Direct ALL your inquiries and comments through the Contract Specialist at daniel.cotto@ihs.gov

During the Pre-Award phase, do **NOT** contact the people named in this or other files.
Contacting these people may lead to questioning your company's ethical practices.

Promoting an organizational culture that encourages ethical conduct and a commitment to compliance with the law is part of the contractor's responsibility determination.

- Refer to FAR RFO 9.104-1 General standards(d) "Have a satisfactory record of integrity and business ethics."

Certain portions of document have been removed and/or redacted.

PHASE 4

iHouse 19 Unit Apartment Building

Phase 4 - Construction Documents (Final CD)



August 13, 2024

JSRa
JOHNSON SMITTHIPONG & ROSAMOND ASSOCIATES, INC.
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August 13, 2024

Antoine Panther
Civil Engineer, FAC-COR Level II
Indian Health Service
Navajo Area Office – Division of Facilities Management & Engineering
PO BOX 9020, Window Rock, AZ 86515

RE: Phase 4—Construction Documents (Final CD)
iHouse19 Unit Apartment Building Project
Contract No. HHSI102201800007I (Order# NA23KA190Q7)

Dear Mr. Panther,

Please find enclosed our Phase4 Construction Documents (Final CD) submittal. We have prepared this submittal per the requirements of the A-E Design Guide 2022 and the outlined Scope of Work. Per the acerated schedule, this is a hybrid submittal moving in to the final construction documents. With this submittal there is not a review meeting just a an opportunity for comments.

Once again, thank you for the opportunity to provide you Architectural and Engineering Services and looking forward to finalizing the Construction Documents in order for IHS to proceed to the next phase of procurement.

Sincerely,

Daniel Hargreaves, AIA, FCSI, iSCS, CDT, RAS, LEED Assoc.
Project Architect

Distribution of Documents:
Jong Kim—Indian Health Service

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A3 –Submittal Checklist

Extracted from the 2022 A/E guide. This submittal is a hybrid of the Phase II and Phase III Submittal. Items that are struck out either don't apply to this Building Package (ie site adapt related items) or were removed from the scope or work.

Phase II – Housing Details:

Status	A/E Guide	Description
R	11.1.2.1(1)	Architectural building perspective render
R	11.1.2.2(1)	Civil narrative report on the status of all site related permit activities
R	11.1.2.5(3)	Arc flash analysis, simplified NFPA 70E tables are allowed
R	12.1.2.1(3)	Signage and wayfinding plan (site)
R	12.1.2.5	Electrical power selective coordination study
R	12.1.2.6	Maintainable equipment summary
R	13.1(1)	Final space comparison report
E	~~13.1(2)~~	~~Permitting status summary~~
R	13.1(3)	Final sustainable design status report. If a project is not pursuing LEED certification with documented limitations, at minimum provide a Guiding Principles assessment designers commentary and analysis for each Guiding Principles (5.2).
R	13.1(4)	Final energy and water consumption
R	13.1(5)	Final building commissioning plan including the maintainable equipment summary
R	13.1(6)	Updated OPR/BOD Documentation
R	13.1(8)	Record copy of other reports and studies required by the contract (e.g. archaeological discovery/ study, outstanding NEPA issues, etc.)
E	~~13.1(9)~~	~~Final tenant user manual~~
R	13.1(13)	Complete construction documents including final technical specifications

Items noted as **R** have been reviewed and included with this submittal
Items noted as **E** (with strikeout) are eliminated via scope, or not achievable at this phase of submission
*Items noted as **D** and Italicize are Deferred to a later submission.*



Daniel Hargreaves, AIA, FCSI, iSCS, CDT, RAS, LEED Assoc. (Project Manager) 8/13/24

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Acknowledgements

This Pre-Design Package was prepared by Johnson Smitthipong & Rosamond Associates, Inc (JSRa) working with Indian Health Services (NAV) and the Consultant Team listed below.

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Indian Health Service (IHS)
Contracting Officer: Jong Kim
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Seattle, WA 98104

COR: Antoine Panther
Navajo Area Indian Health Service (NAV)
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ARCHITECT
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MECHANICAL & ELECTRICAL ENGINEER
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PROJECT SCOPE

Project location: Located in Shonto, AZ along Route 16. Directly north of the Inscription House Health Center.

The scope of work requirements and related project information are as follows:

A. The site adaptation of a 19 unit apartment building, originally designed and constructed at Kayenta, AZ, is for the Inscription House Health Clinic in Shonto, AZ using the design-bid-build delivery method.
B. A site location based on an evaluation and discussion of the undeveloped land for the optimal location of the apartment building and RV spaces.
C. The drawings package shall include but not limited to, opinion of construction cost, construction drawings, specifications, FF&E package, and this BOD.
D. The unit break down is for (8) One Bedroom Units, (8) Efficiency (Studio) Units, (2) Two Bedroom Units, & (1) One Bedroom ADA Unit. The total units for this apartment building is 19 units.
E. OMB Circular No. A-45, dated November 25, 2019

PROJECT OVERVIEW

The new apartment building will be constructed within the existing iHouse Housing Area. The building will be built in the northwest undeveloped site. There will be no need for a SSER Phase 1 or Phase 2 for this project. These staff quarters units were justified through the original PJDQ. The site is located at geographical coordinates approximately 36.59716, -110.79115. iHouse undeveloped has approximately 2.6 acres of land available for the apartment to be built.

1. Quantities of each type of unit. Total of 19 Units.
    a. 2 - Two bedroom apartments
    b. 8 - One bedroom apartments
    c. 8 – Efficiency (studio) apartments
    d. 1 – One bedroom ADA apartment

NARRATIVES

Architectural

The design's main objective is to incorporate colors and textures that reflect the Navajo culture and the Shonto region. The quality of materials and finishes specified for this project also achieves and exceeds the high-middle standard of construction.

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Exterior Finish Types:

Walls:
Western One-Kote Stucco
CMU Base (Cut Stone Look)
Concrete Apron all around

Roof:
Standing Seam Metal Roof

Interior Finish Types:

Flooring:
Luxury Vinyl 'plank' Flooring (Living Areas & all other Areas)
Sealed Concrete (Mechanical)

Wall Base:
Semi-Gloss Painted wood to match housing trim.

Walls:
Typical: 5/8" type 'X' Gypsum Board over 2x4 wood studs. Final finish shall be Medium Orange Peel with Latex Paint. Key spaces shall incorporate an accent color.

Wet Walls: 5/8" type 'X' moisture resistant (glass matte) Gypsum Board over 2x4

Doors & Frames:
Painted Wood Door frames and Thremofused doors. Color and finish to match housing trim.
Hollow Metal Doors & Frames (Exterior Doors)

Window:
Residential sliding windows.

Window Sills:
Solid Surface

Window Treatments:
Mini Blinds.

Equipment:
The appliances included are:

- Microwave with Hoodvent
- Range
- Refrigerator
- Washer (top load HE)
- Dryer
- ADA Washer (frontload HE)

- ADA Microwave (countertop unit)

Refer to attached cut sheets for the BOD of each appliance.

Color selection for the exterior has been discussed with the service unit.

- Stucco: Western One Kote – Buff SW7683
- Metal Roofing: Pac-Clad – Forest Green

Interior colors shall be natural earth tones reflecting the Navajo Culture with the use of accent walls in the living and sleeping areas. Final selection shall be made during the submittal process.

Building Envelope:

Window and Skylight
Glass Type: Two Lite Insulated Glass w/ Low-E on Second Surface
Location: @ Each unit
U-Value: 0.25
Solar Heat Gain Factor (SHGF): 0.23
Shading Coefficient:
Air Leakage:

Exterior and Interior Wall
Type of wall: Wood stud
Insulation Type: Closed Cell Spray Foam
Insulation R-Value: 6.5 per inch
Wall U-Value: 0.21
Type of Roof: Metal over wood sheathing
Roof Insulation Type: Closed Cell Spray Foam
Roof Insulation R-Value: 6.5 per inch
Roof U-Value: 0.16

Civil

The new apartment building will include grading of native terrain to lines and measurements for the new apartment building, parking and accessway, extension of a local road currently ending at the existing housing complex and extending all utilities to the new building including water for domestic and fire use and sanitary sewer.

Grading at the propose building has been designed to function mainly as sheet flow. Minor runoff from upstream areas is diverted away from proposed improvements and all on-site grading prevents low points and maintains positive draiange away from the site. The finished surface of the site is graded to balance on-site material earthwork and avoids import and export of earth material. Material import for asphalt, base concrete and bedding is included in earthwork balancing. Similarly, the new access road has been graded to balance earthwork material and prevent onsite ponding of runoff. Additionally, the road has been graded with controlled low points designed to prevent excessive runoff depths within the roadway during major events. These low points use curb breaks to control the flow pattern and discharge collected road runoff. While the site is designed as mainly overland flow, two culverts will

convey flow under the proposed access road. These culverts are designed as riser inlets including geotextile wrap and gravel to filter stormwater and prevent sediment clogging within the pipes.

Sewer service for the building and several dedicated RV spots is provided by approximately 270 LF of new sewer main and service for the building and each stall located on this new main. The new main connects to the existing sewer main discharging to the waste treatment facility North of the iHouse site.

Domestic and fire water will require extending the existing water system currently terminating at the existing housing complex. NTUA and NNFD have been contacted and design information requested. Further information is needed before water design can be finalized. Currently, an assumption of 8" main extension for two new fire hydrants and building fire service is used for the design. This may be revised as additional information is collected.

Civil materials such as asphalt, concrete, aggregate, bedding, riprap, etc. are specified as MAG Uniform Standard Specifications for Public Works Construction materials. As the regionally excepted standard for materials, this ensures the specified materials are available and perform for regional parameters such as climate and native soil conditions.

Structural

A. General Project Description

The iHouse 19-Unit Apartment in Keams Tonalea, AZ is a building consisting of single-story apartment building.

B. Governing Design Codes and Standards

1. Design Building Codes

- Per the 2022 version of the Indian Health Service's Architect/Engineer Design Guide, "the design shall conform to the 2021 edition" of the International Building Code (IBC).
- The National Fire Code (NFC) is listed as the primary governing design code for IHS projects, but *NFPA 5000 - Building Construction and Safety Code,* which contains the structural design information in the NFC, is exempted in lieu of IBC.

2. Referenced Standards

- ASCE 7-16 - for load determination and application
- ACI 318-11 - for structural concrete design
- AISC 360-05 - for structural steel design

C. Code Analysis and Loads

1. Building and Site Designations **Reference**

Occupancy Category .....R1, R2 and B	Per IBC
Roof type ..... Heated, Sloped	
Surface Roughness/Wind Terrain Cat... C	

Seismic Site Class .....D

Geotechnical Report by ATEK Engineering Consultants, LLC Report number 240012

2. Live Loads

- Roof 20 PSF

3. Wind Loads **Reference**

- Basic Wind Speed 105 MPH ASCE 7 Figure 26.5-1A
- Wind Importance Factor, Iw 1.0 ASCE 7 Table 1.5-2
- Exposure Category C ASCE 7 Section 26.7.3

- Preliminary Wind Pressure[1] 22 PSF Calculations
- Approx. Factored Base Shear[2] 8 kips Calculations

4. Snow Loads **References**

- Ground snow loads p_g 15 PSF See Footnote 1
- Snow Importance Factor, I_s 1.0 ASCE 7 Table 7-4
- Exposure Partially Exposed ASCE 7 Table 7-2 notes
- Exposure Factor, C_e 1.0 ASCE 7 Table 7-2
- Thermal Factor, C_t 1.0 ASCE 7 Table 7-3
- Flat Roof Snow Load, p_f 15 PSF Per Calculations

5. Seismic Loads **References**

- Mapped MCE accelerations:
  - Short-period, S_s 0.243 USGS Data (see calcs)
  - 1-second period, S_1 0.071 USGS Data (see calcs)
- Earthquake Importance Factor. I_E 1.0
- Long-Period transition period 22 seconds
- Site coefficients:
  - Short-period, F_a 1.6 ASCE Table 11.4-1 (see calcs)
  - 1-second period, F_v 2.4 ASCE Table 11.4-2 (see calcs)
- Design Spectral Acceleration Parameters:
  - Short-period, S_{DS} 0.259 Calculations
  - 1-second period, S_{D1} 0.114 Calculations

- Seismic Force-Resisting System
  - Response Modification, R 6.5
  - System Overstrength, Ω_o 3
  - Deflection Amplification, C_d 4
- Seismic Response Coefficient, C_s 0.0399 Calculations
- Approx. Base Shear 18.3 Kips Calculations

D. Building Design Narrative

A wood framed structural system was deemed best for this project since it is the most cost effective solution when compared to light gage steel framed or masonry construction for the following reasons:

- Wood framing materials are readily available in this area.
- Local labor is knowledgeable when building with wood than with light gage framing.
- Wood is a renewable material and has good LEED ratings.
- Masonry and light gage framing are more expensive.

For these reasons, the building structure will consist of wood framing with wood structural panels for shear walls as the lateral load force resisting system.

The roof diaphragm will be wood structural panels attached to wood roof trusses. The roof trusses will the pre-engineered type supported on wood framed walls.

The foundation design will be based upon the Geotechnical Evaluation Report by Western Technologies, Project No. 2527JW116. The on-site soils consist of some construction debris and loose to very dense Silty Sands with variable amounts of gravel. A post tensioned foundation system and a stem wall foundation supporting the entire structure including the slab at grade. We choose somewhat of combination of foundation systems since we determined that it was the best value for this project. The slab will also be post-tensioned for crack control to minimize any concrete shrinkage issues. Since the deep edge foundation is needed to get below the frost line anyway it made the most sense to go with this mixed solution. This foundation system was also chosen because it can be placed monolithically which saves time and money. It also will give a more robust foundation system with the post-tensioning.

Mechanical

HVAC

Each of the new residences, office area, and RV area will be equipped with a high efficiency 3-ton/19.5 SEER2/8.5 HSPF2 (minimum), high efficiency 2-ton/19 SEER2/8.5 HSPF2 (minimum), high efficiency 1-ton/16 SEER2/9.3 HSPF2 (minimum) split heat pump system, respectively, with an indoor vertical air handling unit located in the mechanical room and the condensing unit outdoor near the area; the system is 30% percent more efficient than 2018 IECC requirement in both cooling and heating.

Ceiling mounted exhaust fans will be located in each toilet room and in the laundry. Minimum exhaust airflow quantities will be provided based on the current adopted version of the International Mechanical Code. Dryer exhaust vent to be routed to a location on wall to prevent birds from nesting.

Plumbing

Water

The building will be served by a 3” domestic water pipe to rise below grade in the mechanical room; reduced pressure zone backflow preventer will be located on the site. Civil engineering drawings will show water pipe and equipment past five feet outside of each residence.

Hot water to each residence will be provided by a 40 gallon electric hot water heater with two heating elements, master thermostatic mixing valve, and hot water return pump all located in the mechanical room.

Sewer

The building will be served by a 6-inch sewer main; the civil engineering drawing will show the extension of the underground facility sewer main to five feet outside of the new addition where it will continue on the plumbing drawings.

Fire Protection

Each residence is to be fully sprinklered. The residences are to be connected to the existing site domestic water system. The residence branch main will enter the mechanical room where the fire riser will be located.

Electrical Design

General Electrical Design and Installation

Electrical engineering and design shall comply with the Indian Health Service 2022 Architect/Engineer Guide, Codes, Standards and Guidelines as identified within 2.3.2 of the IHS 2022 Guidelines, Navajo Tribal Utility Authority (NTUA), the 2023 National Electrical Code, 2021 International Residential Code and the 2021 NFPA 101 Life Safety Code.

Incoming Site Utilities Power

The site NTUA primary service will originate from the existing NTUA overhead aerial distribution pole line with new NTUA overhead aerial distribution extended to the project site. A new riser pole per NTUA Standard CM-17 will be provided adjacent to the new overhead aerial distribution pole line with a slack span to the new riser pole. The new underground primary distribution to the site will originate from the new riser pole. (1) six inch rigid galvanized riser conduit will be provided on the new riser pole per NTUA CM-17 transitioning to (1) six inch Schedule 80 rigid PVC conduit within the underground trench to a pad mounted switching cubicle complete with a ground sleeve. Pad mounted switching cubicle shall be furnished and installed by NTUA. The ground sleeve will be furnished by NTUA, contractor installed. (1) 3” underground conduit with pull rope will be provided from the pad mounted switching cubicle to each of the NTUA pad mounted transformers. NTUA shall furnish, install, terminate and test the incoming primary conductors from the riser pole to the switching cubicle and to the pad mounted transformers.

Two NTUA pad mounted transformers will be located adjacent to the building and the secondary service entrances. A third NTUA pad mounted transformer will be located adjacent to the RV parking. Each pad mounted transformer will be complete with a ground sleeve provided by NTUA and installed by the contractor. The concrete pad, ground sleeve and grounding for each pad mounted transformer shall comply with NTUA Standards CM-12, CM-28 and CM-24.
The underground primary duct bank will require a NTUA ten foot easement consisting of five feet on each side of the installed underground conduit to the respective NTUA pad switching cubicle and mounted transformers. The primary trench, bedding, detectable warning tape, backfill and compaction shall comply with NTUA Standard CM-05 with the incoming underground primary conduits at a minimum depth to the bottom of the conduit at forty-eight inches below finished grade.

The apartment building will have two metered service entrances. Each metered service entrance will source one-half of the building apartments under a single meter. Each of these two service entrances will be sourced from a separate NTUA pad mounted transformer. The incoming underground from the NTUA pad mounted transformer will consist of conduit and copper conductors provided by the electrical contractor. Each of the service entrance switchboards will contain a main incoming circuit breaker and feeder circuit breakers to source their respective panelboard located within each apartment. Copper SER cable will be utilized from each of these circuit breakers to the respective apartment panelboard.
A third metered service entrance will be provided adjacent to the RV parking area. The service entrance will consist of a NEMA 3R stanchion mounted panelboard, service entrance rated with a incoming main circuit breaker and three feeder branch circuit breakers sourcing (3) RV service pedestals. Provisions within the panelboard will be provided to source (2) future additional RV service pedestals. Underground conduits with pull wires will be provided to the future pedestal locations and capped for the future installation of the RV pedestals.
The RV pedestals shall be as manufactured by Utility Supply Group, catalog number H75P-3L or approved equal. Pedestal shall be pad mounted, non-metered NEMA 3R, 100A rated, 240V/120-1Phase-3Wire with (1) 50A, (1)30A and (1) 20A GFCI duplex receptacle. Pedestal shall be complete with LED light, photocell and lockable cover.

Incoming Site Utilities Telephone/Data

An underground four inch conduit with copper cabling will be provided to the telephone/data terminal board located within the storage room in the office.

Branch circuit panelboards

Branch circuit panelboards within the apartments will be flush mounted within each apartment. Panelboards shall have a bus ampacity of 200 amperes at 120/240V-1 phase- 3 wire, main lug only with a short circuit rating of 10,000 AIC. Panelboards shall be provided with branch circuit breakers as reflected within the panelboard schedules on the drawings. All 120V 15A and 20A branch circuit breakers shall be arc-fault circuit interrupter per NEC 210.12. Panelboard shall provide a minimum of six breaker unused spaces in addition to the required design branch circuit breakers.

An owner's branch circuit panelboard within the 19 Unit apartment building will be provided for the owner within the electrical room within RV commons and office housekeeping. Panelboard shall have a bus ampacity of 200 amperes at 120/240V-1 phase- 3 wire, main lug only with a short circuit rating of 10,000 AIC. Panelboards shall be provided with branch circuit breakers as reflected within the panelboard schedules on the drawings.

Site Lighting

All site lighting light fixture lamp sources will be LED consisting of pole mounted light fixtures and wall mounted on the apartment building providing lighting for safety and security. All site lighting will be photocell controlled providing light from dusk to dawn. All light fixtures shall be Energy Star rated and made in America. Emergency battery packs will be provided within selected wall mounted exterior lights to provide emergency egress lighting away from the building.

Interior Lighting

All interior light fixture lamp sources will be LED. The light fixtures specified which are presently not manufactured with standard LED lamps will be re-lamped with LED Energy Star rated lamps. All light fixtures shall be Energy Star rated and made in America. Interior lighting will be controlled by toggle switches for all rooms and in compliance with NEC 210.70. Emergency battery packs will be provided within selected light fixtures to provide emergency egress lighting .

Exterior Lighting

All exterior patio light fixture lamp sources will be LED. Exterior patios will be toggle switch controlled by the resident. All light fixtures shall be Energy Star rated and made in America.

Receptacles

Duplex receptacles will be located and spaced in compliance with the 2023 National Electrical Code, Article 210 Branch Circuits. All duplex receptacles within the residences will be tamper-resistant per NEC Article 406.12.

Duplex receptacles within the living rooms, dining rooms and bedrooms receptacles will be spaced horizontally along the floor line so no wall space is more than six feet from a receptacle. Any wall space two feet or more measured horizontally including around corners within these above mentioned rooms will have a duplex receptacle.

Duplex receptacles within the kitchen above the counters
will be spaced horizontally so no wall space is more than twenty-four inches from a receptacle. Countertops twelve inches or more will require a duplex receptacle. Island countertops measuring twenty four inches in length or greater and twelve inches or greater in depth will have at least one duplex receptacle. Duplex receptacles for island counters per NEC 210.52(C)(2).

A duplex receptacle will be provided within each bathroom adjacent to the sink. Each receptacle within bathroom will be on a dedicated branch circuit per NEC Article 210.11(C)(3).

Laundry rooms will be provided with one duplex receptacle for the washer and a 30 amp, 250V receptacle for an electric dryer.

A duplex receptacle will be provided in hallways ten feet or longer.

A duplex receptacle will be provided within each patio area. A duplex receptacle will be provided within twenty-five feet of mechanical equipment.

All duplex receptacles located within the kitchen, in bathrooms, patios and exterior of the apartment building will be ground fault circuit interrupter type, non-feed through.

All 15A and 20A,125V duplex receptacles within the residences shall be tamper-resistant. Receptacles within the bathrooms rooms in the residences shall be GFCI tamper-resistant. Exterior receptacles shall be GFCI, weather resistant, tamper-resistant with NEMA 3R in-use metallic covers.

All wiring devices shall be decorator style, white with white thermoplastic coverplates.

Snow-melting will be provided at building entrances sidewalks and electric hot boxes will be provided on the backflow preventer(s).

Fire Alarm

The apartment building will be provided with a digital, addressable fire alarm systems

The fire alarm system will be constructed with UL listed components and installed by a licensed fire alarm system Contractor with a minimum of five years of experience. The installing Contractor and the State Fire Marshall will certify the entire system prior to acceptance.

The fire alarm system will consist of fire alarm control units, standby power supplies, smoke detectors, carbon monoxide detectors, fire alarm pull boxes, audible notification appliances and visible notification appliances. The fire alarm control panel shall be located within the reception area of the office.

The system will monitor fire suppression system water-flow and tamper switches.

Audible and visible notification appliances will be listed to applicable UL standards and installed I accordance with NFPA and ADA requirements. Standard audible and visible appliances will be installed throughout for occupant notification. Low frequency (520 Hz) audible appliances will be installed in family bedrooms and resident rooms compliance with NFPA 72. Suitable visible notification appliances will be installed in accessible sleeping compartment to comply with NFPA and ADA requirements.

Manual pull stations will be installed at specific selected exits.

The fire alarm system wiring will be installed in metallic conduit in order to meet the NFPA 72 Level 1 Pathway Survivability requirements.

All junction and back boxes will be painted red and any junction box larger than 4 square inches shall be required to contain wire terminal strips for all splices and wire connections. The covers of all fire alarm junction boxes shall have the letters “FA” stenciled on the cover (White letters on red covers).

The minimum size conduit required will be 3/4” EMT and the minimum size fire alarm cable will be #18 AWG for data and #14 AWG for DC power.

The entire system shall be installed, tested, and documented in accordance with NFPA 72.

Carbon Monoxide Detectors

Carbon monoxide detectors will be provided within all residences located within the hallway(s) adjacent to the bedrooms and laundry room. Detectors shall be hardwired with battery back-up and shall be complete with audible alarm, continuous digital display, peak level memory, test button, and reset button. Detector shall be UL listed and compliant with UL2034 standard testing.

Basket Cable Tray

A 12” wide by 4” deep basket cable tray will be provided within the accessible attic space for the distribution of the cable television and telephone/data systems cabling. The cable tray shall be installed the full length of the main center corridor and will tee off to the work area within the office. A 4’x8’x3/4” fire resistant plywood terminal board with a #6 ground conductor will be provided within the work area.

Low Voltage Systems Conduits

From each cable television outlet and from each telephone/data outlet a three-quarter inch EMT conduit with a pull wire shall be provided from each outlet box installed up into the accessible attic space for cabling and future cabling updates. Conduits within the attic space shall terminate with a nylon bushing.

Cable Television System

Each residence will be independently cabled with broadband coaxial cable, RG6 18 gage copper clad steel, quad shield CATV cable. Cable television outlets will be provided within Living room and each bedroom for each apartment.

A flush mounted junction box will be provided within the exterior wall above the electrical service entrance for a cable satellite dish. A two and a half inch (2-½") conduit from the junction box will be stubbed into the attic space for the installation of the CATV cabling.

Telephone/Data

Within each residence three telephone/data outlets will be provided. Each telephone outlet will consist of two cabled ports. One outlet will be located within the kitchen, one within the living room and one within the master bedroom. All telephone/data cabling will be Cat6.

Within each apartment the Cat6 cabling shall be routed to a small box media converter with a built-in data port for a router located on the shelf within the closet of each residence. From each apartment the Cat6 cabling shall be routed to the telephone/data backboard located within the storage room within the office.

Wireless Access Points (WAPS)

Wireless access points will be provided within the apartment building located within the main corridor to provide full wireless coverage throughout the apartment building. The WAP Cat6 cabling will be provided back to the telephone/data terminal board located within the storage room within the office.

Electric Vehicle Charging Station

A Level 1 pedestal mounted dual electric car charging station will be provided. Charging station will require the electric car user to utilize a credit or debit car to utilize the charging station.

Renewable Energy

A Solar PV Parking Canopy will be provided with the west canopy is being proposed as the solar PV canopy. With an estimated roof square footage of 2100 square feet and utilizing 415 watt solar panels the PV system can provide a calculated minimum of 15 % of the electrical annual kWh demand load. The calculated 15% annual kWh demand for this project is 74,080kWh. Based on the proposed 415 watt panel with a square footage of 20.4 square feet per panel equates to 103 panels. 103 panels will produce 42,745 watts or 42.745kW. A 42.745 kW solar PV system calculated will produce 77,490kWh/year. Based on an average solar system cost of $2720/kw and a NTUA rate of $0.0656/kWh the estimated ROI would be 22.87 years. The projected tilt for the Solar PV Parking Canopy is 20 degrees. The proposed design will provide (3)15kW transformerless inverters mounted on the canopy steel columns. Each inverter shall have an underground feeder to a distribution panelboard located adjacent to the Service Entrance SESA. This panelboard will be connected to a circuit breaker within Service Entrance SESA. An Interconnection Agreement will be required with NTUA prior to installation and bringing the Soler PV System on line.

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SUSTAINABILITY GOALS (Guiding Principles)

Employ Integrated Assessment, Operation, and Management Principles

Integrated Assessment, Operation, and Management

1. Consider the environmental impact of siting decisions and use an integrated project team to: establish energy and other environmental performance goals in the design process; follow sustainable landscape design principles; evaluate electric vehicle charging needs; consider design choices that improve environmental performance, support health and wellness of building occupants and consider climate risks including wildfire; and consider all stages of the building's life cycle.

- The Integrated team is scheduled to meet regularly during phase submittals through the course of the project. Project review meetings with the owner shall be included and coordinated. The project is planned to be a Design, Bid, Build project. As such the A/E team will not know the identity of the General Contractor during the design phase and will make coordinated decisions with IHS on behalf of the builder related to design items. Design expectations are set early and then refined through the sustainable goals with the entire team. Items that may be out of scope or budget are reviewed by the team and then discussed with IHS.
- The Integrated team includes:
    - Owner Representative: Antoine Panther, NA- IHS
    - Architect: Daniel Hargreaves, JSRa Architects
    - Structural: Ron Schneider, Schneider & Associates
    - Mechanical: Mark Alvarez, Bernhard
    - Electrical: Jacob Clark, Bernhard

Commissioning

2. Commission and recommission at least every 4 years to optimize building performance using commissioning agents who are independent of the design and construction or operating team. Commissioning should be consistent with the Energy Independence and Security Act (EISA) section 432 and Federal Energy Management Program (FEMP) commissioning guidance.

- Commissioning was not included in the A/E Scope of work. IHS may elect to perform Commissioning services at a later time under a separate contract.
- Design team will submit updated Energy Star Certified Homes Checklists corresponding to each floor plan for each design phase of the project.

Optimize Energy Performance

Energy Efficiency

3.

A. For new construction, ensure energy efficiency is 30% better than the current American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 standard, OR
B. For modernization, ensure:

1) Energy use is 20% below the fiscal year (FY) 2015 energy use baseline, OR
2) Energy use is 30% below the FY 2003 energy use baseline, OR
3) The building has an ENERGY STAR® rating of 75 or higher, OR
4) For building types not in ENERGY STAR Portfolio Manager, where adequate benchmarking data exists, the building is in the top quartile of energy performance for its building type, AND

C. Use energy efficient products, as required by statute

- The iHouse 19 Unit Apartment project shall comply with mandatory sections of the ASHRAE 90.1-2016 or 2018 IECC. REScheck Windows Version 4.7.2.0 shall be used to evaluate building performance.

Renewable and Clean Energy

4. Evaluate and implement, where appropriate, life cycle cost-effective renewable energy projects on-site; consider long-term off-site renewable sources and Renewable Energy Certificates (RECs); and utilize clean and alternative energy where possible.

- Solar Hot Water Heating - A feasibility study shall be performed to determine the feasibility of constructing a solar hot water heating system for each unit capable of delivering at least 30% of the hot water demand. Feasibility shall be based upon using a 40-yr payback analysis.
- On-Site Renewable Energy - A feasibility study shall be performed to determine the feasibility of constructing an on-site renewable energy system capable of providing at least 7.5% of the annual electrical load of each unit. The size and scope of the renewable energy system(s) shall be determined through a cost feasibility analysis to determine how to proceed. Feasibility shall be based on the allotted budget, and a life-cycle cost analysis using a 40-yr payback calculation.

Metering

5. Install building level meters for electricity, natural gas, and steam; install advanced or standard meters as appropriate.

- Smart metering shall be discussed during the design charrette with IHS to determine feasibility.

Benchmarking

6. Benchmark building performance at least annually, preferably using ENERGY STAR Portfolio Manager; regularly monitor building energy performance against historic performance data and peer buildings.

- All Units shall have Electrical meters.
- Additional Benchmarking services and tools shall be discussed with IHS at design charette to determine what is desired and appropriate for the abilities of the Crownpoint service unit maintenance staff.

Protect and Conserve Water

Indoor Water Use

7. A. Build to ASHRAE standard 189.1-2014 sections 6.3.2, 6.4.2, and 6.4.3, or current comparable ASHRAE standards, AND B. Use water-efficient products; install building level water meters; optimize cooling tower operations; and eliminate single pass cooling.

- All fixtures selected shall be water efficient, refer to the following list. Water meters are provided at each unit and comply with the standards set by the utility company NTUA. WaterSense numbers noted below shall be used to meet or better the baseline.
    - Water Closets: 1.1 GPF (WaterSense 1.28 GPF)
    - Lavatory: 1.2 GPM (WaterSense 1.5 GPM)
    - Kitchen: 1.5 GPM w/aerator (WaterSense 2.2 GPM)
    - Shower: 1.75 GPM (WaterSense 2.0 GPM)
    - Water Heater Single-Family: Gas 0.73 UEF or 86% Efficiency (EnergyStar qualified)

Outdoor Water Use

8.

A. Separately meter water for irrigation systems greater than 25,000 square feet, AND
B. Use water efficient landscapes, AND
C. Limit potable water use for irrigation to 50% or more below conventional practices using methodologies from (but not the numeric requirements contained in) ASHRAE standard 189.1-2014 section 6.5.1, or current comparable ASHRAE standards, to calculate water use of conventional practices

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- All disturbed areas that do not receive decomposed granite mulch shall be hydroseeded with Seed Mix. This cover is a native vegetation that does not require irrigation.
- A.) Type of Irrigation System: None.
- B.) Type of Landscape: Homes sites shall be designed using xeriscape design methodologies. New tree plantings are not currently planned for project.
- Ground cover/hardscape material: Decomposed Granite.
- C.) No Potable water is used for landscaping, the project will not include new plantings. An irrigation system will not be provided.

Alternative Water

9. Consider alternative sources of water where cost-effective and permitted by local laws and regulations.
    - There is no landscaping services provided under this contract. Xeriscaping methodologies shall be employed with limited use of plantings. Turf grass shall not be used on this project. Decomposed granite for the front area and numerous pedestrian walkways shall be used to eliminate the need for supplemental water from irrigation.

Stormwater Management

10. For new construction meet or exceed EISA section 438 stormwater management requirements.
    - The project site shall be studied to best understand current water run off flows and volumes and how to be best detain and retain it on site based on EISA 438

requirements. Detention and retention options shall be discussed with IHS and the Inscription House service unit during the design charrette to better understand if there are any limits to these systems by the end user.

Enhance Indoor Environmental Quality

Ventilation and Thermal Comfort

11. Meet the current ASHRAE 55 and either 62.1 or 62.2 standards for ventilation and thermal comfort.

Per ASHRAE 62.2, the ventilation is as follows:
Single-Family:
1.) Whole-house Ventilation Required: 50 to 80 CFM, design target shall be 100 CFM, (Basis of design exhaust fan system: Panasonic Whisper Green total house exhaust system and control)
2.) Kitchen Ventilation Required: 100 CFM, design target shall be 300 CFM with microwave with 2-speed exhaust fan vented to the exterior.
3.) Bathroom Ventilation Required: 50 CFM, design target shall be 100 CFM.

Per ASHARE 55, Thermal Environmental Conditions for Human Occupancy, all occupied areas are air conditioned, the ASHARE 55 specified that the designed thermal environmental conditions to be acceptable to 80% or more of the occupants within the space. The project shall comply with ASHRAE requirements for indoor temperature.

Daylighting and Lighting Controls

12. Maximize opportunities for daylighting in regularly occupied space, automatic dimming controls or accessible manual controls, task lighting, and shade and glare control.

- All Living spaces have direct access to daylight via windows. All windows shall be provided with manually adjustable mini-blinds as shown on the floor plans.
- All lights fixtures shall utilize LED.

Indoor Air Quality

13. Develop and implement an indoor air quality policy that considers the following: moisture control, use of low emitting materials and products with low pollutant emissions, necessary protocols to protect indoor air quality during construction and in the finished building, prohibition of smoking in any form inside and within 25 feet of all building entrances, operable windows, and building ventilation intakes, and use of integrated pest management techniques

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- Moisture Control: An under-slab vapor barrier (15mil) shall be installed at all slab on grade. Exterior details and specification reference this requirement. Water resistant at wet area shall be utilized. Exterior finishes include stucco, ground face CMU and metal roof with a vapor barrier applied to the thermal insulation at the interior.
- Low-Emitting Materials: Each specification section shall reference low VOC where applicable.
- Protect Indoor Air During Construction: Project Specification Section 015721 - INDOOR AIR QUALITY CONTROLS requires all ducts be protected during construction.

- Prohibit Smoking: iHouse Service Unit has a policy of No Smoking. Each building shall include a No Smoking sign at the front door.

Occupant Health and Wellness

14. Promote opportunities for voluntary increased physical movement of building occupants such as making stairwells an option for circulation, active workstations, fitness centers, and bicycle commuter facilities; and support convenient access to healthy dining options, potable water, daylight, plants, and exterior views.

- Site amenities are currently out of scope.
- Carbon monoxide detectors shall be provided within all residences located within the hallway(s) adjacent to the bedrooms. Detectors shall be hardwired with battery back-up.

Reduce the Environmental Impact of Materials

Material Content and Performance

15. Procure products that meet the following requirements where applicable:
    A. RCRA section 6002, AND
    B. FSRIA section 9002, AND
    C. Federally Recommended Specifications, Standards and Ecolabels or are on the Federal Green Procurement Compilation for other green products, as appropriate, AND
    D. Avoid ozone depleting compounds and high GWP chemicals

- A.)Project specifications shall include products that include recycled content.
- B.) Rural access to shall be considered when selecting building materials, design team shall select materials that are biobased on a as-needed basis, while considering availability options for replacement materials in the future.
- C.) Each specification section references low VOC were applicable.
- D.) Standard HVAC units on the market for residential installation do not utilize alternative coolants. R410a refrigerant has replaced the previous R-22 Freon standard since 2010. For residential construction due to rural access to building supply, precluded pursuing exotic refrigerant. R410a is used as a current industry standard, along with owners request for simple systems due to access for maintenance.

Waste Diversion

16. Where markets exist, provide reuse and recycling services for building occupants and divert at least 50% of non-hazardous non-construction related materials from landfills.

- The remote rural location currently does not have infrastructure in place to handle to recycled content collection. This item may become accessible and managed by the owner after substantial completion and is not part of the design or construction.

Materials Management

17. Where markets exist, divert at least 50% of construction and demolition materials from landfills.

- The remote rural location currently does not have infrastructure in place to handle to recycled content diversion collection. Construction techniques, including efficient framing are being utilized to reduce construction waste.

Assess and Consider Climate Change Risks

Mission Criticality

18. Determine long-term mission criticality of the physical asset and operations to be housed in the facility to inform the design of new construction and modernization to increase climate resilience.

- The project will include the construction of a single apartment building with 19 units and utility services improvements to the apartment building. These new quarters will be used to support the iHouse Health Center operations and mission objectives in providing quality healthcare to the Navajo Nation community.

  Because some Tribes and Indigenous peoples are among those in the region with the highest rates of poverty and unemployment, and because many are still directly reliant on natural resources, they are among the most at risk to climate change (4th National Climate Assessment Vol. 11, 2019). Indigenous health is based on interconnected social and ecological systems that are being disrupted by a changing climate. As these changes continue, the health of individuals and communities will be uniquely challenged by climate impacts to lands, waters, foods, and other plant and animal species (4th National Climate Assessment Vol. 11, 2019).

  This expanding development for healthcare professionals to service the Crownpoint Health Care Facility will reduce risks to the existing infrastructure and community as a whole providing on-going quality healthcare to Tribes and Indigenous peoples in the future.

Floodplain Considerations

19. For new construction, avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and avoid floodplain development whenever there is a practicable alternative.

- Apartment building is being constructed on the existing facility land. The A/E will further investigate the site and its location relative to the designated 100 year floodplain within a required 50-foot Erosion Hazard Setback (EHS) for development.

Facility Design

20. For new construction, balance options to address predicted climate change impacts against mission criticality, cost, and security to determine design parameters; at a minimum, include low and no cost resilience measures to address predicted climate conditions.

- As outlined in the 4th National Climate Assessment Vol. 11, 2019, the Southwest region reflects a broad range of climate conditions, including the hottest and driest climate in the United States. This results in intensifying droughts, critical water demands from growing populations, and ground water depletion, suggesting the need for flexible water management techniques. In addition, the ability of electrical utility providers to meet growing energy use is decreasing as a result of drought and rising temperatures.

  The proposed development is to further evaluate the feasibility to supplement the buildings electrical energy use and hot water heating demand by means of utilizing on-site renewable technologies, e.g. photovoltaic and solar availability. The intent is to reduce energy consumption and improve energy efficiencies in overall performance in fossil fuel reduction.

Facility Adaptation

21. For modernization, take action to mitigate identified risks, considering mission criticality, climate impacts, cost, and phased adaptation over time.

- N/A

CODES

Applicable Codes and Standards:

2021 IBC -International Building Code
2017 National Electrical Code (NEC)
2021 IMC - International Mechanical Code
2021 IPC - International Plumbing Code
2021 IFC - International Fire Code
2021 IECC - International Energy Conservation Code
2021 NFPA 101
Chapter 30 Apartments
2010 Standards for Architectural Barriers Act

In addition to the above codes, the contractor is responsible for constructing the project so as to comply with all applicable referenced standards, including but not limited to:

NFPA (National Fire Protection Association) Codes:
10 - Standard for Portable Fire Extinguishers
13 – Sprinklers for Commercial Buildings
24 - Installation of Private Fire Service Mains and their Appurtenance
1142 - Standard on water Supplies for Suburban and Rural Fire Fighting
Navajo Tribal Utility Authority (NTUA) Standard Details
Navajo Nation EPA Regulations
Navajo Nation Clean Water Act

Navajo Nation Domestic Wastewater Regulations
Navajo Nation Safe Drinking Water Act
Navajo Nation Primary Drinking Water Regulation

I. Administration:
A. Multi-Family, Transient: IBC applies to the apartment building.
B. All construction is new

II. Definitions:
A. APARTMENT: NFPA Defines any building with three or more dwelling units as an apartment.
B. DWELLING UNIT: A single unit providing complete independent living facilities for one or more persons.
C. HABITABLE SPACE. A space in a building for living, sleeping, eating or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces.

III. Occupancy Class (IBC 310.3)
A. Apartment = IBC, R-2

IV. IBC Area & Construction Type
A. Construction Type VB (IBC Table 601)
B. Area Limit per Sprinklered VB = R-2: 28,000sf (IBC Table 506.2)
C. 19 Apartment Units = 19,130sf actual building (IBC table 1004.5 – residential 200 gross)

V. Exterior Walls:
A. IBC – Table 602, Type VB construction, No fire resistance requirements when greater than 10'

VI. Light, Ventilation and Heating:
A. IBC 1204.2: Habitable rooms shall have a glazing area not less than 8% of the floor area.

GLAZING AREA

Unit Type	8% Target Area	Actual Area
1-Bedroom	48 SF	56 SF
1-Bedroom ADA	56 SF	78 SF
2-Bedroom	57 SF	78 SF
Efficiency	34 SF	58 SF

VII. Minimum Room Areas:
A. IBC – 1208.1 Habitable space (other than kitchen) shall not be less than 7' in any plan dimension.

VIII. Ceiling Height:
A. IBC 1208 Habitable spaces and corridors shall have a ceiling height of not less than 7 feet 6 inches above the finish floor. Bathrooms, toilet rooms, kitchens, storage rooms and laundry rooms shall have a ceiling height not less than 7 feet above finished floor. Exception: Sloping Ceilings

IX. Sanitation:
- A. IBC – 1209.2.3 Shower and bathtubs with showers shall be finished with a nonabsorbent surface extending to a height of 6 feet above the drain inlet.

X. Glazing:
- A. IBC – 2406 Individual glazed area, including glass mirrors, in hazardous locations shall comply with the IBC per table 2406.2
- B. Hazardous locations include glazing in doors. Glazing adjacent to doors (lowest edge 24” AFF). Windows with lowest part of glazing less than 18” AFF.

XI. Emergency Escape and Rescue Openings:
- A. NFPA 24.2.2.1 – Dwelling Units of 2 or more rooms, every sleeping room shall have one primary means of escape and a secondary means of escape.
  1. Secondary Means of escape shall be an outside window or door not less than 5.7sf Clear height -24" Clear width 20". Sill height of not more than 44 inches AFF. Window shall be within 20ft of grade.
- B. NFPA 30.2.1.2 – Apartment means of escape shall comply with Section 24.2.
- C. IBC - 1030 Basements and every sleeping room shall have at least one operable emergency escape and rescue opening. Minimum Dimensions: Clear opening -5.7 s.f. Clear height -24" Clear width 20". Sill height of not more than 44 inches.

XII. Means of Egress:
- A. IBC 1004 Occupant Load factor is 200 gross (2 Bedroom is largest unit at 830sf = 5) All Units only require one means of egress.
- B. IBC 1010.1 Means of Egress doors shall be clear width of 32”. Measurement shall be from door face to door stop when door is 90 degrees open.
- C. IBC 1020.1 Corridors serving more than 10 occupants shall have a 30 minute rating if fully sprinklered.
- D. IBC 1020.2 Hallways (Corridors) within the dwelling unit shall not be less than 36” clear.

XIII. Smoke Alarms
- A. NFPA 24.3.4.1 & 30.3.4.5, IBC 907.2.10.2 Smoke alarms shall be installed in each sleeping room, outside each sleeping area, and on each additional story.
- B. NFPA 24.3.4.2 – Carbon Monoxide alarms or detectors shall be provided with dwelling units that have an attached garage.

XIV. Insulation & Foam Plastic IBC 2603:
- A. All foam plastic shall have a name spread index of not more than 75 and shall have a smoke-developed Index of not more than 450 when tested by ASTM E 84.
- B. Foam plastic shall be separated from the interior of a building by an approved thermal barrier of minimum ½ inch gypsum wallboard or an approved thermal barrier material.
- C. IBC 2603.4.1.7 Foam Filled Exterior doors in R2 are not required to have a fire protection rating

XV. Flame Spread and Smoke Density:
- A. IBC 803.1.2 (Class C) Wall and ceiling finishes shall have a flame spread classification of not

greater than 200 nor a smoke-developed index greater than 460 as tested by ASTME84.

XVI. Dwelling Unit Separation:
- A. NFPA 30.3.7.2 – Buildings protected by an approved automatic sprinkler system, each dwelling unit shall be separated by ½ hour fire resistive rating.
- B. IBC 420.2 Walls separating Dwelling units shall constructed as fire partitions per 708.
- C. IBC 708.3 Walls shall be 1hour unless Type VB construction with automatic sprinkler system shall be not less than ½ hour.

XVII. Moisture decay & Termites: N/A

XVIII. Accessibility:
- A. IBC Chapter 11 refers to ICC A117.1. Accessible Units shall comply with the technical section of the 2010 ABA & ICC A117.1

XIX. Energy Efficiency IECC Chapter 4:
- A. Climate zone: 5
- B. Insulation and fenestration requirements by component (Table C402.4)
  1. Fenestration U-factor. 0.30
  2. Skylight U-factor: 0.55
  3. Glazing SHGC: No Requirement
  4. Roof R-Value: R30ci
  5. Wood frame wall R-value: 20+3.8ci - or- 13+7.5ci
  6. Slab R-value and depth: R20, 2ft
- C. The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film or solid material.
  1. All joints, seams and penetrations.
  2. Site-built windows, doors and skylights.
  3. Openings between window and door assemblies and their respective jambs and framing.
  4. Utility penetrations.
  5. Dropped ceilings or chases adjacent to the thermal envelope.
  6. Knee walls.
  7. Walls and ceilings separating the garage from conditioned spaces.
  8. Behind tubs and showers on exterior walls.
  9. Common walls between dwelling units.
  10. Other sources of infiltration.
- D. Refer to mechanical, plumbing, and electrical drawings for systems compliance.

XX. Additional Requirements:
- A. Refer to structural, mechanical, plumbing, and electrical drawings for discipline specific code requirements and compliance.

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SPACE PROGRAM

Unit Type	Min Target Area	Max Target Area	Actual Area
1-Bedroom	730 SF	810 SF	734 SF
1-Bedroom ADA	800 SF	890 SF	805 SF
2-Bedroom	1,000 SF	1,250 SF	976 SF
Efficiency	550 SF	730 SF	519 SF

VALUE ENGINEERING

During the kickoff meeting on April 17, 2024, it was determined that the best Value Engineering (VE) was selecting site Option 1, the northwest location, in lieu of site Option 2, near the retention basin. Option 2 was deemed to have a higher cost impact and flood concerns.

Additional VE items discussed were maintenance and cost regarding material finishes. The decision was to simplify interior finishes. Paint selection was reduced to one field color and two accents. All flooring and casework finishes will be the same to simplify maintenance.

Appendix A1
Renderings

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iHouse 19 Unit Apartment Building; Inscription House, AZ



Exterior



Burnt Orange Study

JSRa
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Green Study (Light CMU Base)



Terra Cotta Study

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Interior Typical Living Room



Interior Typical Kitchen

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iHouse 19 Unit Apartment Building

Tonalea, AZ

Appendix A2
GeoTech Report

JSRa
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DRAFT GEOTECHNICAL EXPLORATION REPORT
IHS IDIQ IHOUSE
INDIAN ROUTE 6290
TONALEA, ARIZONA

Prepared for:
Johnson Smitthipong & Rosamond Associates, Inc.
5210 E. Williams Circle, Suite 600
Tucson, Arizona



Prepared by:
ATEK Engineering Consultants, LLC
111 South Weber Drive, Suite 1
Chandler, Arizona 85226

ATEK Project # 240012

June 5, 2024

June 5, 2024
ATEK Project #240012

Daniel Hargreaves, AIA, FCSI, ISCS, CDT, RAS, LEED Assoc.
Director of Operations
Johnson Smitthipong & Rosamond Associates, Inc.
5210 E. Williams Circle, Suite 600
Tucson, Arizona

Regarding: DRAFT Geotechnical Exploration Report

Project: IHS IDIQ iHouse
Indian Route 6290
Tonalea, Arizona

Dear Mr. Hargreaves:

ATEK Engineering Consultants, LLC is pleased to present the attached DRAFT Geotechnical Exploration Report for the IHS IDIQ iHouse located in Tonalea, Arizona within the Navajo Nation. The purpose of our study was to explore and evaluate the subsurface conditions at the proposed site to develop geotechnical engineering recommendations for project design and construction.

