
Peak Discharge (M3/S)	0.9
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	94.12
Precipitation Volume (M3)	12208.3
Loss Volume (M3)	3369.19
Excess Volume (M3)	8839.11
Direct Runoff Volume (M3)	8839.11
Baseflow Volume (M3)	0

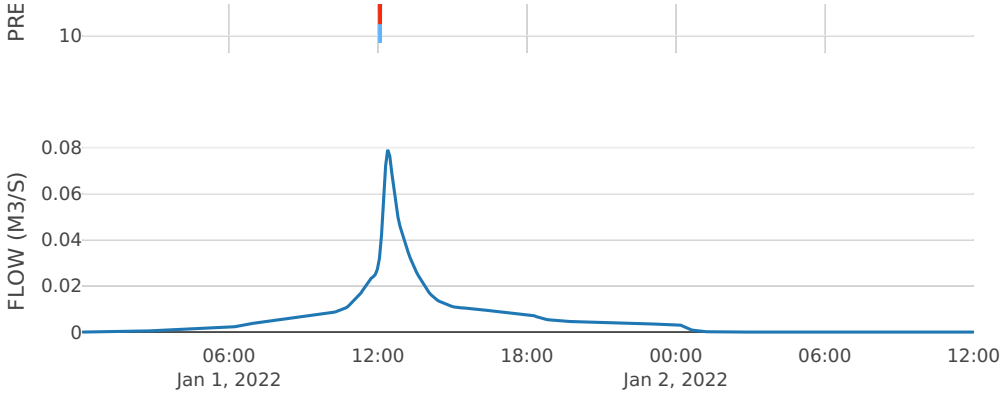


Subbasin: Post-01

Area (KM2) : 0.01
Downstream : Soak - Post - 01

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	89.3
Initial Abstraction	1.6
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-01	
Peak Discharge (M3/S)	0.08
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	103.8
Precipitation Volume (M3)	943.8
Loss Volume (M3)	190.23
Excess Volume (M3)	753.57
Direct Runoff Volume (M3)	753.57
Baseflow Volume (M3)	0

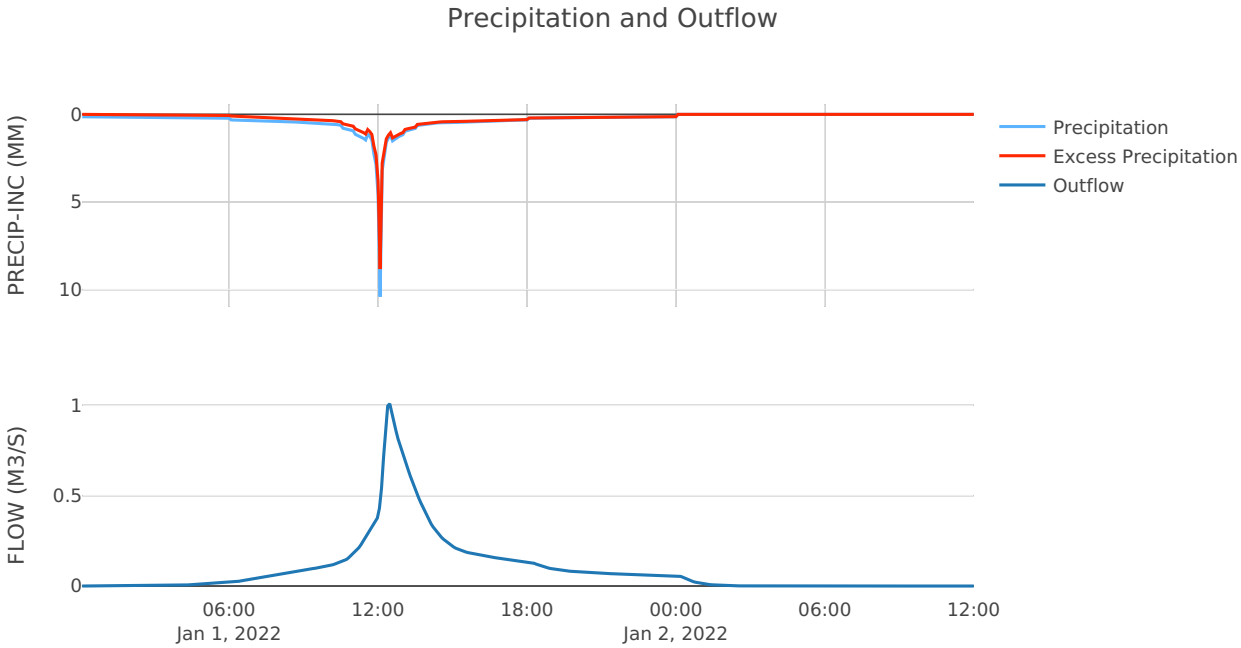




Subbasin: Post-02

Area (KM2) : 0.13
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.6
Initial Abstraction	4.8
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.6
Time Area Method	Default
Results: Post-02	
Peak Discharge (M3/S)	1.01
Time of Peak Discharge	01Jan2022, 12:25
Volume (MM)	95.29
Precipitation Volume (M3)	16326.7
Loss Volume (M3)	4359.54
Excess Volume (M3)	11967.16
Direct Runoff Volume (M3)	11967.16
Baseflow Volume (M3)	0