Based on our findings, the site is considered suitable for the proposed construction, provided geotechnical recommendations presented in the attached report are followed. Specific recommendations regarding the geotechnical aspects of the project design and construction are presented in the attached report. The recommendations contained within this report are dependent on the provisions provided in the Limitations and Recommended Additional Services sections of this report.

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned.

Sincerely,
ATEK Engineering Consultants, LLC

Antonio Lopez, P.E.
Geotechnical Group Manager

Armando Ortega, P.E.
Principal Geotechnical Engineer

Distribution: (1) Addresses (Electronic Copy)

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1. INTRODUCTION

This report presents the results of our draft geotechnical exploration for the IHS IDIQ iHouse located in Tonalea, Arizona within the Navajo Nation. A Site Location Map is presented in **Appendix A** of this report. The following sections of this report describe our understanding of the project and our scope of services.

1.1. Project Description

The proposed project is the construction of a new 19-unit apartment complex in Tonalea, Arizona just north of the Inscription House Health Clinic. The proposed apartment building will be a one-story building with an approximate footprint of 18,000 square feet. The proposed construction is wood stud framing with stucco and CMU Veneer. Additionally, improvements include parking areas, Recreational Vehicle spaces, and storm drain site retention.

1.2. Purpose

The purpose of this geotechnical study was to evaluate the general surface and subsurface conditions at the site, and to present recommendations related to geotechnical aspects of design and construction of the proposed project.

1.3. Scope of Services

Our study included a site reconnaissance, subsurface exploration, soil sampling, field and laboratory testing, engineering analyses, and preparation of this report. This report presents geotechnical recommendations for design and construction of proposed structures. The recommendations contained in this report are subject to the limitations presented herein. Attention is directed to the “Limitations” section of this report.

DRAFT

2. FIELD EXPLORATION

2.1. General

Prior to the start of drilling, the Arizona 811 and the Navajo Tribal Utility Authority was contacted to locate existing utilities at the boring locations. The field exploration was performed on May 21, 2024. Three soil borings were drilled to a depth of twenty (20) feet below existing grade. The soil test borings were drilled using a truck mounted CME-55 power drill rig equipped with 7 and ¼-inch outside diameter hollow stem augers. The percolation test was drilled using a truck mounted CME-55 power drill equipped with 15-inch outside diameter solid stem augers. The borings were located in the field at the approximate locations shown on the Sample Location Plan included in **Appendix B** of this report. Upon completion of the borings, the boreholes were backfilled with excavated materials.

2.2. Soil Test Borings

Disturbed and relatively undisturbed samples were taken at the direction of the field engineer during drilling operations. Relatively undisturbed samples of the subsurface materials were obtained using a California sampler with a 2.5-inch inside diameter and a 3.0-inch outside diameter. Disturbed samples were obtained using a Standard Penetration/Split Spoon Sampler (SPT) with a 1.5-inch inside diameter and 2.0-inch outside diameter. The California and the SPT samplers were driven 12 and 18 inches, respectively, using a 140-pound hammer falling 30 inches, and blow counts for successive 6-inch penetration intervals were recorded. After the sampler was withdrawn from the borehole, the samples were removed, sealed to minimize moisture loss, and submitted to the laboratory.

Soil classifications made in the field from auger cuttings and samples were re-evaluated in the laboratory after further examination and testing. The soils were classified in accordance with the Unified Soil Classification System presented in **Appendix C**.

Sample classifications, blow counts recorded during sampling, and other related information, were recorded on the soil boring logs. The boring logs are presented in **Appendix C**. The information presented on the logs are a combination of factual and interpretive information. Lines delineating subsurface strata and group symbols are based on field observations made at the time of the field study. Actual subsurface lines delineating subsurface strata may be gradual and vary.

2.3. Percolation Test Boring

Percolation testing was completed in general accordance with the Arizona Administrative Code Title 18, Chapter 9, A 310 Section F and the sides of the test hole were sleeved with an impermeable surface. The percolation depths and recorded rates are presented in the following table.

Percolation Test Location	Percolation Depth Below Existing Grade (feet)	Percolation Rate (min/inch)	Soil Type (USCS)
P-1	3.0	1.0	SP-SM

Siltation, vegetation growth and other factors tend to slow infiltration rates within the basin. The infiltration rates provided above are unfactored field measurements and a proper reduction factor should be applied in the retention design.

The excavation of the retention basin should be accomplished with light weight excavation equipment to avoid compaction of the exposed native soils. No traffic should be allowed within the retention basin after construction. It should be noted that compaction of the basin will reduce the infiltration rates. If compaction within the basin floor occurs, the exposed surface should be scarified to a minimum depth of 8-inches and left uncompacted.

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3. LABORATORY TESTING

Selected soil samples from the borings were tested in the laboratory for classification purposes and to evaluate their engineering properties. The laboratory tests included:

- Gradation;
- Atterberg limits;
- Moisture content;
- One-dimensional consolidation;
- Undisturbed ring density;
- Standard Proctor;
- Swell potential of soil;
- pH test;
- Resistivity test;
- Sulfate content;
- And chloride content.

A brief description of each test performed on the soil samples and the results are presented in **Appendix D** of this report.

4. GENERAL SITE CONDITIONS

4.1. Surface Conditions

The project is located approximately 1,000 feet north of the Inscription House Health Clinic in Tonalea, Arizona. The project site is bound by Indian Route 6290 on the east, undeveloped land to the north and west, and the residential staff quarters housing to the south. Rough graded earthen roads connect the project site to the existing residential subdivision. At the time of our field study project site had heavy vegetation.

4.2. Subsurface Conditions

Residual soils were encountered at the project site. In general, these surface soils consist of Silty Sand (SM). These soils were found to have a relative density ranging from loose to very dense. The underlying subsurface soils encountered during our field exploration consisted of Silty Sand (SM). These soils were found to have a relative

density of very dense. **Potential sandstone can be encountered at a depth of 5 feet below existing grade or deeper**. For additional information see Boring Logs presented in **Appendix C**.

4.3. Groundwater Conditions

Groundwater was not encountered within the soil test borings and it is anticipated that groundwater will not be a factor in design or construction of the planned improvements. It should be noted that soil moisture conditions within the area may vary depending on rainfall and/or runoff conditions not apparent at the time of our field study.

4.4. Geologic Hazards

4.4.1. Liquefaction Potential

Based on the site soils and groundwater conditions encountered at the project site during this study, the preliminary potential for soil liquefaction is considered to be negligible.

4.4.2. Collapsible Soils

Collapsible soils are soils with the potential for a decrease in volume with an increase in external load or moisture content. These soils are typically found in areas of alluvial deposits with semi-arid to arid climates. Based on the information collected during our field study and subsequent laboratory testing, we anticipate collapse-susceptible soils will be encountered during construction. Based on ASTM D 5333, a calculated collapse potential, I_C, of the tested undisturbed ring samples collected during our field study resulted in 0.63 percent indicating a slight collapse potential.

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4.4.3. Expansive Soils

Residual soil was encountered on the project site and generally have poor to good engineering properties. Expansive soils are soils with the potential for an increase in volume with an increase in moisture content. Based on the information collected during our field study and subsequent laboratory testing, we anticipate expansive-susceptible soils will be encountered during construction. Additionally, based on ASTM 4546, the expansive potential of the remolded sample collected during our field study, in the upper 5 feet, indicated an expansive potential.

4.5. Seismic Considerations

The project site is located in northern Arizona which is an area of low seismic activity. The following values were developed using the Seismic Design Maps by Structural Engineers Association by Location, the ASCE 7-16 Reference and are based on knowledge of local geologic conditions, and subsurface soils encountered during our study. A 100-foot soil test boring was not advanced during our field study. The geographic coordinates listed below were used in developing the seismic design factors.

Central Latitude.....36.597353˚
Central Longitude.....-110.791619˚

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Seismic Design Factors	Value
Site Class	D
F_a, Site Coefficient	1.6
F_v, Site Coefficient	2.4
S_s, Mapped Spectral Acceleration at 0.2-second Period	0.243 g
S_1, Mapped Spectral Acceleration at 1.0-second Period	0.071 g
S_{MS}, Spectral Acceleration at 0.2-second Period Adjusted for Site Class	0.389 g
S_{M1}, Spectral Acceleration at 1.0-second Period Adjusted for Site Class	0.171 g
S_{DS}, Design Spectral Response Acceleration at 0.2-second Period	0.259 g
S_{D1}, Design Spectral Response Acceleration at 1.0-second Period	0.114 g

4.6. Earth Fissures and Land Subsidence

The project site is located in an area with no documented earth fissures and in an area without measured land subsidence.

5. ENGINEERING ANALYSES AND RECOMMENDATIONS

5.1. Earthwork

All existing structural remnants, fill, pavement, topsoil, vegetation and organic soils should be removed from below structural areas. The following sections present earthwork recommendations based on our understanding of the project, the finding of our field exploration, results of the laboratory tests and engineering analysis. Based on the finding of our field exploration, laboratory test results and engineering analysis, it is our opinion that the proposed construction can be supported on a spread footing system as presented in the following sections.

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5.1.1. Frost Heave

This project is in an area with an anticipated frost depth of 30 inches based on Coconino County Arizona Community Development Table R301.2(1) between elevation 5,700 to 7,100 above sea level. To protect against frost heave, the use of fine-grained soils should be avoided in and around structural areas. The potential for snowpack adjacent to the structural areas may allow significant moisture to increase into fills around the outer edge of foundations therefore the exterior should be graded for positive drainage away from the structural areas. Also, to reduce the potential for moisture migration, refer to section 5.4 of this report.

5.1.2. Spread Footings

The existing surface soils should be removed to a minimum depth of one (1) foot below bottom of proposed spread footing elevation or below the existing surface elevation, whichever is deeper. The excavation of the site soils should be within the entire footprint of the structure and extend laterally for a minimum distance of five (5) feet beyond the perimeter of structure. The exposed subsurface soils should be scarified to a depth of eight (8) inches: moisture conditioned to within two (2) percent of optimum moisture content and compacted to a minimum of 95 percent of maximum dry density. Optimum moisture content and maximum dry density should be determined by ASTM D698. The excavated soils should be replaced with soil-cement per section 5.1.7 of this report to bring the site to finish pad elevation.

5.1.3. Sidewalks and Exterior Slabs

The site soils tested as part of this project exhibit swelling potential and should not be used within one foot of finished subgrade. The existing surface soils below concrete flatwork (sidewalks and exterior slabs) should be replaced with one foot of soil-cement per section 5.1.7.

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5.1.4. Pavement Site Preparation and Grading

The pavement section presented in this report is based on the site soils encountered during our field exploration. The native soils should be scarified to a depth of twelve (12) inches: moisture conditioned to within two (2) percent of optimum moisture content and compacted to a minimum of ninety-five (95) percent of maximum dry density. Optimum moisture content and maximum dry density should be determined by ASTM Test Method D 698.

5.1.5. Aggregate Base Course

The aggregate base used in support of Portland cement concrete and asphaltic concrete pavements should conform to the local governing agency and/or Maricopa Association of Governments (MAG) Section 702 Specifications. The plasticity index of the fraction of material passing the No. 40 sieve should not exceed five when tested in accordance with ASTM Test Method D 4318. Coarse aggregate should have a percent of wear, when subjected to the Los Angeles abrasion test (ASTM Test Method C 131), of no greater than 40 when exposed to a maximum of 500 revolutions.

A minimum of four (4) inch layer of clean, granular material should be placed beneath concrete slabs to serve as a leveling base, and to aid in concrete curing. The material should conform to the gradation requirements set by the local governing agency and/or MAG section 702 specifications for Aggregate Base Course (ABC). The use of moisture barriers beneath the floor slabs may be helpful, but is not a geotechnical requirement; however, the architect or the slab designer should evaluate their need.

All aggregate base material should be placed in lifts not greater than eight (8) inches and compacted to a minimum of 95 percent of maximum dry density below Portland cement concrete and one hundred percent of maximum dry density below asphaltic concrete pavements as determined by ASTM Test Method D 698 or as specified by local

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specification. The moisture content during compaction should be maintained within two percent of optimum moisture content.

5.1.6. Engineered Fill

Engineered fill may consist of native soils and/or imported soils. Pea gravel and poorly-graded materials should not be used as engineered fill unless approved by the geotechnical engineer. All engineered fills should be compacted as noted in section 5.

1. Native soils with low expansive potentials can be used as fill material for the following:
    - general site grading
    - foundation areas
    - foundation backfill
    - pavement areas

2. Imported soils with low expansive potentials could be used as fill material for the following:
    - general site grading
    - foundation areas
    - interior floor slab areas
    - foundation backfill
    - exterior slab areas
    - pavement areas

3. Imported soils (if required) should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
3"	100
No. 4 Sieve	50-100
No. 200 Sieve	50 (max)
Liquid Limit	30 (max)
Plasticity Index	15 (max)

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Swell Test

Maximum Swell Potential .....1.5 %*

*Measured on a sample compacted to approximately 95 percent of the ASTM D 698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 PSF surcharge and submerged.

Corrosion Potential	**(PPM)**
Sulfate Content (ARIZ 733)	1,000(max)
Chloride Content (ARIZ 736)	500(max)

4. Imported soils (low-frost susceptible) should conform to the following:

Gradation	**Percent finer by weight (ASTM C136)**
3"	100
No. 4 Sieve	25-60
No. 200 Sieve	15 (max)

Swell Test

Maximum Swell Potential 1.5*

*Measured on a sample compacted to approximately 95 percent of the ASTM D 698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 PSF surcharge and submerged.

Corrosion Potential	**(PPM)**
Sulfate Content (ARIZ 733)	1,000(max)
Chloride Content (ARIZ 736)	500(max)

5. Aggregate base should conform to MAG and/or the local governing specifications.

6. Frozen soils should not be used as fill or backfill.

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7. The following are intended to guide in establishing adequate support for the conventional foundation elements:
    - Any natural washes, depressions or new excavations which are to be filled, should be widened as necessary to accommodate compaction equipment and provide a level base for placing fill.
    - Any engineered fill (backfill) materials placed beneath the foundations should meet the requirements for Engineered Fill Materials.
    - All footing excavations should be relatively level and free of loose or disturbed material and inspected by a qualified representative of the Geotechnical Engineer.

8. All fill soils to be used beneath the foundations; slabs and pavements should be approved by the Geotechnical Engineer. Fill should be placed in eight (8) inch loose lifts, moisture conditioned to within 2 percent of optimum moisture content and compacted to a minimum of 95 percent of maximum dry density. Fill materials placed at depth greater than five (5) feet should be compacted to 100 percent of maximum dry density to finished grade elevation. Optimum moisture content and maximum dry density should be determined by ASTM Test Method D 698.

5.1.7. Soil-Cement

The soil cement should be constructed and replaced in general accordance with Maricopa Association of Governments (MAG) Section 311. The mix design prepared by the Contractor should attain a minimum 7-day compressive strength of 200 psi.

5.2. Excavation

The field sampling and exploration was performed using a truck-mounted drill rig with 7 and ¼-inch outside diameter hollow stem augers. We present the following general comments regarding ease of excavation with the understanding that they are opinions based on the test borings. The project consultant and contractor should become

familiar with this report including boring logs to evaluate potential hard dig conditions. **Please note that excavation characteristics are best evaluated by performing test excavations with the size and type of equipment the contractor plans on using at the site, which was not conducted as part of this study.**

It is anticipated that shallow excavations in the site soils can most likely be accomplished by conventional earth moving equipment in good operating condition. Excavations deeper than five feet may require specialized equipment. Refusal blow counts, greater than 50 blows per foot, were encountered from 5 feet to 20 feet below existing grade on potential sandstone. Sloughing and caving of near surface soils should be considered during grading operations. Please refer to Section 4 and the boring logs presented in **Appendix** C of this report for more information.

5.2.1. Trench Backfill

Materials

Pipe zone backfill (i.e., material beneath and in the immediate vicinity of the pipe) should consist of soil with a maximum particle size less than one inch. Trench zone backfill (i.e., material placed between the pipe zone backfill and finished subgrade) may consist of soil that meets the requirements for structural fill provided above.

If import material is used for pipe or trench zone backfill, we recommend it consist of fine-grained sand. In general, poorly graded coarse-grained sand and gravel should not be used for pipe or trench zone backfill due to the potential for site soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel.

Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local codes and/or bedding requirements for specific types of pipes. We recommend the project

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Civil Engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

Compaction Criteria

Backfill of trenches should utilize site soils with particle diameter less than 3-inches, in order to aid compaction and reduce potential differential settlement problems. Backfilling of utility trenches should be in 12-inch maximum loose lifts, and compacted to a minimum of 90 percent and 95 percent of ASTM D-698 (standard Proctor), in non-structural areas and structural areas, respectively. Please note that the local governing agency specifications may surpass these trench backfill requirements. Jetting, flooding, or puddling of cohesive backfill soils should not be utilized under any circumstances.

Care must be used during compaction of backfill against stem walls. Hand operated equipment and thin backfill lifts are suggested to reduce the buildup of additional excessive wall pressure due to compaction method. To reduce the potential for a subsurface wall blowout, heavy construction equipment should not be operated in close proximity to the below ground structures or earth retaining structures.

5.2.2. Temporary Excavations

General

All excavations must comply with applicable local, state, and federal safety regulations including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Generally, construction site safety is solely the responsibility of the Contractor, who shall also be responsible for the means, methods, and sequencing of construction operations. We are providing the information below strictly as a service to our client. **Under no circumstances should the information be interpreted that ATEK is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.**

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Excavations and Slopes

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced; and, if not followed, could result in substantial penalties to the Owner, Contractor, and/or earthwork subcontractor and/or utility subcontractors.

Near-surface soils encountered during our field study consisted predominantly of Silty Sand (SM). In our opinion, these soils would be considered a Type C soil when applying OSHA regulations. For this soils type OSHA recommends a maximum slope inclination of 1½(h):1(v) or flatter for excavations 20 feet or less in depth. Steeper cut slopes may be utilized for excavations less than five (5) feet deep depending on the strength, moisture content, and homogeneity of the soils as observed in the field. Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face.

Construction Considerations

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within one-third the slope height from the top of any excavation. Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation. Shoring, bracing, or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Arizona.

During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water should be collected and disposed of outside the construction limits.

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5.2.1. Permanent Excavations and Slopes

We recommend all permanent cut and fill slopes in soil be constructed at a gradient no steeper than 3(h):1(v). During wet weather, erosion could become a problem. Proper drainage and maintenance is recommended. To reduce the potential for surface erosion, a berm or "V" ditch may be located at the top of slopes subject to significant overland water flows in order to intercept and redirect surface runoff.

Fill placed on slopes steeper than 5(h):1(v) should be benched into the existing slope. It is recommended that the slope face be compacted as presented in the earthwork section of this report.

5.3. Structures

5.3.1. Shallow Spread Footings

The anticipated frost depth for the project area is 30-inches below existing site grade. Therefore, concrete slabs and post-tensioned slab-on-ground foundations should have turn downs which extend below the anticipated frost depth.

Allowable Bearing Pressure for Shallow Foundations

Footing Depth Below Finished Grade (ft.)*	Allowable Bearing Pressure (psf)
2.5	2,500
3.0	3,000

***Note**: Footing depth is defined as the depth below the lowest adjacent finished grade elevation within 5-feet of the edge of the footing.

A one-third increase may be applied to the design bearing pressures when considering short duration loads, such as wind and seismic.

Continuous footings and isolated column footings should have a minimum width of 16-inches and 24 inches respectively. The minimum widths are recommended for ease of construction, and to provide a margin of safety against a local or punching shear failure of the foundation soils. All footings should be reinforced to reduce potential distress caused by differential foundation movement.

All the footing excavations should be observed by the Geotechnical Engineer prior to placement of reinforcing steel and/or concrete. If subsurface conditions are encountered that are different than indicated by the borings, revised recommendations may be required.

Settlement of footings designed as recommended above are estimated not to exceed 1-inch. Differential settlements over, a horizontal distance of 50 feet between similarly loaded footings, are expected to be less than ½-inch and ¾-inch for wall and column footings, respectively. Significant moisture increases above those recommended for compaction could result in additional movements. In order to minimize the sensitivity of the structure to differential settlements, footings should be reinforced to allow for a degree of load redistribution should a localized zone of supporting soils become saturated.

5.3.1.1. Structural Slab

The subgrade in the structural slab area should be prepared as recommended in section 5.1.

For design of structural slabs on grade, a modulus of subgrade reaction, ks, of 200 pci is recommended for slabs bearing on competent soils prepared as recommended above. However, this ks value is based on a bearing area of one square foot. In order to account

for size effects a reduction is recommended for larger areas. The following approximation of ks (based on Terzaghi's equation) can be used for mats of various dimensions.

ks (in pci) = $200[(B+1)/(2B)]^2$ where B is the width of the mat (in feet)

Additionally, it is recommended that a thicken edge be constructed on the slab to minimize the potential for edge damage.

5.3.2. Resistance to Lateral Loads

Proposed walls/structures that will retain soil must be designed to withstand lateral soil pressures. Cantilevered retaining walls, or unrestrained walls subject to lateral earth pressures, should be designed for an equivalent fluid pressure (EFP) of 37 Pounds per Cubic Foot (PCF). Restrained walls should be designed to withstand a residual or long-term at-rest (Ko) earth pressure condition of 56 PCF.

A passive EFP of 300 PCF may be used for shallow spread footings. A coefficient of friction of 0.39 is recommended for computing lateral resistance between the base of footing and soil in analyzing lateral loads. Vehicular surcharge loads and/or hydrostatic pressure will increase the recommended EFP.

Only cohesionless, free-draining granular materials should be used as backfill, adjacent to earth-retaining structures. We recommend that backfill directly behind the walls be compacted with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 3 feet of the walls during backfilling, to avoid developing excessive temporary or long-term lateral soil pressures. Positive gravity drainage of the backfill should be provided.

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5.3.2.1. Wall Drainage

The above-recommended values do not include lateral pressures due to hydrostatic forces. Therefore, wall backfill should be free draining and provisions should be made to collect and dispose of excess water that may accumulate behind earth retaining structures. In cases where site soils become saturated an equivalent fluid pressure of 90 PCF should be used.

Wall drainage should be collected by continuous perforated drainpipes, filter fabric, and gravel connected to weep holes. The drainpipe must run parallel to the wall. We recommend drain rock consist of durable stone having 100 percent passing the 1-inch sieve and zero percent passing the No. 4 sieve. Synthetic filter fabric should have an equivalent opening size (EOS), U.S. Standard Sieve, of between 40 and 70, a permeability of at least 0.02 centimeters per second and minimum puncture strength of 50 pounds.

5.3.2.2. Backfill Placement

All backfill should be placed and compacted in accordance with recommendations provided above for engineered fill. Care must be used during compaction of backfill against the below ground tanks walls. Hand operated equipment and thin backfill lifts are suggested to reduce the buildup of additional excessive wall pressure due to compaction method. To reduce the potential for a subsurface wall blowout, heavy construction equipment should not be operated next to the walls.

5.4. Moisture Protection

Soil support values reduce with an increase of moisture content. Therefore, positive drainage is essential to the successful performance of any structure. Good surface and subsurface drainage should be established during and after construction to prevent the soils below or adjacent to the structural areas and utility trenches from becoming wet.

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Infiltration of water into utility or foundation excavations must be prevented during construction. The drainage design must route all storm and sprinkler water away from the structural areas in a positive manner. All water should be diverted away from areas where it could penetrate the ground surface near the structural areas. Watering of plants should be avoided adjacent to the buildings. Desert-type landscaping is advisable near the structural areas. Plants, which require more water, should be located and drained away from the structural areas.

5.5. Corrosion Potential

5.5.1. Electrical Resistivity

Electrical Resistivity of a soil is a measure of resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. As a soil's resistivity decreases, its corrosivity increases.

A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals is shown in the following table.

Resistivity (ohm-cm)	Corrosivity Classification
0 to 1,000	Severely corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately corrosive
Over 10,000	Mildly corrosive

Sample Location	pH	Resistivity (Ohm-cm)
Bulk Sample B-1	8.1	3,400

Based on the laboratory tests as shown above, this soil would be considered "moderately corrosive". It should be noted that these corrosion conditions are for the soils at submerged moisture conditions. Resistivities at drier moisture contents would be less corrosive than the results of the test.

The pH values of the samples tested were slightly basic. In most cases, pH is not a significant factor in corrosion in the near-neutral pH range (5<pH<9).

Estimated life for various gage galvanized CMP, based on Figure 6.7 of the Handbook of Steel Drainage & Highway Construction Products published by American Iron and Steel Institute Fourth Edition, 1993, is tabulated below. Details of the laboratory test results are presented in the **Appendix C** of this report.

Sample Location	Design Life (yrs)		
	16 Gage	14 Gage	12 Gage
Bulk Sample B-1	107	139	192

5.5.2. Sulfate and Chloride Content

Selected samples of the near-surface soils encountered at the site were subjected to chemical analysis for the purpose of corrosion assessment. The samples were tested for soluble sulfates, and soluble chlorides. The samples were tested in general accordance with Arizona Test Methods 733, and 736 for soluble sulfates, and soluble chlorides, respectively. The test results are provided in **Appendix C**.

Based on provisions of American Concrete Institute (ACI) 318 Section 4.3, Table 4.3.1, *Requirements for Concrete Exposed to Sulfate-Containing Solutions* a sulfate concentration below 0.10 percent by weight (1,000 ppm) is negligible. Based on the laboratory results, sulfate contents of the site soils tested indicate a negligible corrosion potential to concrete.

Based on the laboratory result of the sample collected for this project, chloride contents of the site soils tested indicate a negligible corrosion potential.

5.6. Pavement Areas

The on-site soils should be suitable as pavement subgrade soils provided all unsuitable debris, rubble, oversized cobbles, etc. are removed. A flexible and/or rigid pavement is recommended for the pavement areas. The recommended pavement sections are based on the assumption that the subgrade soils are prepared in accordance with section 5.1 of this report.

The flexible pavement section should consist of Central Plant Mix Asphaltic Concrete Pavement (AC) on compacted Aggregate Base Course (ABC) as recommended in the table below. Flexible pavement should be placed in accordance with MAG Section 321 and local municipality standards.

PAVEMENT AREA	ASPHALT SURFACE THICKNESS (IN)	AGGREGATE BASE COURSE THICKNESS (IN)
Parking Areas*	3.0	6.0

Our calculations for design of the pavements section is based upon our classification of the subsurface soils, the calculated traffic in 18 kips equivalent single axle loads, the site preparation and grading recommendations provided above. A design life of 20 years was used in design.

Areas subject to sustained, heavy concentrated loads, such as dumpster areas should be paved with Portland Cement Concrete (PCC). A pavement section of 6 inches of PCC on 4 inches of aggregate base course is recommended in these areas. We should be contacted for additional recommendations if there are any areas subjected to volumes of traffic heavier than those assumed for this report.

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6. CLOSURE

6.1. Limitations

Our professional services have been performed using that degree and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar localities. No warranty is expressed or implied.

The recommendations contained in this report are based on our field exploration, laboratory test results, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the test borings excavated during the field subsurface exploration. It is anticipated that some variations in the soil conditions will exist on-site. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to the recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified.

It is the Client's responsibility to see that all parties to the project including the designer, contractor, subcontractor, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

This report is for the exclusive purpose of providing Geotechnical Engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. This report has also not addressed the site geology and the possible presence of geologic hazards.

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This report may be used only by the Client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on and off-site), or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the Client, who wishes to use this report, shall notify ATEK of such intended use. Based on the intended use of this report, ATEK may require that additional work be performed and that an updated report be issued.

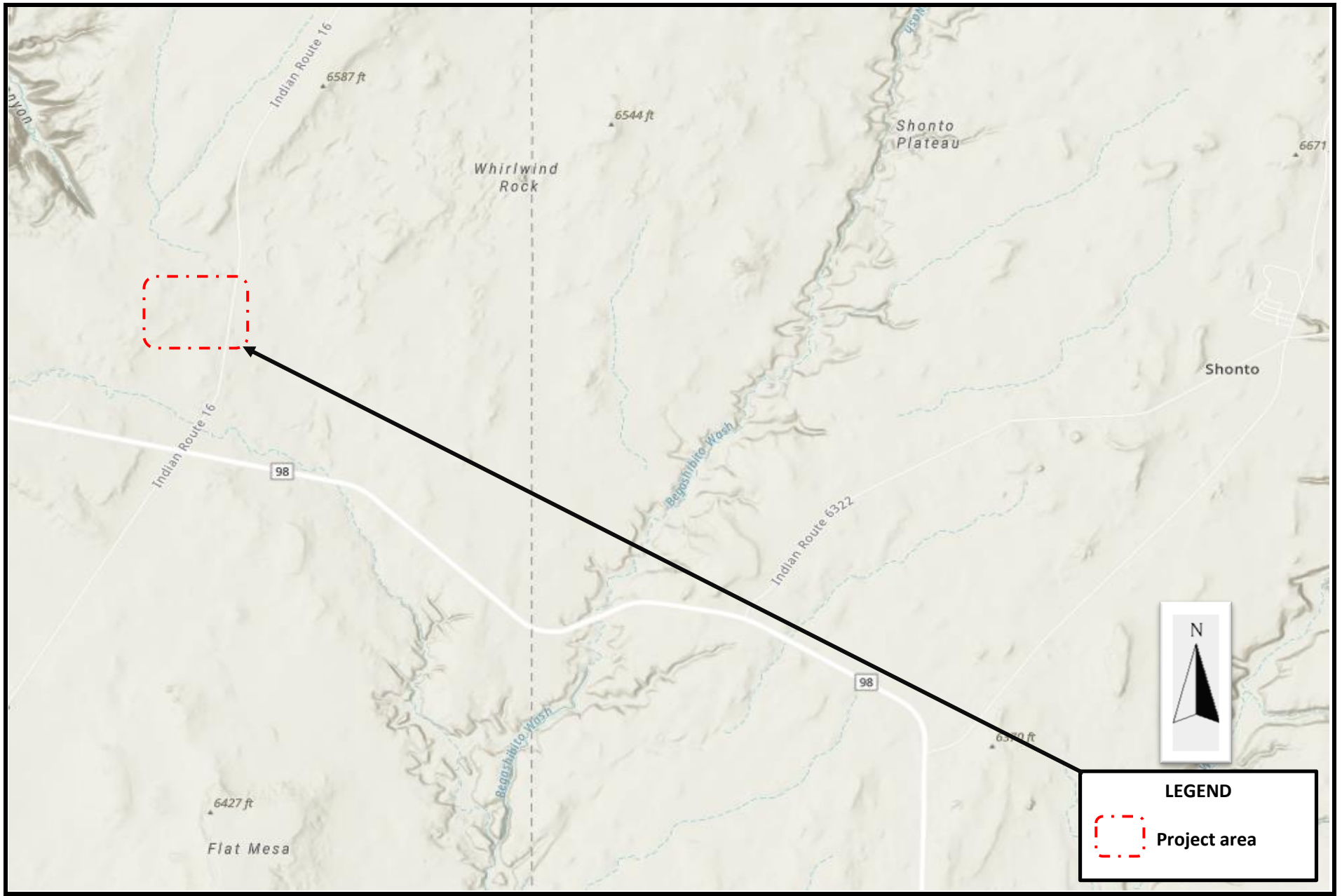
6.2. Recommended Additional Services

The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be performed during the construction. These tests and observations should be performed by the Geotechnical Engineer's representative and should include, but not limited to the following:

- Observe and document that any existing surficial vegetation and other deleterious materials have been removed from the site as required in site preparation section.
- Approve any material used as import to document that it meets the requirements outlined above before placement.
- Monitor the backfill procedures.
- Perform field density tests, as needed, to verify compaction compliance. The representative should monitor the progress of compaction and filling operations.
- Keep records of on-site activities and progress.

Observation of footing excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present. Construction testing, including field and laboratory evaluation of fill and backfill materials, concrete and steel should be performed to determine whether applicable project requirements have been met.

APPENDIX A
Site Location Map



Project #: 240012	**Site Location Map - Sheet 1 of 1**	atek ENGINEERING CONSULTANTS
Date: 5/20/2024	IHS IDIQ iHouse	111 South Weber Drive, Suite 1
Drawn by: M Mendoza	Tonalea, Arizona	Chandler, AZ 85226

Basemap provided by ArcGIS

APPENDIX B
Sample Location Plan



Project Address Indian Rte 6290 Tonalea, AZ 86044 Basemap provided by Google Earth	Project #: 240012 Date: 5/20/2024 Drawn by: M Mendoza	**Boring Location Plan - Sheet 1 of 1** IHS IDIQ iHouse Tonalea, Arizona

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APPENDIX C
FIELD STUDY AND BORING LOGS

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APPENDIX C
FIELD STUDY

BORINGS

The subsurface conditions at the site were explored on May 21, 2024, by drilling soil borings using a truck mounted CME drill rig with 7 and a ¼-inch outside diameter hollow stem auger. The locations of soil test borings performed for this study are shown in **Appendix B** of this report.

The locations of borings were located by visual sighting and pacing from existing site features and, therefore, should be considered approximate. Actual boring locations may vary from those indicated in **Appendix B**.

Our field engineer maintained a log of the excavations; visually classified soils encountered according to the Unified Soil Classification System (USCS) (see USCS Table); and obtained samples of the subsurface materials.

SAMPLING PROCEDURES

Soil samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance, and returned to our laboratory for further testing. After borings were completed, they were backfilled with the excavated soils.

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

Unified Soil Classification System – C1
Log Key – C2
Charts and Definitions – C3
Terminology Used to Describe Soils – C4
Logs of Soil Borings

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LESS THAN 5% PASSING NO. 200 SIEVE	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LESS THAN 5% PASSING NO. 200 SIEVE	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% PASSING NO. 200 SIEVE	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing No. 200 sieve require dual USCS symbols. (See KEY A-3 if provided)

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Drafted By: AM

Date: May, 2024

Project Number: 240012

UNIFIED SOIL CLASSIFICATION SYSTEM

IHS IDIQ – iHouse 19 Unit Apartment
Johnson Smitthipong & Rosamond Associates, Inc.
Tonalea, Arizona

KEY

C-1

LOG SYMBOLS



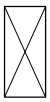
BULK / GRAB SAMPLE



MODIFIED CALIFORNIA SAMPLER
(2 inch inside diameter)



GRAB SAMPLE



STANDARD PENETRATION
SPLIT SPOON SAMPLER
(2.0-inch O.D. X 1.4-inch I.D.)



SHELBY TUBE
(3 inch outside diameter)



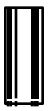
NON-STANDARD PENETRATION
SPLIT SPOON SAMPLER
(1.5-inch O.D. X 0.9-inch I.D.)



BDBGM SIZE CORE BARREL
(1.65-inch I.D.)



BW44 SIZE CORE BARREL
(1.75-inch I.D.)



HQ-3 SIZE CORE BARREL
(2.4-inch I.D.)



WATER LEVEL
(level after completion)



WATER LEVEL
(level where first encountered)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.

2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.

3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.

4. In general, the Unified Soil Classification designations presented on the logs were based on visual classification in the field, modified where appropriate by visual classifications in the office, and/or laboratory gradation and index testing.

5. NA = Not Analyzed

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Date: May, 2024

Project Number: 240012

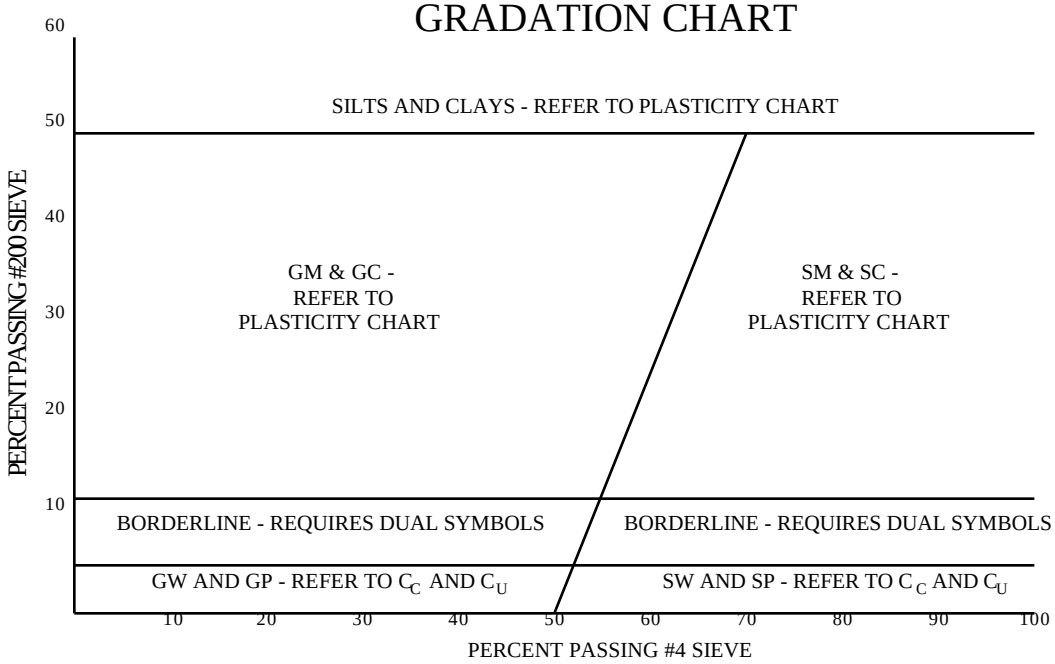
LOG KEY

IHS IDIQ – iHouse 19 Unit Apartment
Johnson Smitthipong & Rosamond Associates, Inc.
Tonalea, Arizona

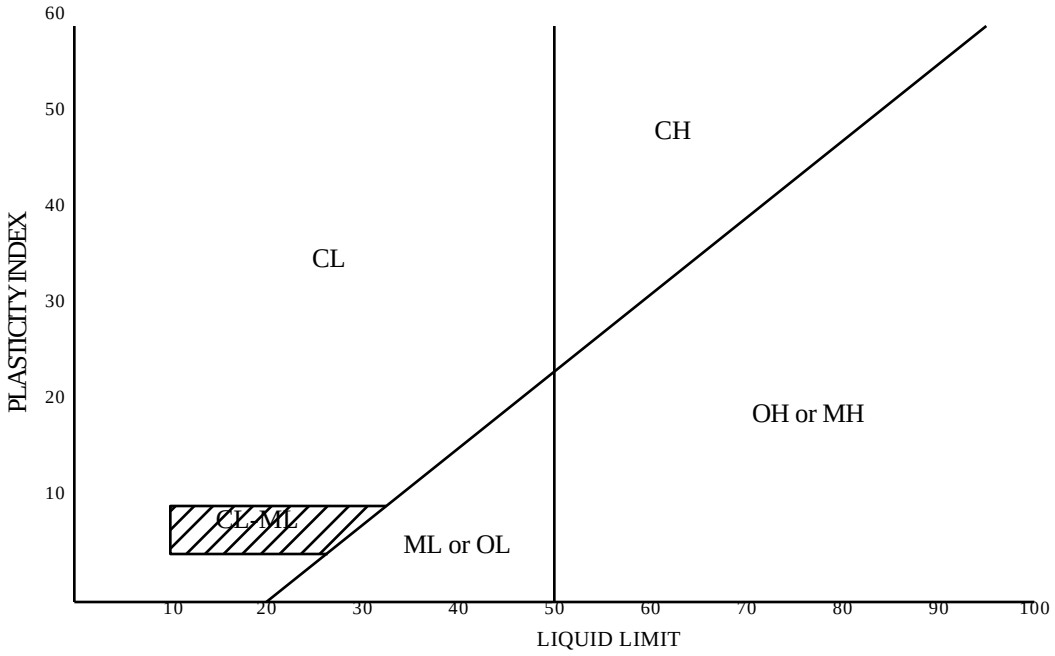
KEY

C-2

GRADATION CHART



PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL FRACTION	PARTICLE SIZE RANGE
Boulders	Greater than 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Coarse Gravel	75mm to 19mm (3in. to 3/4in.)
Fine Gravel	19mm (3/4in.) to No. 4 sieve
Coarse Sand	No. 4 sieve to No. 10 sieve
Medium Sand	No. 10 sieve to No. 40 sieve
Fine Sand	No. 40 sieve to No. 200 sieve
Fines	less than No. 200 sieve

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Date: May, 2024

Project Number: 240012

CHARTS & DEFINITIONS

IHS IDIQ – iHouse 19 Unit Apartment
Johnson Smitthipong & Rosamond Associates, Inc.
Tonalea, Arizona

KEY

C-3

TERMINOLOGY USED ON THE BORING LOGS TO DESCRIBE
THE FIRMNESS, DENSITY, OR CONSISTENCY OF SOILS

The standard penetration resistance (**N**) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Terms for description of partially saturated and/or cemented soils including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0 - 4	Very soft
5 - 8	soft
9 - 15	Moderately firm
16 - 30	Firm
31 - 50	Very firm
51+	Hard

2. Terms for description of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
51+	Very dense

3. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency
0 - 2	Very soft
3 - 4	soft
5 - 8	Moderately stiff
9 - 15	Stiff
16 - 30	Very Stiff
31+	Hard

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Project Number: 240012

TERMINOLOGY USED TO DESCRIBE SOILS

IHS IDIQ – iHouse 19 Unit Apartment
Johnson Smitthipong & Rosamond Associates, Inc.
Tonalea, Arizona

KEY

C-4

Project Name: IHS IDIQ iHouse		Client: Johnson Smitthipong & Rosamond Associates, Inc.	
Borehole Location: See Location Plan			Sheet 1 of 1
Borehole Number: B-1		Driller: Wildcat	Logger: Marilyn Mendoza
Drilling Equipment: CME-55	Borehole Diameter (in.): 7.25 HSA	Date Started: 5/21/2024	Date Finished: 5/21/2024

Elevation (ft)

Notes:

DEPTH (ft)	DRILL OPERATION	SAMPLE	STANDARD PENETRATION TEST SPT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT LL	PLASTICITY INDEX PI	-200 (%)	USCS CLASSIFICATION	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	REMARKS
				6.2		NV	NP	30	SM		SILTY SAND (SM), 70% fine to medium grained sand, 30% fines, loose, nonplastic, reddish brown, slightly moist, no cementation, weak reaction to HCl		
			2-4	11.3	100.3								Swell Potential of Soil=3.15%
5			26-50/2"								Very dense, brown, weak cementation, no reaction to HCl, (weathered sandstone)		
10			50/2"								Light brown, moist		
15			50/3"										
20			50/3"									20.3	

Bottom of auger @ 20.0 feet bgs.
Bottom of sampler @ 20.3 feet bgs.
No groundwater encountered.

Sampler Types: Split Spoon; Penetrometer; Shelby; Vane Shear; Bulk Sample; California; Grab Sample

Operation Types: Auger Hollow Stem; Hand Auger; Bullnose; ODEX; Core Barrel; Excavated Pit

WATER LEVEL OBSERVATIONS

	While Drilling	Upon Completion of Drilling		
Time After Drilling	N/A	N/A	N/A	N/A
Depth To Water (ft)	N/A	N/A	N/A	N/A

Remarks: Not Encountered

ATEK Project Number: 240012

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LOG OF EXPLORATORY BORING B-1

Fig. 1

240012 FINAL LOGS.GPJ ` 5-30-24 ` M Mendoza ` ATEK BORING (W/REMARKS-SH#-SAME FIG#) `

Revised 10-14-11 (MAT)

Project Name: IHS IDIQ iHouse		Client: Johnson Smitthipong & Rosamond Associates, Inc.	
Borehole Location: See Location Plan			Sheet 1 of 1
Borehole Number: B-2		Driller: Wildcat	Logger: Marilyn Mendoza
Drilling Equipment: CME-55	Borehole Diameter (in.): 7.25 HSA	Date Started: 5/21/2024	Date Finished: 5/21/2024

Elevation (ft)

Notes:

DEPTH (ft)	DRILL OPERATION	SAMPLE	STANDARD PENETRATION TEST SPT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT LL	PLASTICITY INDEX PI	-200 (%)	USCS CLASSIFICATION	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	REMARKS
0									SM		SILITY SAND (SM), medium dense, nonplastic, reddish brown, moist, weak cementation, no reaction to HCl		
			5-8										
5			50/3"								Very dense, light brown, (weathered sandstone)		
10			50/2"										
15			50/2"										
20			50/3"									20.3	

Bottom of auger @ 20.0 feet bgs.
Bottom of sampler @ 20.3 feet bgs.
No groundwater encountered.

Sampler Types: Split Spoon; Penetrometer; Shelby; Vane Shear; Bulk Sample; California; Grab Sample

Operation Types: Auger Hollow Stem; Hand Auger; Bullnose; ODEX; Core Barrel; Excavated Pit

WATER LEVEL OBSERVATIONS

While Drilling ▽ N/A ft	Upon Completion of Drilling ▼ N/A ft			
Time After Drilling	N/A	N/A	N/A	N/A
Depth To Water (ft)	N/A	N/A	N/A	N/A ▼

Remarks: Not Encountered

ATEK Project Number: 240012

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LOG OF EXPLORATORY BORING B-2

Fig. 2

240012 FINAL LOGS.GPJ ` 5-30-24 ` M Mendoza ` ATEK BORING (W/REMARKS-SH#-SAME FIG#) `

Revised 10-14-11 (MAT)

Project Name: IHS IDIQ iHouse		Client: Johnson Smitthipong & Rosamond Associates, Inc.	
Borehole Location: See Location Plan			Sheet 1 of 1
Borehole Number: B-3		Driller: Wildcat	Logger: Marilyn Mendoza
Drilling Equipment: CME-55	Borehole Diameter (in.): 7.25 HSA	Date Started: 5/21/2024	Date Finished: 5/21/2024

Elevation (ft)

Notes:

DEPTH (ft)	DRILL OPERATION	SAMPLE	STANDARD PENETRATION TEST SPT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT LL	PLASTICITY INDEX PI	-200 (%)	USCS CLASSIFICATION	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	REMARKS
0			50/5"	6.2		NV	NP	27	SM		SILITY SAND (SM), 2% fine graded gravel, 71% fine to coarse grained sand, 27% fines, very dense, nonplastic, dark brown, moist, no cementation, weak reaction to HCl		
5			50/4"								Light brown, weak cementation, no reaction to HCl, (weathered sandstone)		
10			50/3"										
15			50/2"										
20			50/3"									20.3	

Bottom of auger @ 20.0 feet bgs.
Bottom of sampler @ 20.3 feet bgs.
No groundwater encountered.

Sampler Types: Split Spoon; Penetrometer; Shelby; Vane Shear; Bulk Sample; California; Grab Sample

Operation Types: Auger Hollow Stem; Hand Auger; Bullnose; ODEX; Core Barrel; Excavated Pit

WATER LEVEL OBSERVATIONS

While Drilling ▽ N/A ft	Upon Completion of Drilling ▼ N/A ft			
Time After Drilling	N/A	N/A	N/A	N/A
Depth To Water (ft)	N/A	N/A	N/A	N/A ▼

Remarks: Not Encountered

ATEK Project Number: 240012

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LOG OF EXPLORATORY BORING B-3

Fig. 3

240012 FINAL LOGS.GPJ ` 5-30-24 ` M Mendoza ` ATEK BORING (W/REMARKS-SH#-SAME FIG#) `

Revised 10-14-11 (MAT)

APPENDIX D
Laboratory Test

APPENDIX D
LABORATORY TESTING

LABORATORY TESTS
Laboratory tests were performed on selected samples to aid in soil classification and to evaluate physical properties of the soils, which may affect the Geotechnical aspects of project design and construction. A description of the laboratory testing program is presented below.

Sieve Analysis
Sieve analyses were performed to evaluate the gradation characteristics of the material and to aid in soil classification. Tests were performed in general accordance with ASTM Test Method C 136 and D 2487.

Atterberg Limits
Atterberg Limits tests were performed to aid in soil classification and to evaluate the plasticity characteristics of the material. Tests were performed in general accordance with ASTM Test Method D 4318.

Moisture Content
Moisture content tests were performed to evaluate moisture-conditioning requirements during site preparation and earthwork grading. Moisture content was evaluated in general accordance with ASTM Test Method D 2216.

One-Dimensional Consolidation
A one-dimensional consolidation test was performed on a ring samples to evaluate consolidation potential of the site soil. Test procedure was in general accordance with ASTM Test Method D 2435.

Undisturbed Ring Density
Undisturbed ring density tests were performed on ring samples to evaluate the in-situ density and moisture content of the site soils. Test procedures were in general accordance with ASTM Test Method D 2937.

Standard Proctor
Standard Proctor tests were performed on bulk soil samples to evaluate the maximum dry density and optimum moisture of the site soils. Test procedures were in general accordance with ASTM Test Method D 698A.

Swell Test
Swell test was performed on bulk soil samples to evaluate the expansion potential of the site soils. Test procedures were in general accordance with ASTM Test Method D 4829.

pH and Resistivity
pH and resistivity tests were performed on the bulk soil sample to evaluate the site soil corrosion potential. Test procedure was in general accordance with Arizona Test Method 236.

Sulfate Content
Sulfate content tests were performed to evaluate the corrosion potential of the on-site soils. Tests were performed in general accordance with ARIZ 733.

Chloride Content
Chloride content tests were performed to evaluate the corrosion potential of the on-site soils. Tests were performed in general accordance with ARIZ 736.