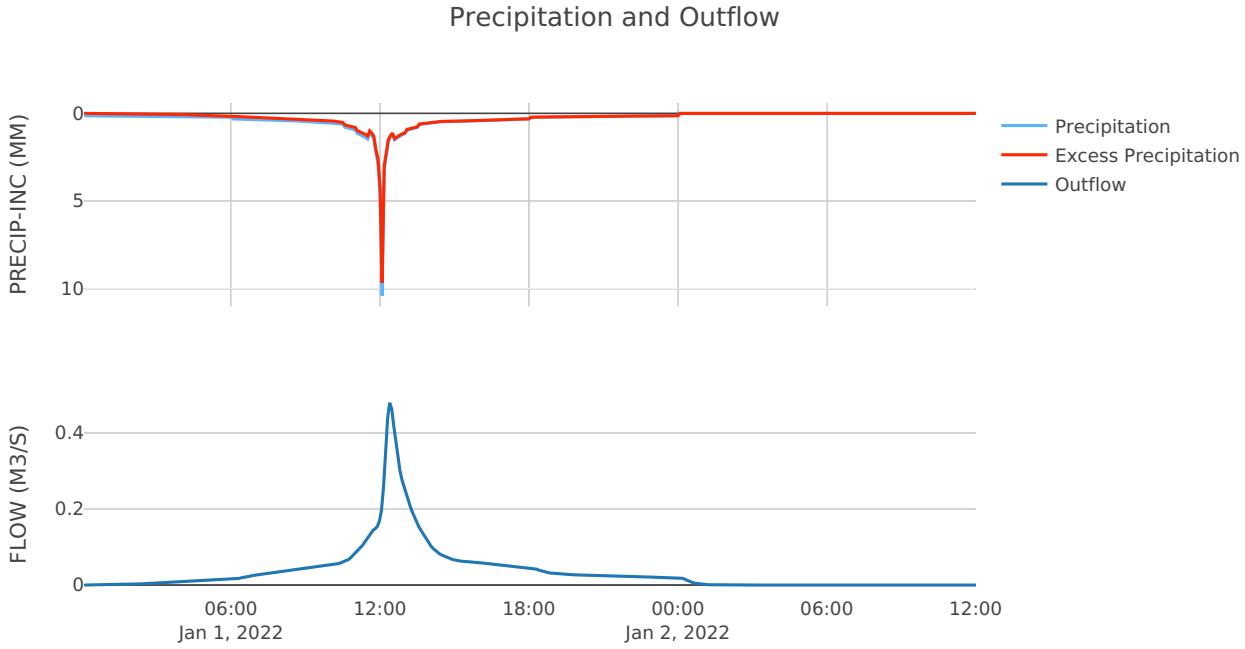


Subbasin: Post-03

Area (KM2) : 0.04

Downstream : Soak - Post - 03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.5
Initial Abstraction	1.2
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-03	
Peak Discharge (M3/S)	0.48
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	108.86
Precipitation Volume (M3)	5515.9
Loss Volume (M3)	897.07
Excess Volume (M3)	4618.83
Direct Runoff Volume (M3)	4618.83
Baseflow Volume (M3)	0

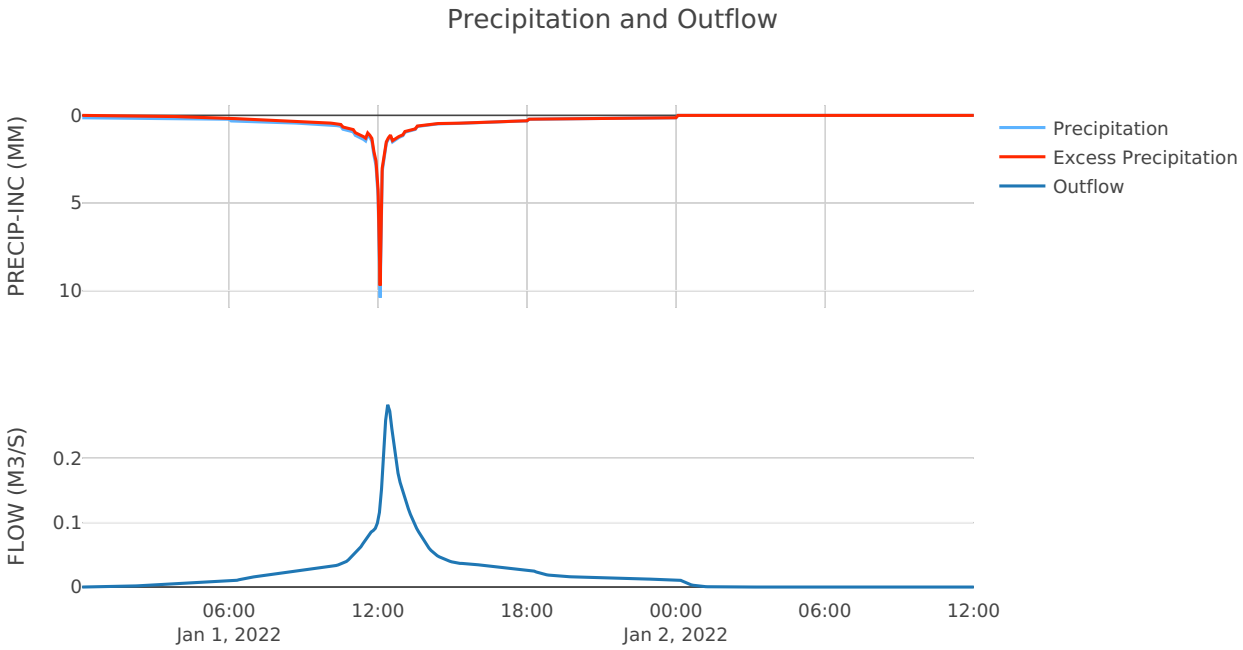


Subbasin: Post-04

Area (KM2) : 0.02
Downstream : Post - Soak - 04

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.8
Initial Abstraction	1.1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-04	
Peak Discharge (M3/S)	0.28
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	109.61
Precipitation Volume (M3)	3237
Loss Volume (M3)	507.78

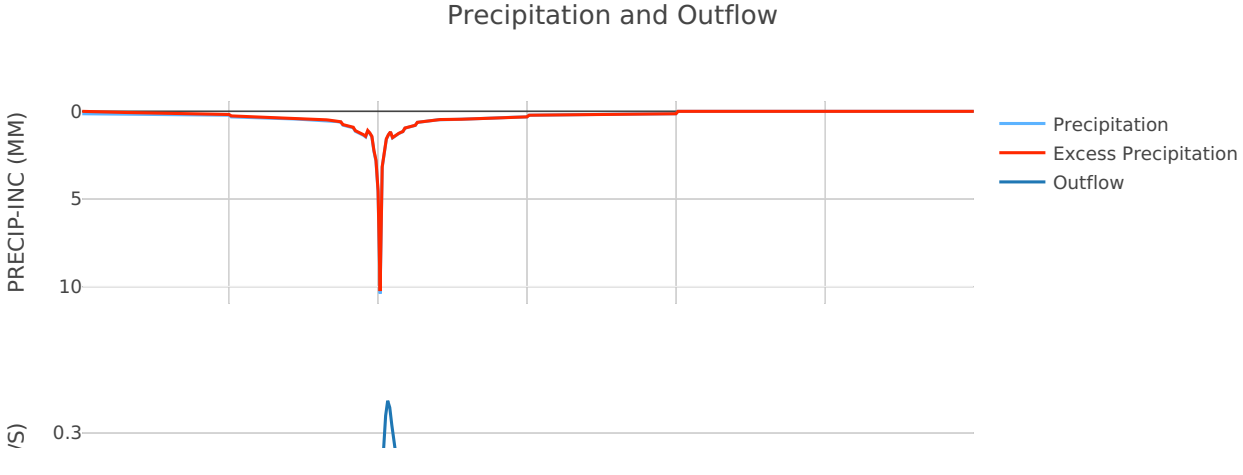
Excess Volume (M3)	2729.22
Direct Runoff Volume (M3)	2729.22
Baseflow Volume (M3)	0

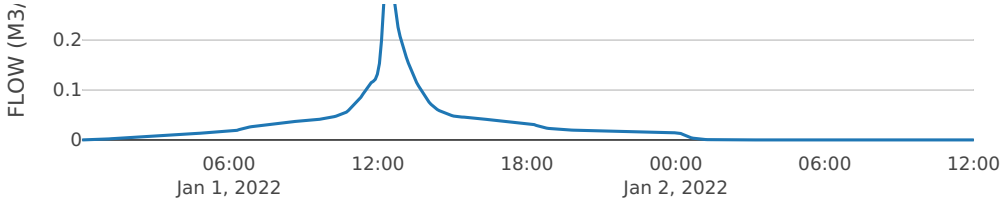


Subbasin: Post-05

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-05	
Peak Discharge (M3/S)	0.36
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	121.34
Precipitation Volume (M3)	3924.7
Loss Volume (M3)	261.55
Excess Volume (M3)	3663.15
Direct Runoff Volume (M3)	3663.15
Baseflow Volume (M3)	0





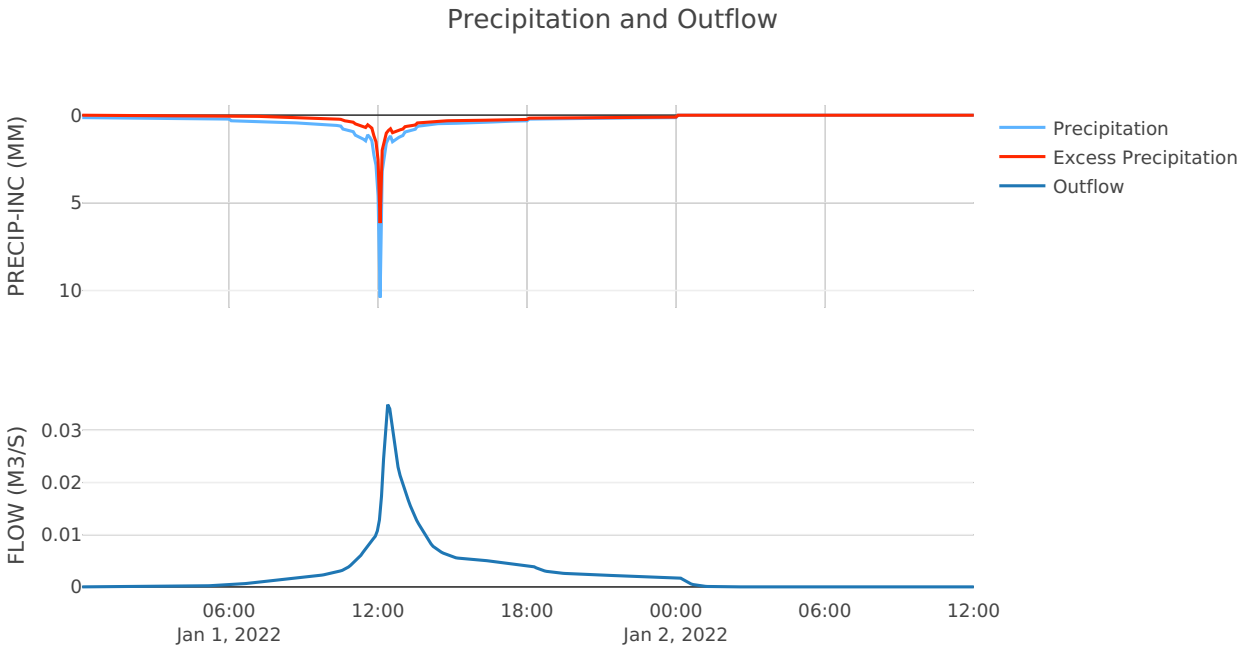
Subbasin: Post-06

Area (KM2) : 0
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	70
Initial Abstraction	5

Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-06	
Peak Discharge (M3/S)	0.03
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	66.81
Precipitation Volume (M3)	648.7
Loss Volume (M3)	315.3
Excess Volume (M3)	333.4
Direct Runoff Volume (M3)	333.4
Baseflow Volume (M3)	0