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PROJECT: IHS IDIQ iHouse
LOCATION: Tonalea, Arizona
SAMPLE DATE: 5/21/2024

PROJECT: 240012
WORK ORDER: 2400122
REVIEWED BY: G. Lopez

MOISTURE CONTENT OF SOIL -- ASTM D 2216

LAB #	SAMPLE SOURCE	MOISTURE		
		WET WEIGHT (g)	DRY WEIGHT (g)	MOISTURE CONTENT
1	Bulk, B-1 @ 0.0'-5.0'	553.7	521.3	6.2%
12	Bulk, B-3 @ 0.0'-2.5'	453.4	427.1	6.2%
19	Bulk, PR-1 @ 0.0'-3.0'	578.1	559.2	3.4%

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PROJECT: IHS IDIQ iHouse
LOCATION: Tonalea, Arizona
SAMPLE DATE: 5/21/2024

PROJECT: 240012
WORK ORDER: 2400122
REVIEWED BY: G. Lopez

DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD -- ASTM D 2937

LAB #	SAMPLE SOURCE	MOISTURE			# OF RINGS	WET WEIGHT + RINGS (g)	WEIGHT OF RINGS (g)	DRY DENSITY (pcf)
		WET WEIGHT (g)	DRY WEIGHT (g)	MOISTURE CONTENT				
2	Ring, B-1 @ 2.5'-3.5'	809.1	727.0	11.3%	6	1080.5	271.4	100.3

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PROJECT:	IHS IDIQ iHouse	**PROJECT NO:**	240012
LOCATION:	Tonalea, Arizona	**WORK ORDER NO:**	2400122
DATE SAMPLED:	5/21/2024	**REVIEWED BY:**	G. Lopez

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

					COBBLES		GRAVEL									SAND								Silt or Clay	
							Coarse					Fine				Coarse		Medium			Fine				
Location & Depth	**USCS**	**LL**	**PL**	**PI**	**6"**	**4"**	**3"**	**2"**	**1 1/2"**	**1 1/4"**	**1"**	**3/4"**	**1/2"**	**3/8"**	**1/4"**	**#4**	**#8**	**#10**	**#16**	**#30**	**#40**	**#50**	**#100**	**#200**	**Lab #**
PERCENT PASSING BY WEIGHT																									
Bulk, B-3 @ 0.0'-2.5'	SM	NV	NP	NP	100	100	100	100	100	100	100	99	99	99	98	98	97	97	97	97	95	89	66	27	12
Bulk, PR-1 @ 0.0'-3.0'	SP-SM	NV	NP	NP	100	100	100	100	100	100	99	98	97	97	96	96	95	95	94	94	92	78	31	8	19

This is a summarized report of the referenced procedures and does not include all reporting requirements. Additional data can be provided at client's request.

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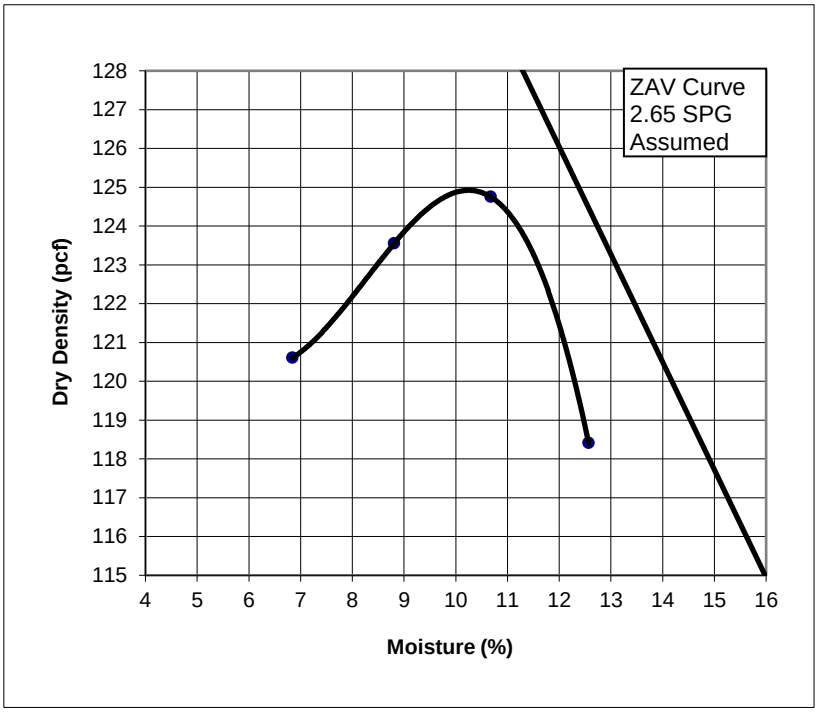
PROJECT:	IHS IDIQ iHouse	**PROJECT NO:**	240012
LOCATION:	Tonalea, Arizona	**WORK ORDER NO:**	2400122
MATERIAL:	Native	**LAB NO:**	1
SAMPLE SOURCE:	Bulk, B-1 @ 0.0'-5.0'	**SAMPLE DATE:**	5/21/2024

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING
STANDARD EFFORT (12,400ft-lb-ft/cu.ft) (ASTM D698A)
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)
LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ASTM D4318) (DRY PREP)

	English (pcf)	Metric (kg / cu.m.)
Maximum dry density:	124.9	2001
Optimum moisture (%):	10.2	10.2



SIEVE SIZE	PERCENT PASSING
6 in / 152mm	100
4 in / 100mm	100
3 in / 75mm	100
2 in / 50mm	100
1 1/2 in / 37.5mm	100
1 1/4 in / 32 mm	100
1 in / 25 mm	100
3/4 in / 19 mm	100
1/2 in / 12.5 mm	100
3/8 in / 9.5 mm	100
1/4 in / 6.4 mm	100
#4, 4.75mm	100
#8, 2.36mm	100
#10, 2.00mm	100
#16, 1.18mm	100
#30, 0.60mm	99
#40, .425mm	92
#50, .300mm	81
#100, .150mm	59
#200, .075mm	30

LL:	NV
PL:	
PI:	NP
USCS:	SM
AASHTO:	A-2-4(0)

NOTES:

AASHTO Description: Silty gravel and sand

- The zero air void curve represents a specific gravity of: 2.65 assumed, (also used in the 'Rock Correction Calculation)
- This is a summarized report of the referenced procedures and does not include all reporting requirements. Additional data can be provided at clients request.

Reviewed by: G. Lopez

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Project:	IHS IDIQ iHouse	**Project Number:**	240012
Location:	Tonalea, Arizona	**Work Order Number:**	2400122
Client:	Johnson Smitthipong & Rosamond Associates, Inc.	**Lab Number:**	See Below
Material:	Native	**Date Sampled:**	05/21/24
Sample Source:	See Below		

Swell Potential of Soil ASTM D4546

Sample Number	Sample Source	Swell (%)	Target Compaction (%)	Actual Compaction (%)	Target Moisture (%)	Actual Moisture (%)
1	Bulk, B-1 @ 0.0'-5.0'	2.6	95.0	95.0	7.2	7.3
Retest 1	Bulk, B-1 @ 0.0'-5.0'	3.7	95.0	95.4	7.2	7.3

Note: Ring Samples were subjected to a 100 psf surcharge.

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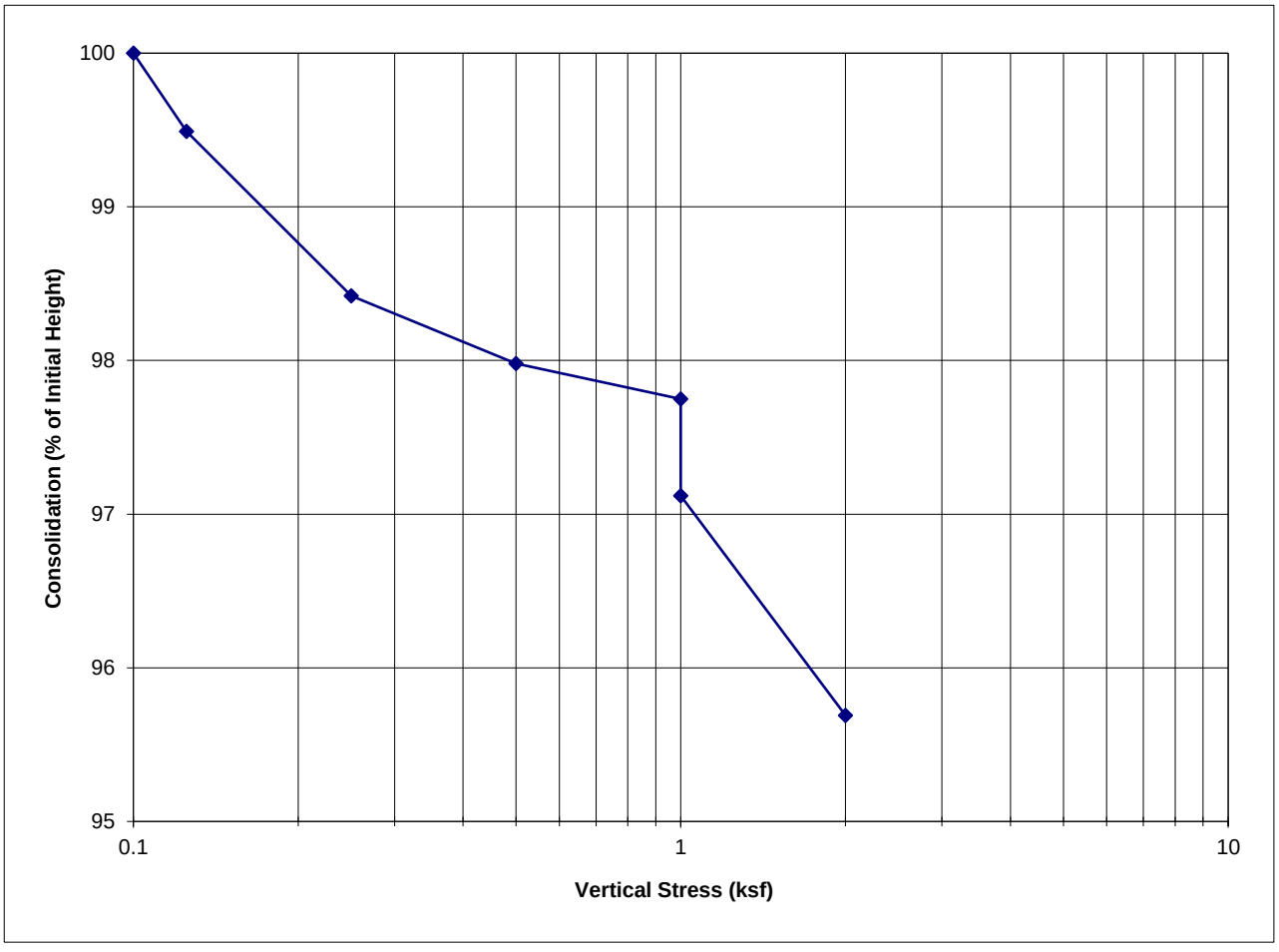
Project:	IHS IDIQ iHouse	**Project Number:**	240012
Project Location:	Tonalea, Arizona	**Work Order Number:**	2400122
Client:	JSRA	**Lab Number:**	7
Material:	Native	**Date Sampled:**	05/21/24
Sample Source:	Ring Sample B-2 @ 2.5'-3.5'		
Sample Prep:	In-Situ		

One-Dimensional Consolidation Properties of Soils (ASTM D2435)

Initial Volume (cu.in)	4.60	Final Volume (cu.in)	4.41
Initial Moisture Content	6.5%	Final Moisture Content	18.2%
Initial Dry Density(pcf)	106.6	Final Dry Density(pcf)	111.4
Initial Degree of Saturation	31%	Final Degree of Saturation	100%
Initial Void Ratio	0.55	Final Void Ratio	0.48
Estimated Specific Gravity	2.65	Saturated at	1 ksf
		Hydro Collapse Potential	0.63%



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Project:	IHS IDIQ iHouse	**Project Number:**	2400112
Location:	Tonalea, Arizona	**Work Order Number:**	2400122
Client:	Johnson Smitthipong & Rosamond Associates, Inc.	**Lab Number:**	See Below
Material:	See Below	**Date Sampled:**	05/21/24
Sample Source:	See Below		

pH & Resistivity (AZ 236)

Sample Number	Sample Source	Resistivity (Ohm-cm)	pH
1	Bulk, B-1 @ 0.0'-5.0'	3,400	8.1

111 South Weber Drive, Suite 1
Chandler, AZ 85226
www.atekec.com
p 480.659.8065
f 480.656.9658

MOTZZ LABORATORY, INC.

Report: 950998
Reported: 5/28/2024
Received: 5/23/2024
PO: 2400122

Laboratory Analysis Report

Atek Engineering Consultants
Antonio Lopez
111 South Weber Dr Suite 1
Chandler, AZ 85226

Project: 240012

Lab Number	Sample ID	
950998-1	1) Bulk, B-1	(0.0-5.0')

Test Parameter

Test	*Method*	*Result*	*Units*
Sulfate	ARIZ 733b	4	ppm
Chloride	ARIZ 736b	8	ppm

iHouse 19 Unit Apartment Building

Tonalea, AZ

Appendix A3
Hydrology Report

JSRa
JOHNSON SMITTHIPONG & ROSAMOND ASSOCIATES, INC.
5210 E Williams Circle, Suite 600 ▪ Tucson, AZ 85711 ▪ v:520.547.7904 ▪ f:520.547.7905 ▪ www.jsra.com

TECHNICAL DRAINAGE STUDY

iHouse Apartments

DOWL Project 3780.41714.01

June 2024

Prepared for:

JSRa Architects
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1.0 INTRODUCTION

1.1 PROJECT LOCATION AND DESCRIPTION

This project involves the construction of a 20,000-square-foot apartment structure, complemented by three RV parking spots equipped with hook-ups. Additionally, the project will include an access road, necessary parking spaces, utilities, and various other amenities to enhance the overall functionality and appeal of the development. This proposed project is located along Navajo Route 16, roughly seven miles west of Shonto and in close proximity to the Navajo Nation EMS, with precise coordinates at 36°35'49.46"N, 110°47'27.85"W (Section 24, Township 37, Range 14E). The entire property and its proposed amenities are situated wholly within the boundaries of the Navajo Nation.

This project is thoughtfully designed to provide modern housing solutions and necessary amenities, while also enhancing the infrastructure and accessibility for the surrounding community. The use of existing natural features and soil characteristics will aid in efficient runoff management, demonstrating a commitment to sustainable and environmentally conscious development practices.

1.2 POTENTIAL IMPACTS

The current design of the proposed project has been meticulously planned to ensure it has minimal impact on the surrounding community, terrain, flora, and fauna. The layout prioritizes environmental preservation and community well-being through the implementation of safe construction practices, conservative design principles, and the thoughtful integration of utilities and amenities. By adopting these approaches, the project aims to significantly reduce its footprint compared to other similar developments, thereby maintaining the integrity of the local environment and community.

In designing this project, every effort has been made to harmonize with the existing landscape. Construction techniques that minimize disruption to the natural terrain have been selected, ensuring that the slopes, soil, and vegetation remain largely undisturbed. Additionally, the project incorporates sustainable practices that protect local wildlife and plant species, preserving the natural habitat and biodiversity of the area.

The primary objective of this development is to provide affordable and comfortable housing options for members of the community and the Navajo Nation. The apartments are designed to meet modern standards of living while remaining accessible to a broad spectrum of residents. By focusing on affordability and comfort, the project addresses a critical need within the community, offering new housing opportunities that enhance the quality of life for many families. An added benefit of this project is the generation of housing opportunities for the nearby EMS facility.

Providing affordable housing in an opportune location, as we are proposing, will benefit the Navajo Nation.

Furthermore, comprehensive analyses have been conducted to assess the potential impacts of the project. These include evaluations of increased impervious surface areas, which can affect local water runoff and drainage patterns. Measures have been proposed to mitigate any negative effects, such as the use of permeable materials and the strategic placement of green spaces. The anticipated increase in population density and the corresponding demand on utilities have also been thoroughly examined. Plans are in place to ensure that the existing infrastructure can accommodate these changes without compromising service quality.

2.0 OBJECTIVES AND PROCEDURES

2.1 ON-SITE RUNOFF MANAGEMENT GOALS

The intent for on-site stormwater detention is to utilize existing drainage patterns to reflect the current conditions of the site most accurately. The aim is to maintain the natural hydrology as much as possible while accommodating the new development. However, the increase in impervious surfaces, such as paved areas and rooftops, necessitates the incorporation of standard stormwater mitigation facilities. These facilities will include curbs, gutters, catch basins, pipes, manholes, and outfall structures, all designed to manage and control stormwater effectively.

As impervious surfaces increase, so does the volume and speed of stormwater runoff, which can lead to enhanced erosion if not effectively managed. To mitigate these effects, our design focuses on removing runoff from surfaces efficiently and routing it through swales, culverts, inlets, and curb breaks. This changes the stormwater conveyance method from sheet flow, where water spreads across the surface, to channel flow, which is more controlled and directed.

This principle will be meticulously applied throughout the proposed building site and along the new access road. The access road, integral to the project's infrastructure, will be equipped with curb breaks strategically placed along its curbline. These curb breaks are designed to collect runoff efficiently from both the road and the adjacent areas. Once collected, the runoff will be directed into an adjacent stormwater infiltration pond, which has been deemed appropriately sized to handle the increased water volume.

The stormwater infiltration pond will play a crucial role in managing the runoff. By allowing water to infiltrate into the ground, it helps maintain the natural groundwater recharge and reduces the potential for flooding. Analysis of the pond's design considers the soil's high infiltration rates, leveraging the natural characteristics of the site to manage stormwater sustainably.

Additionally, the overall stormwater management plan includes various erosion control measures to prevent soil degradation and protect the local ecosystem. These measures might involve the

use of silt fences, sediment traps, and erosion control blankets, all aimed at stabilizing the soil during and after construction.

By carefully integrating these stormwater management facilities, the project aims to create a development that not only meets the needs of the community but also respects and preserves the natural environment. The thoughtful design and implementation of these systems will ensure that the increased runoff from the new impervious areas is managed in a way that minimizes environmental impact and supports sustainable development principles.

2.2 OFF-SITE RUNOFF MANAGEMENT GOALS

Assessing the effects of off-site drainage is crucial for the success of this project, particularly because the infiltration pond is a key resource utilized by various facets of the community. This basin serves as the primary termination point for runoff generated not only by the new development but also by existing structures, such as the Navajo Nation EMS, and the adjacent community, which comprises 21 residences. Ensuring that this basin can handle the additional load is vital to prevent flooding and other adverse effects.

In evaluating off-site drainage, it is essential to consider several factors. First, the current capacity and condition of the infiltration basin must be thoroughly assessed. This involves analyzing historical data on runoff volumes and patterns to understand the basin's performance under different conditions. By doing so, we can determine whether the existing infrastructure is adequate or if upgrades are necessary to accommodate the increased runoff from the new development.

The next step involves a detailed analysis of the expected runoff volumes. This includes calculating the anticipated increase in impervious surfaces from the new buildings and roadway and estimating the corresponding increase in runoff. These calculations must account for various scenarios, including heavy rainfall events, to ensure that the basin can handle peak flows without exceeding its capacity. Determining how the on-site drainage functions, is critical for accurately assessing off-site runoff. Runoff that would otherwise travel along the natural flow paths away from the basin, are now being directed towards it.

The impacts of increased runoff volumes on the infiltration basin and the surrounding area must also be carefully examined. Increased runoff can lead to several issues, including higher rates of erosion, sedimentation, and potential flooding. These effects can degrade the basin's efficiency and negatively impact the local ecosystem. Therefore, it is essential to implement mitigation measures, such as erosion control techniques and sediment traps, to protect the basin and maintain its functionality.

Our project does not anticipate a significant increase in runoff entering the site at the location of the building itself. This is due to the careful design and placement of structures, which aim to minimize impervious surfaces and promote natural infiltration. However, we do expect that the new roadway will incur large volumes of off-site runoff from the adjacent community. The

roadway's design must, therefore, include features such as catch basins, drainage channels, and curb cuts to manage this runoff effectively.

Additionally, the roadway's alignment and grading must be optimized to direct runoff towards the infiltration basin efficiently. This involves precise engineering to ensure that water flows smoothly and safely without causing erosion or pooling. By incorporating these elements into the design, we can manage off-site runoff in a way that protects both the new infrastructure and the existing community.

Further assessment of the sizing of the infiltration basin, expected runoff volumes, and impacts will be detailed later in this report. This section will provide a comprehensive analysis, including hydrologic models and simulations, to ensure that all potential issues are addressed, and that the basin can perform its intended function effectively.

2.3 BEST MANAGEMENT PRACTICES

Throughout the construction of this project, various stabilization and stormwater-mitigation facilities will be utilized to protect the site and surrounding areas from potential stormwater damage. Temporary structures, such as catch basin covers, silt fences, straw waddles, and construction entrances, will be strategically implemented as runoff mitigation tools. These features are designed to reduce the potential impacts of storm events on disturbed and non-stabilized areas, effectively preventing erosion and sediment displacement.

Catch basin covers will prevent debris from entering the stormwater system, while silt fences will trap sediment and prevent it from washing into nearby water bodies. Straw waddles, placed along slopes, will slow runoff, and promote water infiltration into the soil. Construction entrances will minimize the tracking of mud and sediment onto public roads, reducing the environmental impact.

The project will also incorporate permanent facilities to manage stormwater runoff, including catch basins, swales, pipes, and curb cuts. These permanent facilities will be utilized to mitigate construction runoff where possible.

3.0 SUMMARY AND PURPOSE

3.1 METHODOLOGY AND ASSUMPTIONS

For the extent of this report, as approved by the Navajo County Drainage Policy, the Rational Method was utilized to determine the existing and proposed runoff conditions and volumes. This widely accepted procedure is particularly effective for estimating peak runoff rates in small drainage areas, including urbanized regions. The Rational Method simplifies the complex interactions between rainfall, land surface, and runoff through several key assumptions, ensuring consistency and reliability in calculations. These assumptions, detailed in Table 1, encompass factors such as rainfall intensity, runoff coefficients, and drainage area characteristics, providing

transparency and clarity in our analysis. This comprehensive approach facilitates accurate estimation of runoff volumes and guides the design of stormwater management systems to efficiently manage anticipated flows.

To provide transparency and clarity, the specific assumptions made during this analysis are listed below in Table 1. These assumptions include factors such as runoff coefficients, and drainage area characteristics. By outlining these assumptions, we can understand the limitations and considerations involved in the application of the Rational Method. This comprehensive approach helps in accurately estimating the runoff volumes and ensures that the proposed stormwater management systems are designed to handle the expected flow efficiently.

Table 1: Assumptions

Assumption Number	Assumption Name	Assumption Value	Notes
1	C-Value	0.40	Rational Method & SCSC TR-55 Time of Concentration // C-Value for unimproved surfaces
2	C-Value	0.95	Rational Method & SCSC TR-55 Time of Concentration // C-Value for paved surfaces
3	C-Value	.070	Rational Method & SCSC TR-55 Time of Concentration // C-Value for neighborhood areas
4	C-Value	0.99	Rational Method & SCSC TR-55 Time of Concentration // C-Value for infiltration pond
5	Time of Concentration	SCS TR-55 TOC	Formula used for determining Time of Concentration

3.2 SITE DESCRIPTION

Presently, the project site is characterized by its vacant status, overgrown with rabbit brush and other similar species of flora. The terrain features gentle slopes averaging around 2.5%. The predominant soil type at this location is classified as Mespun-Bispen-Rock outcrop complex, which is moist. This soil type falls under Hydrologic Soil Group A, known for its high infiltration rates and efficient water transmission capabilities. Notably, about 200 feet to the southeast of the project site lies an existing infiltration basin, which our project plans to utilize to effectively manage stormwater runoff. This nearby basin shares nearly identical soil and vegetation characteristics, making it highly suitable for our infiltration needs and ensuring effective stormwater management.

The location intended for the new access road is also currently being used in a manner consistent with the proposed usage. The primary goal of constructing this new access road is to significantly improve community accessibility, both to the new development and to the surrounding residential area, thereby enhancing connectivity and ease of movement for the residents. Runoff from the roadway is expected to follow the existing drainage pattern that terminates in the adjacent detention basin.

3.3 DESIGN PARAMETERS

Designing a stormwater mitigation report for Navajo County, Arizona requires careful consideration of several key parameters to effectively address the region's unique environmental and infrastructural challenges. Navajo County, characterized by its arid climate and occasional intense rainfall events, necessitates a robust approach to managing stormwater to prevent flooding, erosion, and water quality degradation.

Firstly, this report extensively analyzes the site's hydrological characteristics, including rainfall patterns, soil types, and topography. Understanding these factors is crucial for determining the potential impact of stormwater runoff and designing appropriate mitigation measures.

Secondly, this assessment evaluates existing infrastructure such as drainage systems, retention basins, and historic drainage patterns. Identifying the existing capacities and conditions helps in assessing their effectiveness and potential need for upgrades or expansion.

It is crucial that this report and our design adhere to local regulations and guidelines governing stormwater management in Navajo County. Compliance with these regulations ensures that proposed solutions are not only effective but also legally permissible.

4.0 HYDROLOGY

4.1 EXISTING HYDROLOGY

The existing site hydrology consists of eight distinct subbasins. These subbasins converge at the infiltration basin during storm events. The current basin topography has sufficient capacity to allow for the complete collection and retention of runoff from the site, preventing overtopping during 100-year, 24-hour storm events. This ensures that even during extreme weather conditions, the site can manage water flow effectively, mitigating potential flood risks and protecting the surrounding infrastructure. The infiltration basin's design plays a crucial role in maintaining the site's hydrological balance, particularly during significant rainfall events. Additionally, the site's vegetation and soil composition contribute to its ability to absorb and filter stormwater, enhancing the overall efficiency of the hydrological system.

The following Table 2 represents flow quantities and volumes for the 2-, 10-, 50-, and 100-year, 24-hour storms, providing a comprehensive overview of the site's hydrological response to various storm intensities. This data is critical for engineers and planners to develop strategies for

sustainable water management and infrastructure development, ensuring long-term environmental and community health.

Table 2: "Existing Hydrology"

Subbasin Name	Subbasin Size (ac)	Runoff C-Value	Time of Concentration	Outfall Location	Peak Runoff (cfs)				Total Runoff (in)			
					2-year	10-year	50-year	100-year	2-year	10-year	50-year	100-year
1	7.2	0.5	13.3	Infil. Basin	4.1	7.0	11.0	13.2	0.1	0.2	0.3	0.4
2	9.4	0.5	15.0	Infil. Basin	5.2	8.8	13.8	16.6	0.1	0.2	0.4	0.4
3	4.5	0.75	11.3	Infil. Basin	5.1	8.7	13.7	16.4	0.2	0.4	0.6	0.7
4	3.1	0.95	2.5	Infil. Basin	3.1	5.3	8.4	10.0	0.2	0.3	0.5	0.5
5	0.9	0.65	10.2	Infil. Basin	0.9	1.5	2.3	2.8	0.2	0.3	0.4	0.5
6	0.6	0.5	8.6	Infil. Basin	0.4	0.7	1.1	1.3	0.1	0.2	0.3	0.4
10	3.2	0.99	0.0	Infiltration	4.8	8.1	12.7	15.3	0.3	0.4	0.7	0.8
SUMMATION	29.0	0.65	-	-	23.6	40.1	63.0	75.6	1.2	2.0	3.1	3.7

4.2 PROPOSED HYDROLOGY

The intent of the extents of the design is to mimic the existing and historic drainage patterns of the project site most nearly. Current topography of the site indicates that the nearby infiltration basin is the termination point of the majority of the runoff in the immediate vicinity. Therefore, the design was conducted in such a manner that this infiltration basin will be used for a similar purpose. The analysis for the proposed hydrology is centered around the detention basin. Significant runoff will likely not enter the apartment complex parking lot or immediate area from adjacent drainage. However, the roadway will incur significant flow along its path. The analysis of the proposed hydrology serves the purpose to assess the total flows that will be entering the infiltration basin to ensure proper compliance with local codes.

Currently, portions of the project site do not naturally flow towards the infiltration basin. Our design will rectify this and ensure that the majority of the runoff from this site will terminate into the infiltration basin. The logic behind this deviation from the historic drainage pattern is twofold: firstly, it will ensure that runoff from this site does not discharge towards the nearby sewage lagoon; secondly, it will merge our project with the surrounding infrastructure in order to ensure a more uniform drainage pattern moving forward.

Additionally, the new design incorporates advanced hydrological modeling to predict and manage water flow more effectively. This involves creating detailed simulations of various storm scenarios to optimize the placement and capacity of drainage features. By doing so, we can prevent potential flooding and erosion issues that could arise from heavy rainfall events.

The following Table 3 represents flow quantities and volumes for the 2-, 10-, 50-, and 100-year, 24-hour storms, providing a comprehensive overview of the site's hydrological response to various

storm intensities. This data is critical for engineers and planners to develop strategies for sustainable water management and infrastructure development, ensuring long-term environmental and community health.

Table 3: "Proposed Hydrology"

Subbasin Name	Subbasin Size (ac)	Runoff C-Value	Time of Concentration	Outfall Location	Peak Runoff (cfs)				Total Runoff (in)			
					2-year	10-year	50-year	100-year	2-year	10-year	50-year	100-year
1	7.2	0.5	13.3	Infil. Basin	4.1	7.0	11.0	13.2	0.1	0.2	0.3	0.4
2	9.4	0.5	15.0	Infil. Basin	5.2	8.8	13.8	16.6	0.1	0.2	0.4	0.4
3	4.5	0.75	11.3	Infil. Basin	5.1	8.7	13.7	16.4	0.2	0.4	0.6	0.7
4	3.1	0.95	2.5	Infil. Basin	3.1	5.3	8.4	10.0	0.2	0.3	0.5	0.5
5	0.9	0.65	10.2	Infil. Basin	0.9	1.5	2.3	2.8	0.2	0.3	0.4	0.5
6	0.6	0.5	8.6	Infil. Basin	0.4	0.7	1.1	1.3	0.1	0.2	0.3	0.4
7	0.1	0.95	1.5	Infil. Basin	0.2	0.3	0.5	0.7	0.3	0.4	0.7	0.8
8	0.1	0.95	2.5	Infil. Basin	0.2	0.3	0.4	0.5	0.3	0.4	0.7	0.8
9	1.7	0.95	5.8	Infil. Basin	2.5	4.2	6.6	8.0	0.3	0.5	0.8	0.9
10	3.2	0.99	0.0	Infiltration	4.8	8.1	12.7	15.3	0.3	0.4	0.7	0.8
SUMMATION	30.9	0.67	-	-	26.4	45.0	70.6	84.8	2.0	3.3	5.2	6.3

The design also takes into consideration the future development of the surrounding area. By aligning our drainage system with the long-term plans for the region, we ensure that the project not only meets current needs but is also adaptable to future changes. This forward-thinking approach will help maintain the efficiency and effectiveness of the drainage system over time.

The following Table 4 expresses the differences of the weighted C-Value and flows between the proposed and existing conditions.

Table 4: "Existing vs. Proposed"

Value	Existing	Proposed	Delta (as #)	Delta (as %)
Weighted C-Value	0.65	0.67	0.0	3%
Flow,2-yr	23.6	26.4	2.9	12%
Flow, 10-yr	40.1	45.0	4.8	12%
Flow, 50-yr	63.0	70.6	7.6	12%
Flow, 100-yr	75.6	84.8	9.1	12%

5.0 HYDRAULICS

5.1 ON-SITE CONVEYANCE

The proposed primary form of onsite conveyance of stormwater is sheet flow. Aside from one single catch basin and pipe, the majority of the on-site runoff will be mitigated through careful grading practices, proper erosion control, and thorough spread analysis. The design has been compiled in a manner to convey runoff through this site along curbs, gutters, and swales before its outfall into the nearby infiltration pond.

At this time, on-site conveyance is a remarkably uncomplicated design with a vested interest in preserving the historic drainage pattern while improving the system to increase community safety and health. The use of sheet flow as the primary conveyance method ensures that water is distributed evenly across the surface, reducing the potential for erosion, and promoting natural infiltration into the soil. This approach not only maintains the integrity of the existing landscape but also minimizes the need for extensive and costly underground piping systems.

The grading practices implemented are meticulously planned to create gentle slopes that direct water flow efficiently without causing excessive runoff or erosion. These slopes are complemented by strategically placed curbs and gutters that guide the water towards designated swales. The swales, designed to handle significant volumes of water, act as natural channels that slow down the flow and allow for sediment to settle, improving water quality before it reaches the infiltration pond.

The runoff from the site that is not directed towards the access road and collected there is directed through a curb break. The curb break serves as an avenue for the runoff that will reduce spread onto the roadway and parking lot. The backing of this curb break is a riprap, earthen swale with the purpose of directing flows towards the access road. The termination of the swale is a small detention pond, outfitted with an outlet culvert. This basin serves to reduce sedimentation and increase water quality.

The simplicity of the design with minimal reliance on mechanical systems means that it is easier to maintain and less likely to fail. The focus on preserving historic drainage patterns respects the natural hydrology of the area, ensuring that the project integrates seamlessly with the existing landscape and infrastructure.

The proposed stormwater management design leverages the natural topography and historical drainage patterns of the site to create an efficient, sustainable, and low-maintenance system. By prioritizing sheet flow, careful grading, and erosion control, the design not only mitigates runoff effectively but also enhances the overall environmental health of the area. This approach ensures that the project will provide long-term benefits in terms of community safety, environmental protection, and infrastructure resilience.

5.2 OFF-SITE CONVEYANCE

One of the most critical factors to consider for this design is the runoff effects and historic drainage patterns of the surrounding area. Currently, the majority of the surrounding area to the south of the project, flows via sheet flow to the infiltration pond. Areas that are incorporated in this flow

include the parking lot of the Navajo Nation EMS, the adjacent residential streets, the residences themselves and the surrounding undeveloped rangeland.

An important aspect of our design is to understand how the existing drainage patterns lie and how our design could impact their flow paths. Currently the EMS parking lot, residential streets and 10 of the 21 residences flow along the street curb and gutter and into the southwest corner of the pond. This location is the planned beginning-point of our new access road. In order to accommodate these flows, we had to determine the runoff quantities that will be traveling down this passage. The most-prudent and least-costly method to allow the runoff to leave the street is the implementation of a curb break and riprap. This will allow the runoff on the western portion of the road to flow out of the curb and gutter assembly and directly into the pond.

Runoff on the eastern portion of the roadway can easily leave the curb assemblies through curb breaks, however runoff on the western side cannot do so. The assembly of the western side of the road was designed to have one primary stormwater mitigation method, with two redundant methods. The primary for of runoff relief is through a doble catch basin that outfalls directly into the infiltration pond. These catch basins and the associated pipe has been designed to accommodate nearly all of the runoff.

In the event this catch basin is clogged or cannot accommodate the runoff, the crown of the roadway has been carefully designed to be below the back of curb elevation. This will allow runoff to flow across the roadway and in through the curb breaks on the other side of the street. In the event this is not possible, the western side of the roadway has been designed to have a swale along the back of walk. If runoff overflows the curb, it will traverse down the swale before being discharged into a detention pond. This pond has been designed similarly to the one adjacent to the site and the outlet pipe has been designed appropriately.

5.3 FLOODPLAIN ANALYSIS

Per the FEMA FIRMette, the area where the site is located, and the adjacent vicinity are classified as “Zone D.” A “Zone D” is characterized as “Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk” (FEMA, 2022). This type of zoning is typically reserved for lands that are owned by either the US Forest Service, the Bureau of Land Management, or Tribal Nations.

However, a hydraulic modeling and mapping effort was conducted by the US Army Corps of Engineers at the nearby Kayenta community. This community is the Chapter responsible for the land under the project site. Floodplain analysis and mapping determined that there was minimal flood risk to the community. Similar soil types, proximity, and rainfall conditions could lead to the assumption that this site could also be considered to have minimal flood risk.

The Zone D classification indicates a level of uncertainty in flood risk due to the absence of detailed flood hazard analysis. This uncertainty can affect various aspects of planning, development, and insurance within the zone. Despite this, the modeling efforts by the US Army Corps of Engineers provide a valuable reference point. Their detailed analysis at Kayenta, which shares geographic and climatic similarities with our project site, suggests that the flood risk is indeed minimal.

This conclusion is further supported by the comparable soil types and hydrological conditions between Kayenta and our site. The soil composition plays a crucial role in determining the

infiltration rate and runoff potential during heavy rainfall events. The soils in this region, characterized by a mix of sand, silt, and clay, typically have good drainage properties, reducing the likelihood of significant surface water accumulation and flooding.

Additionally, the historical rainfall data for the area indicates that while the region does experience periodic heavy rains, the overall precipitation levels are relatively moderate. This consistent climatic pattern supports the assumption of a low flood risk, as there are fewer instances of extreme weather events that could overwhelm the historic drainage facilities.

6.0 DETENTION BASIN

6.1 BASIN DESCRIPTION

The basin currently presides to the southeast of the proposed project site. The perimeter of the high-water mark before overtopping is nearly 50,000 square feet, and its depth from this elevation to the lowest point is approximately 3.5 feet. A geotechnical report was conducted in June 2024 by Atek Engineering Consultants. This inspection found that the soil is comprised of inorganic silts and fine sands, which contribute to a high infiltration rate.

The report also highlighted the robustness of the basin's design, noting that the soil's composition allows for rapid absorption of water, thereby significantly reducing the risk of overflow during heavy rainfall events. This high infiltration rate ensures that the basin can handle substantial volumes of runoff efficiently, thereby protecting the surrounding infrastructure and minimizing the risk of flooding.

The Navajo County Drainage Policy states that any ponds must be sized to accommodate a 100-year, 2-hour storm event. By our calculations, it was determined that the capacity of the pond (103,885 cubic feet) is not exceeded by the 100-year, 24-hour storm. It was determined that the maximum depth of runoff in the pond is nearly 1.7-feet while the pond has a total depth of 3.0-feet.

6.2 INLET STRUCTURES

Detention basin inlets and inlet structures are a very integral part of the stormwater mitigation plan. These often take the form of pipe inlets, open gutter inlets and canal inlets. Our design has utilized both pipe inlets and open gutter inlets to convey water from the runoff surface into the pond. Along the length of the proposed access road, runoff will accumulate from the surrounding areas. Along the eastern side of the roadway, it is intended for 36-inch curb cuts to be used as spillways where the runoff will be allowed to leave the curb assembly and enter the infiltration basin. At these locations, geotextile fibers and riprap will be installed to ensure erosion is minimized.

There are three locations for this project where pipe inlets will be utilized. The first location is on the southern portion of the proposed access road, near the tie-in location. This drop inlet is responsible for conveying the runoff from one acre of the rangeland, 1.7 acres of the neighborhood, nearly all of the existing roadway (1.8 acres) and the first 120-feet of the proposed access road. Runoff traveling down the existing roadways historically sheet flows off the pavements, onto the unimproved road and into the basin. Adding a crown and pavement to this

area, prevents the runoff from crossing the road. To remedy this, a double-drop inlet will be implemented on the western side of the road with a pipe extending under the roadway and into the infiltration basin. The pipe will outfall into the southwest corner of the basin, similar to the historic drainage pattern. It is proposed that this pipe be 18-inch PVC.

The second pipe inlet is on the northern portion of the proposed roadway, near where the proposed driveway for our site begins. This culvert pipe is responsible for conveying water from the site's drainage swale, under and across the roadway as well as accepting approximately 7.2 acres of rangeland runoff. The pipe outfalls into the northwestern corner of the infiltration basin. The proposed culvert is a 24-inch PVC pipe.

The third culvert is located centrally along the road, south of the project site, and near an existing driveway. This culvert is the outfall of a pond and drainage swale that collect runoff that would historically flow over the location of the proposed access road. The culvert pipe is designed to be 18-inch PVC. The hydraulic information on the three pipe inlets during a 100-year, 24-hour storm is displayed in Table 5.

Table 5: "Pipe Inlet Flows"

Value	*Southern Inlet*	*Central Culvert*	*Northern Culvert*
Pipe Size (in)	*18*	*18*	*24*
Pipe Sloped (%)	*1.7*	*0.5*	*0.5*
Peak Flow (100yr, 24hr // cfs)	*14.9*	*15.5*	*19.2*
Design Flow (cfs)	*18.0*	*10.0*	*22.2*
Velocity (ft/s)	*8.4*	*8.8*	*6.5*

It is important to note that the Central Culvert is surcharged as its peak flow is above its design flow. However, the detention pond sized for this location has sufficient capacity to detain the runoff without overtopping. It is expected that this pond will drain sufficiently in a 100-year storm event.

7.0 SUMMARY AND CONCLUSIONS

7.1 SUMMARY AND CODE ADHERENCE

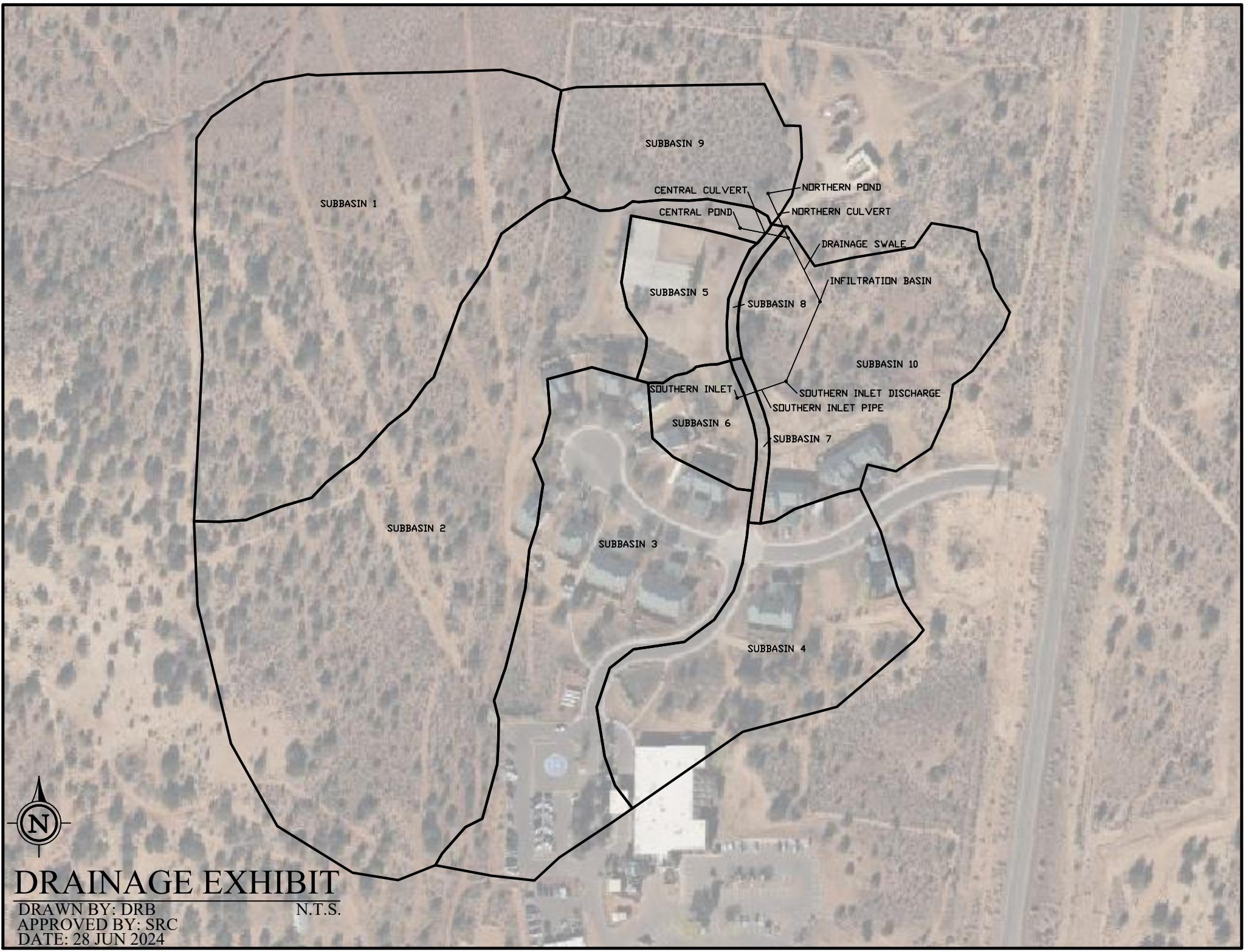
Using the parameters laid out by the Navajo County Drainage Policy, the site has been meticulously designed to manage not only its own flow but also any off-site flows that may enter the area. This careful planning ensures that the infrastructure can handle water from multiple sources without causing adverse effects.

To further ensure the effectiveness of the drainage design, an in-depth analysis was conducted on the nearby infiltration basin. This basin is a crucial component as it is intended to accommodate the increased runoff produced by the site. The comprehensive analysis included evaluating the capacity and performance of the basin under various conditions.

Through this detailed analysis, it was determined that the nearby infiltration basin has sufficient capacity to manage the runoff generated by the site. The study confirmed that the basin can efficiently handle the expected water volume without reaching its limit. Moreover, the evaluation also focused on the inlets leading into the basin and their associated detention ponds. It was verified that these inlets and detention ponds do not overtop or overflow even during a 100-year 24-hour storm event, which is a significant test of their capacity and resilience.

The successful assessment and verification of the drainage and infiltration systems highlight the robustness of the site's design. By adhering to the Navajo County Drainage Policy and conducting thorough analyses, the site is well-prepared to manage water flow and runoff, ensuring stability and sustainability in various weather conditions.