Subbasin: Post-07

Area (KM2) : 0
Downstream : Post - Soak - 07

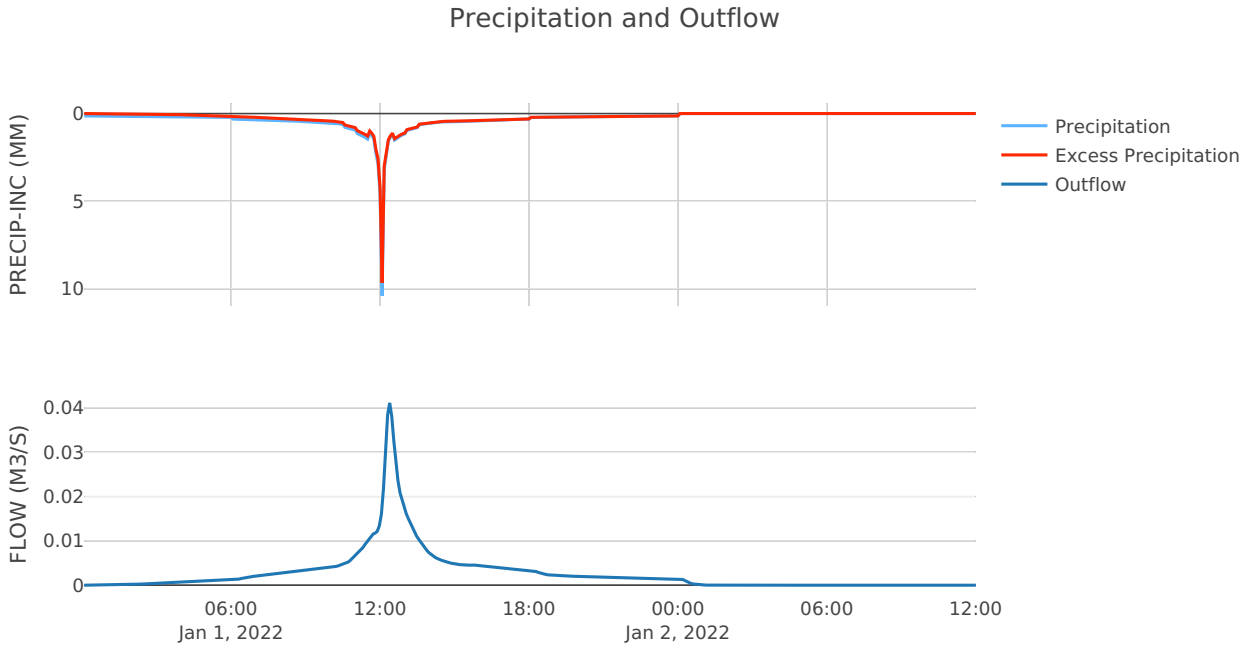
Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.25
Time Area Method	Default

Results: Post-07

Peak Discharge (M3/S)	0.04
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	108.64
Precipitation Volume (M3)	417.69
Loss Volume (M3)	68.63
Excess Volume (M3)	349.06
Direct Runoff Volume (M3)	349.06
Baseflow Volume (M3)	0



Subbasin: Post-08

Area (KM2) : 0.02
Downstream : Post - Soak - 08

Loss Rate: Scs

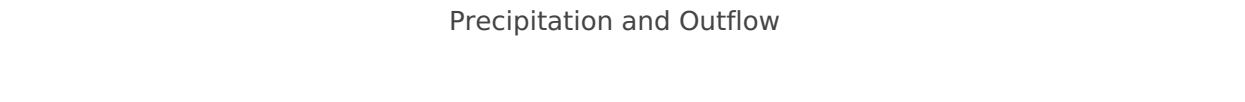
Percent Impervious Area	0
Curve Number	91.4
Initial Abstraction	1.2

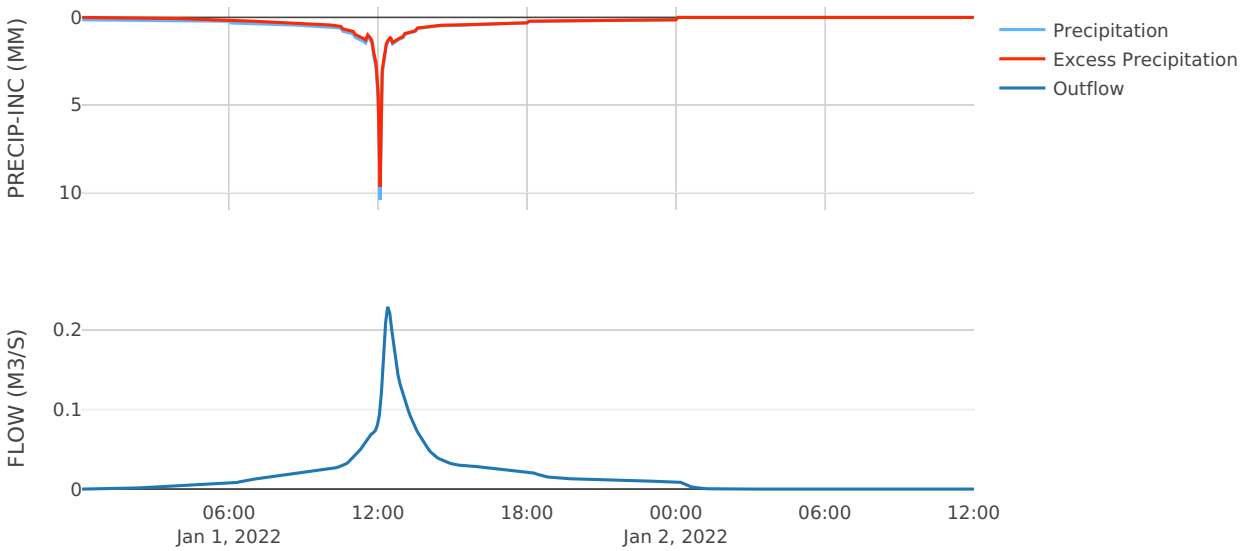
Transform: Clark

Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default

Results: Post-08

Peak Discharge (M3/S)	0.23
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	108.64
Precipitation Volume (M3)	2639
Loss Volume (M3)	433.58
Excess Volume (M3)	2205.42
Direct Runoff Volume (M3)	2205.42
Baseflow Volume (M3)	0