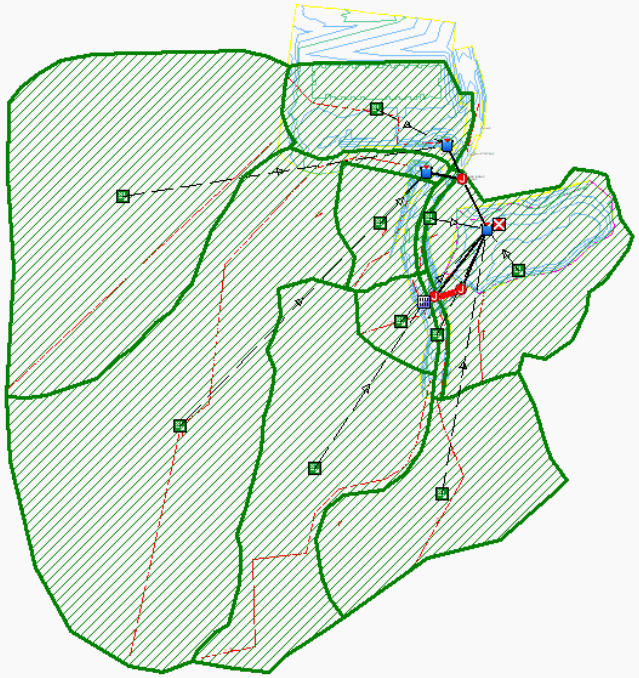
APPENDIX 1: EXHIBITS



DRAINAGE EXHIBIT

DRAWN BY: DRB N.T.S.
APPROVED BY: SRC
DATE: 28 JUN 2024

APPENDIX 2: HYDROLOGIC MODEL OUTPUTS



Project Description

File Name	ihouse SSA model.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	6:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	5	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	10
Nodes	8
Junctions	3
Outfalls	1
Flow Diversions	0
Inlets	1
Storage Nodes	3
Links	8
Channels	3
Pipes	5
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	2 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Subbasin_1	7.20	0.4000	0.32	0.13	0.91	4.12	0 00:13:15
2	Subbasin_10	3.23	0.9000	0.27	0.25	0.79	4.76	0 00:10:00
3	Subbasin_2	9.38	0.4100	0.34	0.14	1.29	5.17	0 00:14:58
4	Subbasin_3	4.53	0.7300	0.29	0.21	0.97	5.12	0 00:11:16
5	Subbasin_4	3.08	0.6200	0.27	0.17	0.52	3.13	0 00:10:00
6	Subbasin_5	0.93	0.5800	0.28	0.16	0.15	0.88	0 00:10:13
7	Subbasin_6	0.61	0.4000	0.27	0.11	0.07	0.40	0 00:10:00
8	Subbasin_7	0.13	0.9500	0.27	0.26	0.03	0.20	0 00:10:00
9	Subbasin_8	0.11	0.9500	0.27	0.26	0.03	0.17	0 00:10:00
10	Subbasin_9	1.70	0.9500	0.29	0.28	0.47	2.48	0 00:11:30

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	M Surcha Dep Attair
1	3-Jun	Junction	6339.00	6342.00	0.00	6342.00	0.00	0.00	6339.00	0.
2	SOUTHERN_INLET_FES	Junction	6339.00	6342.00	0.00	6342.00	0.00	5.05	6342.65	0.
3	SWALE_CONVERGE	Junction	6338.29	6342.29	0.00	4.00	0.00	9.99	6339.21	0.
4	Out-04	Outfall	6339.00					0.00	6339.00	
5	CENTRAL_CULVERT	Storage Node	6338.50	6342.50	0.00		0.00	5.79	6339.79	
6	INFIL_POND	Storage Node	6336.00	6339.10	0.00		0.00	21.67	6336.05	
7	NORTH_CULVERT	Storage Node	6337.20	6341.20	0.00		0.00	6.36	6339.46	

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)	
1	CENTRAL_CULVERT	Pipe	CENTRAL_CULVERT	SWALE_CONVERGE	74.00	6337.57	6337.17	0.5400	18.000	0.0100	4.75	7.27	0.65
2	FAKE_PIPE	Pipe	SOUTHERN_INLET_FES	INFIL_POND	5.00	6342.50	6337.00	110.0000	10.000	0.0050	5.07	59.75	0.08
3	Link-08	Pipe	3-Jun	INFIL_POND	15.00	6345.00	6336.00	60.0000	40.000	0.0010	0.00	8895.17	0.00
4	NORTHERN_CULVERT	Pipe	NORTH_CULVERT	SWALE_CONVERGE	72.00	6336.78	6336.37	0.5700	24.000	0.0100	5.65	36.19	0.16
5	SOUTHERN_PIPE	Pipe	SOUTHERN_INLET	SOUTHERN_INLET_FES	103.00	6340.80	6339.00	1.7500	18.000	0.0100	5.05	18.05	0.28
6	BYPASS	Channel	SOUTHERN_INLET	3-Jun	5.00	6345.00	6345.00	0.0000	6.000	0.0140	0.00	9.15	0.00
7	Link-07	Channel	INFIL_POND	Out-04	5.00	6339.10	6339.00	2.0000	12.000	0.0320	0.00	648.11	0.00
8	SWALE	Channel	SWALE_CONVERGE	INFIL_POND	129.00	6338.39	6337.65	0.5700	36.000	0.0320	9.98	195.20	0.05

Inlet Summary

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft^2)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	0.00	10.00	5.12	N/A	N/A	N/A	7.00

Subbasin Hydrology

Subbasin : Subbasin_1

Input Data

Area (ac) 7.2
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	7.2	A	0.4
Composite Area & Weighted Runoff Coeff.	7.2		0.4

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	9.9	0	0

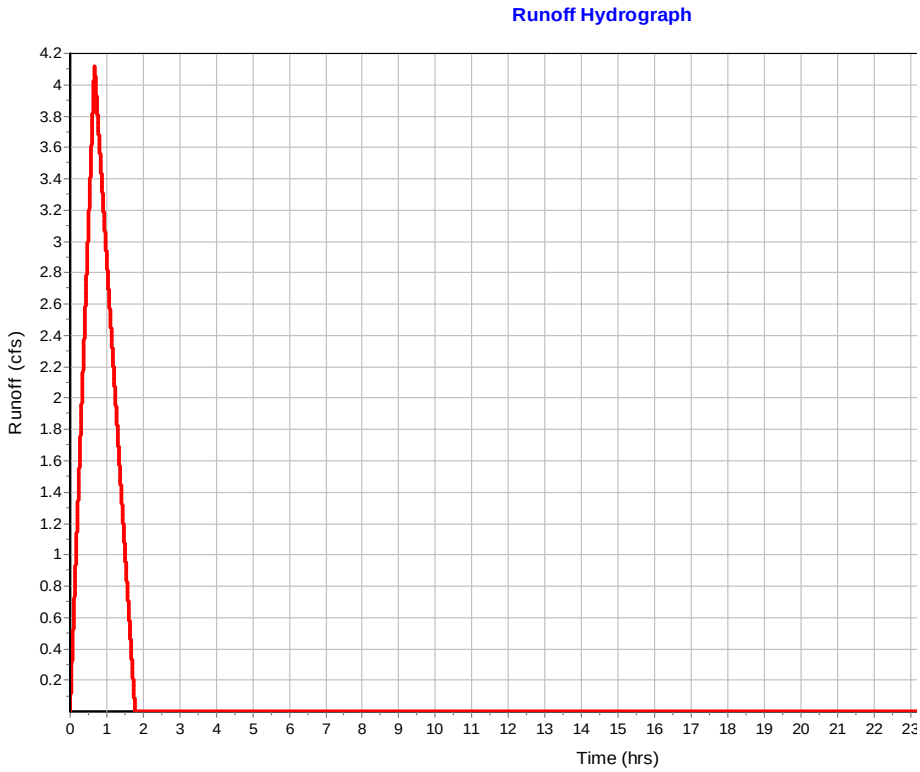
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	696	0	0
Slope (%) :	4.6	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.46	0	0
Computed Flow Time (min) :	3.35	0	0

Total TOC (min) 13.25

Subbasin Runoff Results

Total Rainfall (in)	0.32
Total Runoff (in)	0.13
Peak Runoff (cfs)	4.12
Rainfall Intensity	1.431
Weighted Runoff Coefficient	0.4
Time of Concentration (days hh:mm:ss)	0 00:13:15

Subbasin : Subbasin_1



Subbasin : Subbasin_10

Input Data

Area (ac)	3.23
Weighted Runoff Coefficient	0.9

Runoff Coefficient

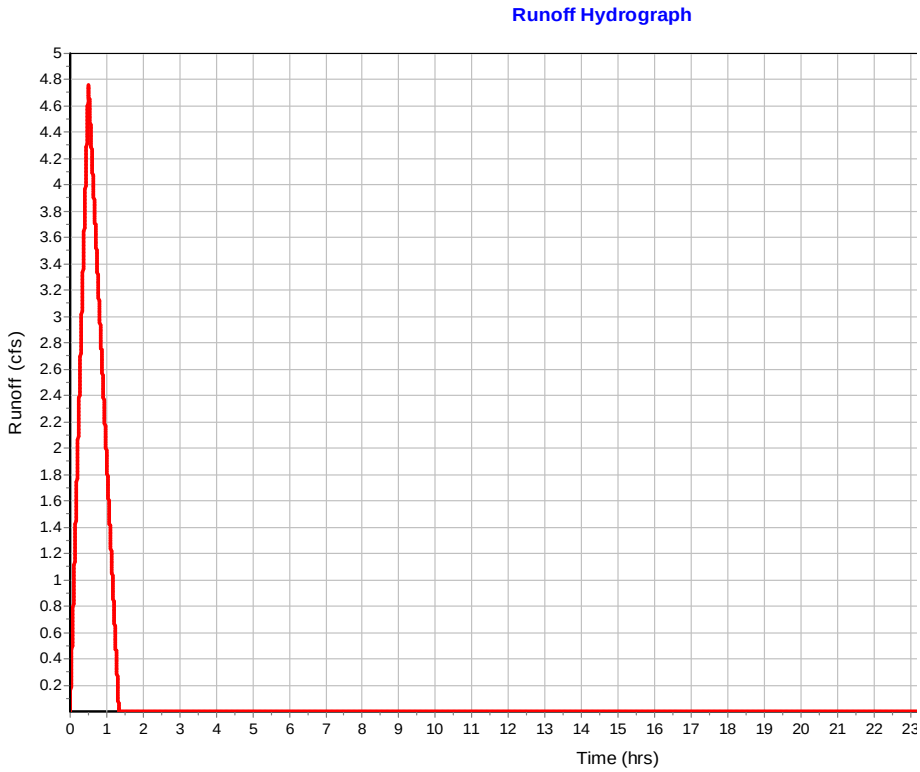
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	3.23	A	0.9
Composite Area & Weighted Runoff Coeff.	3.23		0.9

Time of Concentration

Subbasin Runoff Results

Total Rainfall (in)	0.27
Total Runoff (in)	0.25
Peak Runoff (cfs)	4.76
Rainfall Intensity	1.638
Weighted Runoff Coefficient	0.9
Time of Concentration (days hh:mm:ss)	0 00:00:00

Subbasin : Subbasin_10



Subbasin : Subbasin_2

Input Data

Area (ac)	9.38
Weighted Runoff Coefficient	0.41

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.16	A	0.7
-	9.22	A	0.4
Composite Area & Weighted Runoff Coeff.	9.38		0.41

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

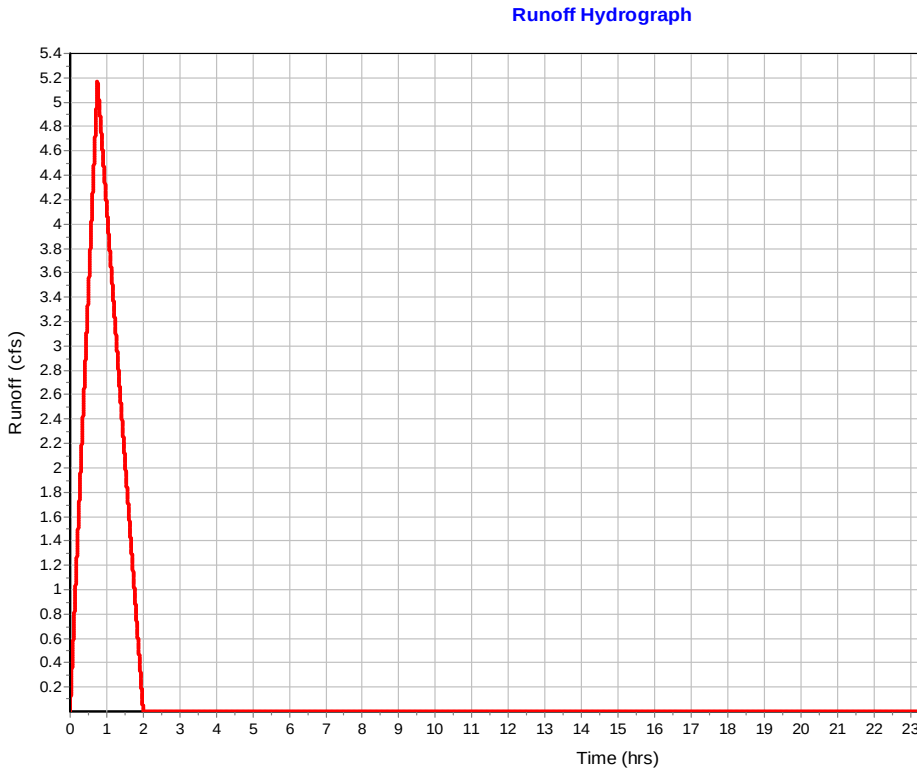
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1278	0	0
Slope (%) :	3.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.1	0	0
Computed Flow Time (min) :	6.87	0	0

Total TOC (min) 14.97

Subbasin Runoff Results

Total Rainfall (in)	0.34
Total Runoff (in)	0.14
Peak Runoff (cfs)	5.17
Rainfall Intensity	1.343
Weighted Runoff Coefficient	0.41
Time of Concentration (days hh:mm:ss)	0 00:14:58

Subbasin : Subbasin_2



Subbasin : Subbasin_3

Input Data

Area (ac) 4.53
Weighted Runoff Coefficient 0.73

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.74	A	0.7
-	1	A	0.4
-	1.79	A	0.95
Composite Area & Weighted Runoff Coeff.	4.53		0.73

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	115	0	0
Slope (%) :	10.8	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.24	0	0
Computed Flow Time (min) :	7.87	0	0

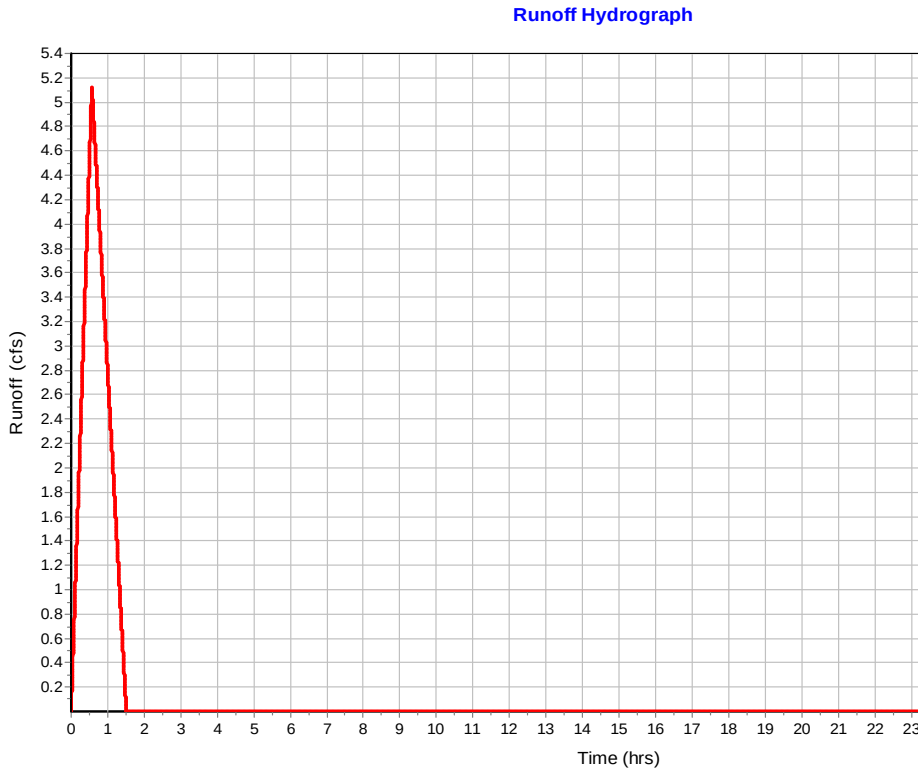
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	820	0	0
Slope (%) :	3.9	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	4.01	0	0
Computed Flow Time (min) :	3.41	0	0

Total TOC (min) 11.28

Subbasin Runoff Results

Total Rainfall (in) 0.29
Total Runoff (in) 0.21
Peak Runoff (cfs) 5.12
Rainfall Intensity 1.549
Weighted Runoff Coefficient 0.73
Time of Concentration (days hh:mm:ss) 0 00:11:17

Subbasin : Subbasin_3



Subbasin : Subbasin_4

Input Data

Area (ac)	3.08
Weighted Runoff Coefficient	0.62

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.62	A	0.7
-	1.55	A	0.4
-	0.91	A	0.95
Composite Area & Weighted Runoff Coeff.	3.08		0.62

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

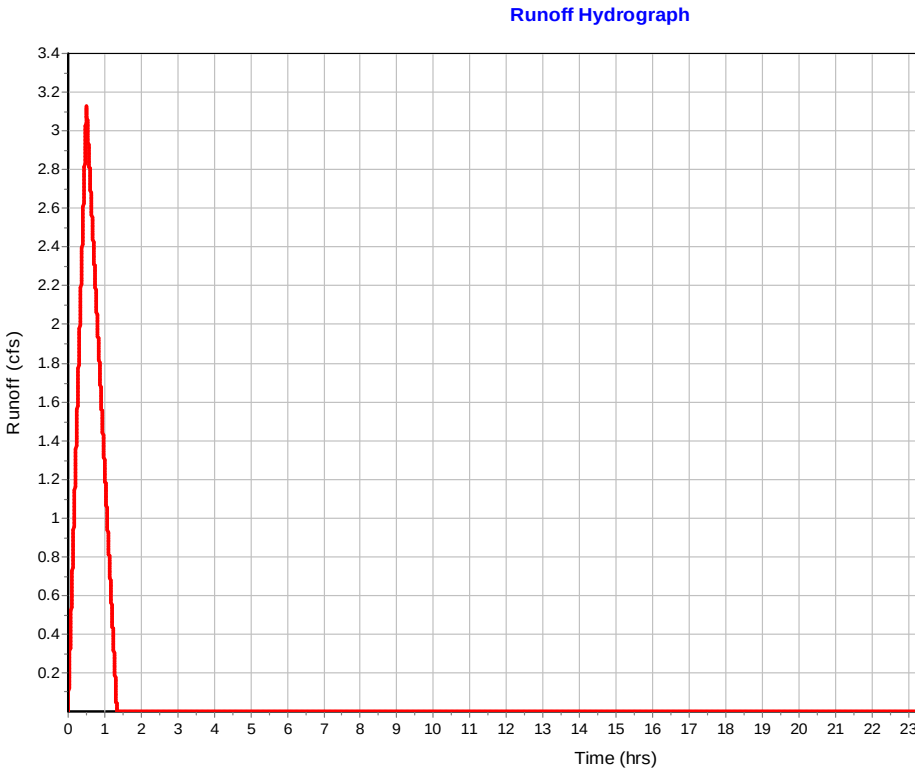
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	103	125	56
Slope (%) :	7.6	3.7	1.8
Surface Type :	Bare & untilled	Unpaved	Paved
Velocity (ft/sec) :	2.76	3.1	2.73
Computed Flow Time (min) :	0.62	0.67	0.34

Total TOC (min) 9.74

Subbasin Runoff Results

Total Rainfall (in)	0.27
Total Runoff (in)	0.17
Peak Runoff (cfs)	3.13
Rainfall Intensity	1.638
Weighted Runoff Coefficient	0.62
Time of Concentration (days hh:mm:ss)	0 00:09:44

Subbasin : Subbasin_4



Subbasin : Subbasin_5

Input Data

Area (ac) 0.93
Weighted Runoff Coefficient 0.58

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.31	A	0.95
-	0.62	A	0.4
Composite Area & Weighted Runoff Coeff.	0.93		0.58

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	5.2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.18	0	0
Computed Flow Time (min) :	9.43	0	0

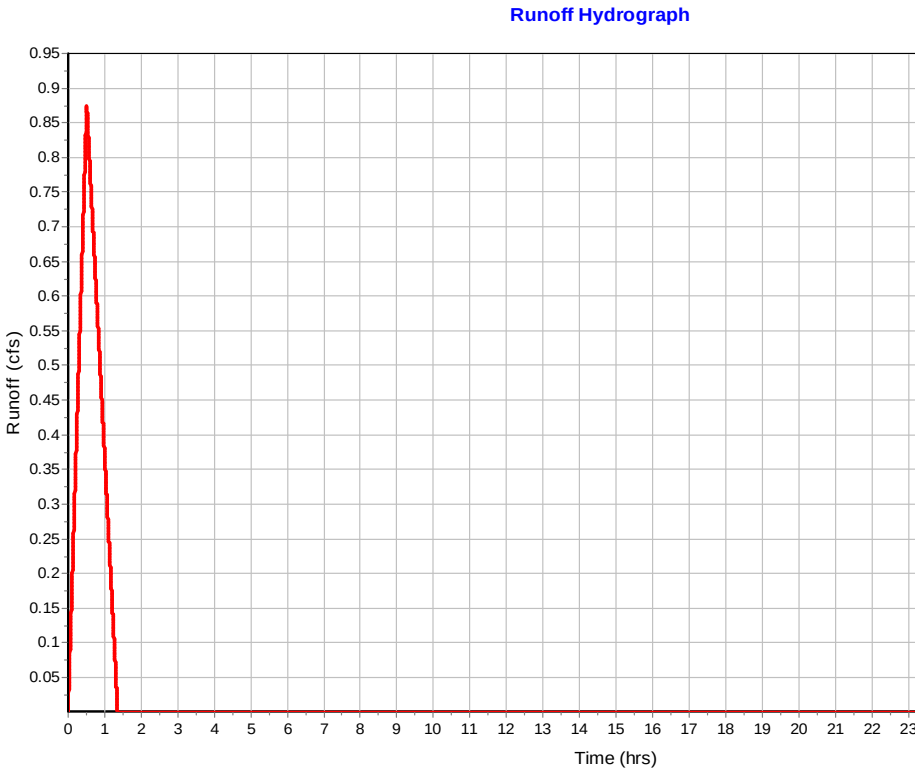
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	174	0	0
Slope (%) :	5.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.68	0	0
Computed Flow Time (min) :	0.79	0	0

Total TOC (min) 10.22

Subbasin Runoff Results

Total Rainfall (in) 0.28
Total Runoff (in) 0.16
Peak Runoff (cfs) 0.88
Rainfall Intensity 1.622
Weighted Runoff Coefficient 0.58
Time of Concentration (days hh:mm:ss) 0 00:10:13

Subbasin : Subbasin_5



Subbasin : Subbasin_6

Input Data

Area (ac) 0.61
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.61	A	0.4
Composite Area & Weighted Runoff Coeff.	0.61		0.4

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.4	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.19	0	0

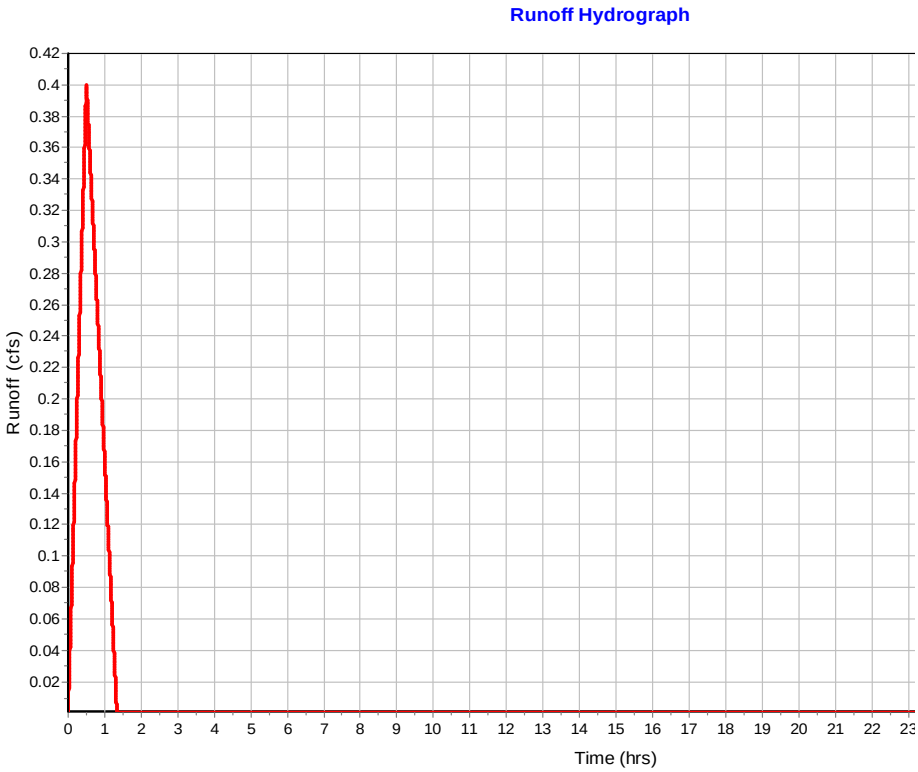
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	131	0	0
Slope (%) :	7.4	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	5.53	0	0
Computed Flow Time (min) :	0.39	0	0

Total TOC (min) 8.58

Subbasin Runoff Results

Total Rainfall (in) 0.27
Total Runoff (in) 0.11
Peak Runoff (cfs) 0.4
Rainfall Intensity 1.638
Weighted Runoff Coefficient 0.4
Time of Concentration (days hh:mm:ss) 0 00:08:35

Subbasin : Subbasin_6



Subbasin : Subbasin_7

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.13	A	0.95
Composite Area & Weighted Runoff Coeff.	0.13		0.95

Time of Concentration

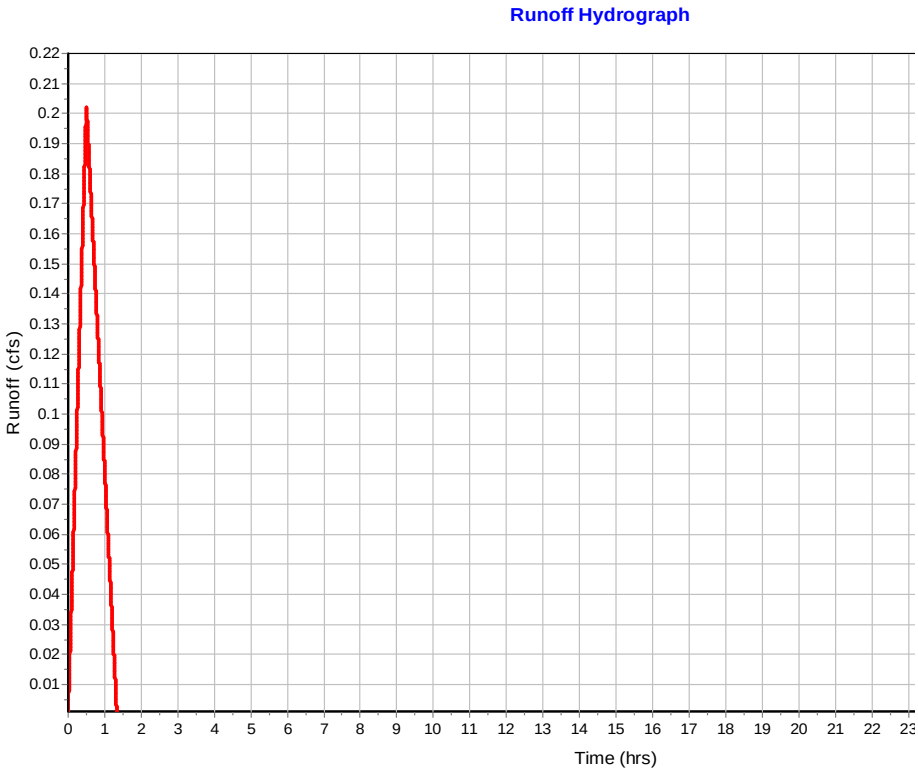
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	264	0	0
Slope (%) :	2	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0	0
Computed Flow Time (min) :	1.53	0	0

Total TOC (min) 1.53

Subbasin Runoff Results

Total Rainfall (in) 0.27
Total Runoff (in) 0.26
Peak Runoff (cfs) 0.2
Rainfall Intensity 1.638
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:01:32

Subbasin : Subbasin_7



Subbasin : Subbasin_8

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.11	A	0.95
Composite Area & Weighted Runoff Coeff.	0.11		0.95

Time of Concentration

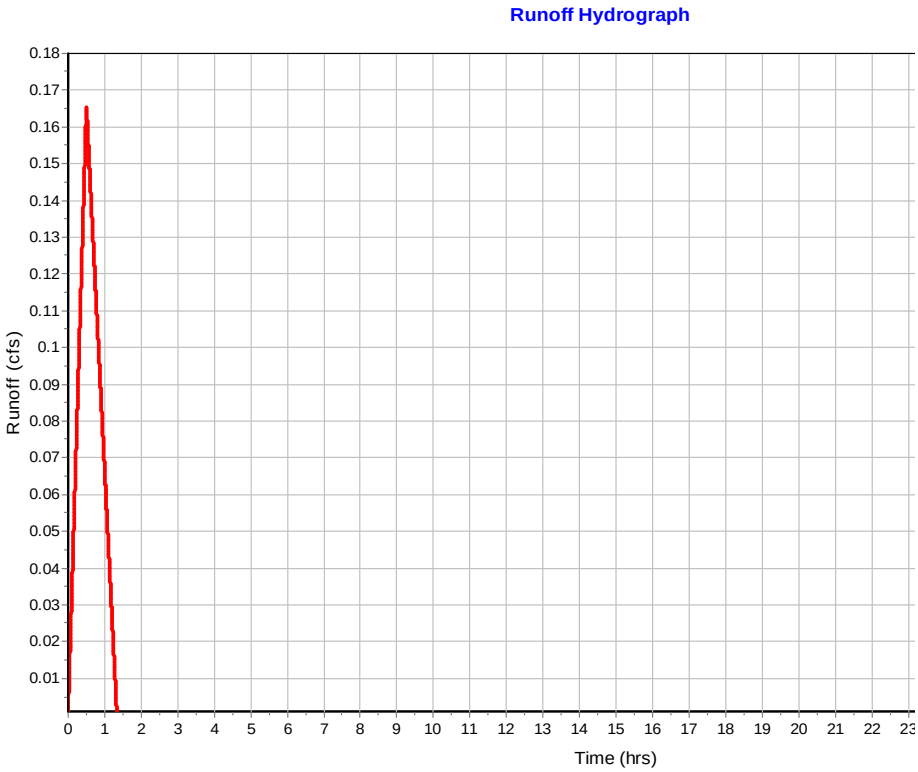
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.015	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.68	0	0
Computed Flow Time (min) :	2.46	0	0

Total TOC (min) 2.46

Subbasin Runoff Results

Total Rainfall (in) 0.27
Total Runoff (in) 0.26
Peak Runoff (cfs) 0.17
Rainfall Intensity 1.638
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:02:28

Subbasin : Subbasin_8



Subbasin : Subbasin_9

Input Data

Area (ac)	1.7
Weighted Runoff Coefficient	0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.7	A	0.95
Composite Area & Weighted Runoff Coeff.	1.7		0.95

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	80	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.14	0	0
Computed Flow Time (min) :	9.83	0	0

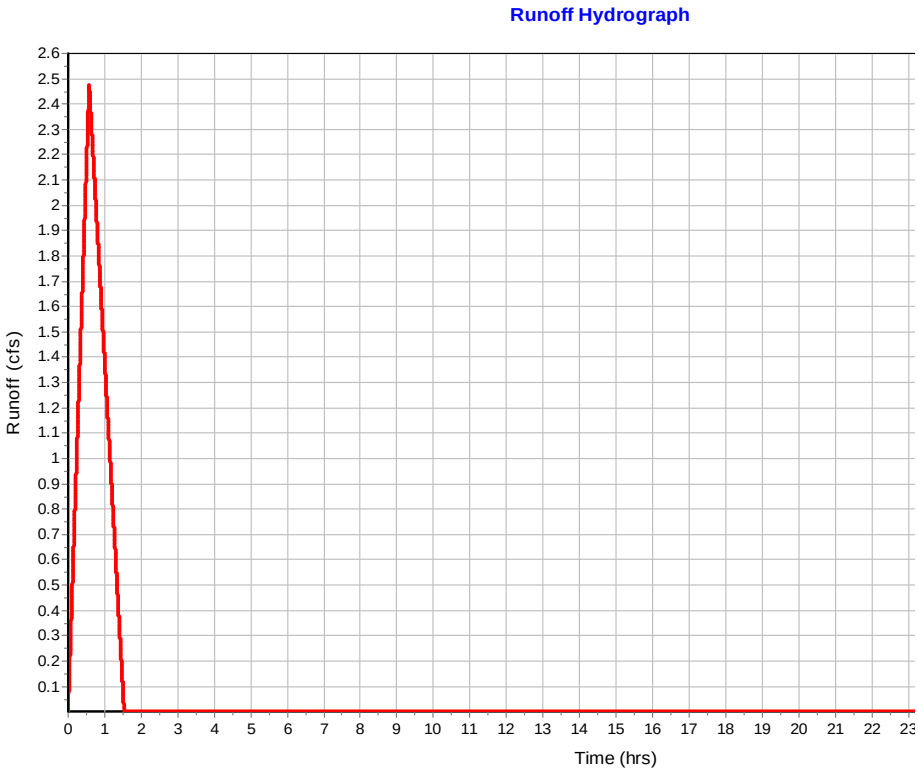
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	300	44	0
Slope (%) :	3	3	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.52	2.79	0
Computed Flow Time (min) :	1.42	0.26	0

Total TOC (min) 11.51

Subbasin Runoff Results

Total Rainfall (in)	0.29
Total Runoff (in)	0.28
Peak Runoff (cfs)	2.48
Rainfall Intensity	1.534
Weighted Runoff Coefficient	0.95
Time of Concentration (days hh:mm:ss)	0 00:11:31

Subbasin : Subbasin_9



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Mini C
1	3-Jun	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
2	SOUTHERN_INLET_FES	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
3	SWALE_CONVERGE	6338.29	6342.29	4.00	0.00	-6338.29	4.00	-6338.29	0.00	1

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Tim Max Occurre (days hh:r
1	3-Jun	0.00	0.00	6339.00	0.00	0.00	9.33	6339.00	0.00	0 0
2	SOUTHERN_INLET_FES	5.05	0.00	6342.65	3.65	0.00	0.69	6342.47	3.47	0 0
3	SWALE_CONVERGE	9.99	0.00	6339.21	0.92	0.00	3.08	6338.33	0.04	0 0

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entran Loss
1	BYPASS	5.00	6345.00	4.20	6345.00	6.00	0.00	0.0000	Rectangular	0.500	20.000	0.0140	0.00
2	Link-07	5.00	6339.10	3.10	6339.00	0.00	0.10	2.0000	Rectangular	1.000	100.000	0.0320	0.00
3	SWALE	129.00	6338.39	0.10	6337.65	1.65	0.74	0.5700	Trapezoidal	3.000	22.000	0.0320	0.50

Channel Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)	
1	BYPASS	0.00	0 00:00	9.15	0.00	0.00		0.00	0.00	0.00	
2	Link-07	0.00	0 00:00	648.11	0.00	0.00		0.00	0.00	0.00	
3	SWALE	9.98	0 00:44	195.20	0.05	2.53	0.85	0.66	0.22	0.00	

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	F
1	CENTRAL_CULVERT	74.00	6337.57	-0.93	6337.17	-1.12	0.40	0.5400	CIRCULAR	18.000	18.000	
2	FAKE_PIPE	5.00	6342.50	3.50	6337.00	1.00	5.50	110.0000	CIRCULAR	9.960	9.960	
3	Link-08	15.00	6345.00	6.00	6336.00	0.00	9.00	60.0000	CIRCULAR	39.960	39.960	
4	NORTHERN_CULVERT	72.00	6336.78	-0.42	6336.37	-1.92	0.41	0.5700	CIRCULAR	24.000	24.000	
5	SOUTHERN_PIPE	103.00	6340.80	0.00	6339.00	0.00	1.80	1.7500	CIRCULAR	18.000	18.000	

No. of Barrels
1
1
1
1
1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Surcha
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		
1	CENTRAL_CULVERT	4.75	0 00:46	7.27	0.65	3.76	0.33	1.10	0.73	
2	FAKE_PIPE	5.07	0 00:35	59.75	0.08	50.00	0.00	0.16	0.19	
3	Link-08	0.00	0 00:00	8895.17	0.00	0.00		0.03	0.01	
4	NORTHERN_CULVERT	5.65	0 00:40	36.19	0.16	2.31	0.52	1.46	0.73	
5	SOUTHERN_PIPE	5.05	0 00:35	18.05	0.28	5.77	0.30	1.50	1.00	17

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Init Wat Elevati (
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	5.00	0.(

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	SOUTHERN_INLET	N/A	0.0200	0.0160	0.0620	2.00	0.0656	7.00

Inlet Results

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Tim Max D Occurre (days hh:r
1	SOUTHERN_INLET	5.12	5.12	N/A	N/A	N/A	14.28	6346.19	0.39	0 0

Storage Nodes

Storage Node : CENTRAL_CULVERT

Input Data

Invert Elevation (ft)	6338.50
Max (Rim) Elevation (ft)	6342.50
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6338.50
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

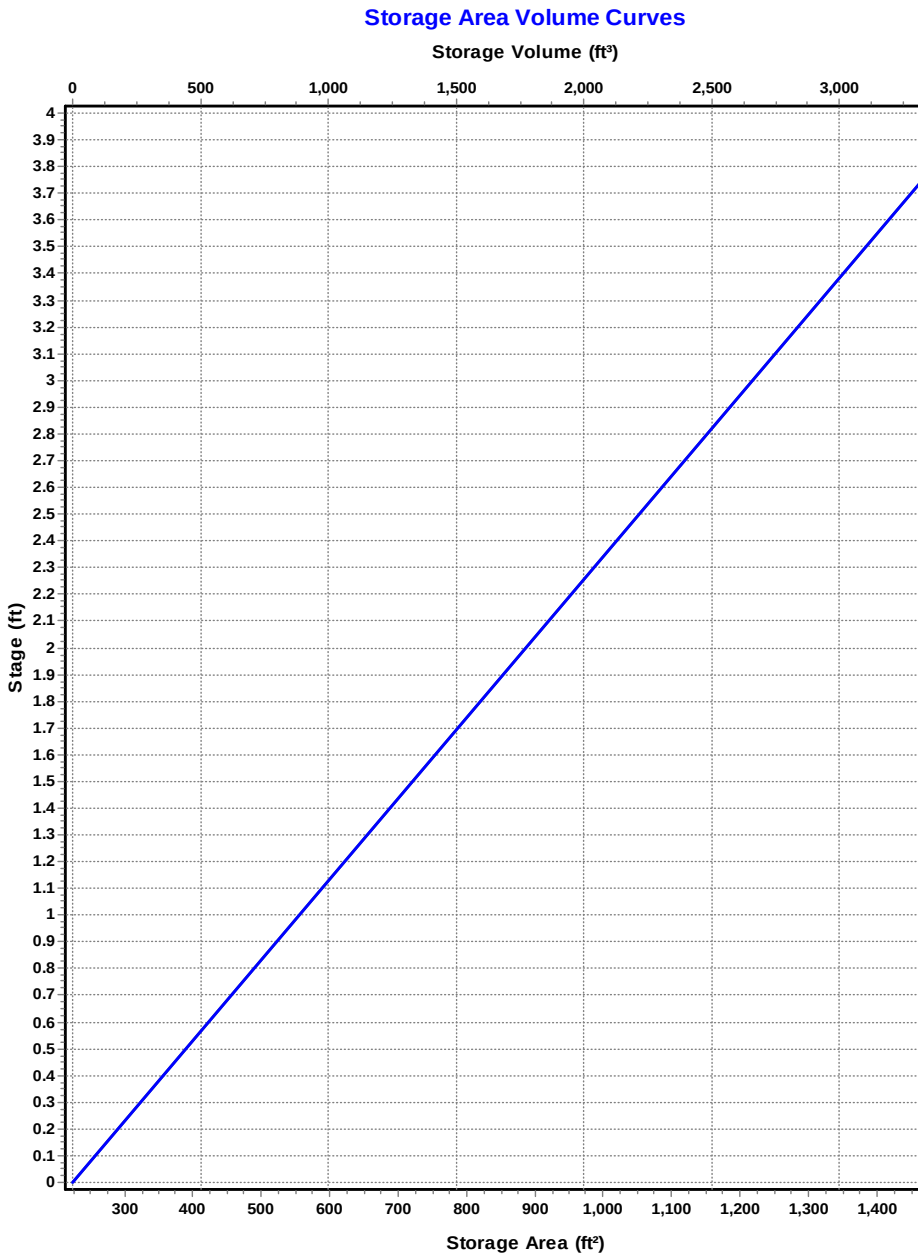
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : CENTRAL CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	224	0
4	1550	3548


Storage Area Volume Curves
Storage Volume (ft³)
0
500
1,000
1,500
2,000
2,500
3,000
Stage (ft)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
1,400
Storage Area (ft²)

Storage Node : CENTRAL_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	5.79
Peak Lateral Inflow (cfs)	5.79
Peak Outflow (cfs)	4.75
Peak Exfiltration Flow Rate (cfm)	55.27
Max HGL Elevation Attained (ft)	6339.79
Max HGL Depth Attained (ft)	1.29
Average HGL Elevation Attained (ft)	6338.55
Average HGL Depth Attained (ft)	0.05
Time of Max HGL Occurrence (days hh:mm)	0 00:46
Total Exfiltration Volume (1000-ft³)	4.728
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : INFIL_POND

Input Data

Invert Elevation (ft)	6336.00
Max (Rim) Elevation (ft)	6339.10
Max (Rim) Offset (ft)	3.10
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6336.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

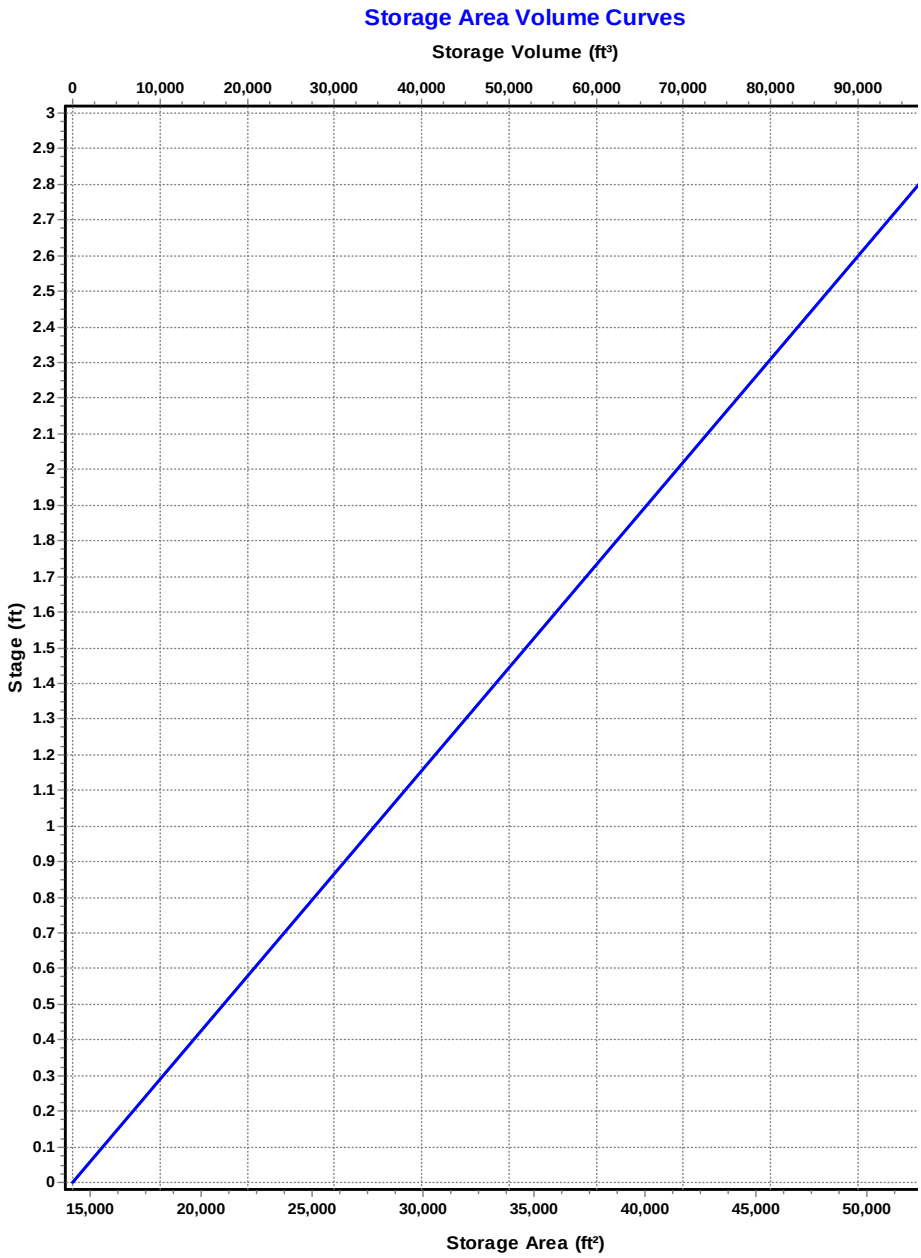
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : INFILTRATION POND

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	14221	0
3	55036	103885.5


Storage Area Volume Curves
Storage Volume (ft³)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
Stage (ft)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
Storage Area (ft²)

Storage Node : INFIL_POND (continued)

Output Summary Results

Peak Inflow (cfs)	21.67
Peak Lateral Inflow (cfs)	8.65
Peak Outflow (cfs)	0
Peak Exfiltration Flow Rate (cfm)	1242.36
Max HGL Elevation Attained (ft)	6336.05
Max HGL Depth Attained (ft)	0.05
Average HGL Elevation Attained (ft)	6336
Average HGL Depth Attained (ft)	0
Time of Max HGL Occurrence (days hh:mm)	0 00:43
Total Exfiltration Volume (1000-ft³)	63.427
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NORTH_CULVERT

Input Data

Invert Elevation (ft)	6337.20
Max (Rim) Elevation (ft)	6341.20
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6337.20
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Infiltration/Exfiltration

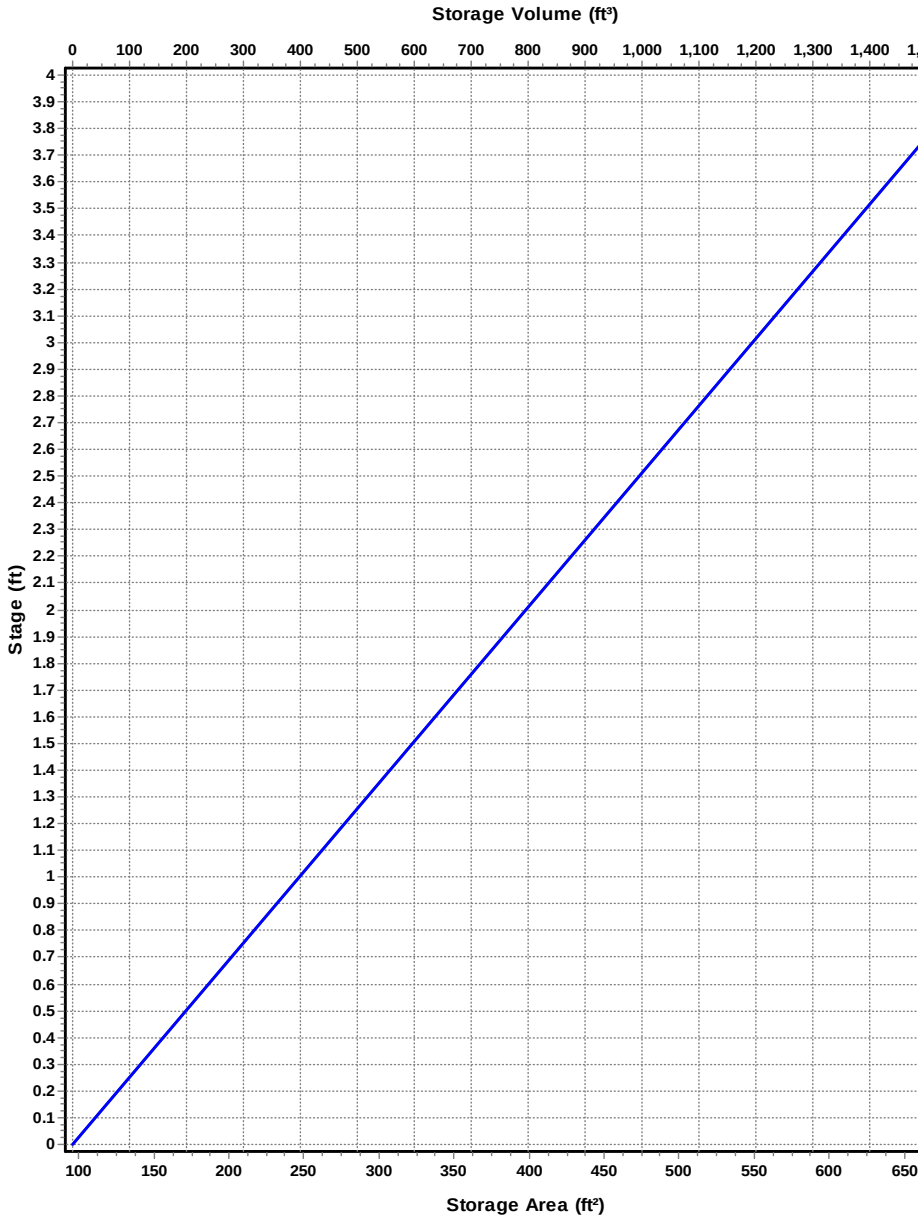
Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : NORTHERN CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	96	0
4	700	1592

Storage Area Volume Curves



Storage Node : NORTH_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	6.36
Peak Lateral Inflow (cfs)	6.36
Peak Outflow (cfs)	5.65
Peak Exfiltration Flow Rate (cfm)	38.66
Max HGL Elevation Attained (ft)	6339.46
Max HGL Depth Attained (ft)	2.26
Average HGL Elevation Attained (ft)	6337.33
Average HGL Depth Attained (ft)	0.13
Time of Max HGL Occurrence (days hh:mm)	0 00:40
Total Exfiltration Volume (1000-ft³)	4.41
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name	ihouse SSA model.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	6:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	5	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	10
Nodes	8
Junctions	3
Outfalls	1
Flow Diversions	0
Inlets	1
Storage Nodes	3
Links	8
Channels	3
Pipes	5
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	10 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Subbasin_1	7.20	0.4000	0.54	0.22	1.56	7.02	0 00:13:15
2	Subbasin_10	3.23	0.9000	0.47	0.42	1.35	8.10	0 00:10:00
3	Subbasin_2	9.38	0.4100	0.57	0.23	2.19	8.79	0 00:14:58
4	Subbasin_3	4.53	0.7300	0.50	0.36	1.65	8.72	0 00:11:16
5	Subbasin_4	3.08	0.6200	0.47	0.29	0.89	5.32	0 00:10:00
6	Subbasin_5	0.93	0.5800	0.47	0.27	0.25	1.49	0 00:10:13
7	Subbasin_6	0.61	0.4000	0.47	0.19	0.11	0.68	0 00:10:00
8	Subbasin_7	0.13	0.9500	0.47	0.44	0.06	0.34	0 00:10:00
9	Subbasin_8	0.11	0.9500	0.47	0.44	0.05	0.28	0 00:10:00
10	Subbasin_9	1.70	0.9500	0.50	0.48	0.81	4.22	0 00:11:30

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	M Surcha Dep Attair
1	3-Jun	Junction	6339.00	6342.00	0.00	6342.00	0.00	0.00	6339.00	0.
2	SOUTHERN_INLET_FES	Junction	6339.00	6342.00	0.00	6342.00	0.00	8.49	6342.68	0.
3	SWALE_CONVERGE	Junction	6338.29	6342.29	0.00	4.00	0.00	17.74	6339.46	0.
4	Out-04	Outfall	6339.00					0.00	6339.00	
5	CENTRAL_CULVERT	Storage Node	6338.50	6342.50	0.00		0.00	9.86	6340.33	
6	INFIL_POND	Storage Node	6336.00	6339.10	0.00		0.00	37.65	6336.64	
7	NORTH_CULVERT	Storage Node	6337.20	6341.20	0.00		0.00	10.83	6339.98	