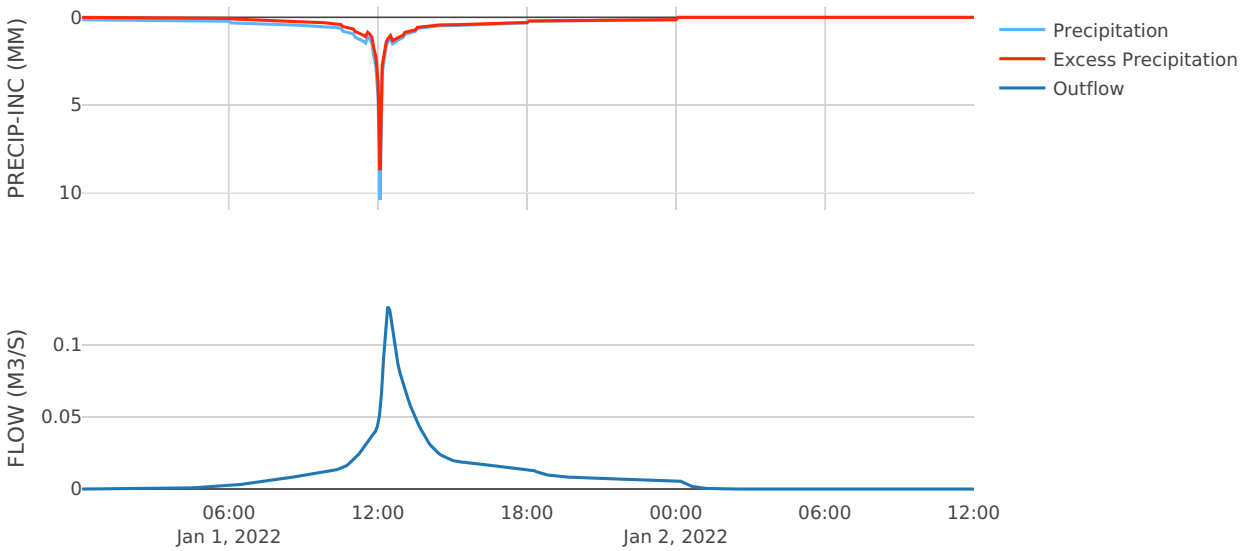


Subbasin: Post-09

Area (KM2) : 0.01
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.4
Time Area Method	Default
Results: Post-09	
Peak Discharge (M3/S)	0.13
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	93.93
Precipitation Volume (M3)	1727.7
Loss Volume (M3)	479.38
Excess Volume (M3)	1248.32
Direct Runoff Volume (M3)	1248.32
Baseflow Volume (M3)	0

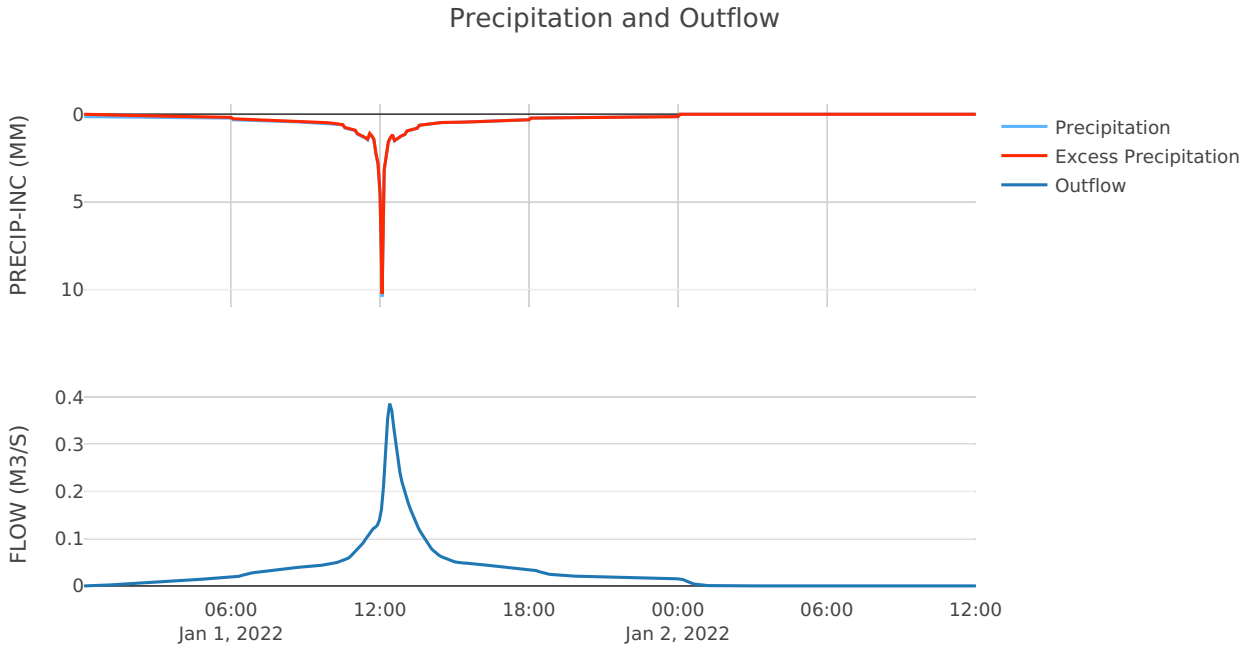
Precipitation and Outflow



Subbasin: Post-10

Area (KM2) : 0.03
Downstream : Check Point (post)

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96.6
Initial Abstraction	0.3
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-10	
Peak Discharge (M3/S)	0.39
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	121.34
Precipitation Volume (M3)	4157.4
Loss Volume (M3)	277.06
Excess Volume (M3)	3880.34
Direct Runoff Volume (M3)	3880.34
Baseflow Volume (M3)	0