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow Design Flo Rat
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)	
1	CENTRAL_CULVERT	Pipe	CENTRAL_CULVERT	SWALE_CONVERGE	74.00	6337.57	6337.17	0.5400	18.000	0.0100	8.47	7.27	1.1
2	FAKE_PIPE	Pipe	SOUTHERN_INLET_FES	INFIL_POND	5.00	6342.50	6337.00	110.0000	10.000	0.0050	8.51	59.75	0.1
3	Link-08	Pipe	3-Jun	INFIL_POND	15.00	6345.00	6336.00	60.0000	40.000	0.0010	0.00	8895.17	0.0
4	NORTHERN_CULVERT	Pipe	NORTH_CULVERT	SWALE_CONVERGE	72.00	6336.78	6336.37	0.5700	24.000	0.0100	9.98	36.19	0.2
5	SOUTHERN_PIPE	Pipe	SOUTHERN_INLET	SOUTHERN_INLET_FES	103.00	6340.80	6339.00	1.7500	18.000	0.0100	8.49	18.05	0.4
6	BYPASS	Channel	SOUTHERN_INLET	3-Jun	5.00	6345.00	6345.00	0.0000	6.000	0.0140	0.00	9.15	0.0
7	Link-07	Channel	INFIL_POND	Out-04	5.00	6339.10	6339.00	2.0000	12.000	0.0320	0.00	648.11	0.0
8	SWALE	Channel	SWALE_CONVERGE	INFIL_POND	129.00	6338.39	6337.65	0.5700	36.000	0.0320	17.74	195.20	0.0

Inlet Summary

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft^2)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	0.00	10.00	8.72	N/A	N/A	N/A	7.00

Subbasin Hydrology

Subbasin : Subbasin_1

Input Data

Area (ac) 7.2
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	7.2	A	0.4
Composite Area & Weighted Runoff Coeff.	7.2		0.4

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	9.9	0	0

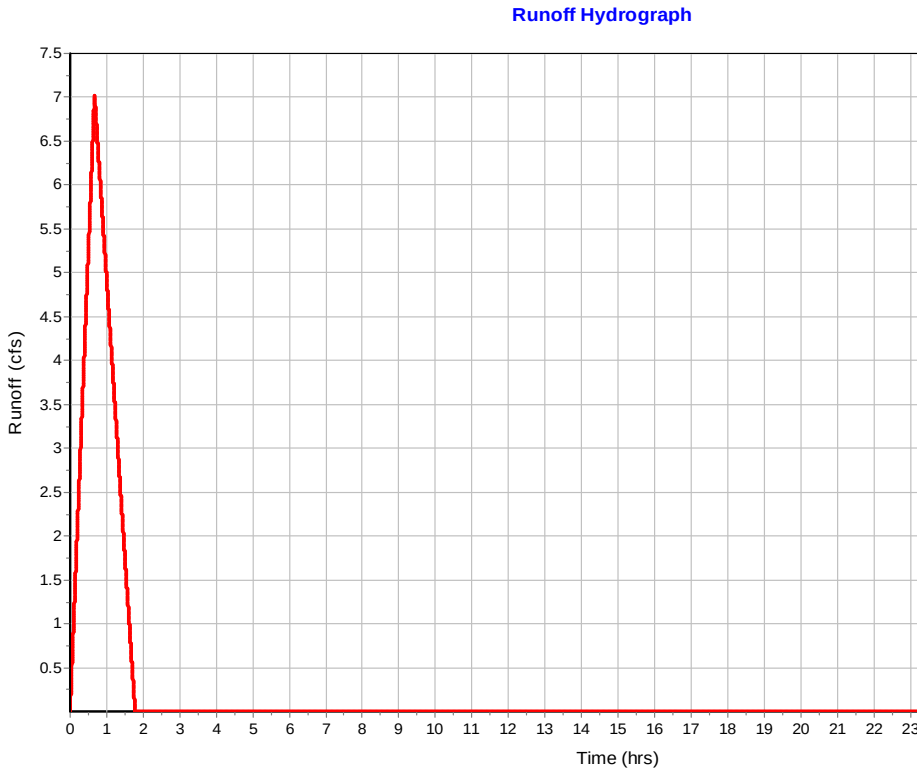
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	696	0	0
Slope (%) :	4.6	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.46	0	0
Computed Flow Time (min) :	3.35	0	0

Total TOC (min) 13.25

Subbasin Runoff Results

Total Rainfall (in)	0.54
Total Runoff (in)	0.22
Peak Runoff (cfs)	7.02
Rainfall Intensity	2.436
Weighted Runoff Coefficient	0.4
Time of Concentration (days hh:mm:ss)	0 00:13:15

Subbasin : Subbasin_1



Subbasin : Subbasin_10

Input Data

Area (ac)	3.23
Weighted Runoff Coefficient	0.9

Runoff Coefficient

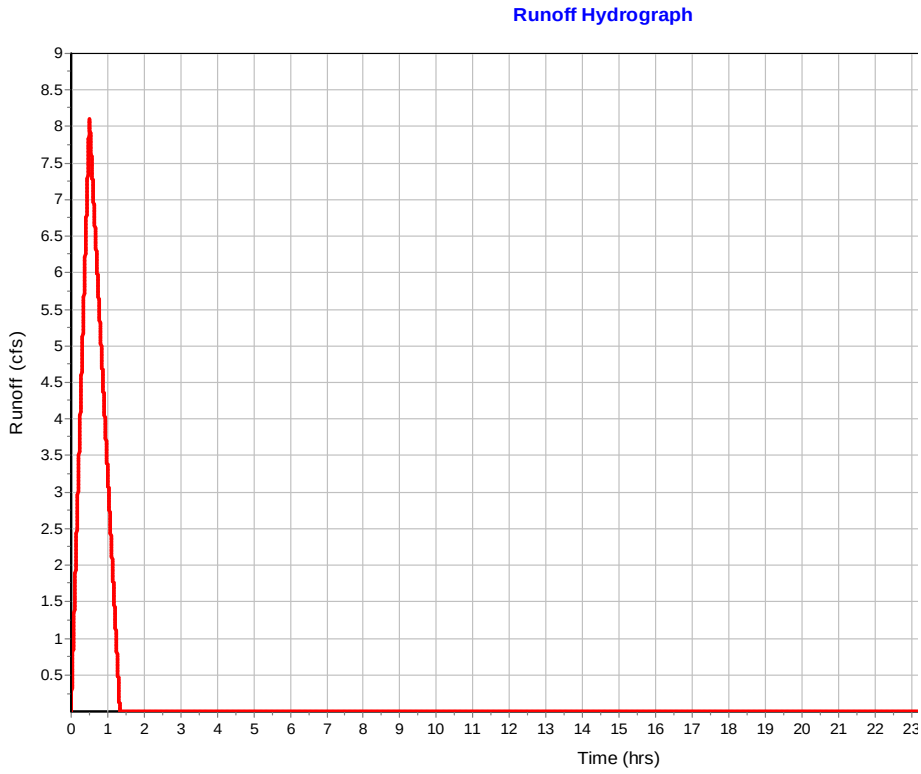
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	3.23	A	0.9
Composite Area & Weighted Runoff Coeff.	3.23		0.9

Time of Concentration

Subbasin Runoff Results

Total Rainfall (in)	0.47
Total Runoff (in)	0.42
Peak Runoff (cfs)	8.1
Rainfall Intensity	2.787
Weighted Runoff Coefficient	0.9
Time of Concentration (days hh:mm:ss)	0 00:00:00

Subbasin : Subbasin_10



Subbasin : Subbasin_2

Input Data

Area (ac) 9.38
Weighted Runoff Coefficient 0.41

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.16	A	0.7
-	9.22	A	0.4
Composite Area & Weighted Runoff Coeff.	9.38		0.41

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

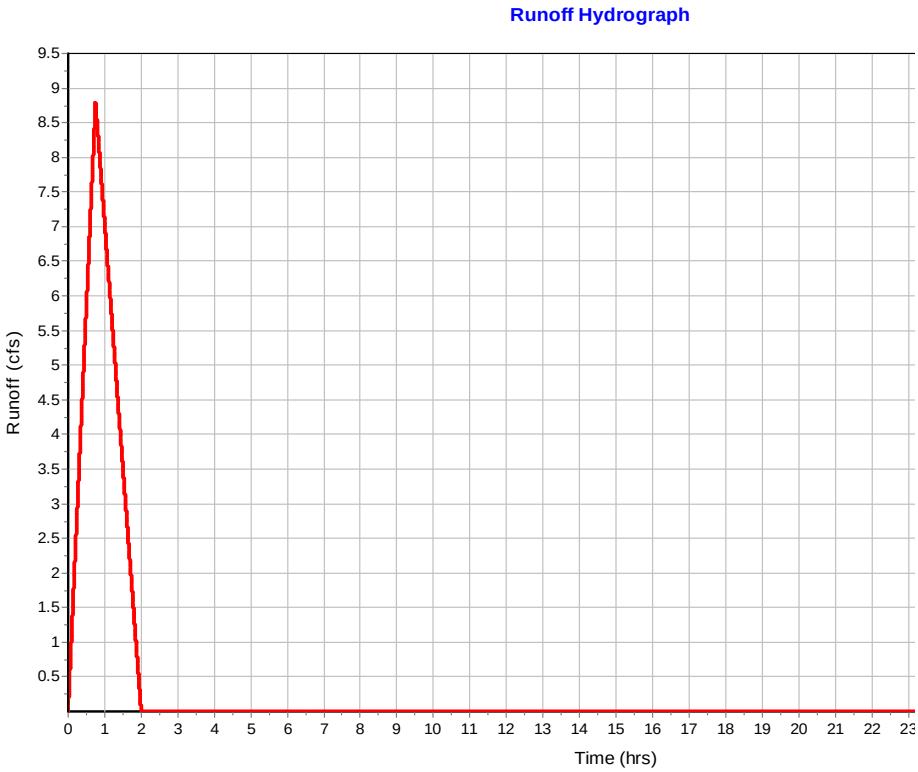
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1278	0	0
Slope (%) :	3.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.1	0	0
Computed Flow Time (min) :	6.87	0	0

Total TOC (min) 14.97

Subbasin Runoff Results

Total Rainfall (in) 0.57
Total Runoff (in) 0.23
Peak Runoff (cfs) 8.79
Rainfall Intensity 2.286
Weighted Runoff Coefficient 0.41
Time of Concentration (days hh:mm:ss) 0 00:14:58

Subbasin : Subbasin_2



Subbasin : Subbasin_3

Input Data

Area (ac) 4.53
Weighted Runoff Coefficient 0.73

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.74	A	0.7
-	1	A	0.4
-	1.79	A	0.95
Composite Area & Weighted Runoff Coeff.	4.53		0.73

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	115	0	0
Slope (%) :	10.8	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.24	0	0
Computed Flow Time (min) :	7.87	0	0

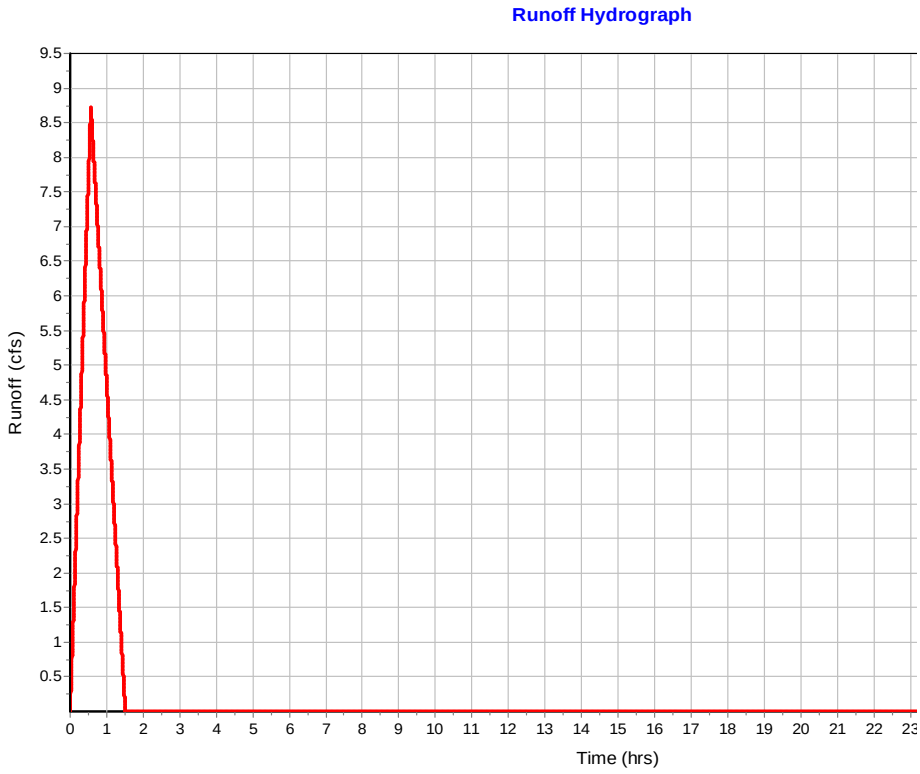
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	820	0	0
Slope (%) :	3.9	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	4.01	0	0
Computed Flow Time (min) :	3.41	0	0

Total TOC (min) 11.28

Subbasin Runoff Results

Total Rainfall (in) 0.5
Total Runoff (in) 0.36
Peak Runoff (cfs) 8.72
Rainfall Intensity 2.636
Weighted Runoff Coefficient 0.73
Time of Concentration (days hh:mm:ss) 0 00:11:17

Subbasin : Subbasin_3



Subbasin : Subbasin_4

Input Data

Area (ac) 3.08
Weighted Runoff Coefficient 0.62

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.62	A	0.7
-	1.55	A	0.4
-	0.91	A	0.95
Composite Area & Weighted Runoff Coeff.	3.08		0.62

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

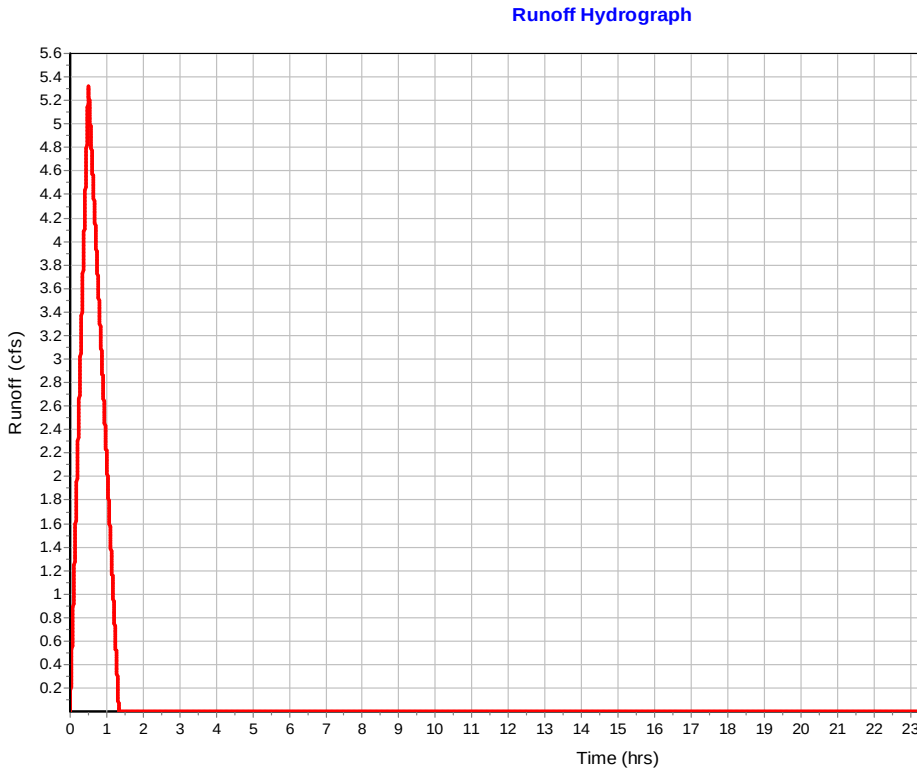
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	103	125	56
Slope (%) :	7.6	3.7	1.8
Surface Type :	Bare & untilled	Unpaved	Paved
Velocity (ft/sec) :	2.76	3.1	2.73
Computed Flow Time (min) :	0.62	0.67	0.34

Total TOC (min) 9.74

Subbasin Runoff Results

Total Rainfall (in) 0.47
Total Runoff (in) 0.29
Peak Runoff (cfs) 5.32
Rainfall Intensity 2.787
Weighted Runoff Coefficient 0.62
Time of Concentration (days hh:mm:ss) 0 00:09:44

Subbasin : Subbasin_4



Subbasin : Subbasin_5

Input Data

Area (ac) 0.93
Weighted Runoff Coefficient 0.58

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.31	A	0.95
-	0.62	A	0.4
Composite Area & Weighted Runoff Coeff.	0.93		0.58

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	5.2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.18	0	0
Computed Flow Time (min) :	9.43	0	0

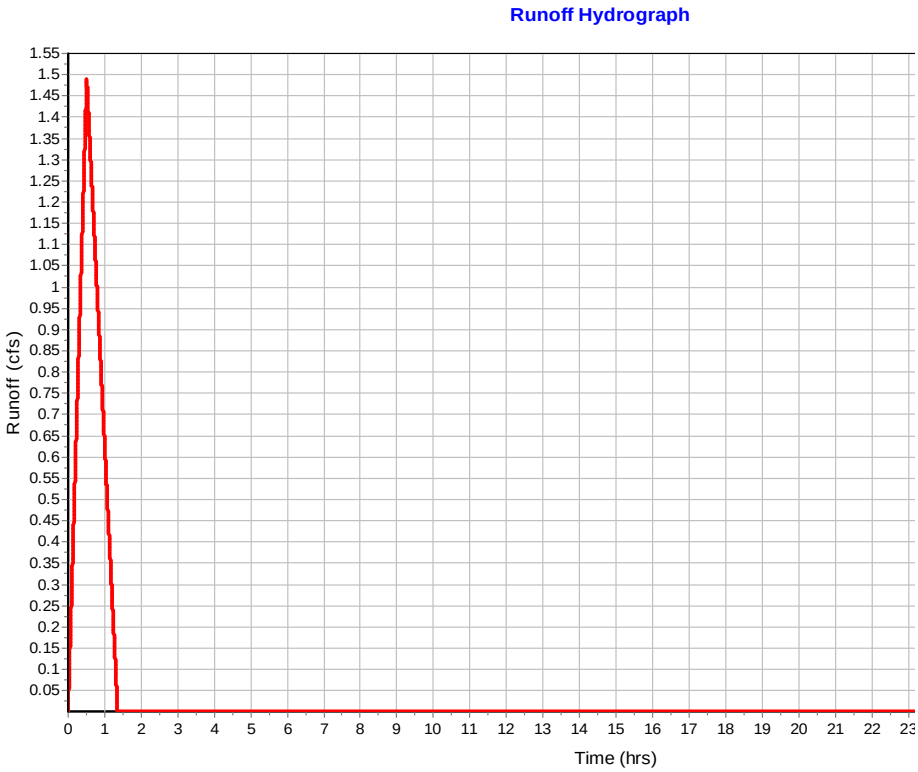
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	174	0	0
Slope (%) :	5.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.68	0	0
Computed Flow Time (min) :	0.79	0	0

Total TOC (min) 10.22

Subbasin Runoff Results

Total Rainfall (in) 0.47
Total Runoff (in) 0.27
Peak Runoff (cfs) 1.49
Rainfall Intensity 2.76
Weighted Runoff Coefficient 0.58
Time of Concentration (days hh:mm:ss) 0 00:10:13

Subbasin : Subbasin_5



Subbasin : Subbasin_6

Input Data

Area (ac) 0.61
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.61	A	0.4
Composite Area & Weighted Runoff Coeff.	0.61		0.4

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.4	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.19	0	0

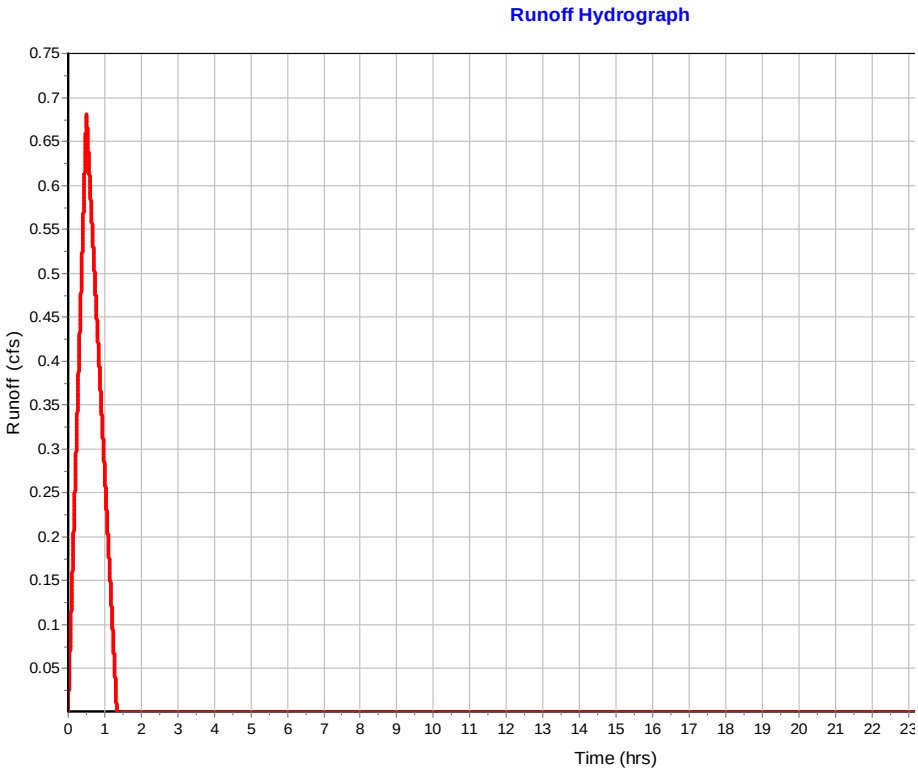
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	131	0	0
Slope (%) :	7.4	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	5.53	0	0
Computed Flow Time (min) :	0.39	0	0

Total TOC (min) 8.58

Subbasin Runoff Results

Total Rainfall (in) 0.47
Total Runoff (in) 0.19
Peak Runoff (cfs) 0.68
Rainfall Intensity 2.787
Weighted Runoff Coefficient 0.4
Time of Concentration (days hh:mm:ss) 0 00:08:35

Subbasin : Subbasin_6



Subbasin : Subbasin_7

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.13	A	0.95
Composite Area & Weighted Runoff Coeff.	0.13		0.95

Time of Concentration

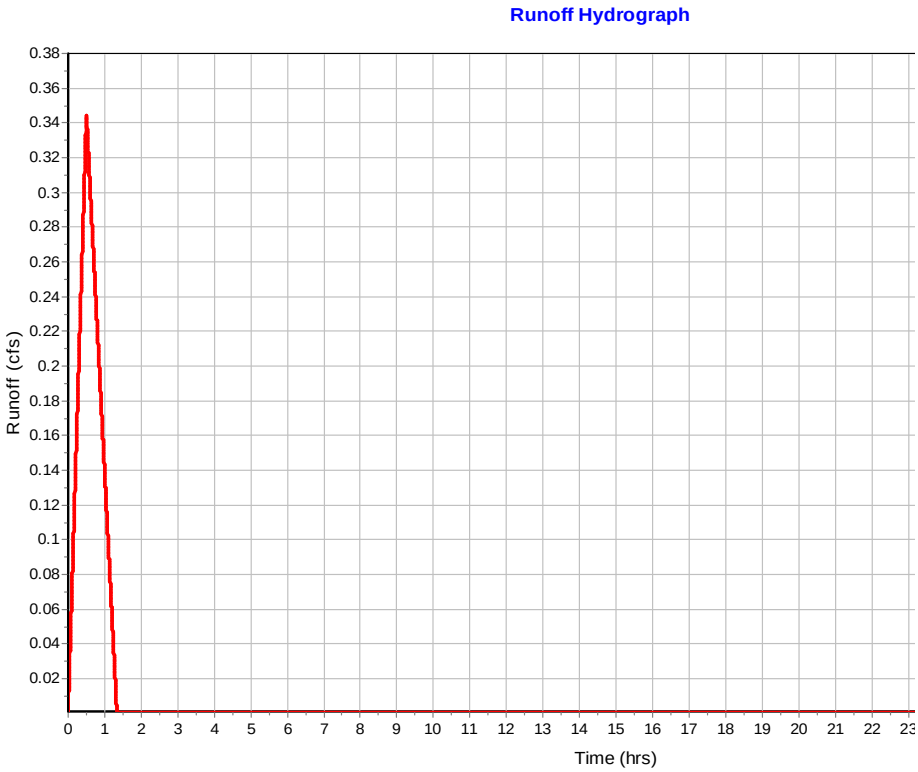
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	264	0	0
Slope (%) :	2	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0	0
Computed Flow Time (min) :	1.53	0	0

Total TOC (min) 1.53

Subbasin Runoff Results

Total Rainfall (in) 0.47
Total Runoff (in) 0.44
Peak Runoff (cfs) 0.34
Rainfall Intensity 2.787
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:01:32

Subbasin : Subbasin_7



Subbasin : Subbasin_8

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.11	A	0.95
Composite Area & Weighted Runoff Coeff.	0.11		0.95

Time of Concentration

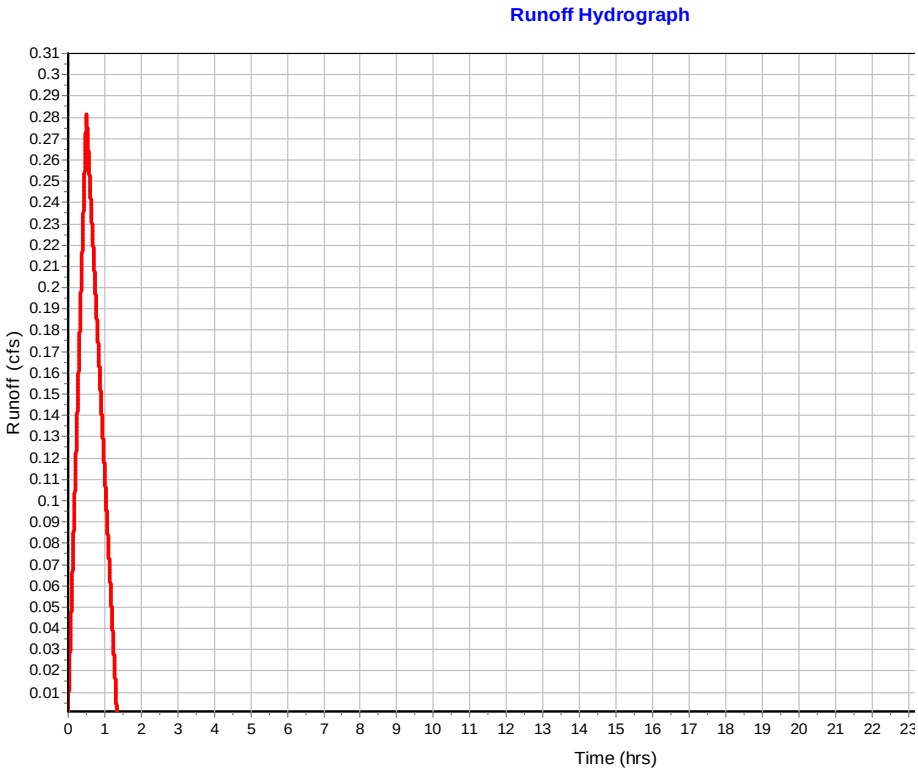
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.015	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.68	0	0
Computed Flow Time (min) :	2.46	0	0

Total TOC (min) 2.46

Subbasin Runoff Results

Total Rainfall (in) 0.47
Total Runoff (in) 0.44
Peak Runoff (cfs) 0.28
Rainfall Intensity 2.787
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:02:28

Subbasin : Subbasin_8



Subbasin : Subbasin_9

Input Data

Area (ac) 1.7
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.7	A	0.95
Composite Area & Weighted Runoff Coeff.	1.7		0.95

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	80	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.14	0	0
Computed Flow Time (min) :	9.83	0	0

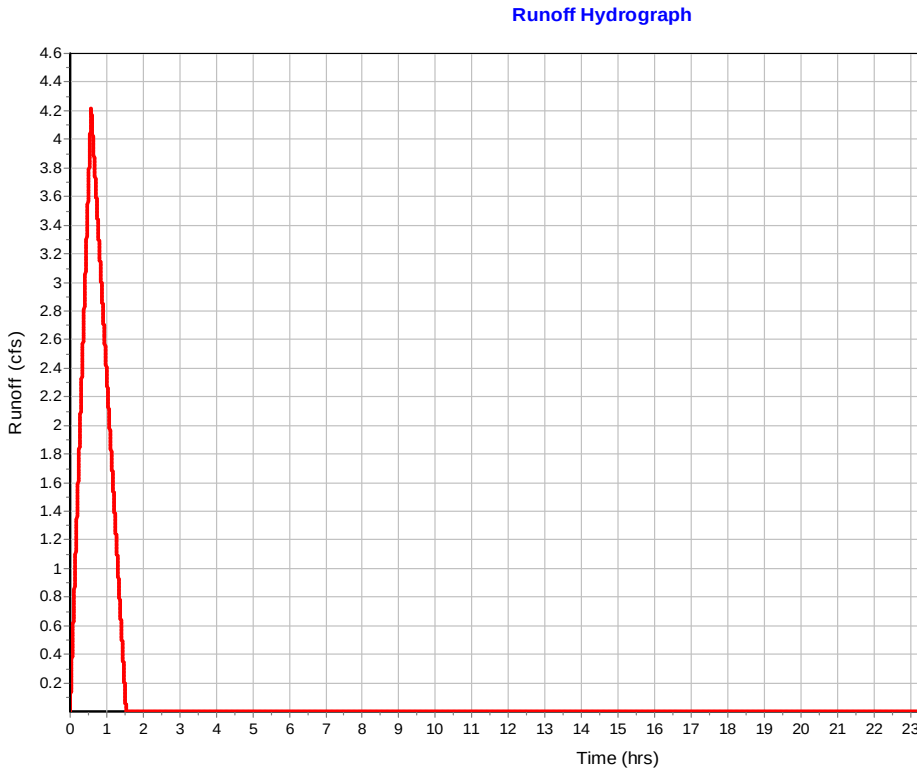
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	300	44	0
Slope (%) :	3	3	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.52	2.79	0
Computed Flow Time (min) :	1.42	0.26	0

Total TOC (min) 11.51

Subbasin Runoff Results

Total Rainfall (in) 0.5
Total Runoff (in) 0.48
Peak Runoff (cfs) 4.22
Rainfall Intensity 2.611
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:11:31

Subbasin : Subbasin_9



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Mini C
1	3-Jun	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
2	SOUTHERN_INLET_FES	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
3	SWALE_CONVERGE	6338.29	6342.29	4.00	0.00	-6338.29	4.00	-6338.29	0.00	1

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Tim Max Occurre (days hh:r
1	3-Jun	0.00	0.00	6339.00	0.00	0.00	9.33	6339.00	0.00	0 0(
2	SOUTHERN_INLET_FES	8.49	0.00	6342.68	3.68	0.00	0.65	6342.48	3.48	0 0(
3	SWALE_CONVERGE	17.74	0.00	6339.46	1.17	0.00	2.83	6338.34	0.05	0 0(

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entran Loss
1	BYPASS	5.00	6345.00	4.20	6345.00	6.00	0.00	0.0000	Rectangular	0.500	20.000	0.0140	0.00
2	Link-07	5.00	6339.10	3.10	6339.00	0.00	0.10	2.0000	Rectangular	1.000	100.000	0.0320	0.00
3	SWALE	129.00	6338.39	0.10	6337.65	1.65	0.74	0.5700	Trapezoidal	3.000	22.000	0.0320	0.50

Channel Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froud Numb
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)	
1	BYPASS	0.00	0 00:00	9.15	0.00	0.00		0.00	0.00	0.00	
2	Link-07	0.00	0 00:00	648.11	0.00	0.00		0.00	0.00	0.00	
3	SWALE	17.74	0 00:44	195.20	0.09	3.00	0.72	0.89	0.30	0.00	

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	F
1	CENTRAL_CULVERT	74.00	6337.57	-0.93	6337.17	-1.12	0.40	0.5400	CIRCULAR	18.000	18.000	
2	FAKE_PIPE	5.00	6342.50	3.50	6337.00	1.00	5.50	110.0000	CIRCULAR	9.960	9.960	
3	Link-08	15.00	6345.00	6.00	6336.00	0.00	9.00	60.0000	CIRCULAR	39.960	39.960	
4	NORTHERN_CULVERT	72.00	6336.78	-0.42	6336.37	-1.92	0.41	0.5700	CIRCULAR	24.000	24.000	
5	SOUTHERN_PIPE	103.00	6340.80	0.00	6339.00	0.00	1.80	1.7500	CIRCULAR	18.000	18.000	

No. of Barrels
1
1
1
1
1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Surcha
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		
1	CENTRAL_CULVERT	8.47	0 00:46	7.27	1.16	5.10	0.24	1.34	0.89	
2	FAKE_PIPE	8.51	0 00:35	59.75	0.14	50.00	0.00	0.20	0.24	
3	Link-08	0.00	0 00:00	8895.17	0.00	0.00		0.32	0.10	
4	NORTHERN_CULVERT	9.98	0 00:40	36.19	0.28	3.75	0.32	1.59	0.79	
5	SOUTHERN_PIPE	8.49	0 00:36	18.05	0.47	6.41	0.27	1.50	1.00	17

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Init Wat Elevati (
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	5.00	0.(

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	SOUTHERN_INLET	N/A	0.0200	0.0160	0.0620	2.00	0.0656	7.00

Inlet Results

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Tim Max D Occurre (days hh:r
1	SOUTHERN_INLET	8.72	8.72	N/A	N/A	N/A	25.06	6346.41	0.61	0 0

Storage Nodes

Storage Node : CENTRAL_CULVERT

Input Data

Invert Elevation (ft)	6338.50
Max (Rim) Elevation (ft)	6342.50
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6338.50
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

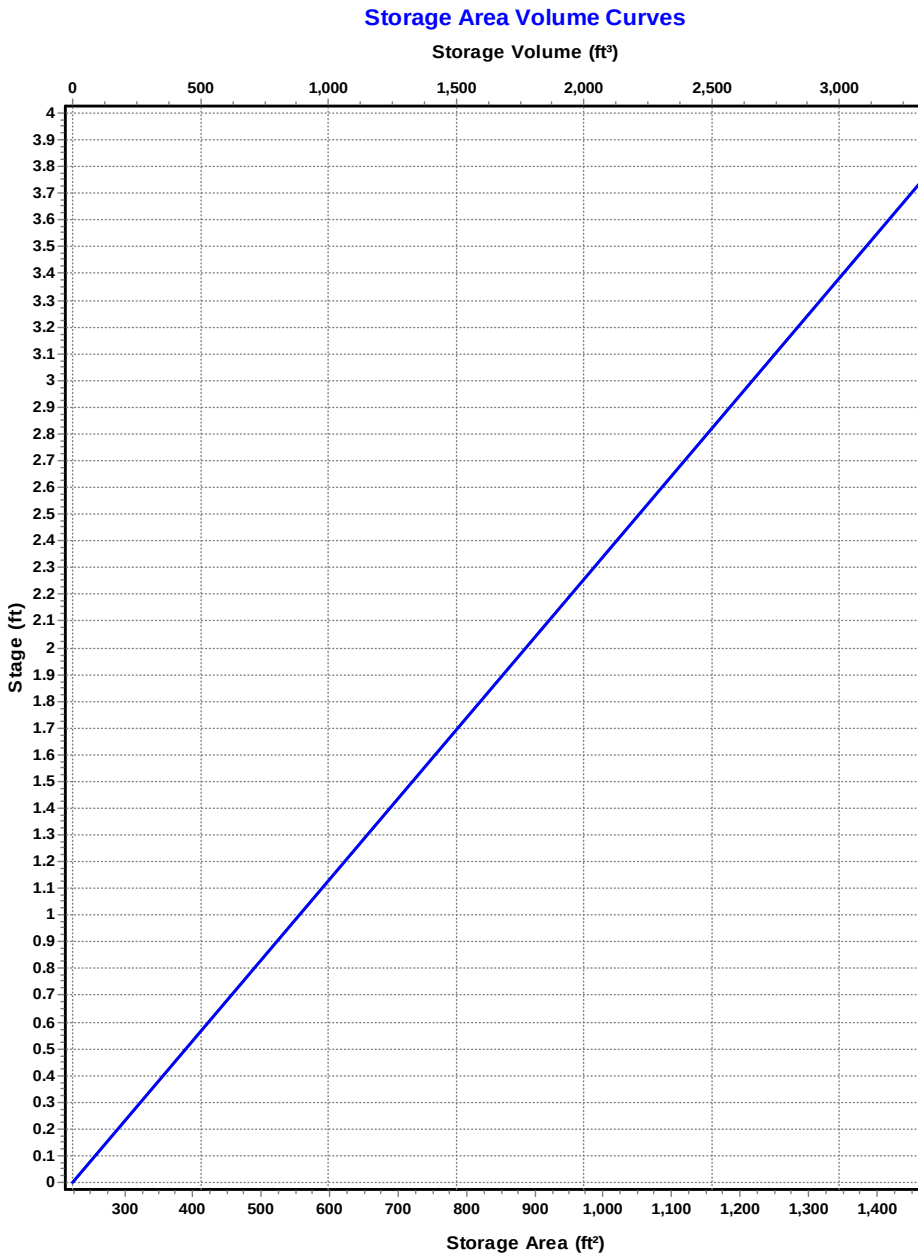
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : CENTRAL CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	224	0
4	1550	3548


Storage Area Volume Curves
Storage Volume (ft³)
0
500
1,000
1,500
2,000
2,500
3,000
Stage (ft)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
1,400
Storage Area (ft²)

Storage Node : CENTRAL_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	9.86
Peak Lateral Inflow (cfs)	9.86
Peak Outflow (cfs)	8.47
Peak Exfiltration Flow Rate (cfm)	70.85
Max HGL Elevation Attained (ft)	6340.33
Max HGL Depth Attained (ft)	1.83
Average HGL Elevation Attained (ft)	6338.57
Average HGL Depth Attained (ft)	0.07
Time of Max HGL Occurrence (days hh:mm)	0 00:46
Total Exfiltration Volume (1000-ft³)	5.964
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : INFIL_POND

Input Data

Invert Elevation (ft)	6336.00
Max (Rim) Elevation (ft)	6339.10
Max (Rim) Offset (ft)	3.10
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6336.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

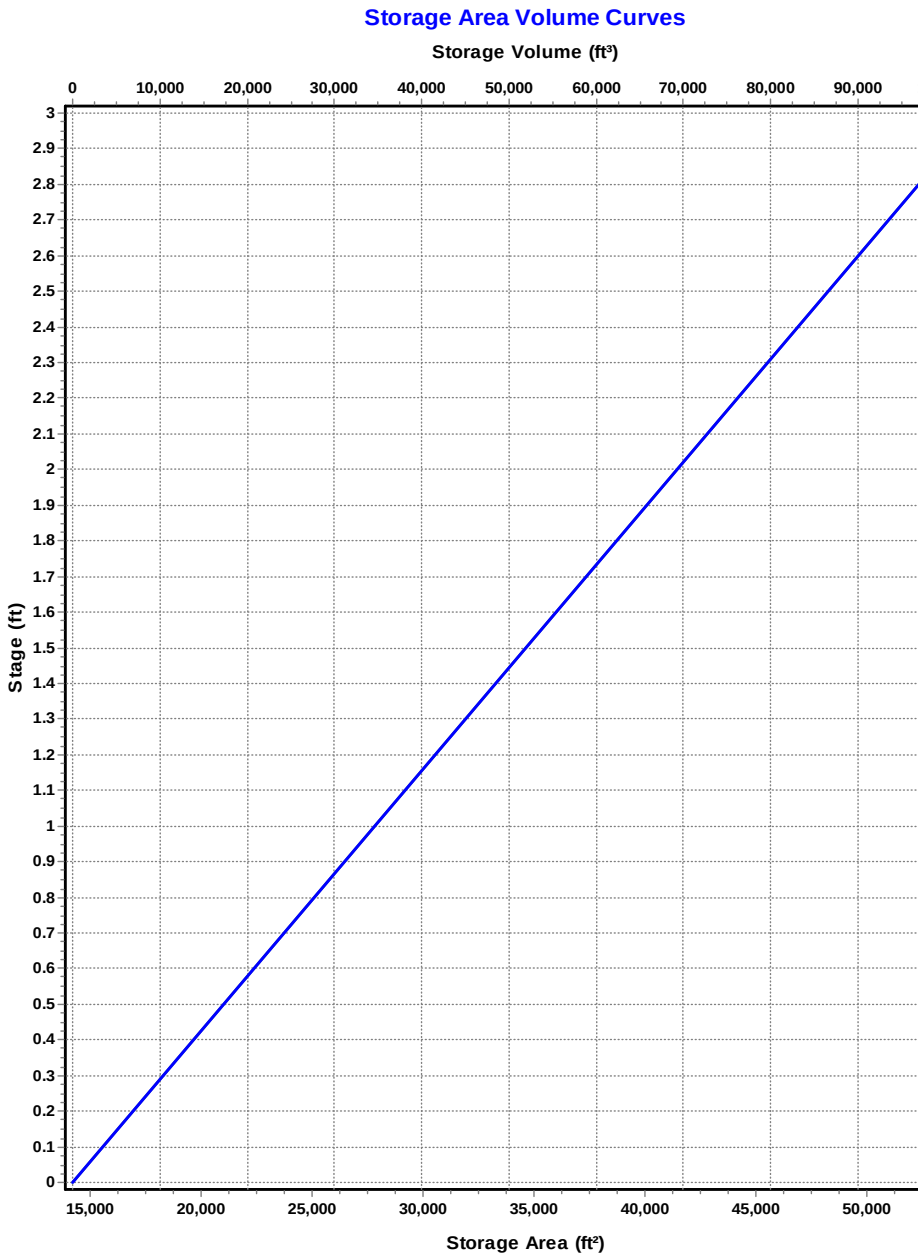
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : INFILTRATION POND

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	14221	0
3	55036	103885.5


Storage Area Volume Curves
Storage Volume (ft³)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
Stage (ft)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
Storage Area (ft²)

Storage Node : INFIL_POND (continued)

Output Summary Results

Peak Inflow (cfs)	37.65
Peak Lateral Inflow (cfs)	14.73
Peak Outflow (cfs)	0
Peak Exfiltration Flow Rate (cfm)	1907.85
Max HGL Elevation Attained (ft)	6336.64
Max HGL Depth Attained (ft)	0.64
Average HGL Elevation Attained (ft)	6336.01
Average HGL Depth Attained (ft)	0.01
Time of Max HGL Occurrence (days hh:mm)	0 00:50
Total Exfiltration Volume (1000-ft³)	114.568
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NORTH_CULVERT

Input Data

Invert Elevation (ft)	6337.20
Max (Rim) Elevation (ft)	6341.20
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6337.20
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Infiltration/Exfiltration

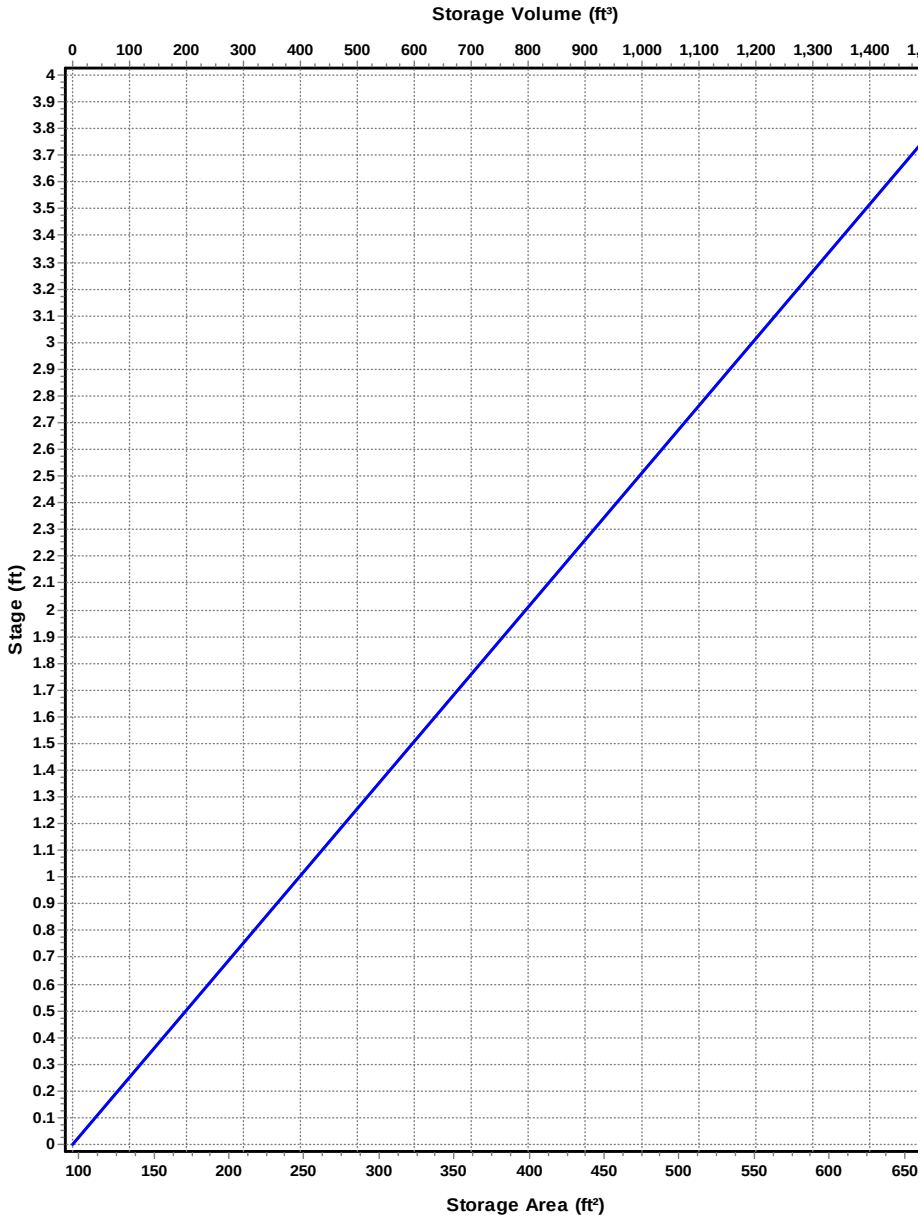
Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : NORTHERN CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	96	0
4	700	1592

Storage Area Volume Curves



Storage Node : NORTH_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	10.83
Peak Lateral Inflow (cfs)	10.83
Peak Outflow (cfs)	9.98
Peak Exfiltration Flow Rate (cfm)	46.16
Max HGL Elevation Attained (ft)	6339.98
Max HGL Depth Attained (ft)	2.78
Average HGL Elevation Attained (ft)	6337.35
Average HGL Depth Attained (ft)	0.15
Time of Max HGL Occurrence (days hh:mm)	0 00:40
Total Exfiltration Volume (1000-ft³)	5.017
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name	ihouse SSA model.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	6:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	5	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	10
Nodes	8
Junctions	3
Outfalls	1
Flow Diversions	0
Inlets	1
Storage Nodes	3
Links	8
Channels	3
Pipes	5
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	50 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Subbasin_1	7.20	0.4000	0.85	0.34	2.45	11.02	0 00:13:15
2	Subbasin_10	3.23	0.9000	0.73	0.66	2.12	12.72	0 00:10:00
3	Subbasin_2	9.38	0.4100	0.90	0.37	3.45	13.81	0 00:14:58
4	Subbasin_3	4.53	0.7300	0.78	0.57	2.59	13.69	0 00:11:16
5	Subbasin_4	3.08	0.6200	0.73	0.45	1.39	8.36	0 00:10:00
6	Subbasin_5	0.93	0.5800	0.73	0.43	0.40	2.34	0 00:10:13
7	Subbasin_6	0.61	0.4000	0.73	0.29	0.18	1.07	0 00:10:00
8	Subbasin_7	0.13	0.9500	0.73	0.69	0.09	0.54	0 00:10:00
9	Subbasin_8	0.11	0.9500	0.73	0.69	0.07	0.44	0 00:10:00
10	Subbasin_9	1.70	0.9500	0.79	0.75	1.27	6.62	0 00:11:30

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	M Surcha Dep Attair
1	3-Jun	Junction	6339.00	6342.00	0.00	6342.00	0.00	0.00	6339.00	0.
2	SOUTHERN_INLET_FES	Junction	6339.00	6342.00	0.00	6342.00	0.00	13.17	6342.82	0.
3	SWALE_CONVERGE	Junction	6338.29	6342.29	0.00	4.00	0.00	28.01	6339.71	0.
4	Out-04	Outfall	6339.00					0.00	6339.00	
5	CENTRAL_CULVERT	Storage Node	6338.50	6342.50	0.00		0.00	15.48	6341.26	
6	INFIL_POND	Storage Node	6336.00	6339.10	0.00		0.00	59.35	6337.38	
7	NORTH_CULVERT	Storage Node	6337.20	6341.20	0.00		0.00	17.01	6340.58	