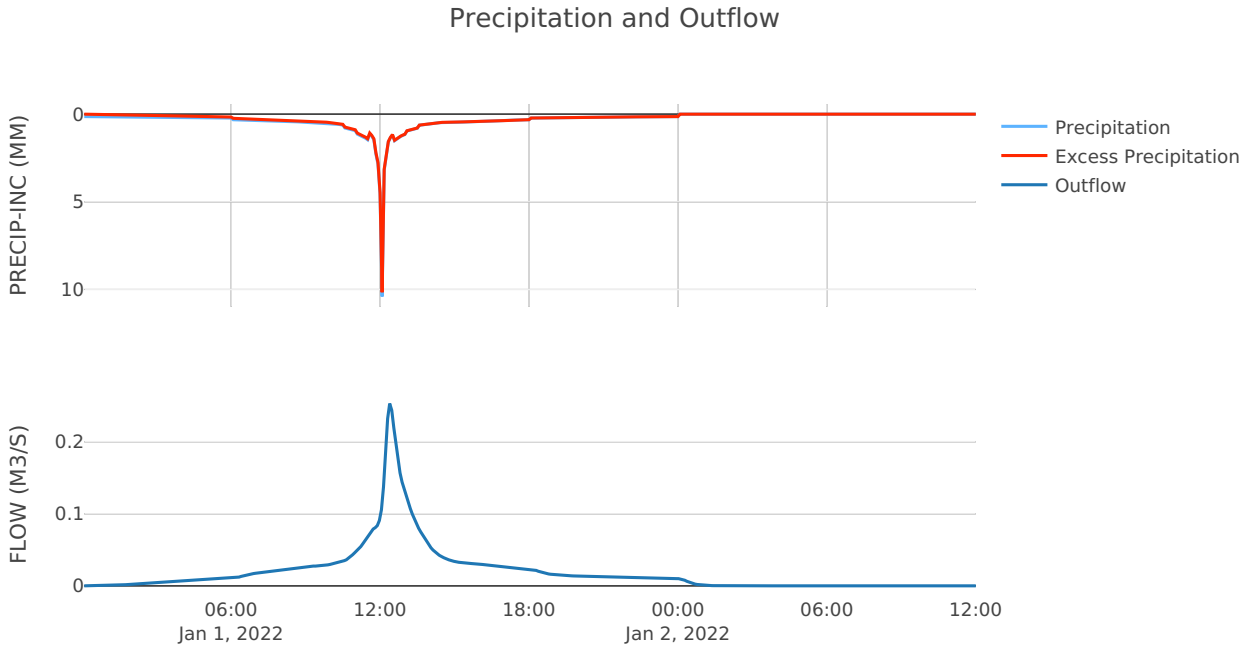


Subbasin: Post-11

Area (KM2) : 0.02
Downstream : Post - Soak - 11

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	95.6
Initial Abstraction	1
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.33
Storage Coefficient	0.35
Time Area Method	Default
Results: Post-11	

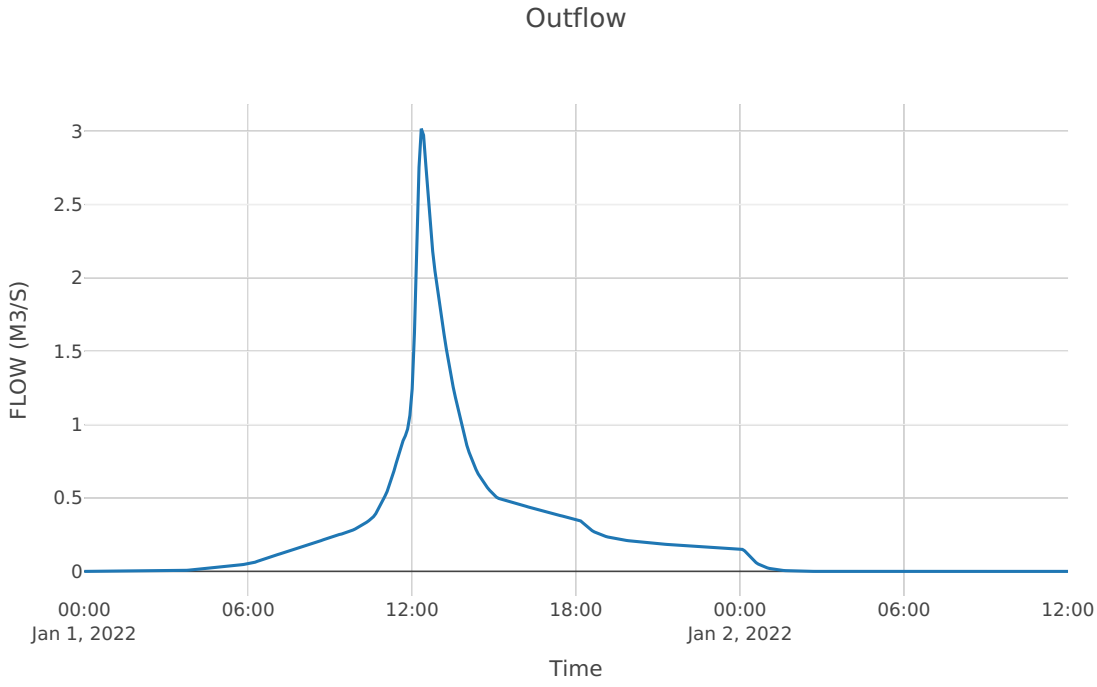
Peak Discharge (M3/S)	0.25
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	118.28
Precipitation Volume (M3)	2752.88
Loss Volume (M3)	248.16
Excess Volume (M3)	2504.72
Direct Runoff Volume (M3)	2504.72
Baseflow Volume (M3)	0



Junction: Check Point (pre)

Results: Check Point (pre)

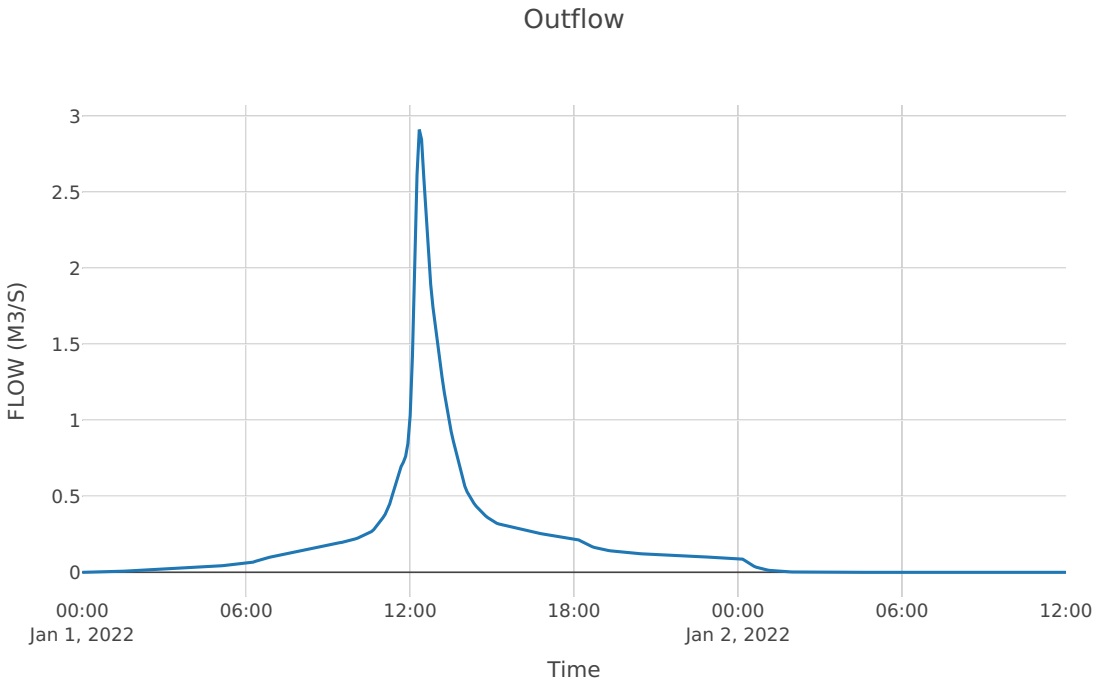
Peak Discharge (M3/S)	3.02
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	89.23



Junction: Check Point (post)

Results: Check Point (post)

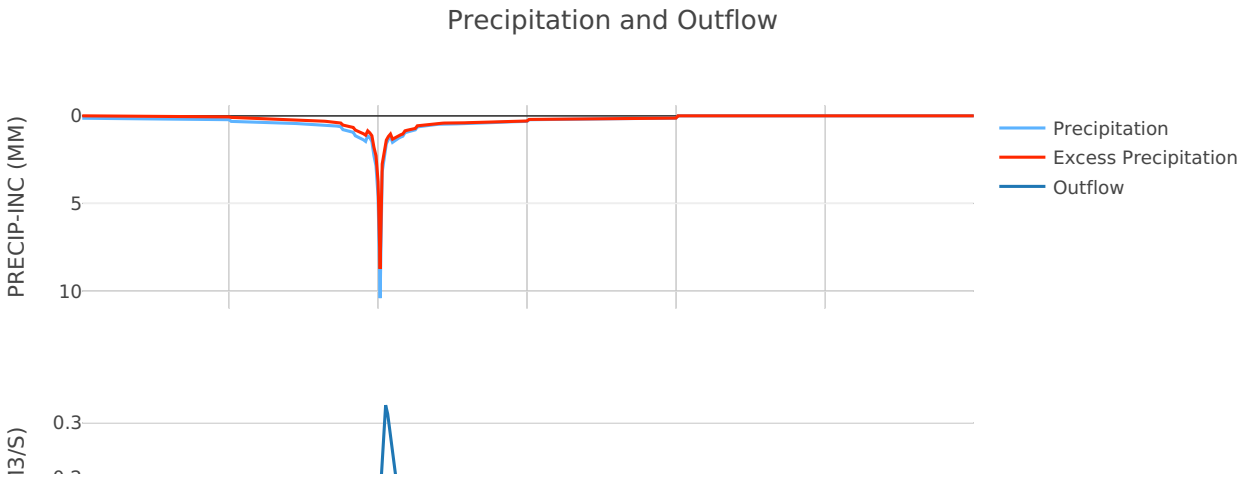
Peak Discharge (M3/S)	2.91
Time of Peak Discharge	01Jan2022, 12:20
Volume (MM)	74.11

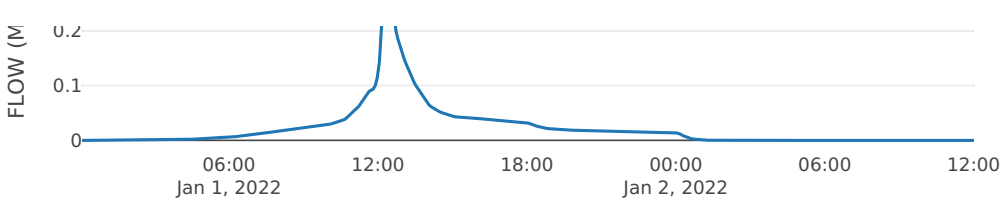


Subbasin: Check Only (Road Pre)

Area (KM2) : 0.03

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	86.1
Initial Abstraction	5
Transform: Clark	
Clark Method	Specified
Time of Concentration	0.2
Storage Coefficient	0.33
Time Area Method	Default
Results: Check Only (Road Pre)	
Peak Discharge (M3/S)	0.33
Time of Peak Discharge	01Jan2022, 12:15
Volume (MM)	94.12
Precipitation Volume (M3)	4011.8
Loss Volume (M3)	1107.16
Excess Volume (M3)	2904.64
Direct Runoff Volume (M3)	2904.64
Baseflow Volume (M3)	0