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow Design Flo Rat
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)	
1	CENTRAL_CULVERT	Pipe	CENTRAL_CULVERT	SWALE_CONVERGE	74.00	6337.57	6337.17	0.5400	18.000	0.0100	13.21	7.27	1.8
2	FAKE_PIPE	Pipe	SOUTHERN_INLET_FES	INFIL_POND	5.00	6342.50	6337.00	110.0000	10.000	0.0050	14.23	59.75	0.2
3	Link-08	Pipe	3-Jun	INFIL_POND	15.00	6345.00	6336.00	60.0000	40.000	0.0010	0.00	8895.17	0.0
4	NORTHERN_CULVERT	Pipe	NORTH_CULVERT	SWALE_CONVERGE	72.00	6336.78	6336.37	0.5700	24.000	0.0100	15.97	36.19	0.4
5	SOUTHERN_PIPE	Pipe	SOUTHERN_INLET	SOUTHERN_INLET_FES	103.00	6340.80	6339.00	1.7500	18.000	0.0100	13.17	18.05	0.7
6	BYPASS	Channel	SOUTHERN_INLET	3-Jun	5.00	6345.00	6345.00	0.0000	6.000	0.0140	0.00	9.15	0.0
7	Link-07	Channel	INFIL_POND	Out-04	5.00	6339.10	6339.00	2.0000	12.000	0.0320	0.00	648.11	0.0
8	SWALE	Channel	SWALE_CONVERGE	INFIL_POND	129.00	6338.39	6337.65	0.5700	36.000	0.0320	27.99	195.20	0.1

Inlet Summary

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft^2)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	0.00	10.00	13.69	N/A	N/A	N/A	7.00

Subbasin Hydrology

Subbasin : Subbasin_1

Input Data

Area (ac) 7.2
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	7.2	A	0.4
Composite Area & Weighted Runoff Coeff.	7.2		0.4

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	9.9	0	0

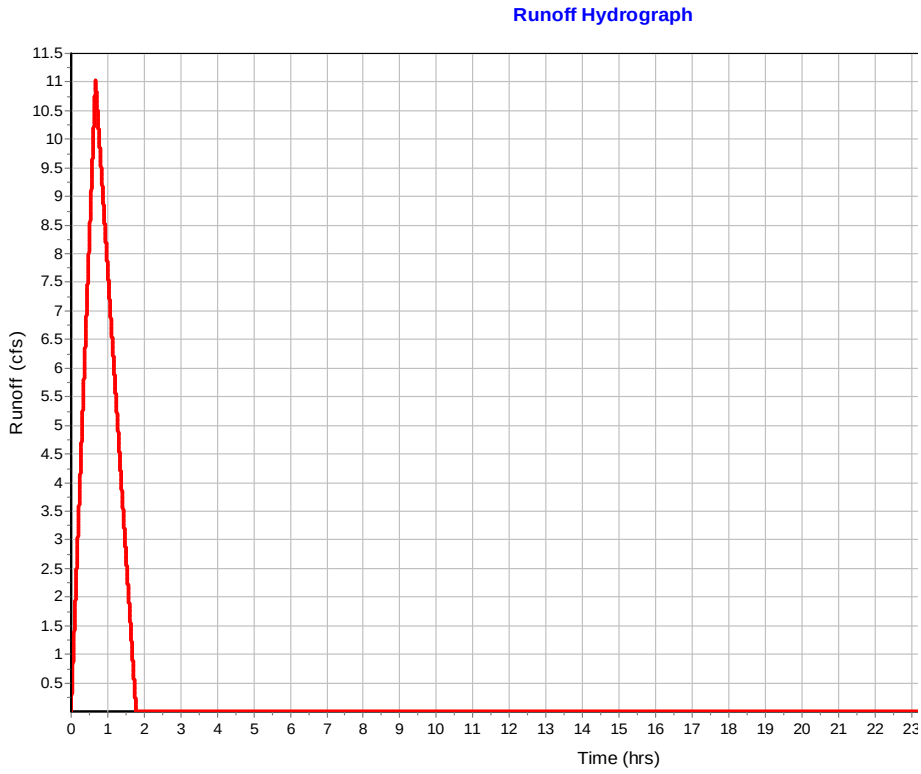
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	696	0	0
Slope (%) :	4.6	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.46	0	0
Computed Flow Time (min) :	3.35	0	0

Total TOC (min) 13.25

Subbasin Runoff Results

Total Rainfall (in)	0.85
Total Runoff (in)	0.34
Peak Runoff (cfs)	11.02
Rainfall Intensity	3.826
Weighted Runoff Coefficient	0.4
Time of Concentration (days hh:mm:ss)	0 00:13:15

Subbasin : Subbasin_1



Subbasin : Subbasin_10

Input Data

Area (ac)	3.23
Weighted Runoff Coefficient	0.9

Runoff Coefficient

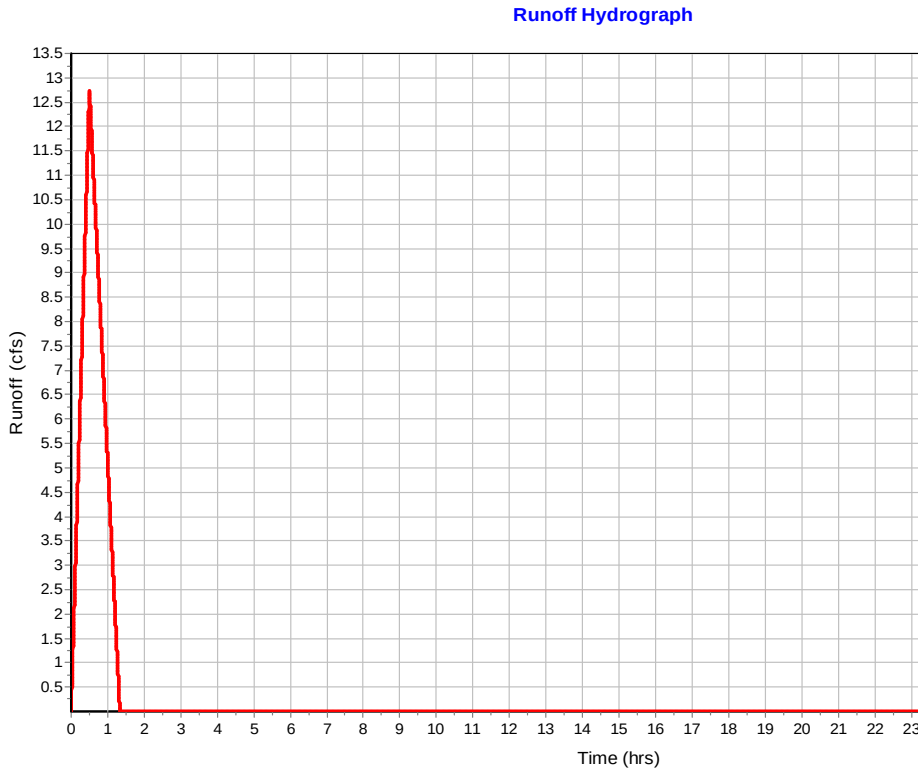
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	3.23	A	0.9
Composite Area & Weighted Runoff Coeff.	3.23		0.9

Time of Concentration

Subbasin Runoff Results

Total Rainfall (in)	0.73
Total Runoff (in)	0.66
Peak Runoff (cfs)	12.72
Rainfall Intensity	4.377
Weighted Runoff Coefficient	0.9
Time of Concentration (days hh:mm:ss)	0 00:00:00

Subbasin : Subbasin_10



Subbasin : Subbasin_2

Input Data

Area (ac) 9.38
Weighted Runoff Coefficient 0.41

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.16	A	0.7
-	9.22	A	0.4
Composite Area & Weighted Runoff Coeff.	9.38		0.41

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

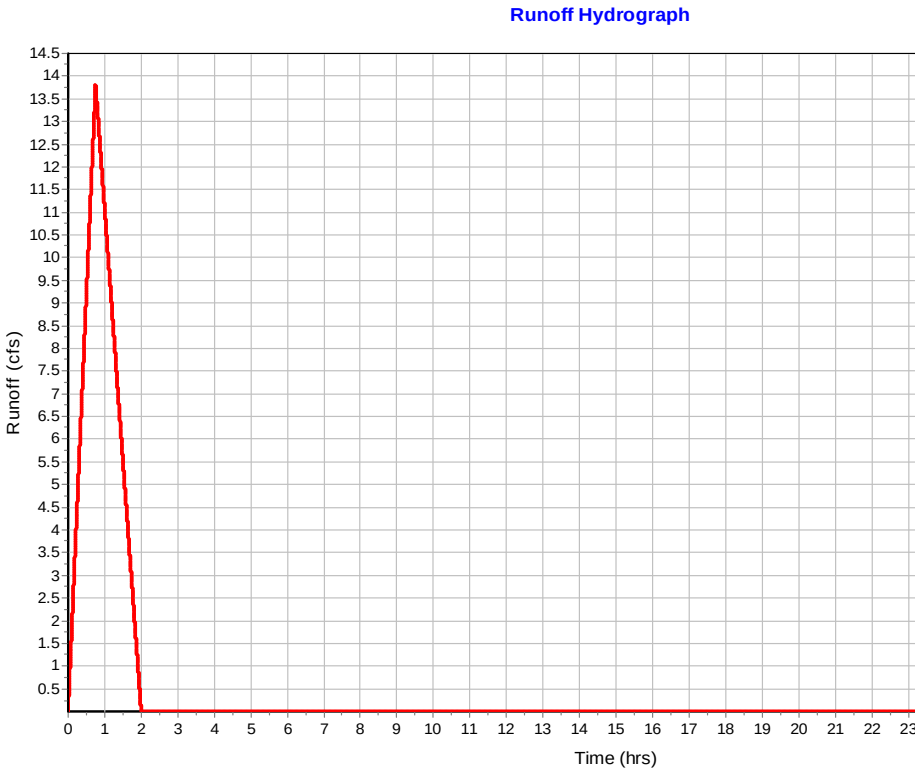
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1278	0	0
Slope (%) :	3.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.1	0	0
Computed Flow Time (min) :	6.87	0	0

Total TOC (min) 14.97

Subbasin Runoff Results

Total Rainfall (in) 0.9
Total Runoff (in) 0.37
Peak Runoff (cfs) 13.81
Rainfall Intensity 3.591
Weighted Runoff Coefficient 0.41
Time of Concentration (days hh:mm:ss) 0 00:14:58

Subbasin : Subbasin_2



Subbasin : Subbasin_3

Input Data

Area (ac) 4.53
Weighted Runoff Coefficient 0.73

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.74	A	0.7
-	1	A	0.4
-	1.79	A	0.95
Composite Area & Weighted Runoff Coeff.	4.53		0.73

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	115	0	0
Slope (%) :	10.8	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.24	0	0
Computed Flow Time (min) :	7.87	0	0

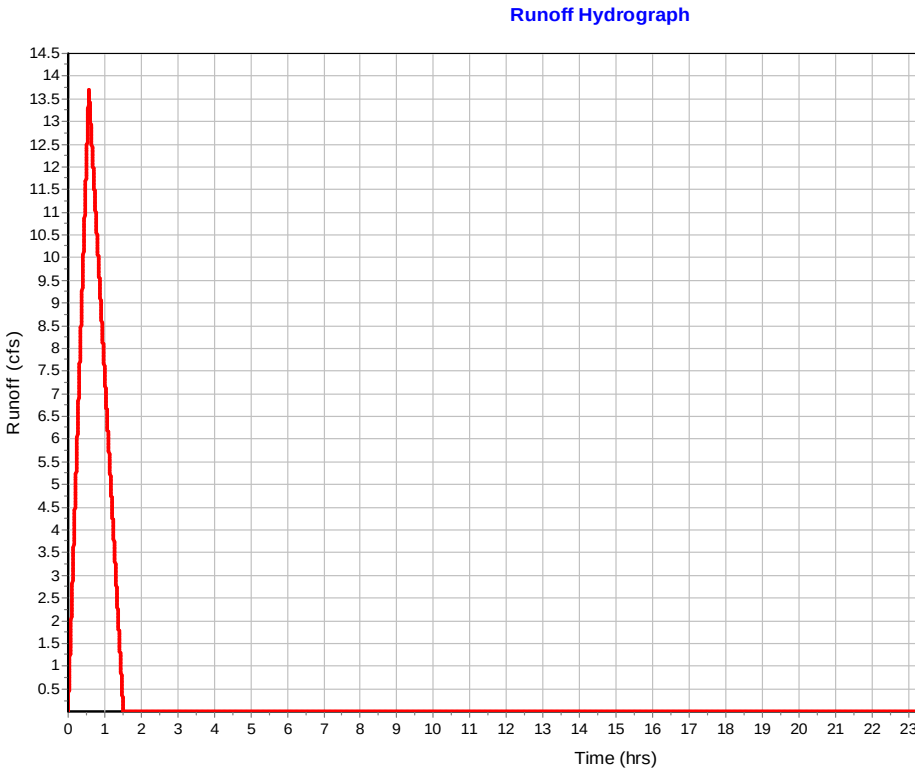
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	820	0	0
Slope (%) :	3.9	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	4.01	0	0
Computed Flow Time (min) :	3.41	0	0

Total TOC (min) 11.28

Subbasin Runoff Results

Total Rainfall (in) 0.78
Total Runoff (in) 0.57
Peak Runoff (cfs) 13.69
Rainfall Intensity 4.141
Weighted Runoff Coefficient 0.73
Time of Concentration (days hh:mm:ss) 0 00:11:17

Subbasin : Subbasin_3



Subbasin : Subbasin_4

Input Data

Area (ac) 3.08
Weighted Runoff Coefficient 0.62

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.62	A	0.7
-	1.55	A	0.4
-	0.91	A	0.95
Composite Area & Weighted Runoff Coeff.	3.08		0.62

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

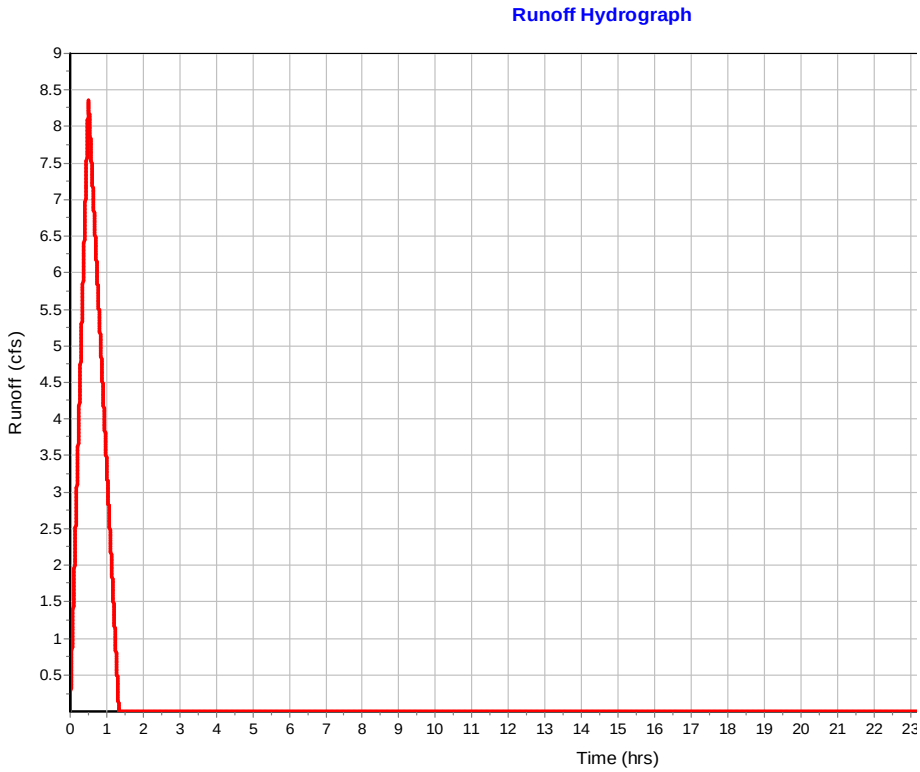
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	103	125	56
Slope (%) :	7.6	3.7	1.8
Surface Type :	Bare & untilled	Unpaved	Paved
Velocity (ft/sec) :	2.76	3.1	2.73
Computed Flow Time (min) :	0.62	0.67	0.34

Total TOC (min) 9.74

Subbasin Runoff Results

Total Rainfall (in) 0.73
Total Runoff (in) 0.45
Peak Runoff (cfs) 8.36
Rainfall Intensity 4.377
Weighted Runoff Coefficient 0.62
Time of Concentration (days hh:mm:ss) 0 00:09:44

Subbasin : Subbasin_4



Subbasin : Subbasin_5

Input Data

Area (ac) 0.93
Weighted Runoff Coefficient 0.58

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.31	A	0.95
-	0.62	A	0.4
Composite Area & Weighted Runoff Coeff.	0.93		0.58

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	5.2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.18	0	0
Computed Flow Time (min) :	9.43	0	0

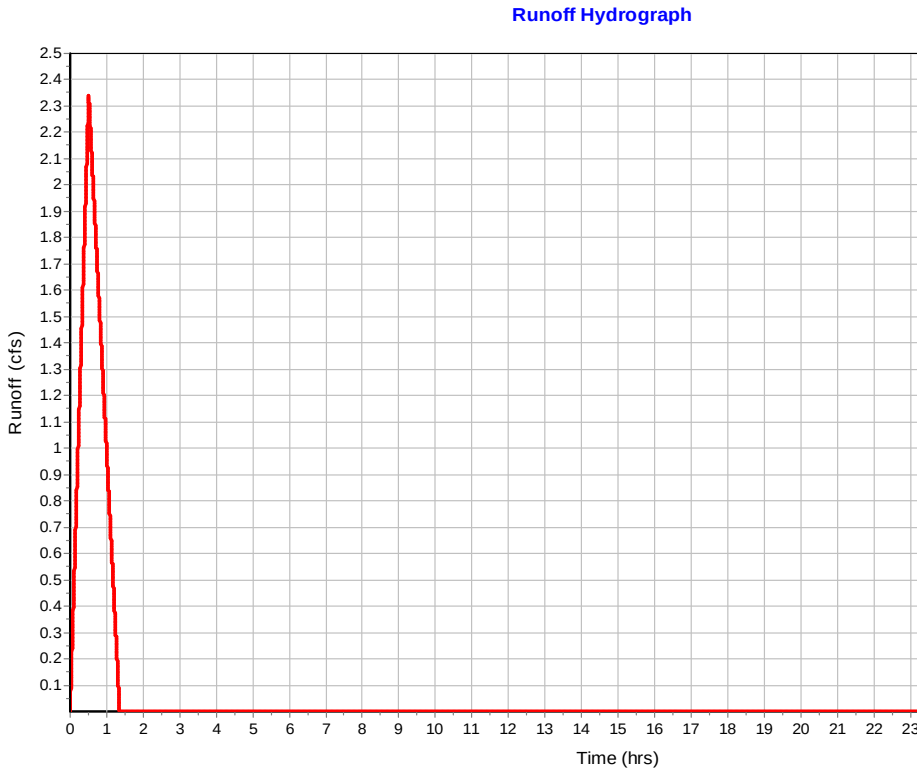
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	174	0	0
Slope (%) :	5.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.68	0	0
Computed Flow Time (min) :	0.79	0	0

Total TOC (min) 10.22

Subbasin Runoff Results

Total Rainfall (in) 0.73
Total Runoff (in) 0.43
Peak Runoff (cfs) 2.34
Rainfall Intensity 4.334
Weighted Runoff Coefficient 0.58
Time of Concentration (days hh:mm:ss) 0 00:10:13

Subbasin : Subbasin_5



Subbasin : Subbasin_6

Input Data

Area (ac) 0.61
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.61	A	0.4
Composite Area & Weighted Runoff Coeff.	0.61		0.4

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.4	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.19	0	0

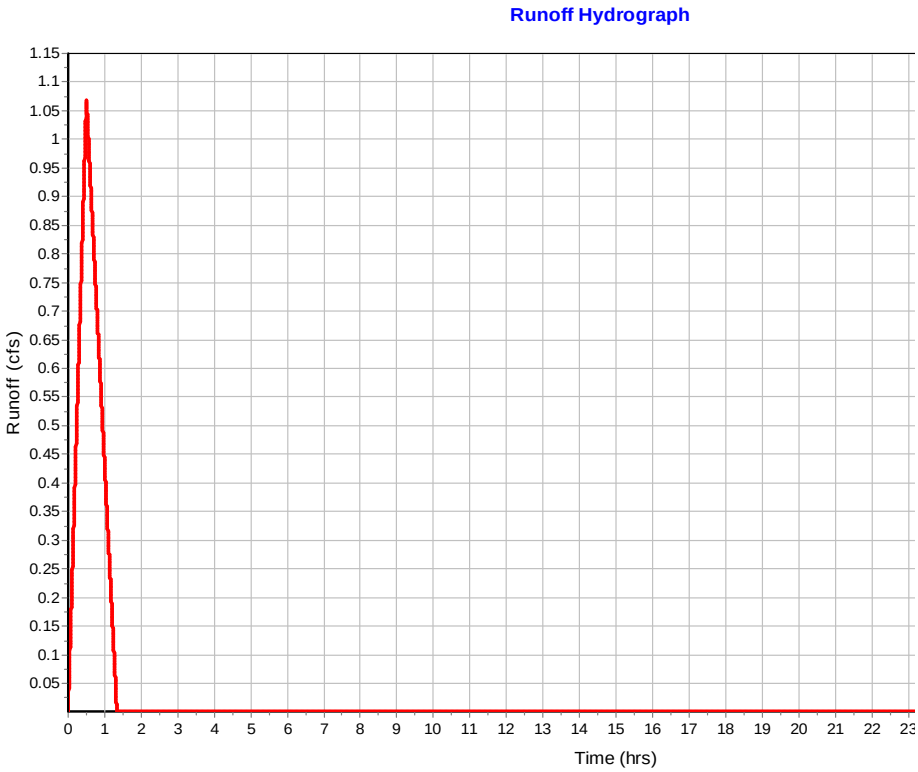
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	131	0	0
Slope (%) :	7.4	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	5.53	0	0
Computed Flow Time (min) :	0.39	0	0

Total TOC (min) 8.58

Subbasin Runoff Results

Total Rainfall (in) 0.73
Total Runoff (in) 0.29
Peak Runoff (cfs) 1.07
Rainfall Intensity 4.377
Weighted Runoff Coefficient 0.4
Time of Concentration (days hh:mm:ss) 0 00:08:35

Subbasin : Subbasin_6



Subbasin : Subbasin_7

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.13	A	0.95
Composite Area & Weighted Runoff Coeff.	0.13		0.95

Time of Concentration

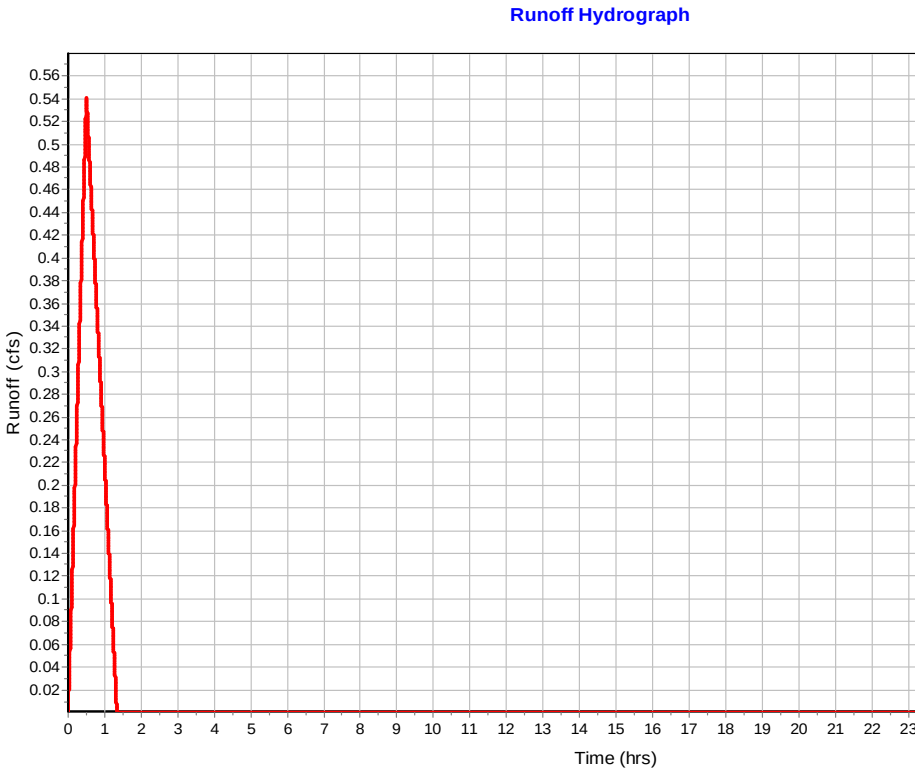
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	264	0	0
Slope (%) :	2	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0	0
Computed Flow Time (min) :	1.53	0	0

Total TOC (min) 1.53

Subbasin Runoff Results

Total Rainfall (in) 0.73
Total Runoff (in) 0.69
Peak Runoff (cfs) 0.54
Rainfall Intensity 4.377
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:01:32

Subbasin : Subbasin_7



Subbasin : Subbasin_8

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.11	A	0.95
Composite Area & Weighted Runoff Coeff.	0.11		0.95

Time of Concentration

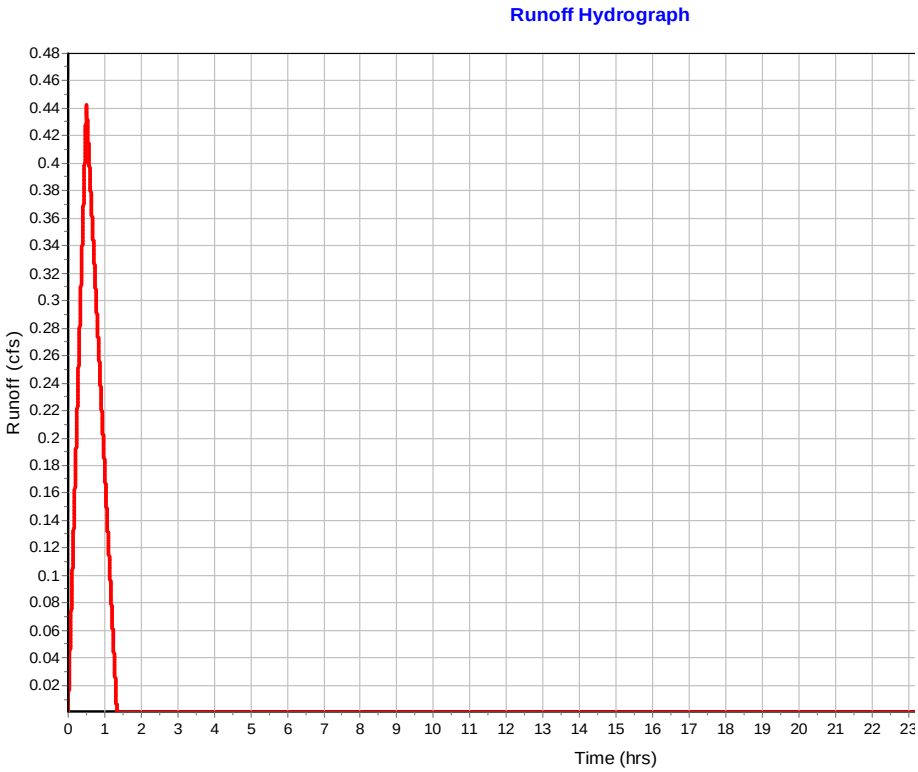
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.015	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.68	0	0
Computed Flow Time (min) :	2.46	0	0

Total TOC (min) 2.46

Subbasin Runoff Results

Total Rainfall (in) 0.73
Total Runoff (in) 0.69
Peak Runoff (cfs) 0.44
Rainfall Intensity 4.377
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:02:28

Subbasin : Subbasin_8



Subbasin : Subbasin_9

Input Data

Area (ac) 1.7
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.7	A	0.95
Composite Area & Weighted Runoff Coeff.	1.7		0.95

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	80	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.14	0	0
Computed Flow Time (min) :	9.83	0	0

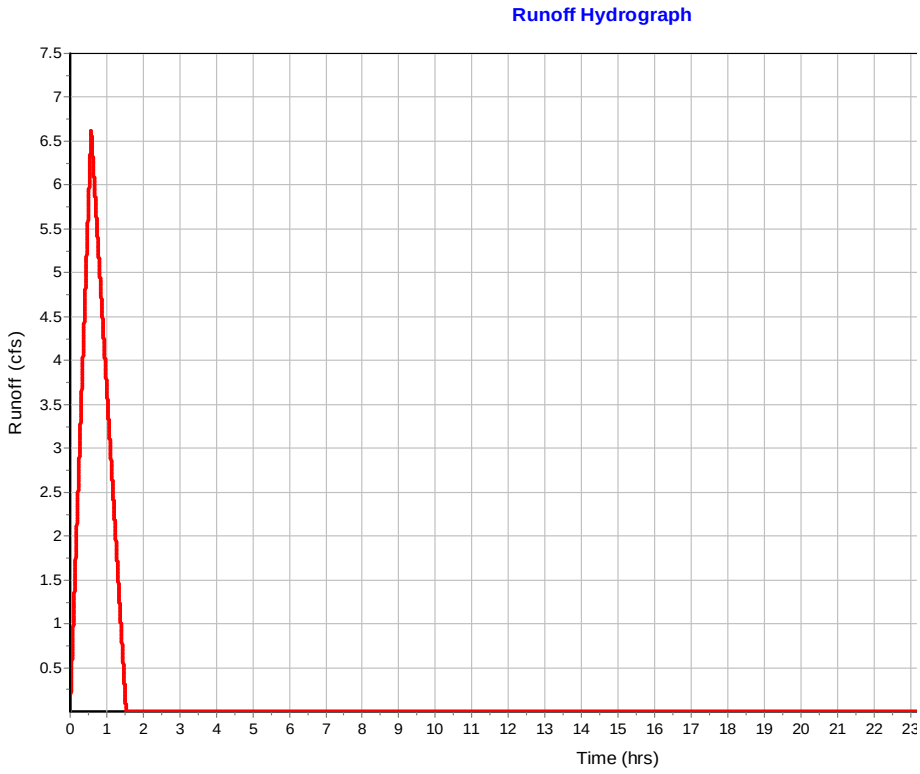
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	300	44	0
Slope (%) :	3	3	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.52	2.79	0
Computed Flow Time (min) :	1.42	0.26	0

Total TOC (min) 11.51

Subbasin Runoff Results

Total Rainfall (in) 0.79
Total Runoff (in) 0.75
Peak Runoff (cfs) 6.62
Rainfall Intensity 4.101
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:11:31

Subbasin : Subbasin_9



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Mini C
1	3-Jun	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
2	SOUTHERN_INLET_FES	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
3	SWALE_CONVERGE	6338.29	6342.29	4.00	0.00	-6338.29	4.00	-6338.29	0.00	1

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Tim Max Occurre (days hh:r
1	3-Jun	0.00	0.00	6339.00	0.00	0.00	9.33	6339.00	0.00	0 0(
2	SOUTHERN_INLET_FES	13.17	0.00	6342.82	3.82	0.00	0.52	6342.49	3.49	0 0(
3	SWALE_CONVERGE	28.01	0.00	6339.71	1.42	0.00	2.58	6338.36	0.07	0 0(

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entran Loss
1	BYPASS	5.00	6345.00	4.20	6345.00	6.00	0.00	0.0000	Rectangular	0.500	20.000	0.0140	0.00
2	Link-07	5.00	6339.10	3.10	6339.00	0.00	0.10	2.0000	Rectangular	1.000	100.000	0.0320	0.00
3	SWALE	129.00	6338.39	0.10	6337.65	1.65	0.74	0.5700	Trapezoidal	3.000	22.000	0.0320	0.50

Channel Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froud Numb
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)	
1	BYPASS	0.00	0 00:00	9.15	0.00	0.00		0.00	0.00	0.00	
2	Link-07	0.00	0 00:00	648.11	0.00	0.00		0.00	0.00	0.00	
3	SWALE	27.99	0 00:43	195.20	0.14	3.41	0.63	1.12	0.37	0.00	

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	F
1	CENTRAL_CULVERT	74.00	6337.57	-0.93	6337.17	-1.12	0.40	0.5400	CIRCULAR	18.000	18.000	
2	FAKE_PIPE	5.00	6342.50	3.50	6337.00	1.00	5.50	110.0000	CIRCULAR	9.960	9.960	
3	Link-08	15.00	6345.00	6.00	6336.00	0.00	9.00	60.0000	CIRCULAR	39.960	39.960	
4	NORTHERN_CULVERT	72.00	6336.78	-0.42	6336.37	-1.92	0.41	0.5700	CIRCULAR	24.000	24.000	
5	SOUTHERN_PIPE	103.00	6340.80	0.00	6339.00	0.00	1.80	1.7500	CIRCULAR	18.000	18.000	

No. of Barrels
1
1
1
1
1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Tota Surch
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		
1	CENTRAL_CULVERT	13.21	0 00:48	7.27	1.82	7.54	0.16	1.46	0.97	
2	FAKE_PIPE	14.23	0 00:45	59.75	0.24	50.00	0.00	0.30	0.36	
3	Link-08	0.00	0 00:00	8895.17	0.00	0.00		0.69	0.21	
4	NORTHERN_CULVERT	15.97	0 00:40	36.19	0.44	5.59	0.21	1.71	0.86	
5	SOUTHERN_PIPE	13.17	0 00:36	18.05	0.73	7.45	0.23	1.50	1.00	17

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Init Wat Elevati (
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	5.00	0.(

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	SOUTHERN_INLET	N/A	0.0200	0.0160	0.0620	2.00	0.0656	7.00

Inlet Results

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Ti Max I Occur (days hh
1	SOUTHERN_INLET	13.69	13.69	N/A	N/A	N/A	30.19	6346.51	0.71	0

Storage Nodes

Storage Node : CENTRAL_CULVERT

Input Data

Invert Elevation (ft)	6338.50
Max (Rim) Elevation (ft)	6342.50
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6338.50
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

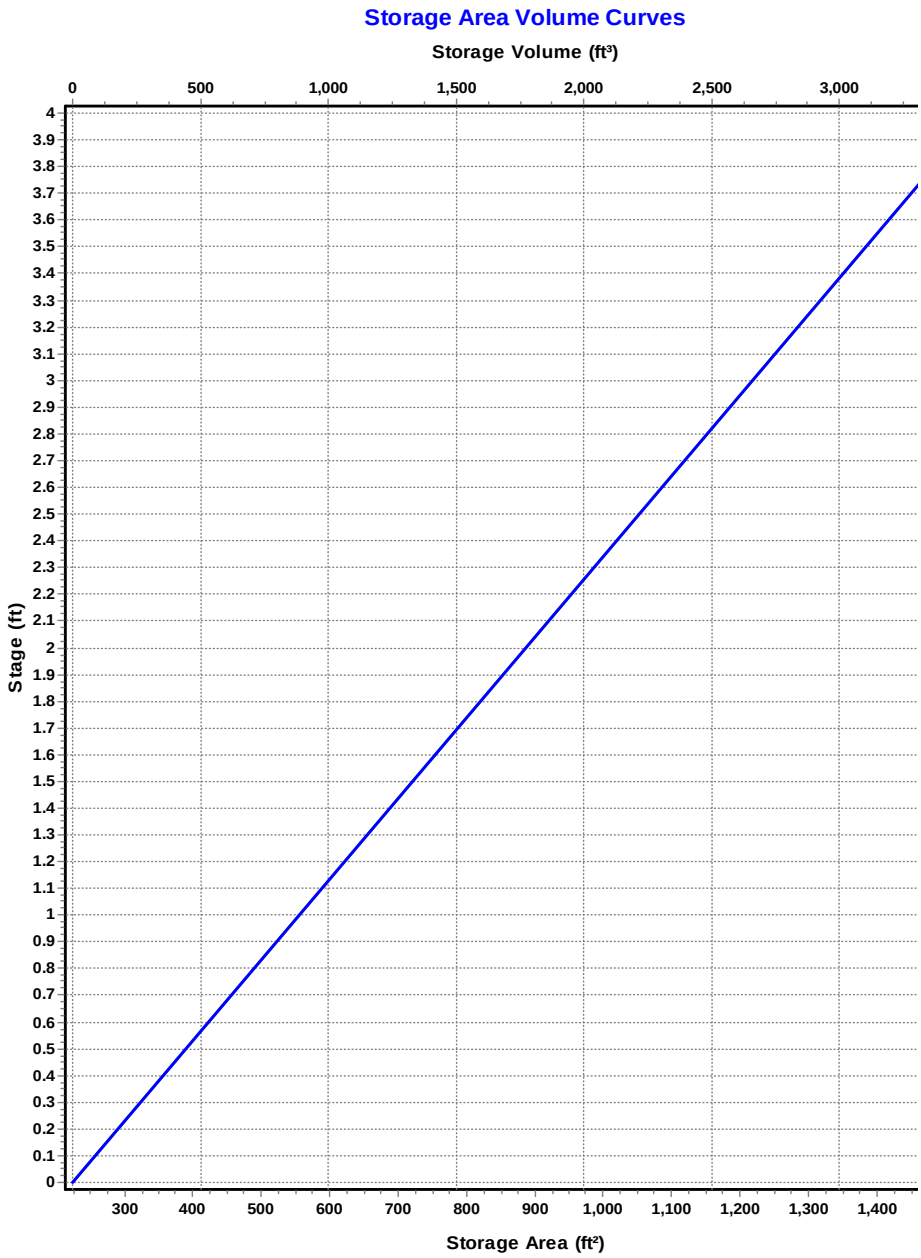
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : CENTRAL CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	224	0
4	1550	3548


Storage Area Volume Curves
Storage Volume (ft³)
0
500
1,000
1,500
2,000
2,500
3,000
Stage (ft)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
1,400
Storage Area (ft²)

Storage Node : CENTRAL_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	15.48
Peak Lateral Inflow (cfs)	15.48
Peak Outflow (cfs)	13.21
Peak Exfiltration Flow Rate (cfm)	98.05
Max HGL Elevation Attained (ft)	6341.26
Max HGL Depth Attained (ft)	2.76
Average HGL Elevation Attained (ft)	6338.61
Average HGL Depth Attained (ft)	0.11
Time of Max HGL Occurrence (days hh:mm)	0 00:47
Total Exfiltration Volume (1000-ft³)	7.549
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : INFIL_POND

Input Data

Invert Elevation (ft)	6336.00
Max (Rim) Elevation (ft)	6339.10
Max (Rim) Offset (ft)	3.10
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6336.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

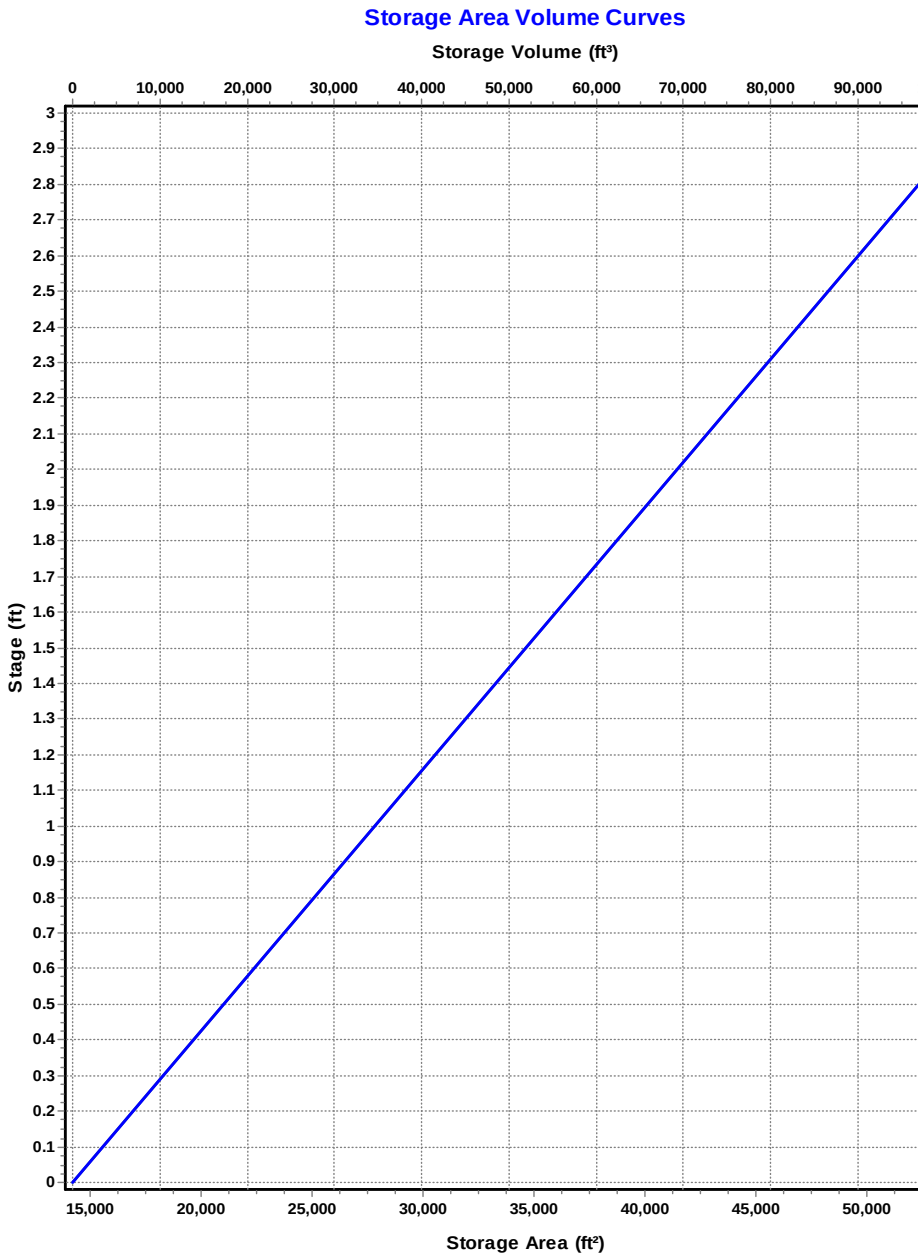
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : INFILTRATION POND

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	14221	0
3	55036	103885.5


Storage Area Volume Curves
Storage Volume (ft³)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
Stage (ft)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
Storage Area (ft²)

Storage Node : INFIL_POND (continued)

Output Summary Results

Peak Inflow (cfs)	59.35
Peak Lateral Inflow (cfs)	23.13
Peak Outflow (cfs)	0
Peak Exfiltration Flow Rate (cfm)	2748.21
Max HGL Elevation Attained (ft)	6337.38
Max HGL Depth Attained (ft)	1.38
Average HGL Elevation Attained (ft)	6336.04
Average HGL Depth Attained (ft)	0.04
Time of Max HGL Occurrence (days hh:mm)	0 00:55
Total Exfiltration Volume (1000-ft³)	185.715
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NORTH_CULVERT

Input Data

Invert Elevation (ft)	6337.20
Max (Rim) Elevation (ft)	6341.20
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6337.20
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Infiltration/Exfiltration

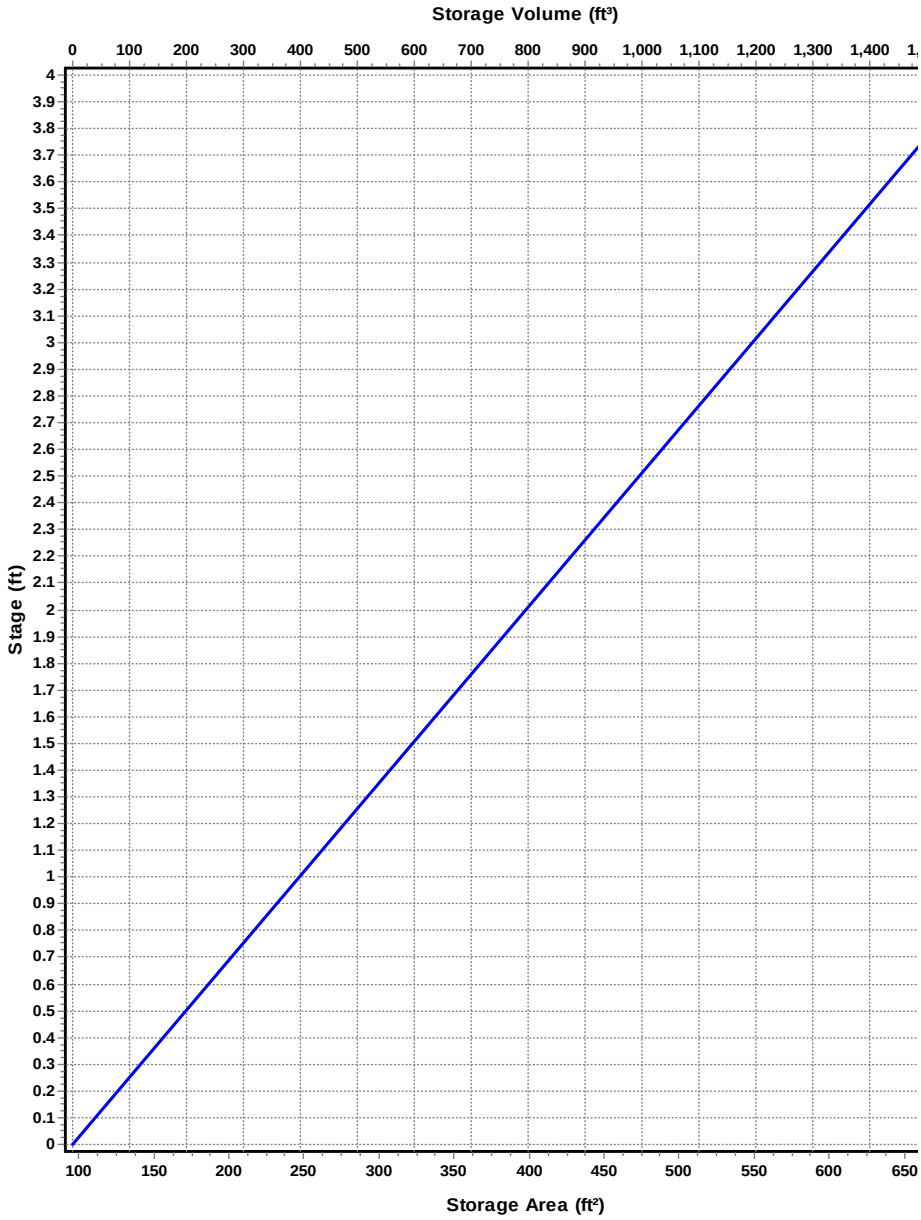
Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : NORTHERN CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	96	0
4	700	1592

Storage Area Volume Curves



Storage Node : NORTH_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	17.01
Peak Lateral Inflow (cfs)	17.01
Peak Outflow (cfs)	15.97
Peak Exfiltration Flow Rate (cfm)	54.7
Max HGL Elevation Attained (ft)	6340.58
Max HGL Depth Attained (ft)	3.38
Average HGL Elevation Attained (ft)	6337.38
Average HGL Depth Attained (ft)	0.18
Time of Max HGL Occurrence (days hh:mm)	0 00:40
Total Exfiltration Volume (1000-ft³)	5.663
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name	ihouse SSA model.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	6:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	5	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	10
Nodes	8
Junctions	3
Outfalls	1
Flow Diversions	0
Inlets	1
Storage Nodes	3
Links	8
Channels	3
Pipes	5
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Subbasin_1	7.20	0.4000	1.02	0.41	2.94	13.23	0 00:13:15
2	Subbasin_10	3.23	0.9000	0.88	0.79	2.55	15.27	0 00:10:00
3	Subbasin_2	9.38	0.4100	1.08	0.44	4.15	16.58	0 00:14:58
4	Subbasin_3	4.53	0.7300	0.94	0.69	3.10	16.43	0 00:11:16
5	Subbasin_4	3.08	0.6200	0.88	0.54	1.67	10.03	0 00:10:00
6	Subbasin_5	0.93	0.5800	0.88	0.51	0.48	2.81	0 00:10:13
7	Subbasin_6	0.61	0.4000	0.88	0.35	0.21	1.28	0 00:10:00
8	Subbasin_7	0.13	0.9500	0.88	0.83	0.11	0.65	0 00:10:00
9	Subbasin_8	0.11	0.9500	0.88	0.83	0.09	0.53	0 00:10:00
10	Subbasin_9	1.70	0.9500	0.94	0.90	1.52	7.95	0 00:11:30

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	M Surcha Dep Attair
1	3-Jun	Junction	6339.00	6342.00	0.00	6342.00	0.00	1.38	6339.70	0.
2	SOUTHERN_INLET_FES	Junction	6339.00	6342.00	0.00	6342.00	0.00	14.97	6342.86	0.
3	SWALE_CONVERGE	Junction	6338.29	6342.29	0.00	4.00	0.00	33.32	6339.82	0.
4	Out-04	Outfall	6339.00					0.00	6339.00	
5	CENTRAL_CULVERT	Storage Node	6338.50	6342.50	0.00		0.00	18.58	6341.98	
6	INFIL_POND	Storage Node	6336.00	6339.10	0.00		0.00	72.70	6337.74	
7	NORTH_CULVERT	Storage Node	6337.20	6341.20	0.00		0.00	20.42	6340.91	