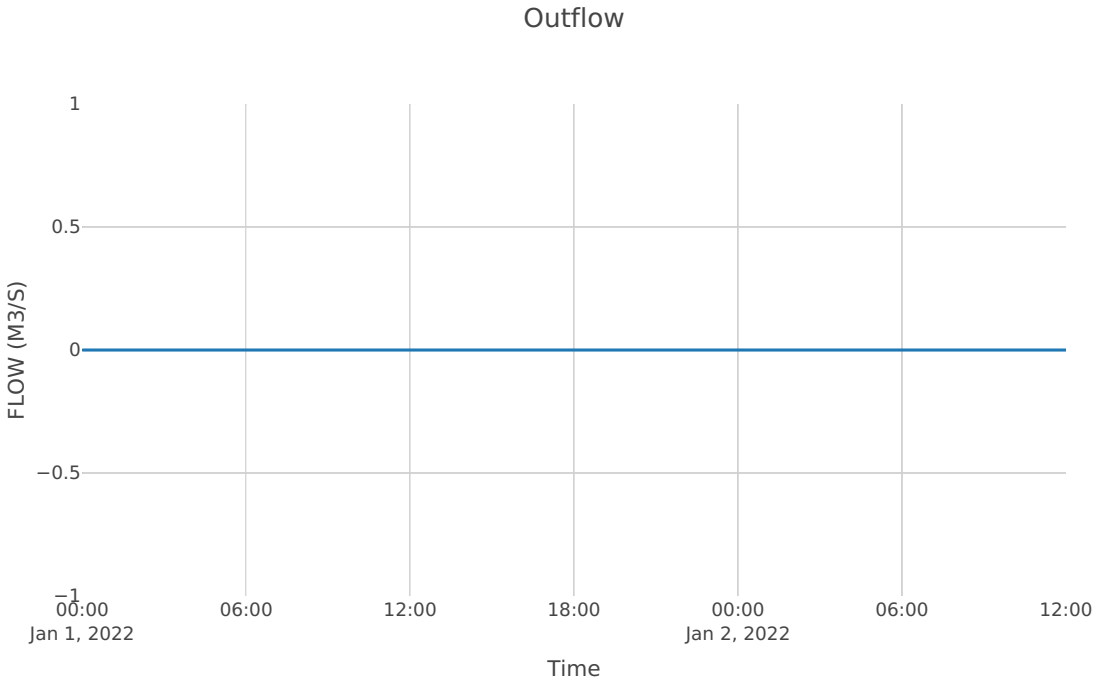




Reservoir: Attenuation Pond

Results: Attenuation Pond

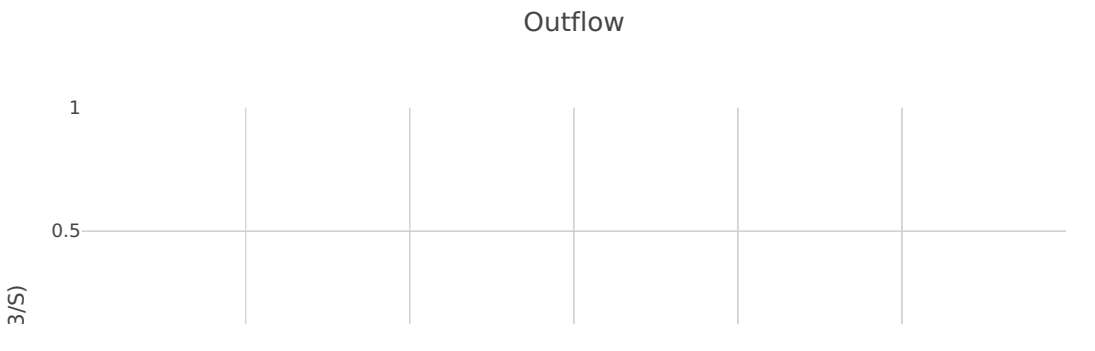
Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	1036.78
Discharge Volume (M3)	0

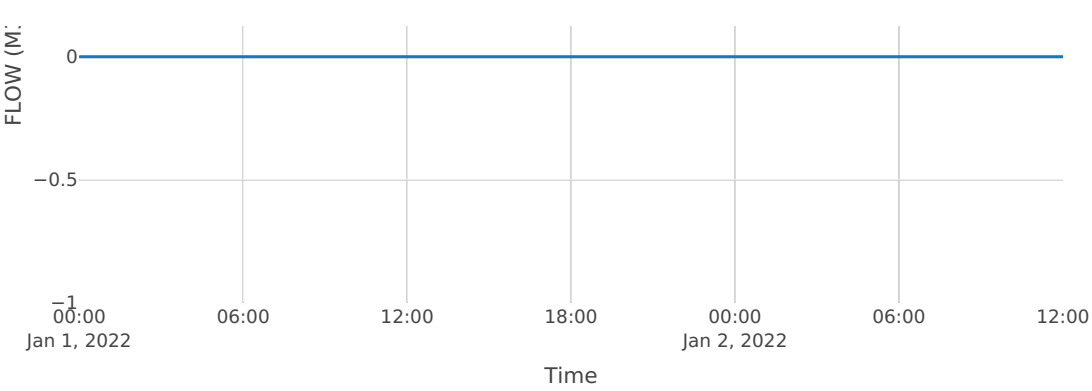


Reservoir: Road Attenuation (lumped)

Results: Road Attenuation (lumped)

Peak Discharge (M3/S)	0
Time of Peak Discharge	31Dec2021, 24:00
Peak Inflow (M3/S)	0
Time of Peak Inflow	31Dec2021, 24:00
Inflow Volume (M3)	0
Maximum Storage (M3)	5.5
Peak Elevation (M)	0.01
Discharge Volume (M3)	0




FLOW (M
0
−0.5
−1
00:00
Jan 1, 2022
06:00
12:00
18:00
00:00
Jan 2, 2022
06:00
12:00
Time