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow Design Flo Rat
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)	
1	CENTRAL_CULVERT	Pipe	CENTRAL_CULVERT	SWALE_CONVERGE	74.00	6337.57	6337.17	0.5400	18.000	0.0100	15.57	7.27	2.1
2	FAKE_PIPE	Pipe	SOUTHERN_INLET_FES	INFIL_POND	5.00	6342.50	6337.00	110.0000	10.000	0.0050	17.63	59.75	0.3
3	Link-08	Pipe	3-Jun	INFIL_POND	15.00	6345.00	6336.00	60.0000	40.000	0.0010	0.00	8895.17	0.0
4	NORTHERN_CULVERT	Pipe	NORTH_CULVERT	SWALE_CONVERGE	72.00	6336.78	6336.37	0.5700	24.000	0.0100	19.25	36.19	0.5
5	SOUTHERN_PIPE	Pipe	SOUTHERN_INLET	SOUTHERN_INLET_FES	103.00	6340.80	6339.00	1.7500	18.000	0.0100	14.97	18.05	0.8
6	BYPASS	Channel	SOUTHERN_INLET	3-Jun	5.00	6345.00	6345.00	0.0000	6.000	0.0140	1.38	9.15	0.1
7	Link-07	Channel	INFIL_POND	Out-04	5.00	6339.10	6339.00	2.0000	12.000	0.0320	0.00	648.11	0.0
8	SWALE	Channel	SWALE_CONVERGE	INFIL_POND	129.00	6338.39	6337.65	0.5700	36.000	0.0320	33.30	195.20	0.1

Inlet Summary

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft^2)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	0.00	10.00	16.43	N/A	N/A	N/A	7.00

Subbasin Hydrology

Subbasin : Subbasin_1

Input Data

Area (ac) 7.2
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	7.2	A	0.4
Composite Area & Weighted Runoff Coeff.	7.2		0.4

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	9.9	0	0

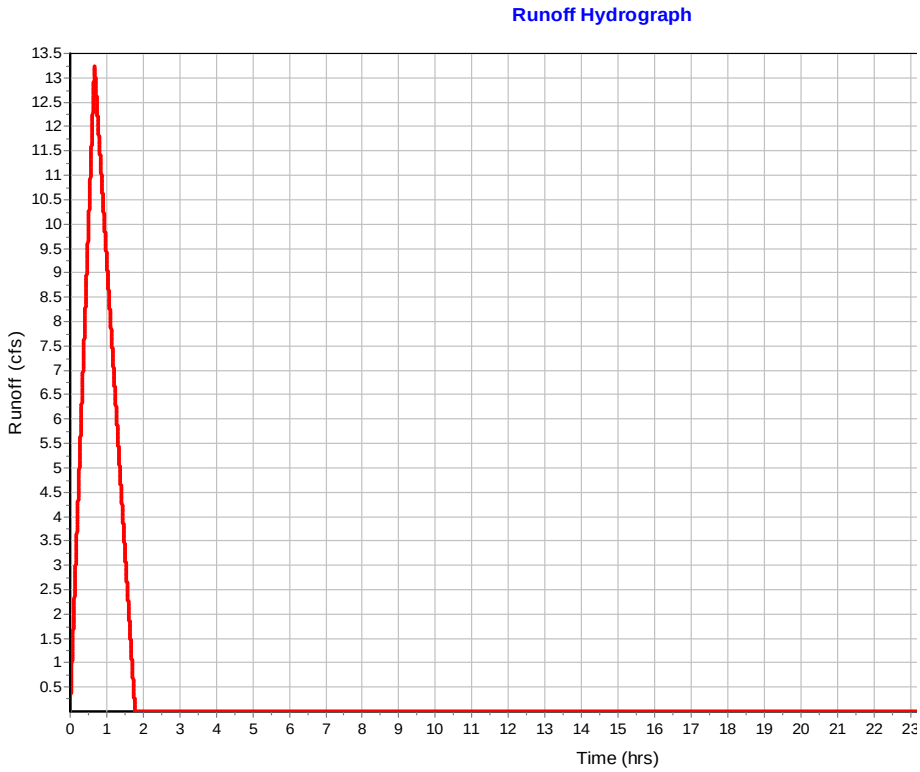
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	696	0	0
Slope (%) :	4.6	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.46	0	0
Computed Flow Time (min) :	3.35	0	0

Total TOC (min) 13.25

Subbasin Runoff Results

Total Rainfall (in)	1.02
Total Runoff (in)	0.41
Peak Runoff (cfs)	13.23
Rainfall Intensity	4.593
Weighted Runoff Coefficient	0.4
Time of Concentration (days hh:mm:ss)	0 00:13:15

Subbasin : Subbasin_1



Subbasin : Subbasin_10

Input Data

Area (ac)	3.23
Weighted Runoff Coefficient	0.9

Runoff Coefficient

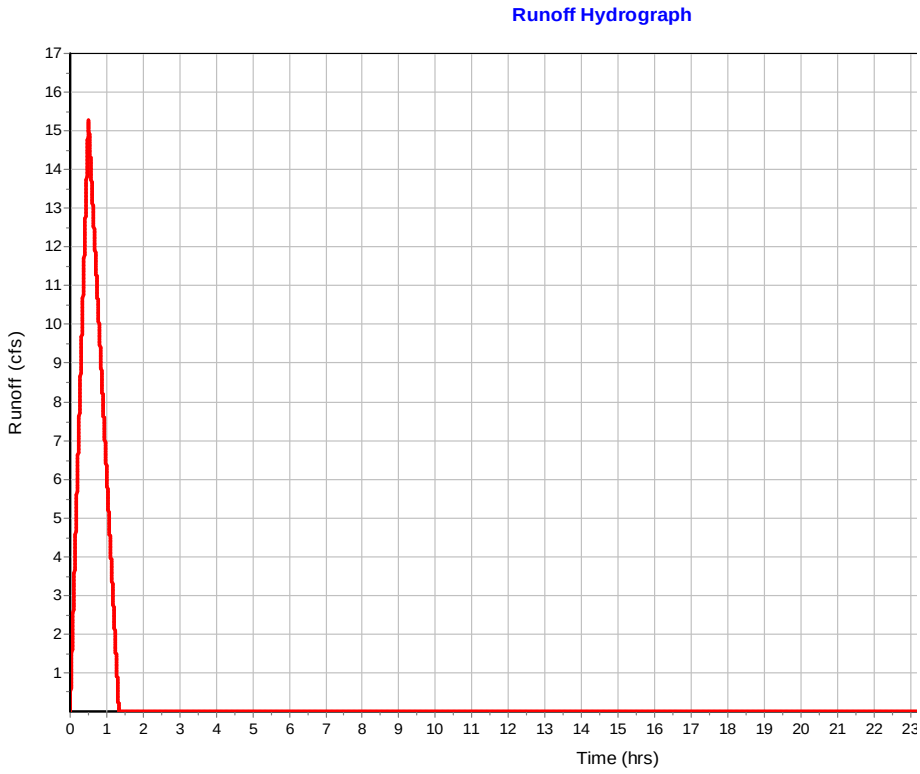
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	3.23	A	0.9
Composite Area & Weighted Runoff Coeff.	3.23		0.9

Time of Concentration

Subbasin Runoff Results

Total Rainfall (in)	0.88
Total Runoff (in)	0.79
Peak Runoff (cfs)	15.27
Rainfall Intensity	5.251
Weighted Runoff Coefficient	0.9
Time of Concentration (days hh:mm:ss)	0 00:00:00

Subbasin : Subbasin_10



Subbasin : Subbasin_2

Input Data

Area (ac)	9.38
Weighted Runoff Coefficient	0.41

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.16	A	0.7
-	9.22	A	0.4
Composite Area & Weighted Runoff Coeff.	9.38		0.41

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

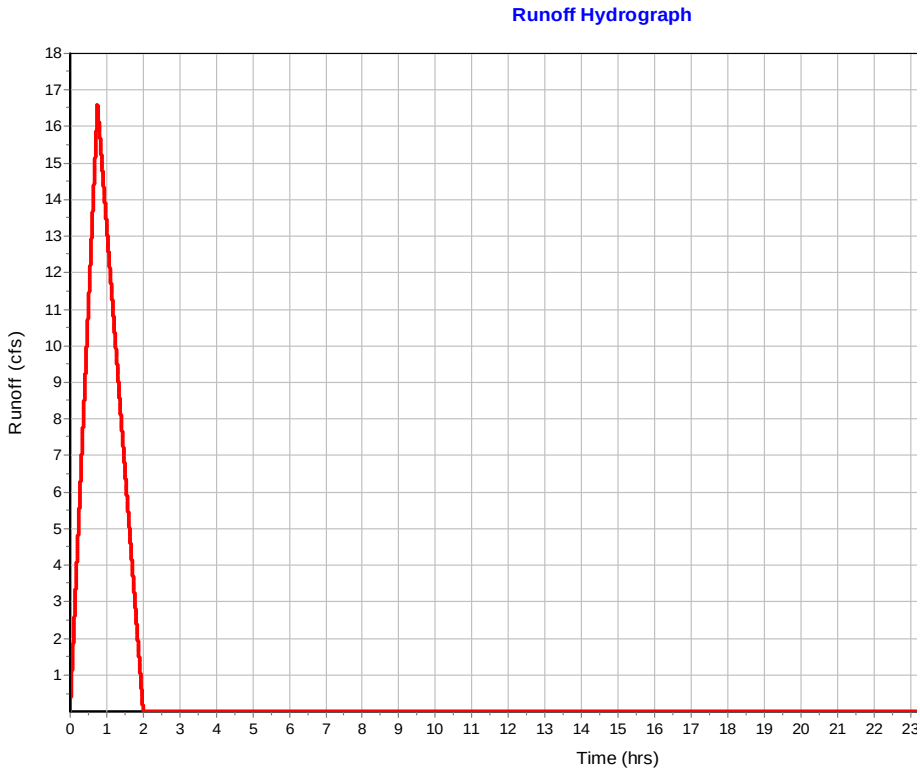
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	1278	0	0
Slope (%) :	3.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.1	0	0
Computed Flow Time (min) :	6.87	0	0

Total TOC (min) 14.97

Subbasin Runoff Results

Total Rainfall (in)	1.08
Total Runoff (in)	0.44
Peak Runoff (cfs)	16.58
Rainfall Intensity	4.311
Weighted Runoff Coefficient	0.41
Time of Concentration (days hh:mm:ss)	0 00:14:58

Subbasin : Subbasin_2



Subbasin : Subbasin_3

Input Data

Area (ac) 4.53
Weighted Runoff Coefficient 0.73

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.74	A	0.7
-	1	A	0.4
-	1.79	A	0.95
Composite Area & Weighted Runoff Coeff.	4.53		0.73

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	115	0	0
Slope (%) :	10.8	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.24	0	0
Computed Flow Time (min) :	7.87	0	0

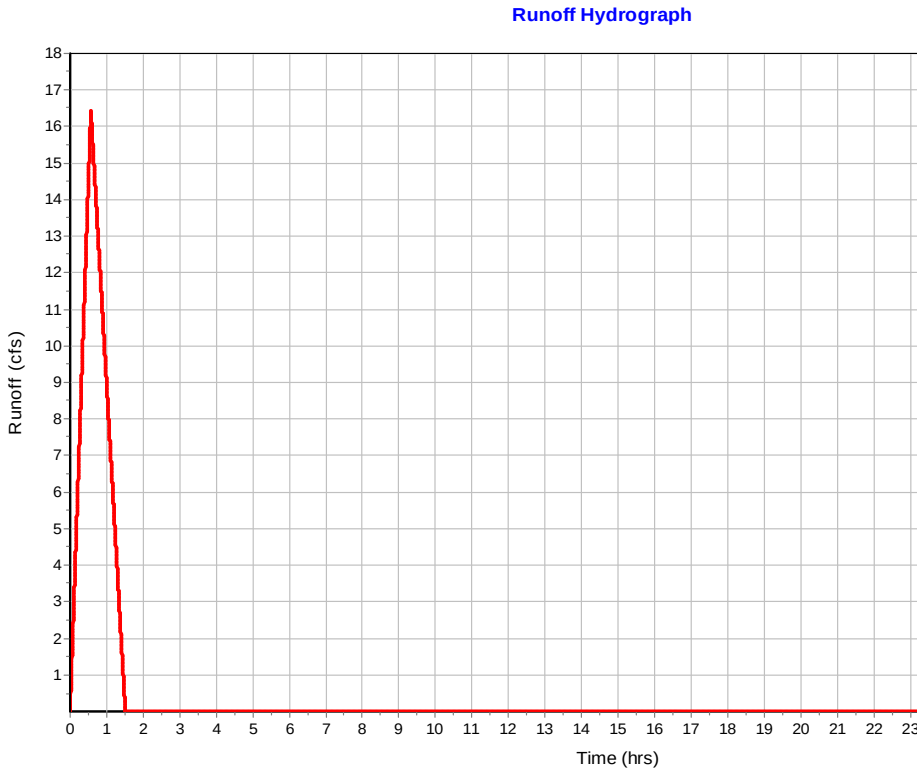
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	820	0	0
Slope (%) :	3.9	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	4.01	0	0
Computed Flow Time (min) :	3.41	0	0

Total TOC (min) 11.28

Subbasin Runoff Results

Total Rainfall (in) 0.94
Total Runoff (in) 0.69
Peak Runoff (cfs) 16.43
Rainfall Intensity 4.969
Weighted Runoff Coefficient 0.73
Time of Concentration (days hh:mm:ss) 0 00:11:17

Subbasin : Subbasin_3



Subbasin : Subbasin_4

Input Data

Area (ac) 3.08
Weighted Runoff Coefficient 0.62

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.62	A	0.7
-	1.55	A	0.4
-	0.91	A	0.95
Composite Area & Weighted Runoff Coeff.	3.08		0.62

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.6	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.21	0	0
Computed Flow Time (min) :	8.1	0	0

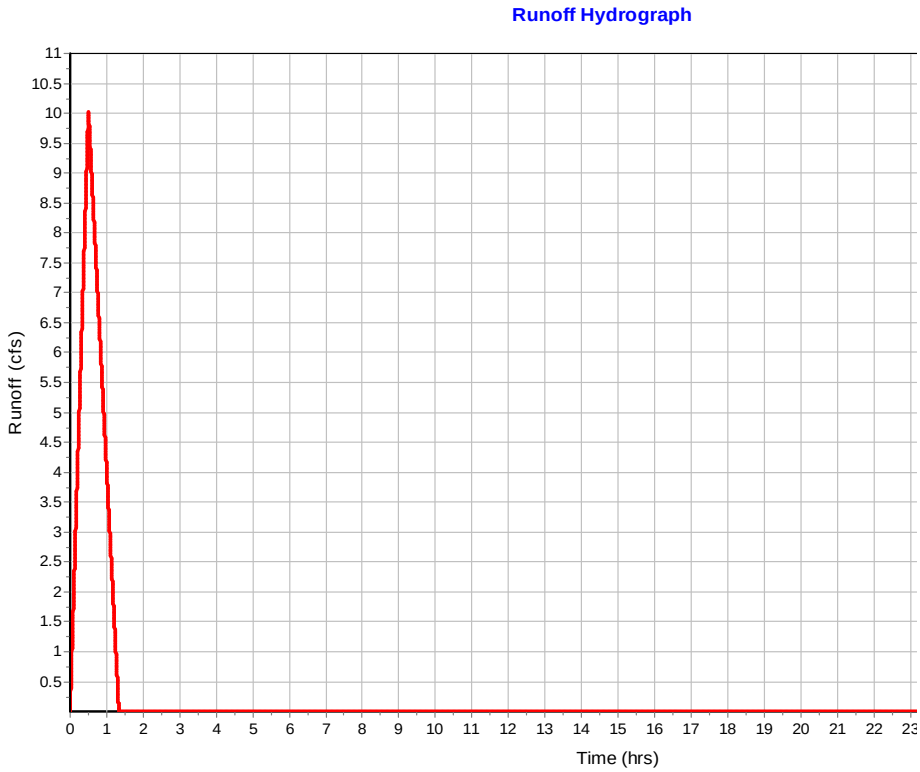
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	103	125	56
Slope (%) :	7.6	3.7	1.8
Surface Type :	Bare & untilled	Unpaved	Paved
Velocity (ft/sec) :	2.76	3.1	2.73
Computed Flow Time (min) :	0.62	0.67	0.34

Total TOC (min) 9.74

Subbasin Runoff Results

Total Rainfall (in) 0.88
Total Runoff (in) 0.54
Peak Runoff (cfs) 10.03
Rainfall Intensity 5.251
Weighted Runoff Coefficient 0.62
Time of Concentration (days hh:mm:ss) 0 00:09:44

Subbasin : Subbasin_4



Subbasin : Subbasin_5

Input Data

Area (ac) 0.93
Weighted Runoff Coefficient 0.58

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.31	A	0.95
-	0.62	A	0.4
Composite Area & Weighted Runoff Coeff.	0.93		0.58

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	5.2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.18	0	0
Computed Flow Time (min) :	9.43	0	0

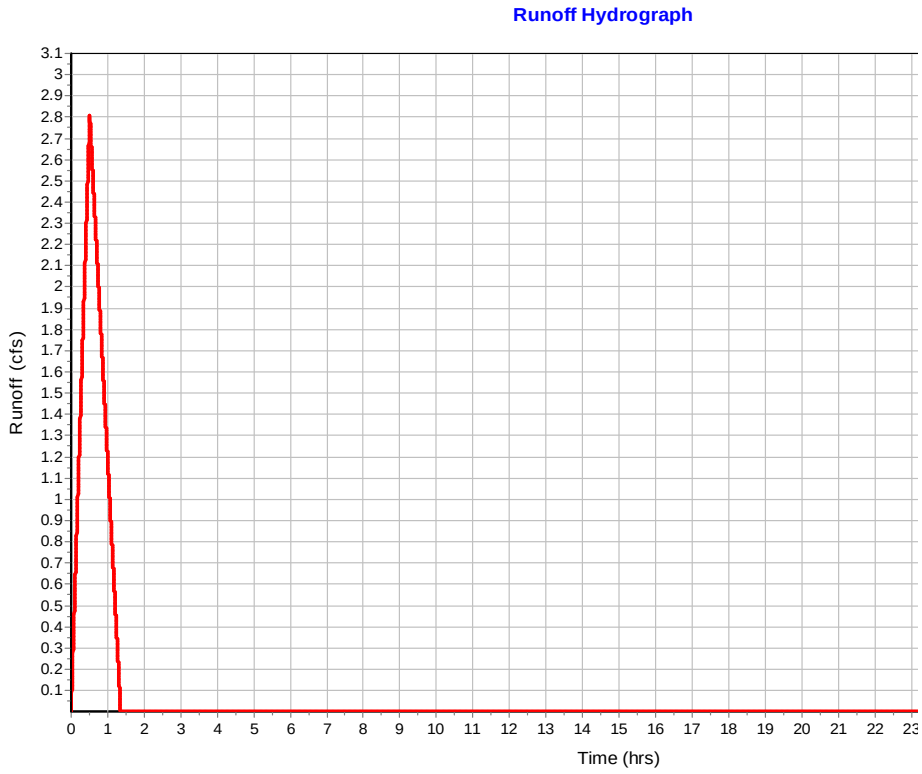
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	174	0	0
Slope (%) :	5.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.68	0	0
Computed Flow Time (min) :	0.79	0	0

Total TOC (min) 10.22

Subbasin Runoff Results

Total Rainfall (in) 0.88
Total Runoff (in) 0.51
Peak Runoff (cfs) 2.81
Rainfall Intensity 5.2
Weighted Runoff Coefficient 0.58
Time of Concentration (days hh:mm:ss) 0 00:10:13

Subbasin : Subbasin_5



Subbasin : Subbasin_6

Input Data

Area (ac) 0.61
Weighted Runoff Coefficient 0.4

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.61	A	0.4
Composite Area & Weighted Runoff Coeff.	0.61		0.4

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	7.4	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.19	0	0

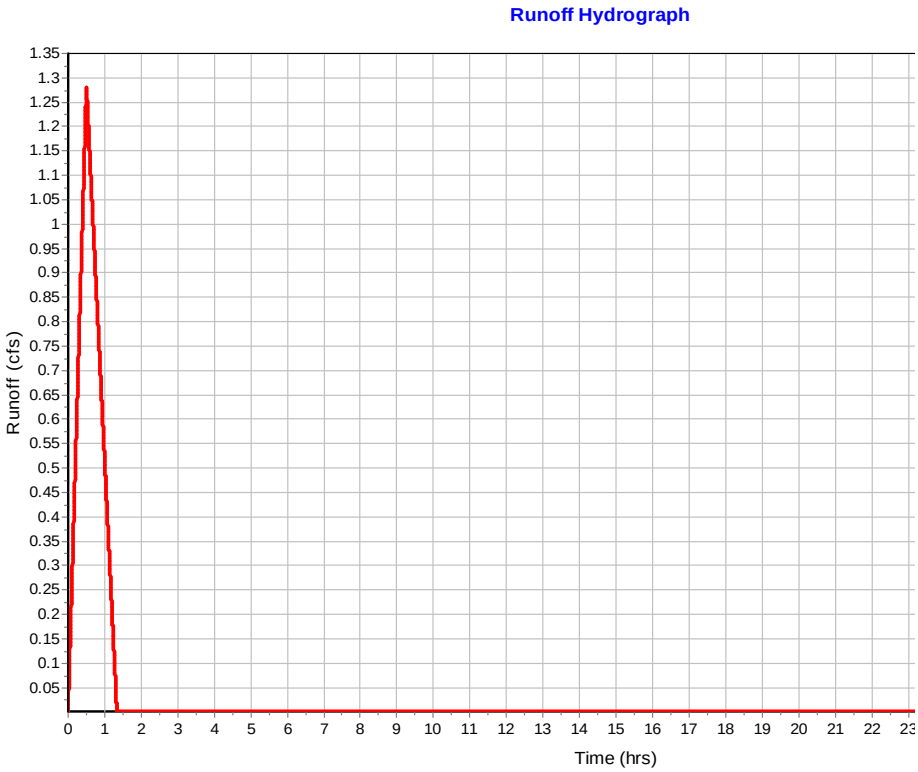
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	131	0	0
Slope (%) :	7.4	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	5.53	0	0
Computed Flow Time (min) :	0.39	0	0

Total TOC (min) 8.58

Subbasin Runoff Results

Total Rainfall (in) 0.88
Total Runoff (in) 0.35
Peak Runoff (cfs) 1.28
Rainfall Intensity 5.251
Weighted Runoff Coefficient 0.4
Time of Concentration (days hh:mm:ss) 0 00:08:35

Subbasin : Subbasin_6



Subbasin : Subbasin_7

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.13	A	0.95
Composite Area & Weighted Runoff Coeff.	0.13		0.95

Time of Concentration

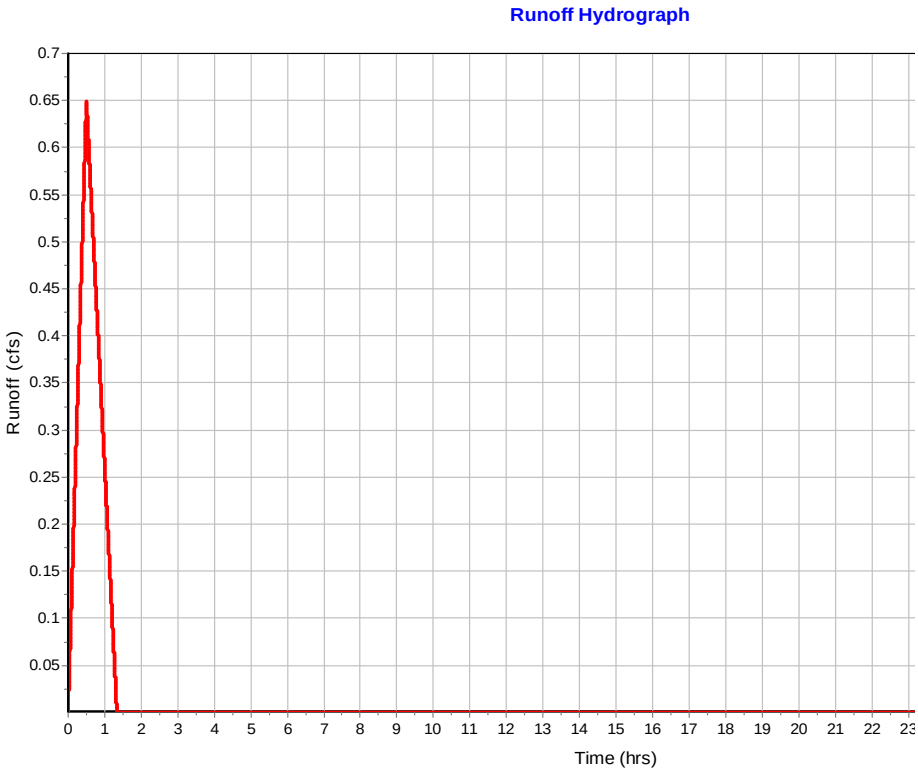
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	264	0	0
Slope (%) :	2	0	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0	0
Computed Flow Time (min) :	1.53	0	0

Total TOC (min) 1.53

Subbasin Runoff Results

Total Rainfall (in) 0.88
Total Runoff (in) 0.83
Peak Runoff (cfs) 0.65
Rainfall Intensity 5.251
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:01:32

Subbasin : Subbasin_7



Subbasin : Subbasin_8

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.11	A	0.95
Composite Area & Weighted Runoff Coeff.	0.11		0.95

Time of Concentration

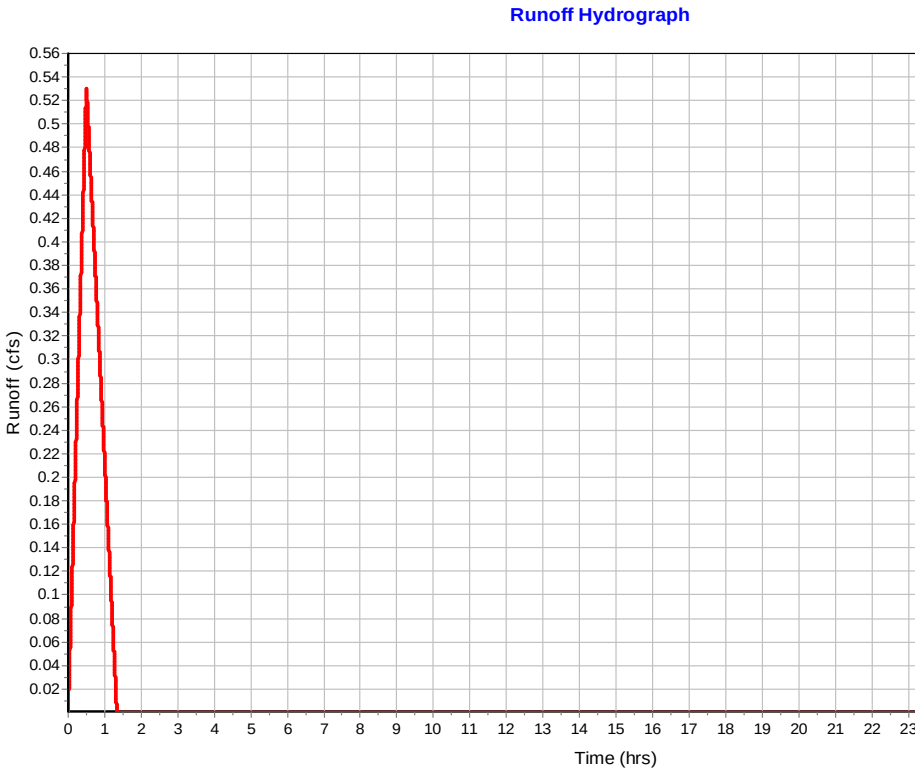
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.015	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.68	0	0
Computed Flow Time (min) :	2.46	0	0

Total TOC (min) 2.46

Subbasin Runoff Results

Total Rainfall (in) 0.88
Total Runoff (in) 0.83
Peak Runoff (cfs) 0.53
Rainfall Intensity 5.251
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:02:28

Subbasin : Subbasin_8



Subbasin : Subbasin_9

Input Data

Area (ac) 1.7
Weighted Runoff Coefficient 0.95

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	1.7	A	0.95
Composite Area & Weighted Runoff Coeff.	1.7		0.95

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.13	0	0
Flow Length (ft) :	80	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1.28	0	0
Velocity (ft/sec) :	0.14	0	0
Computed Flow Time (min) :	9.83	0	0

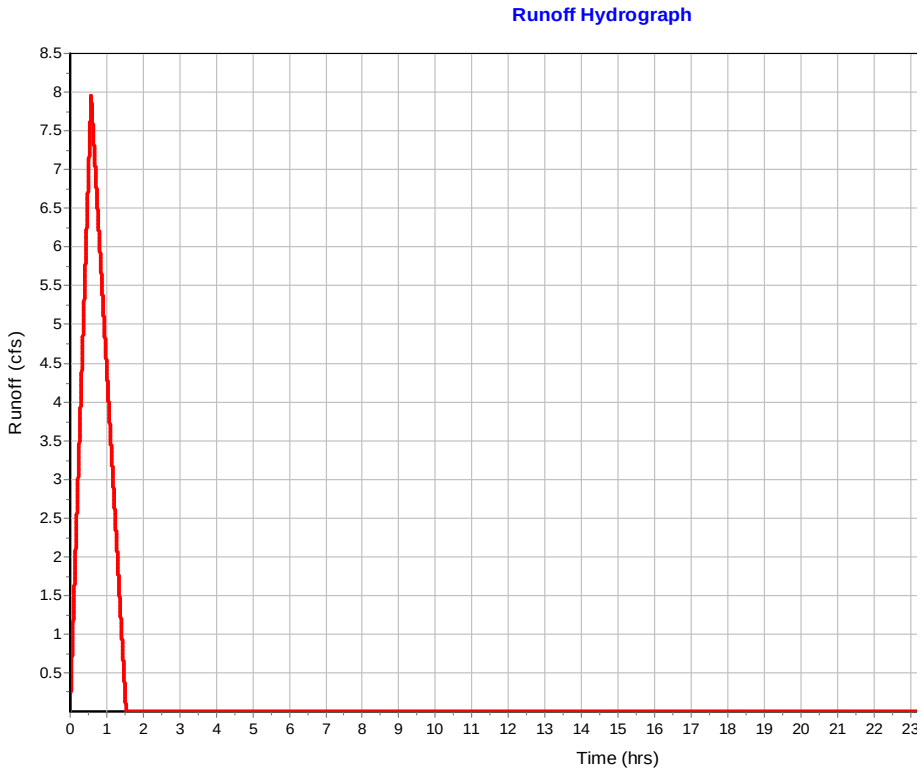
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	300	44	0
Slope (%) :	3	3	0
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.52	2.79	0
Computed Flow Time (min) :	1.42	0.26	0

Total TOC (min) 11.51

Subbasin Runoff Results

Total Rainfall (in) 0.94
Total Runoff (in) 0.9
Peak Runoff (cfs) 7.95
Rainfall Intensity 4.922
Weighted Runoff Coefficient 0.95
Time of Concentration (days hh:mm:ss) 0 00:11:31

Subbasin : Subbasin_9



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Mini C
1	3-Jun	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
2	SOUTHERN_INLET_FES	6339.00	6342.00	3.00	0.00	-6339.00	6342.00	0.00	0.00	
3	SWALE_CONVERGE	6338.29	6342.29	4.00	0.00	-6338.29	4.00	-6338.29	0.00	1

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Tim Max Occurre (days hh:r
1	3-Jun	1.38	0.00	6339.70	0.70	0.00	8.64	6339.68	0.68	0 0(
2	SOUTHERN_INLET_FES	14.97	0.00	6342.86	3.86	0.00	0.48	6342.49	3.49	0 0(
3	SWALE_CONVERGE	33.32	0.00	6339.82	1.53	0.00	2.47	6338.36	0.07	0 0(

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entran Loss
1	BYPASS	5.00	6345.00	4.20	6345.00	6.00	0.00	0.0000	Rectangular	0.500	20.000	0.0140	0.00
2	Link-07	5.00	6339.10	3.10	6339.00	0.00	0.10	2.0000	Rectangular	1.000	100.000	0.0320	0.00
3	SWALE	129.00	6338.39	0.10	6337.65	1.65	0.74	0.5700	Trapezoidal	3.000	22.000	0.0320	0.50

Channel Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froud Numb
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)	
1	BYPASS	1.38	0 00:34	9.15	0.15	1.08	0.08	0.06	0.13	0.00	
2	Link-07	0.00	0 00:00	648.11	0.00	0.00		0.00	0.00	0.00	
3	SWALE	33.30	0 00:43	195.20	0.17	3.57	0.60	1.22	0.41	0.00	

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	F
1	CENTRAL_CULVERT	74.00	6337.57	-0.93	6337.17	-1.12	0.40	0.5400	CIRCULAR	18.000	18.000	
2	FAKE_PIPE	5.00	6342.50	3.50	6337.00	1.00	5.50	110.0000	CIRCULAR	9.960	9.960	
3	Link-08	15.00	6345.00	6.00	6336.00	0.00	9.00	60.0000	CIRCULAR	39.960	39.960	
4	NORTHERN_CULVERT	72.00	6336.78	-0.42	6336.37	-1.92	0.41	0.5700	CIRCULAR	24.000	24.000	
5	SOUTHERN_PIPE	103.00	6340.80	0.00	6339.00	0.00	1.80	1.7500	CIRCULAR	18.000	18.000	

No. of Barrels
1
1
1
1
1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Tota Surch
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		
1	CENTRAL_CULVERT	15.57	0 00:49	7.27	2.14	8.81	0.14	1.50	1.00	
2	FAKE_PIPE	17.63	0 00:37	59.75	0.30	50.00	0.00	0.49	0.59	
3	Link-08	0.00	0 00:00	8895.17	0.00	0.00		0.87	0.26	
4	NORTHERN_CULVERT	19.25	0 00:40	36.19	0.53	6.56	0.18	1.77	0.88	
5	SOUTHERN_PIPE	14.97	0 00:34	18.05	0.83	8.47	0.20	1.50	1.00	17

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Init Wat Elevati (
1	SOUTHERN_INLET	FHWA HEC-22 GENERIC	N/A	On Sag	1	6340.80	6345.80	5.00	0.(

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	SOUTHERN_INLET	N/A	0.0200	0.0160	0.0620	2.00	0.0656	7.00

Inlet Results

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Ti Max I Occur (days hh
1	SOUTHERN_INLET	16.43	16.43	N/A	N/A	N/A	33.01	6346.57	0.77	0

Storage Nodes

Storage Node : CENTRAL_CULVERT

Input Data

Invert Elevation (ft)	6338.50
Max (Rim) Elevation (ft)	6342.50
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6338.50
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

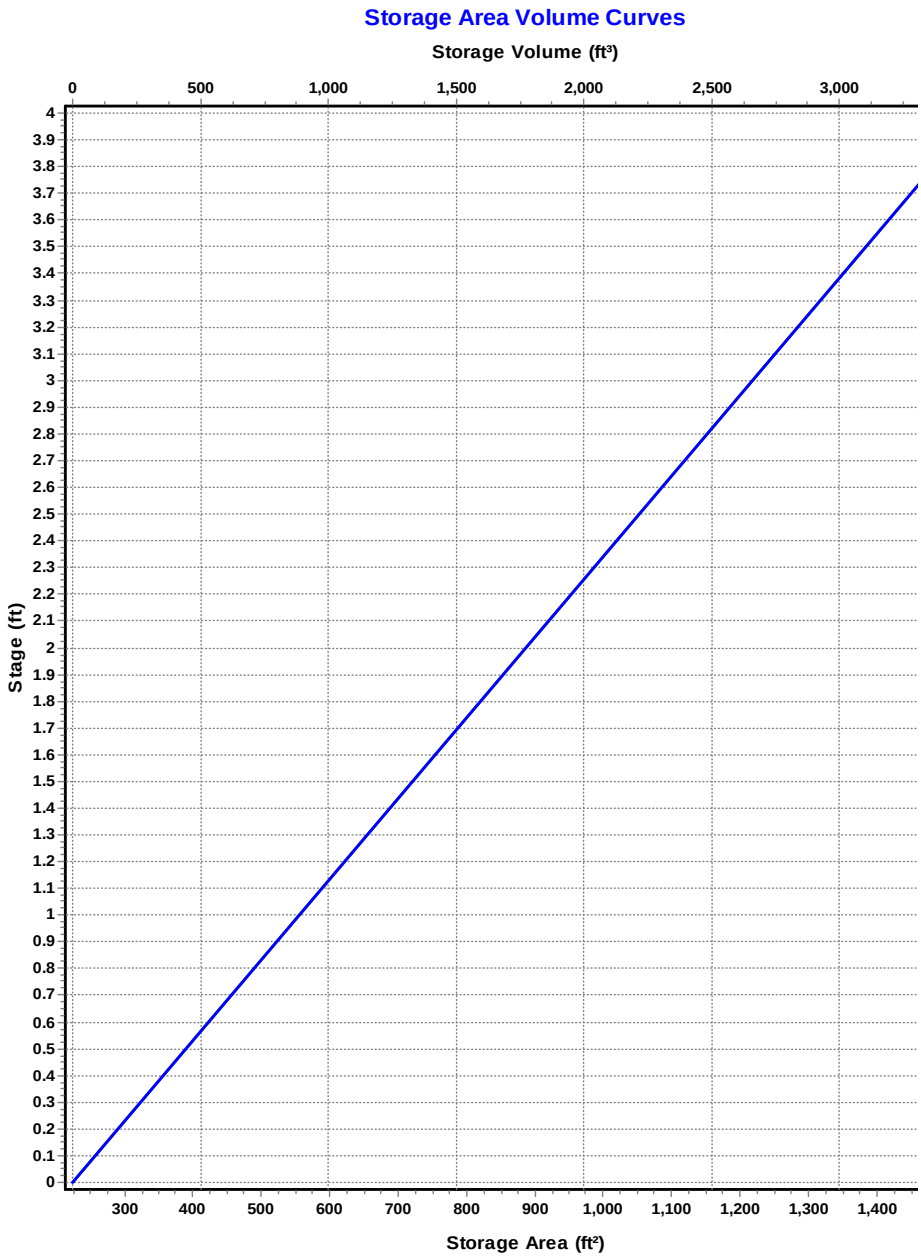
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : CENTRAL CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	224	0
4	1550	3548


Storage Area Volume Curves
Storage Volume (ft³)
0
500
1,000
1,500
2,000
2,500
3,000
Stage (ft)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
1,400
Storage Area (ft²)

Storage Node : CENTRAL_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	18.58
Peak Lateral Inflow (cfs)	18.58
Peak Outflow (cfs)	15.57
Peak Exfiltration Flow Rate (cfm)	119.36
Max HGL Elevation Attained (ft)	6341.98
Max HGL Depth Attained (ft)	3.48
Average HGL Elevation Attained (ft)	6338.63
Average HGL Depth Attained (ft)	0.13
Time of Max HGL Occurrence (days hh:mm)	0 00:48
Total Exfiltration Volume (1000-ft³)	8.62
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : INFIL_POND

Input Data

Invert Elevation (ft)	6336.00
Max (Rim) Elevation (ft)	6339.10
Max (Rim) Offset (ft)	3.10
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6336.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

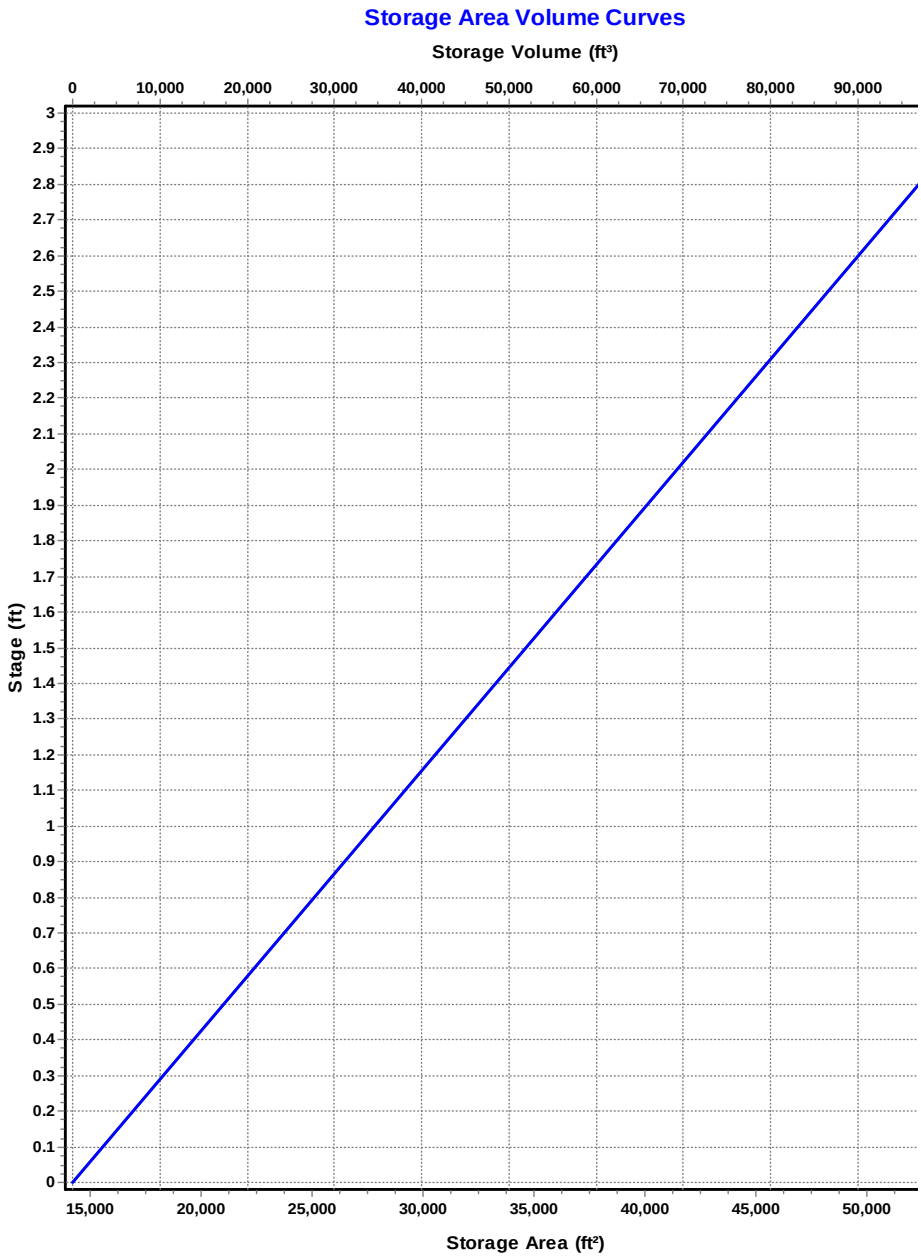
Infiltration/Exfiltration

Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : INFILTRATION POND

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	14221	0
3	55036	103885.5


Storage Area Volume Curves
Storage Volume (ft³)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
Stage (ft)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
Storage Area (ft²)

Storage Node : INFIL_POND (continued)

Output Summary Results

Peak Inflow (cfs)	72.7
Peak Lateral Inflow (cfs)	27.75
Peak Outflow (cfs)	0
Peak Exfiltration Flow Rate (cfm)	3161.67
Max HGL Elevation Attained (ft)	6337.74
Max HGL Depth Attained (ft)	1.74
Average HGL Elevation Attained (ft)	6336.06
Average HGL Depth Attained (ft)	0.06
Time of Max HGL Occurrence (days hh:mm)	0 00:57
Total Exfiltration Volume (1000-ft³)	224.355
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NORTH_CULVERT

Input Data

Invert Elevation (ft)	6337.20
Max (Rim) Elevation (ft)	6341.20
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-6337.20
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Infiltration/Exfiltration

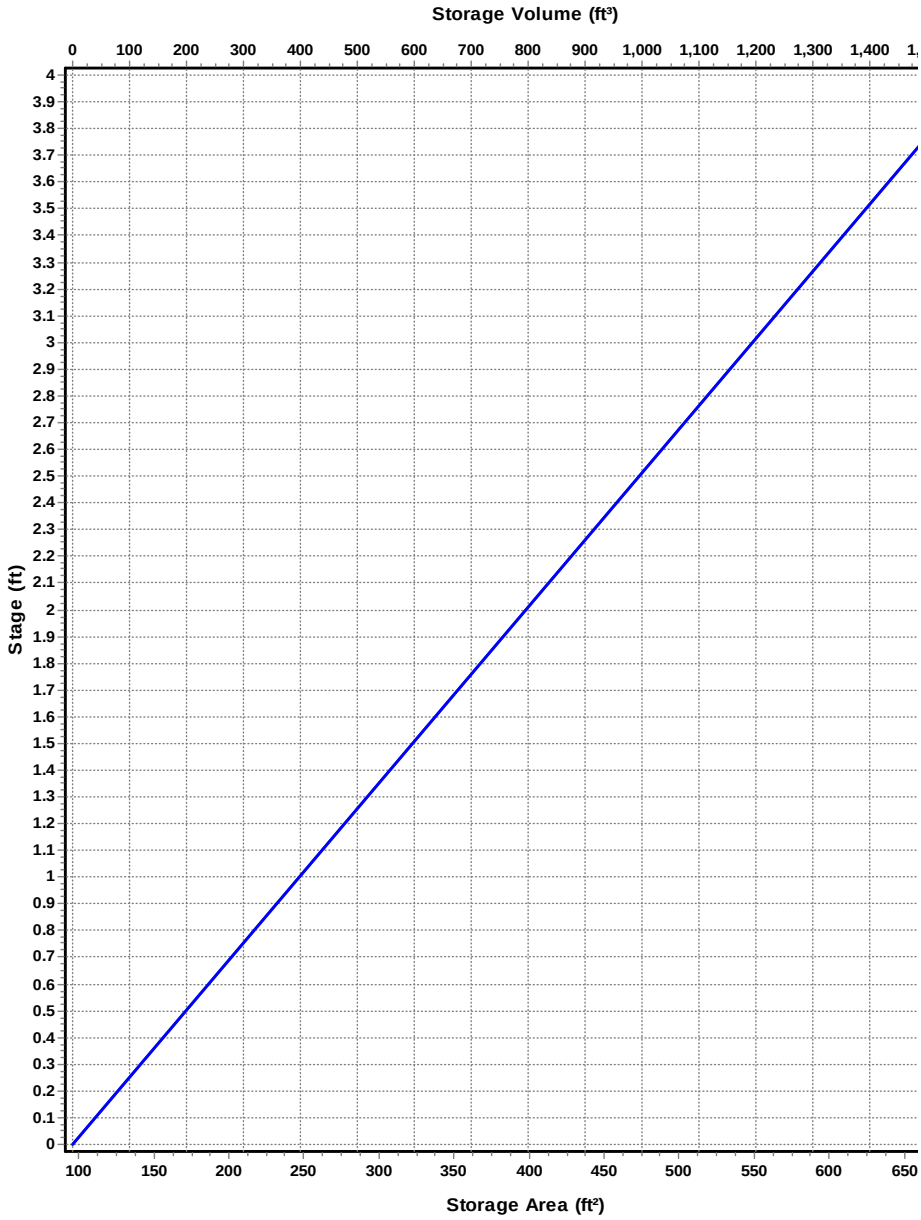
Exfiltration Rate (in/hr)	60

Storage Area Volume Curves

Storage Curve : NORTHERN CULVERT

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	96	0
4	700	1592

Storage Area Volume Curves



Storage Node : NORTH_CULVERT (continued)

Output Summary Results

Peak Inflow (cfs)	20.42
Peak Lateral Inflow (cfs)	20.42
Peak Outflow (cfs)	19.25
Peak Exfiltration Flow Rate (cfm)	59.53
Max HGL Elevation Attained (ft)	6340.91
Max HGL Depth Attained (ft)	3.71
Average HGL Elevation Attained (ft)	6337.39
Average HGL Depth Attained (ft)	0.19
Time of Max HGL Occurrence (days hh:mm)	0 00:40
Total Exfiltration Volume (1000-ft³)	5.98
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

APPENDIX 3: NOAA PRECIPITATION DATA

NOAA Atlas 14, Volume 1, Version 5
Location name: Kaibeto, Arizona, USA*
Latitude: 36.597°, Longitude: -110.791°
Elevation: 6344 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.139** (0.118-0.164)	**0.179** (0.153-0.212)	**0.245** (0.208-0.290)	**0.304** (0.255-0.360)	**0.396** (0.325-0.470)	**0.476** (0.385-0.565)	**0.570** (0.451-0.681)	**0.678** (0.522-0.818)	**0.848** (0.627-1.04)	**1.00** (0.715-1.24)
10-min	**0.212** (0.180-0.250)	**0.272** (0.232-0.322)	**0.373** (0.317-0.441)	**0.462** (0.387-0.547)	**0.602** (0.495-0.716)	**0.725** (0.586-0.860)	**0.868** (0.686-1.04)	**1.03** (0.794-1.24)	**1.29** (0.954-1.58)	**1.52** (1.09-1.89)
15-min	**0.262** (0.223-0.310)	**0.338** (0.288-0.400)	**0.462** (0.392-0.547)	**0.573** (0.480-0.678)	**0.747** (0.614-0.887)	**0.898** (0.726-1.07)	**1.08** (0.850-1.28)	**1.28** (0.985-1.54)	**1.60** (1.18-1.96)	**1.89** (1.35-2.35)
30-min	**0.352** (0.300-0.418)	**0.454** (0.388-0.538)	**0.622** (0.528-0.736)	**0.772** (0.646-0.914)	**1.00** (0.826-1.20)	**1.21** (0.977-1.44)	**1.45** (1.14-1.73)	**1.72** (1.33-2.08)	**2.16** (1.59-2.63)	**2.54** (1.82-3.16)
60-min	**0.436** (0.371-0.517)	**0.562** (0.480-0.666)	**0.769** (0.653-0.911)	**0.955** (0.800-1.13)	**1.24** (1.02-1.48)	**1.50** (1.21-1.78)	**1.79** (1.42-2.14)	**2.13** (1.64-2.57)	**2.67** (1.97-3.26)	**3.15** (2.25-3.91)
2-hr	**0.526** (0.456-0.612)	**0.668** (0.577-0.777)	**0.900** (0.772-1.04)	**1.11** (0.939-1.28)	**1.43** (1.19-1.66)	**1.72** (1.41-2.00)	**2.05** (1.64-2.41)	**2.44** (1.91-2.90)	**3.05** (2.29-3.68)	**3.61** (2.62-4.41)
3-hr	**0.579** (0.510-0.666)	**0.734** (0.642-0.845)	**0.963** (0.841-1.11)	**1.16** (1.01-1.34)	**1.48** (1.26-1.70)	**1.75** (1.47-2.02)	**2.08** (1.71-2.41)	**2.46** (1.98-2.92)	**3.07** (2.39-3.71)	**3.61** (2.74-4.46)
6-hr	**0.698** (0.625-0.787)	**0.872** (0.778-0.981)	**1.11** (0.983-1.25)	**1.31** (1.16-1.48)	**1.61** (1.41-1.82)	**1.87** (1.61-2.12)	**2.18** (1.85-2.49)	**2.56** (2.13-2.95)	**3.16** (2.57-3.75)	**3.70** (2.94-4.50)
12-hr	**0.859** (0.776-0.957)	**1.07** (0.968-1.20)	**1.34** (1.21-1.50)	**1.57** (1.40-1.75)	**1.88** (1.67-2.10)	**2.13** (1.87-2.38)	**2.39** (2.09-2.69)	**2.73** (2.35-3.09)	**3.26** (2.75-3.79)	**3.78** (3.14-4.55)
24-hr	**1.01** (0.897-1.14)	**1.28** (1.14-1.44)	**1.65** (1.46-1.86)	**1.95** (1.73-2.20)	**2.38** (2.09-2.68)	**2.72** (2.38-3.08)	**3.08** (2.68-3.49)	**3.47** (2.99-3.93)	**4.00** (3.41-4.57)	**4.44** (3.73-5.09)
2-day	**1.11** (0.982-1.25)	**1.40** (1.24-1.58)	**1.80** (1.60-2.04)	**2.14** (1.88-2.42)	**2.61** (2.29-2.96)	**3.00** (2.60-3.40)	**3.41** (2.93-3.87)	**3.85** (3.28-4.39)	**4.47** (3.75-5.13)	**4.98** (4.12-5.74)
3-day	**1.19** (1.05-1.34)	**1.50** (1.33-1.70)	**1.94** (1.71-2.18)	**2.29** (2.02-2.59)	**2.79** (2.44-3.16)	**3.20** (2.78-3.62)	**3.63** (3.12-4.12)	**4.08** (3.48-4.66)	**4.73** (3.97-5.42)	**5.25** (4.35-6.06)
4-day	**1.27** (1.13-1.43)	**1.60** (1.42-1.81)	**2.07** (1.83-2.33)	**2.44** (2.15-2.76)	**2.97** (2.60-3.36)	**3.40** (2.95-3.85)	**3.85** (3.32-4.37)	**4.32** (3.69-4.92)	**4.99** (4.19-5.72)	**5.53** (4.59-6.37)
7-day	**1.43** (1.28-1.62)	**1.82** (1.62-2.06)	**2.35** (2.08-2.66)	**2.78** (2.45-3.14)	**3.37** (2.96-3.82)	**3.85** (3.36-4.38)	**4.36** (3.77-4.96)	**4.89** (4.19-5.59)	**5.64** (4.77-6.48)	**6.24** (5.21-7.22)
10-day	**1.61** (1.44-1.81)	**2.05** (1.83-2.30)	**2.64** (2.34-2.96)	**3.10** (2.75-3.48)	**3.74** (3.29-4.21)	**4.24** (3.71-4.78)	**4.77** (4.14-5.39)	**5.33** (4.58-6.04)	**6.10** (5.18-6.96)	**6.70** (5.63-7.69)
20-day	**2.04** (1.82-2.30)	**2.60** (2.31-2.92)	**3.32** (2.96-3.75)	**3.90** (3.46-4.40)	**4.69** (4.13-5.29)	**5.31** (4.65-6.00)	**5.96** (5.18-6.75)	**6.63** (5.71-7.53)	**7.54** (6.42-8.63)	**8.27** (6.97-9.52)
30-day	**2.48** (2.21-2.79)	**3.14** (2.81-3.54)	**4.00** (3.56-4.52)	**4.67** (4.15-5.28)	**5.58** (4.92-6.31)	**6.28** (5.51-7.11)	**7.00** (6.10-7.94)	**7.73** (6.69-8.79)	**8.72** (7.46-9.98)	**9.49** (8.04-10.9)
45-day	**2.96** (2.65-3.34)	**3.76** (3.36-4.24)	**4.79** (4.26-5.41)	**5.58** (4.95-6.33)	**6.66** (5.87-7.55)	**7.49** (6.56-8.50)	**8.36** (7.26-9.52)	**9.24** (7.96-10.6)	**10.5** (8.90-12.1)	**11.5** (9.62-13.3)
60-day	**3.44** (3.06-3.87)	**4.37** (3.89-4.91)	**5.54** (4.92-6.24)	**6.43** (5.69-7.26)	**7.61** (6.69-8.59)	**8.51** (7.43-9.64)	**9.44** (8.18-10.7)	**10.4** (8.93-11.8)	**11.7** (9.90-13.4)	**12.7** (10.6-14.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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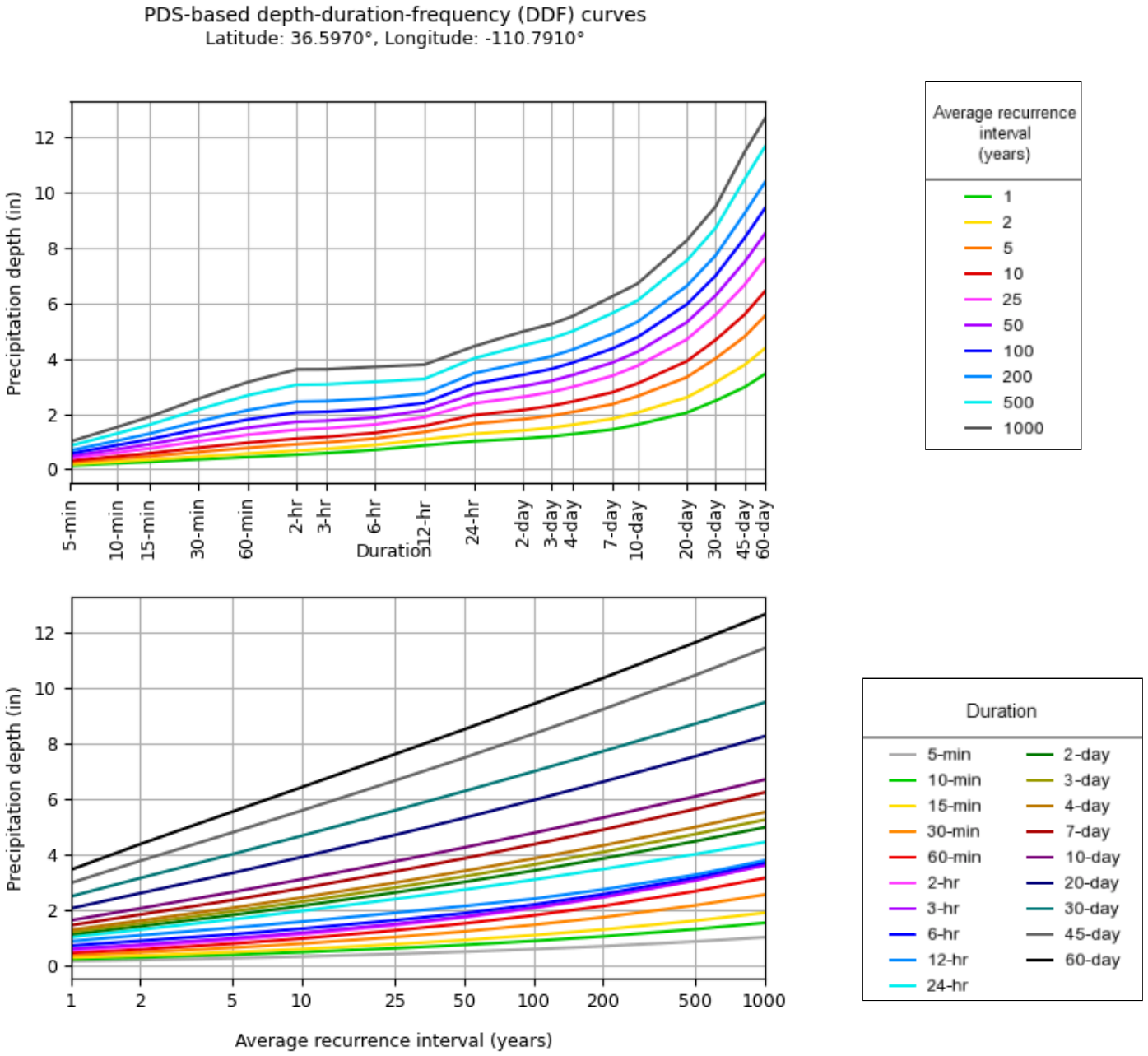
PF graphical



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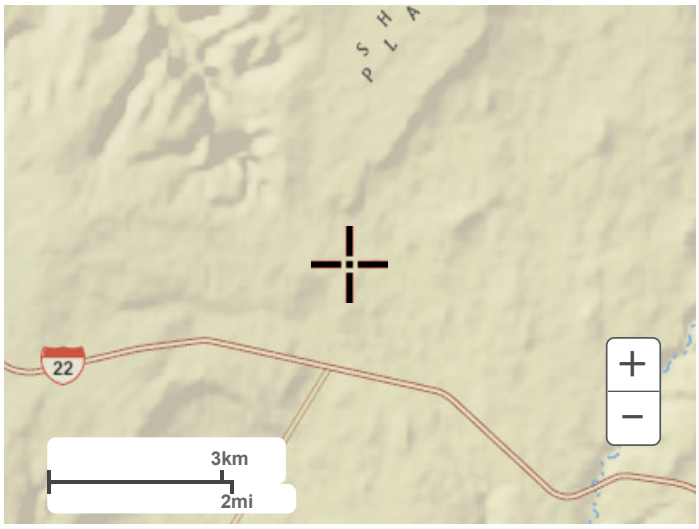
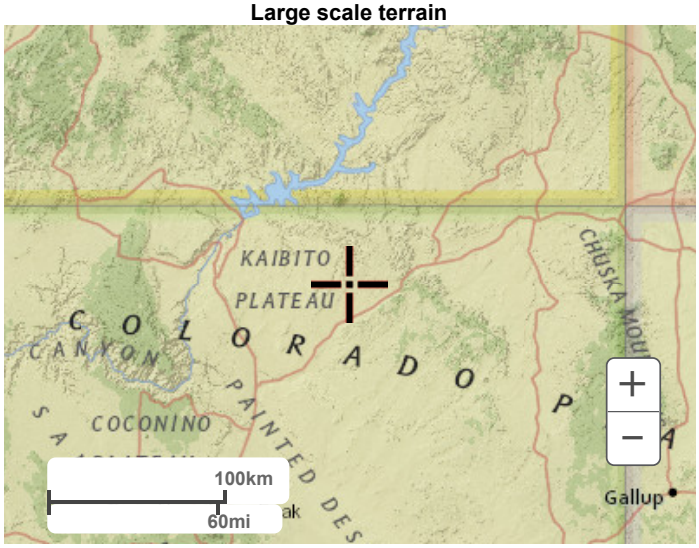
Maps & aerials

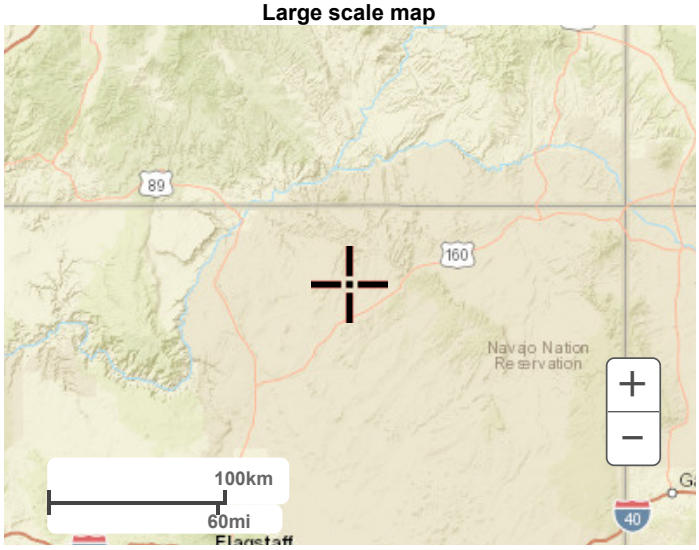
Small scale terrain



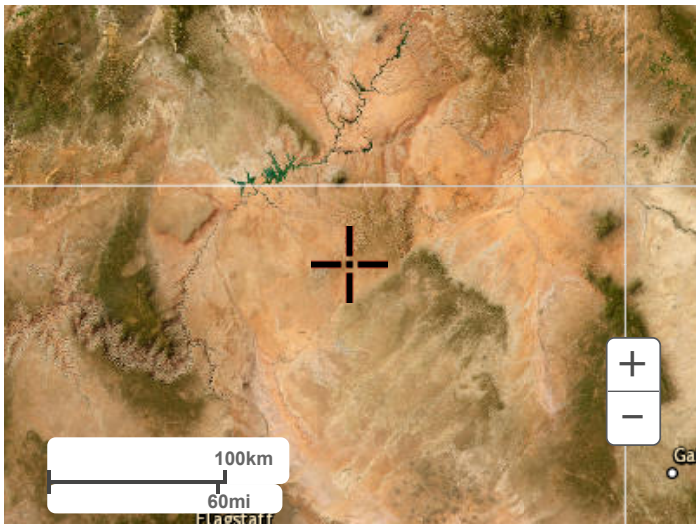
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

NOAA Atlas 14, Volume 1, Version 5
Location name: Kaibeto, Arizona, USA*
Latitude: 36.597°, Longitude: -110.791°
Elevation: 6344 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.67** (1.42-1.97)	**2.15** (1.84-2.54)	**2.94** (2.50-3.48)	**3.65** (3.06-4.32)	**4.75** (3.90-5.64)	**5.71** (4.62-6.78)	**6.84** (5.41-8.17)	**8.14** (6.26-9.82)	**10.2** (7.52-12.4)	**12.0** (8.58-14.9)
10-min	**1.27** (1.08-1.50)	**1.63** (1.39-1.93)	**2.24** (1.90-2.65)	**2.77** (2.32-3.28)	**3.61** (2.97-4.30)	**4.35** (3.52-5.16)	**5.21** (4.12-6.22)	**6.19** (4.76-7.47)	**7.75** (5.72-9.46)	**9.14** (6.53-11.4)
15-min	**1.05** (0.892-1.24)	**1.35** (1.15-1.60)	**1.85** (1.57-2.19)	**2.29** (1.92-2.71)	**2.99** (2.46-3.55)	**3.59** (2.90-4.26)	**4.30** (3.40-5.14)	**5.12** (3.94-6.17)	**6.40** (4.73-7.82)	**7.55** (5.40-9.38)
30-min	**0.704** (0.600-0.836)	**0.908** (0.776-1.08)	**1.24** (1.06-1.47)	**1.54** (1.29-1.83)	**2.01** (1.65-2.39)	**2.42** (1.95-2.87)	**2.90** (2.29-3.46)	**3.45** (2.65-4.16)	**4.31** (3.19-5.27)	**5.09** (3.63-6.32)
60-min	**0.436** (0.371-0.517)	**0.562** (0.480-0.666)	**0.769** (0.653-0.911)	**0.955** (0.800-1.13)	**1.24** (1.02-1.48)	**1.50** (1.21-1.78)	**1.79** (1.42-2.14)	**2.13** (1.64-2.57)	**2.67** (1.97-3.26)	**3.15** (2.25-3.91)
2-hr	**0.263** (0.228-0.306)	**0.334** (0.288-0.388)	**0.450** (0.386-0.522)	**0.553** (0.469-0.642)	**0.713** (0.596-0.829)	**0.857** (0.703-1.00)	**1.02** (0.822-1.20)	**1.22** (0.953-1.45)	**1.53** (1.15-1.84)	**1.80** (1.31-2.21)
3-hr	**0.192** (0.169-0.221)	**0.244** (0.213-0.281)	**0.320** (0.280-0.368)	**0.387** (0.334-0.446)	**0.491** (0.418-0.564)	**0.582** (0.488-0.671)	**0.691** (0.569-0.802)	**0.819** (0.660-0.973)	**1.02** (0.796-1.24)	**1.20** (0.913-1.48)
6-hr	**0.116** (0.104-0.131)	**0.145** (0.129-0.163)	**0.185** (0.164-0.208)	**0.219** (0.193-0.246)	**0.269** (0.235-0.303)	**0.312** (0.269-0.353)	**0.364** (0.309-0.415)	**0.427** (0.356-0.491)	**0.528** (0.428-0.626)	**0.618** (0.490-0.751)
12-hr	**0.071** (0.064-0.079)	**0.088** (0.080-0.099)	**0.111** (0.100-0.124)	**0.129** (0.116-0.144)	**0.156** (0.138-0.174)	**0.176** (0.155-0.197)	**0.198** (0.173-0.223)	**0.226** (0.195-0.256)	**0.270** (0.228-0.314)	**0.313** (0.260-0.377)
24-hr	**0.042** (0.037-0.047)	**0.053** (0.047-0.060)	**0.068** (0.061-0.077)	**0.081** (0.071-0.091)	**0.099** (0.087-0.111)	**0.113** (0.099-0.128)	**0.128** (0.111-0.145)	**0.144** (0.124-0.163)	**0.166** (0.142-0.190)	**0.184** (0.155-0.212)
2-day	**0.023** (0.020-0.025)	**0.029** (0.025-0.032)	**0.037** (0.033-0.042)	**0.044** (0.039-0.050)	**0.054** (0.047-0.061)	**0.062** (0.054-0.070)	**0.071** (0.061-0.080)	**0.080** (0.068-0.091)	**0.093** (0.078-0.106)	**0.103** (0.085-0.119)
3-day	**0.016** (0.014-0.018)	**0.020** (0.018-0.023)	**0.026** (0.023-0.030)	**0.031** (0.028-0.035)	**0.038** (0.033-0.043)	**0.044** (0.038-0.050)	**0.050** (0.043-0.057)	**0.056** (0.048-0.064)	**0.065** (0.055-0.075)	**0.072** (0.060-0.084)
4-day	**0.013** (0.011-0.014)	**0.016** (0.014-0.018)	**0.021** (0.019-0.024)	**0.025** (0.022-0.028)	**0.030** (0.027-0.035)	**0.035** (0.030-0.040)	**0.040** (0.034-0.045)	**0.045** (0.038-0.051)	**0.051** (0.043-0.059)	**0.057** (0.047-0.066)
7-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.012)	**0.013** (0.012-0.015)	**0.016** (0.014-0.018)	**0.020** (0.017-0.022)	**0.022** (0.019-0.026)	**0.025** (0.022-0.029)	**0.029** (0.024-0.033)	**0.033** (0.028-0.038)	**0.037** (0.031-0.042)
10-day	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.010** (0.009-0.012)	**0.012** (0.011-0.014)	**0.015** (0.013-0.017)	**0.017** (0.015-0.019)	**0.019** (0.017-0.022)	**0.022** (0.019-0.025)	**0.025** (0.021-0.028)	**0.027** (0.023-0.032)
20-day	**0.004** (0.003-0.004)	**0.005** (0.004-0.006)	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.011** (0.009-0.012)	**0.012** (0.010-0.014)	**0.013** (0.011-0.015)	**0.015** (0.013-0.017)	**0.017** (0.014-0.019)
30-day	**0.003** (0.003-0.003)	**0.004** (0.003-0.004)	**0.005** (0.004-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.010** (0.009-0.012)	**0.012** (0.010-0.013)	**0.013** (0.011-0.015)
45-day	**0.002** (0.002-0.003)	**0.003** (0.003-0.003)	**0.004** (0.003-0.005)	**0.005** (0.004-0.005)	**0.006** (0.005-0.006)	**0.006** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.010** (0.008-0.012)
60-day	**0.002** (0.002-0.002)	**0.003** (0.002-0.003)	**0.003** (0.003-0.004)	**0.004** (0.003-0.005)	**0.005** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.006-0.009)	**0.008** (0.007-0.010)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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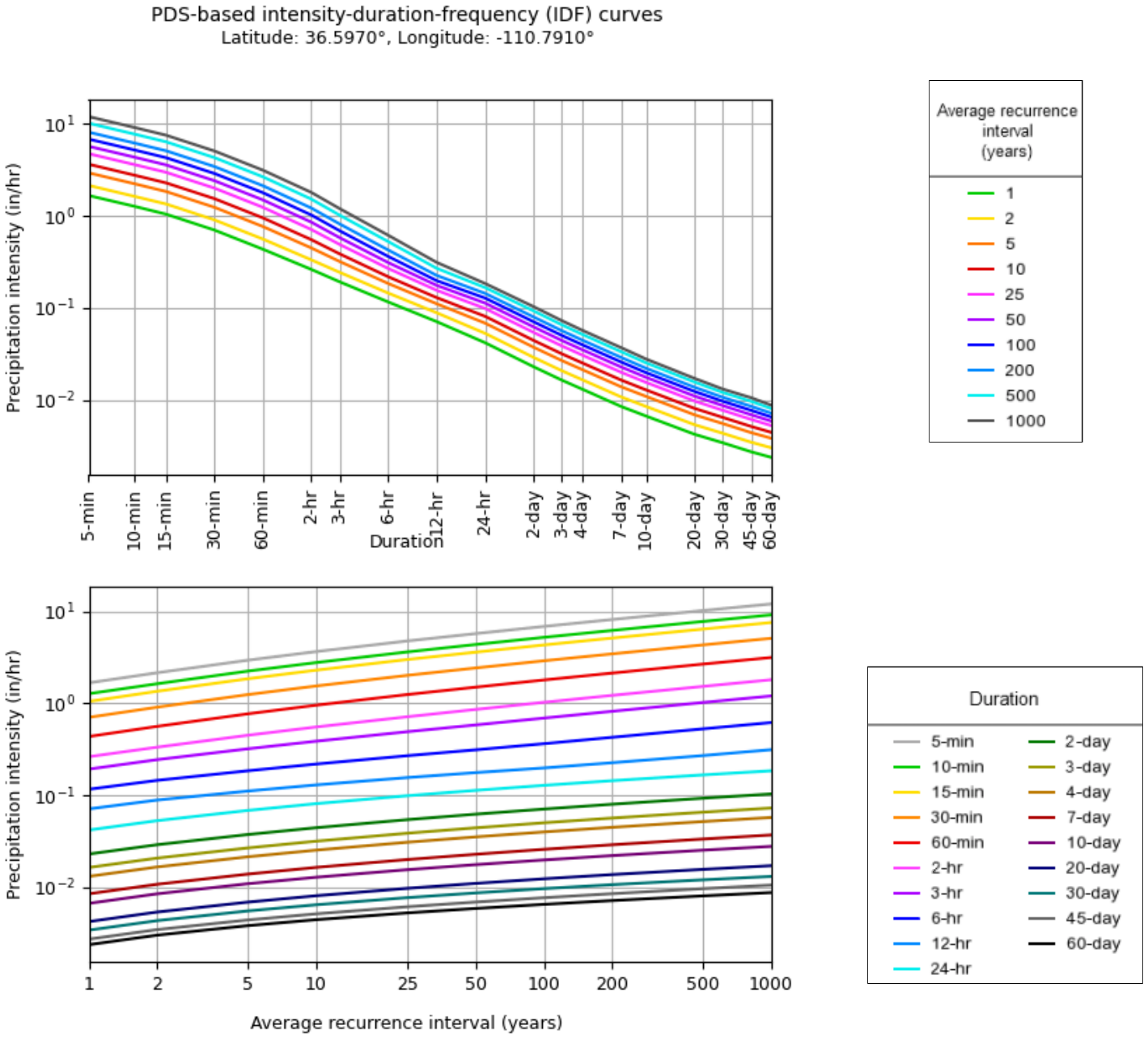
PF graphical



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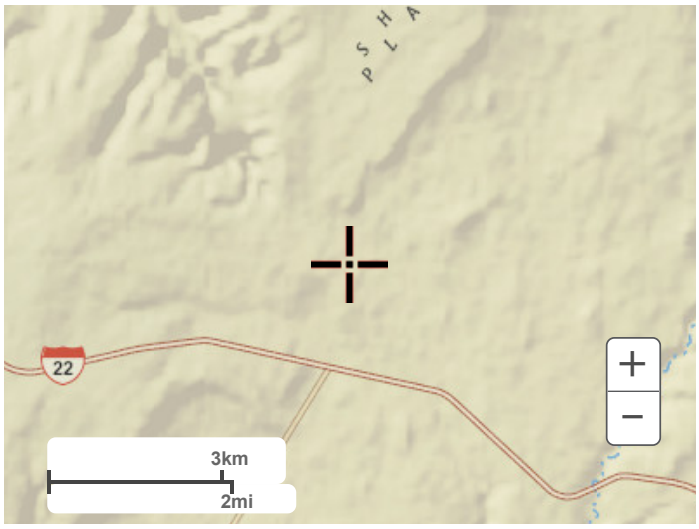
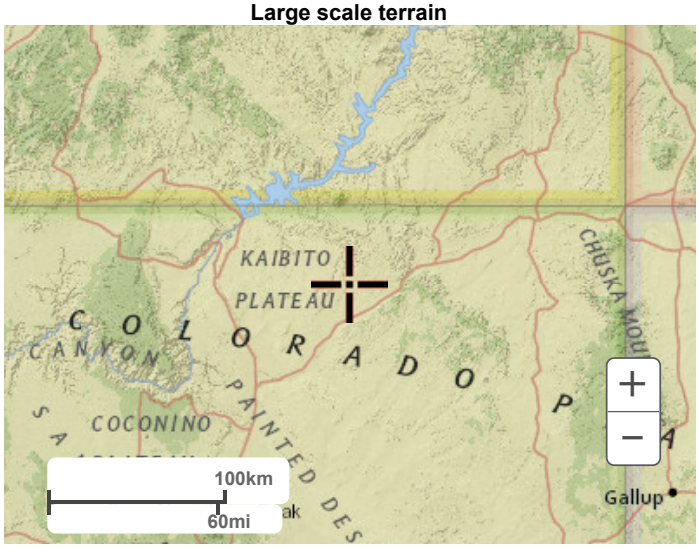
Maps & aerials

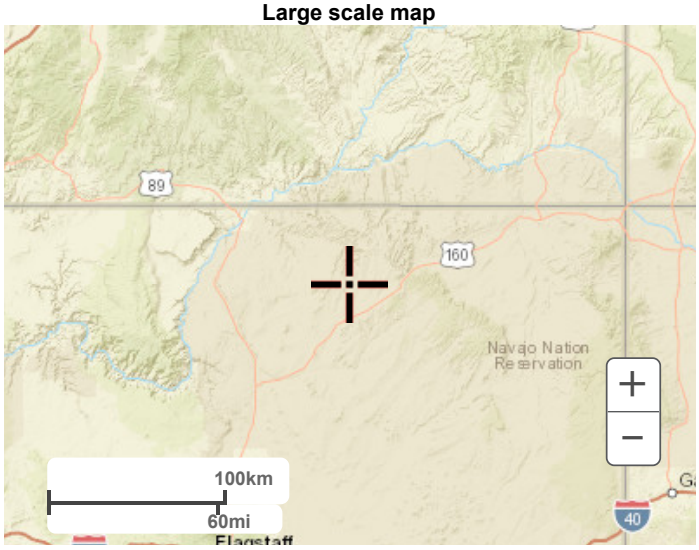
Small scale terrain



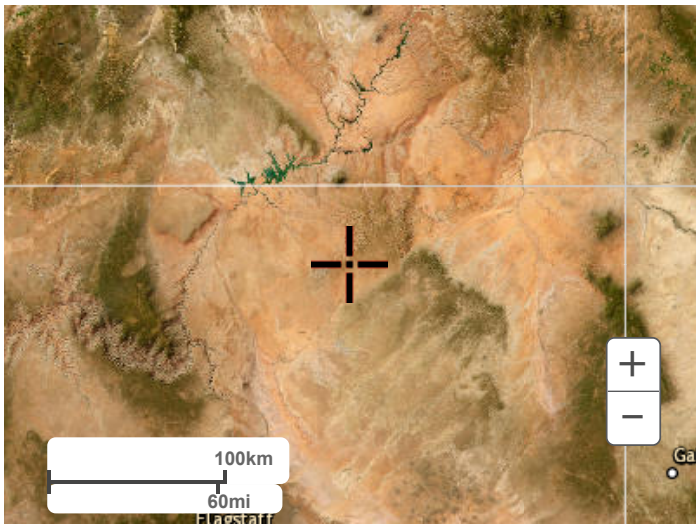
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX 4: WEB SOIL SURVEY

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Navajo Mountain Area, Arizona, Parts of Apache, Coconino and Navajo Counties



June 26, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:594 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 25 50 100 150

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Navajo Mountain Area, Arizona, Parts of Apache, Coconino and Navajo Counties
Survey Area Data: Version 19, Sep 7, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 18, 2021—Nov 30, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
20	Mespun-Bispen-Rock outcrop complex, moist, 1 to 15 percent slopes	1.2	100.0%
Totals for Area of Interest		**1.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Navajo Mountain Area, Arizona, Parts of Apache, Coconino and Navajo Counties

20—Mespun-Bispen-Rock outcrop complex, moist, 1 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2rqrx
Elevation: 5,900 to 7,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Mespun and similar soils: 40 percent
Bispen and similar soils: 25 percent
Rock outcrop: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mespun

Setting

Landform: Dune fields
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Alluvium derived from sandstone and/or eolian sands derived from sandstone over residuum weathered from sandstone

Typical profile

C1 - 0 to 4 inches: sand
C2 - 4 to 21 inches: loamy sand
C3 - 21 to 37 inches: fine sand
C4 - 37 to 60 inches: fine sand

Properties and qualities

Slope: 1 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline (0.1 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c

Hydrologic Soil Group: A
Ecological site: R035XC315AZ - Sandy Upland 10-14" p.z.
Hydric soil rating: No

Description of Bispen

Setting

Landform: Dune fields
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from sandstone and/or eolian sands derived from sandstone over residuum weathered from sandstone

Typical profile

C1 - 0 to 3 inches: fine sand
C2 - 3 to 17 inches: sand
C3 - 17 to 42 inches: fine sand
C4 - 42 to 49 inches: fine sandy loam
R - 49 to 59 inches: bedrock

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 0.7 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: A
Ecological site: R035XC315AZ - Sandy Upland 10-14" p.z.
Hydric soil rating: No

Description of Rock Outcrop

Properties and qualities

Depth to restrictive feature: 0 to 4 inches to lithic bedrock

Minor Components

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

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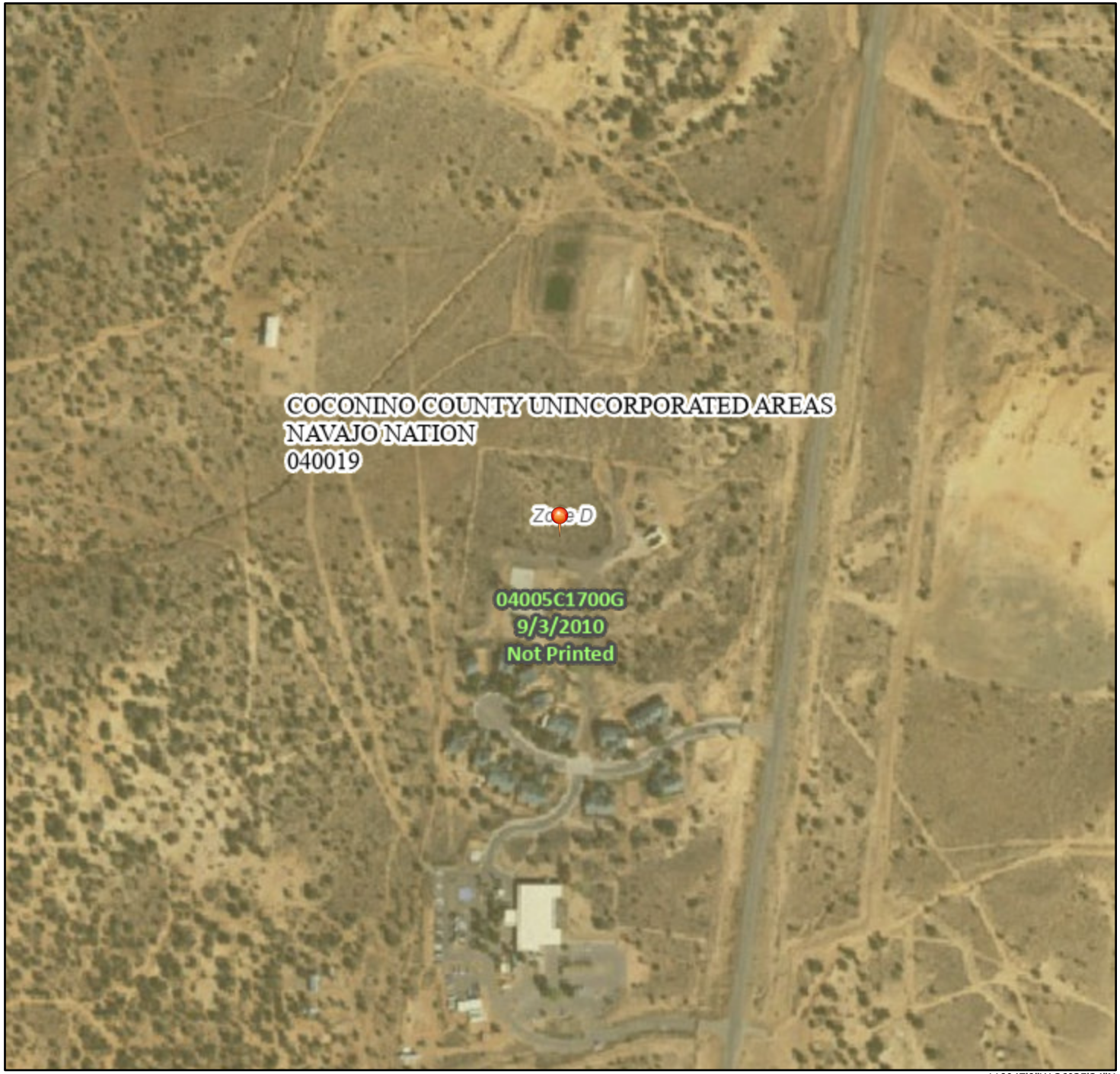
APPENDIX 5: FEMA FIRMETTE

National Flood Hazard Layer FIRMette

FEMA

110°47'46"W 36°36'3"N



110°47'9"W 36°35'34"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/26/2024 at 12:53 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

iHouse 19 Unit Apartment Building

Tonalea, AZ

Appendix A4
Commissioning Plan

JSRa
JOHNSON SMITTHIPONG & ROSAMOND ASSOCIATES, INC.
5210 E Williams Circle, Suite 600 ▪ Tucson, AZ 85711 ▪ v:520.547.7904 ▪ f:520.547.7905 ▪ www.jsra.com

Inscription House Apartments
Tonalea, Arizona

COMMISSIONING PLAN
August 12, 2024

Bernhard

Bernhard TME, LLC ▪ Engineering Division

2990 N. Swan Rd, Suite 227
Tucson, AZ 85712
(520) 323-2381
www.bernhard.com/engineering

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INTRODUCTION

Purpose of the Commissioning Process

The purpose of the Commissioning Process is to ensure that all systems are designed to reflect the facility core philosophies, that each is installed correctly and functions in accordance with the Owner's Project Requirements (OPR) and the design teams Basis of Design (BOD). Further, the Commissioning Process helps to ensure that the building performance is sustainable through an appropriate level of training for the maintenance staff and by verifying the necessary documentation has been provided to the operational staff to maintain the facility in the future.

Commissioning (Cx) is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning with developing a comprehensive Commissioning Plan and continuing through construction and acceptance with installation verifications and functional testing of the systems.

The Architect/Engineer (A/E) will do their own respective commissioning reports as part of construction administration services and will provide **Indian Health Services (IHS)**. This process works in concert with the responsibility of the Design Team and installing Contractor's to provide a quality finished product.

Commissioning is intended to enhance the quality of the building systems startup and aid in the orderly transfer of systems to the beneficial use by the **IHS Staff**.

The Cx Plan is to be used as a guide by Project Team Members throughout the duration of this Project. The detailed testing requirements and procedures will be defined by commissioning specifications and final testing forms that will be issued by the A/E as the project progresses. This Commissioning Plan is written to provide information about the many activities that make up the Cx Process and serves as a living document as the project progresses to record the history of the project. Figure 1 provides an overview of the Commissioning Schedule for the project.

Commissioning Scope

The Cx Process will involve members of the design team and construction team, as well as representatives from **IHS**. The Commissioning Process includes members from all parties involved in design, construction, startup, testing, operation and maintenance. Each team member is responsible for specific commissioning responsibilities throughout the project. The team members involved with Commissioning Process are shown in the Commissioning Plan Outline and the proposed building systems to be commissioned are identified in the Commissioning Plan Outline. The Commissioning Plan Outline, included in the following pages, is a short summary in tabular form of Items and tasks associated with the commissioning process.

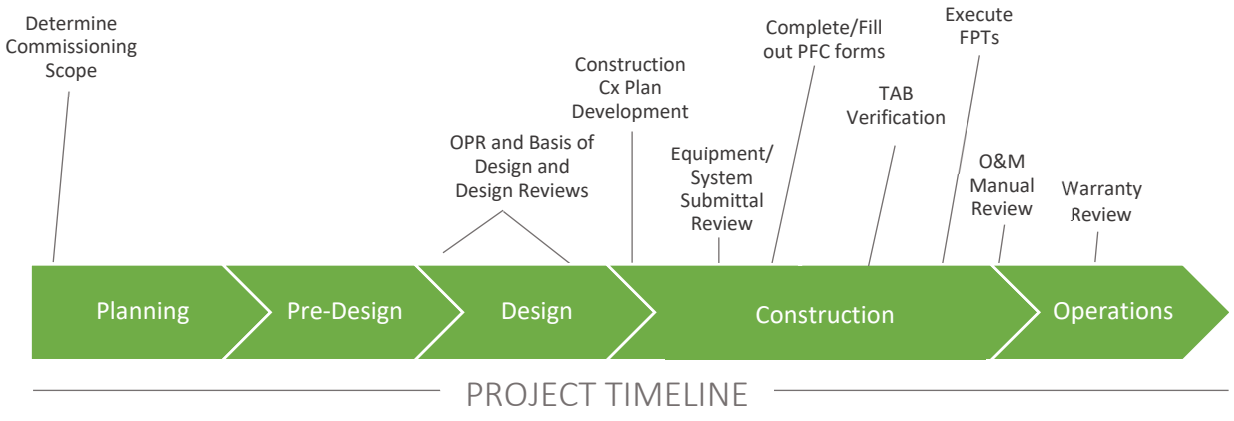

Figure 1 Commissioning Process Schedule Overview

COMMISSIONING PLAN OUTLINE

Item	Tasks	Deliverable	Date
Systems to be Commissioned	• **Life Safety Systems** ➢ Fire Sprinklers ➢ Smoke Detectors and sensors • **Air Handling Unit System** ➢ Air Handling Unit including Supply and Return (or Relief) fans ➢ Exhaust air fans ➢ Diffusers / Grilles (Supply, Return, and Exhaust) ➢ Ductwork (Supply, Return, and Exhaust) • **Major Electrical Systems** ➢ Main Switchgear and all electrical panel boards ➢ Advanced Metering System ➢ Renewable Energy System • **Other Systems** ➢ Water Meter	Commissioning Plan	Start April 2024 Through Project Completion -TBD

Item	Tasks	Deliverable	Date
Owner's Project Requirements	• Create a document that defines the owner's project requirements and present to the design team and owner. – **Responsible Party – Architect.**	Completed OPR Document	April 2024
Develop Commissioning Plan	• Develop Commissioning Plan outlining the Commissioning Process, the roles of each Commissioning Team Member and the scope of the Commissioning work. Responsible Party: **Responsible Party – Bernhard.**	Commissioning Plan	Start June 2024 Final August 2024
Develop Commissioning Specifications	• Develop Commissioning specifications for implementation in to the bid documents. Responsible Party: **Responsible Party – Bernhard.**	Commissioning Specifications (Div. 22, 23 and 26)	August 2024

Item	Tasks	Deliverable	Date
Develop Pre-Functional Checklists to Review and Verify Equipment / System Installation and Startup	• Includes all equipment and systems listed at the beginning of the outline. • Using the project submittals and contract drawings prepare Pre-Functional Checklists. Responsible Party: **Responsible Party – Bernhard** • Verify proper installation, placement and startup of systems and equipment. Complete pre-functional checklist. - Responsible Party: **Responsible Party – Bernhard** • Provide equipment start-up sheets prior to equipment start-ups and post equipment start-ups. Responsible Party: **Responsible Party – General Contractor - TBD** • Provide pipe pressure testing reports. Responsible Party: **Responsible Party – General Contractor - TBD** • Provide pipe flushing reports. Responsible Party: **Responsible Party – General Contractor - TBD** • Correct issues identified by the A/E as a result of the inspections. Responsible Party: **Responsible Party – General Contractor - TBD**	Completed Pre-Functional Checklist. Start-up Reports Component Testing Documentation	Start of Construction Phase: TBD
Test & Balance (TAB) Verification	• Provide pre-tab inspection report. **Responsible Party – General Contractor - TBD** • Review pre-tab inspection report. Responsible Party: **Responsible Party – Bernhard.** • Provide TAB report. **Responsible Party – General Contractor - TBD** • Review TAB Report. Responsible Party: **Responsible Party – Bernhard**	Pre-tab Inspection Review comments. TAB Report Review comments.	Closeout of Construction Phase: TBD

Item	Tasks	Deliverable	Date
Functional Performance Testing (FPTs)	• Includes all equipment and systems listed at the beginning of the outline. • Prepare the Functional Performance Testing protocols for execution for systems listed. Responsible Party: **Responsible Party – Bernhard Cx** • Review controls programming and graphics and provide comments to the controls contractor. Responsible Party: **Responsible Party – Bernhard Cx** • Execute and Witness Functional Performance Testing and complete Functional Performance Testing documentations for systems listed. Responsible Party: **Responsible Party – Bernhard Cx** • Assist Design team by operating the controls system during the functional performance test. Responsible Party: **Responsible Party – General Contractor - TBD** • Functionally test lighting occupancy sensors, daylighting controls and multi-level lighting sensors. Responsible Party: **Responsible Party – Bernhard** • Define deficiencies on issues log. Responsible Party: **Responsible Party – Bernhard**	Completed FPTs. Updated Issues Log.	Midpoint of Construction Phase: TBD
Operations & Maintenance Manual Review	• Submit operations and maintenance manuals for review. Responsible Party: **Responsible Party – General Contractor - TBD** • Review operations and maintenance manuals. Responsible Party: **Responsible Party – Bernhard**	Review Comments	Closeout of Construction Phase: TBD
As-built Drawings Reviews	• Provide mechanical, electrical and control as-built drawings. Responsible Party: **Responsible Party – General Contractor - TBD** • Review mechanical and electrical as-built drawings and control as-built drawings. Responsible Party: **A/E Design team**	Review Comments	Closeout of Construction Phase: TBD

COMMISSIONING TEAM MEMBERS

Firm & Role	Contact Name & Title	Contact Information
Indian Health Service (IHS) **Contracting Officer: Taylor Kanthack** **Division of Engineering Services** **701 5th Avenue, Suite 1650** **Seattle, WA 98104** Owner	***Antoine Panther*** *– COR*	Address: Indian Health Service - Phone: Cell: E-mail: Antoine.Panther@ihs.gov
Johnson Smitthipong & Rosamond Associates Architectural Firm of Record	**Daniel Hargreaves** *– Architect of Record*	Address: Phone & Fax Numbers: Office: 520.547.7904 E-mail: DHargreaves@srarchinc.com
Bernhard MEP / FP Engineering Firm of Record / Commissioning	**Mark Alvarez** *– Mechanical Engineer of Record* **Jacob Clark** *– Electrical Engineer of Record* **Mark Alvarez** *– Plumbing Engineer of Record* **Nick Lombardo** *– Fire Protection Designer*	Address: 2990 N. Swan Rd, Suite 227, Tucson, Az Phone & Fax Numbers: Office: 520.323.2382 Cell: 520.247.3427 (Mark) Cell: 520.822.6017 (Jacob) Cell: 501.519.1213 (Gary) E-mail: malvarez@bernhard.com jclark@bernhard.com nlombardo@bernhard.com

Firm & Role	Contact Name & Title	Contact Information
Schneider Structural Engineers Structural Engineering Firm of Record	**Ron Schneider** – *Structural Engineer of Record*	Address: Phone & Fax Numbers: 520.512.8183 E-mail: rschneider@sasstructural.com
Dowl Civil / Site Engineering Firm of Record	**Rudy Ing** – *Civil / Site Engineer of Record*	Address: Phone & Fax Numbers: Office: 480.753.0800 Cell: 206.920.2182 E-mail: rudying@dowl.com
TBD General Contractor	**TBD** – *Senior Estimator* **TBD –** *Sr. Project Manager* **TBD –** *Project Manager* **TBD** – *Assistant Project Manager* **TBD –** *Senior Superintendent*	Address: TBD Phone & Fax Numbers: TBD E-mail: TBD
TBD Mechanical Contractor	**TBD** -- *Superintendent* **TBD** – *Project Manager* **TBD** – *Sheet Metal Foreman* **TBD** – *Piping Foreman*	Address: TBD Phone & Fax Numbers: TBD E-mail: TBD

Firm & Role	Contact Name & Title	Contact Information
TBD Electrical Contractor (EC)	**TBD -** *Project Manager* **TBD** – *Assistant Project Manager*	Address: TBD Phone & Fax Numbers: TBD E-mail: TBD
TBD Test and Balance Contractor (TAB)	***TBD*** *- Project Manager* ***TBD*** *- TAB Technician*	Address: TBD Phone & Fax Numbers: TBD E-mail: TBD

iHouse 19 Unit Apartment Building

Tonalea, AZ

Appendix A6
Cut Sheets

JSRa
JOHNSON SMITTHIPONG & ROSAMOND ASSOCIATES, INC.
5210 E Williams Circle, Suite 600 ▪ Tucson, AZ 85711 ▪ v:520.547.7904 ▪ f:520.547.7905 ▪ www.jsra.com

ADVANTA
CABINETS



Shown in Slate painted finish
Photo of K Hovnanian Homes Somerset subdivision in Plainfield

Siena™ Slab Cabinetry

Siena offers the classic styling of a **recessed flat center panel** design with the simplicity of **standard reveal** doors to create limitless options for your room's décor. Available in birch or enamel painted finishes.

B Birch Stain finishes:


Double Espresso


Truffle


Espresso


Autumn Brown


Also available in
5-PC drawer front


Nutmeg


Mocha


Café


Toffee

P Enamel Paint* finishes:



Onyx


Slate


Linen


Alpine White

Siena™ Slab Cabinetry – SIMPLE DESIGN, BEAUTIFUL STYLING

3/4" thick solid door frames and drawer fronts • Genuine wood veneer flat center panel • Painted doors come with an MDF center panel • Assembled with five-piece mortise and tenon joinery • Available in square design for all cabinets; drawer fronts available in slab or 5-piece styles • Standard reveal doors and drawer fronts • Single step edge on door frame • Decorative hardware available but not required

*additional charge applies
Visit **advantacabinets.com/paint-disclosure** for more information on our painted finishes.

AdvantaCabinets.com

Proudly Made in America

Kitchen Cabinet Manufacturers Association
Environmental Stewardship Program
All Products Impact the Environment
For ESP Program Criteria, Visit kcma.org

ADVANTA CABINETS

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Advanta Cabinets products are certified by the Kitchen Cabinet Manufacturers Association.

Waterford Stone™

ARTISAN MASONRY STONE VENEERS®

ECHELON™

Quality masonry products from Oldcastle®



Waterford Stone™ evokes the natural, time-honed look of hand-cut stone with its antiqued edges and textured face while featuring the modern benefits of a manufactured masonry veneer. Waterford grants unparalleled design flexibility with its diverse array of sizes and colors, employing Echelon's unique multiple color blending system that will last the life of your project. Waterford Stone may be paired with the EnduraMax™ High Performance Wall System.

Features & Benefits

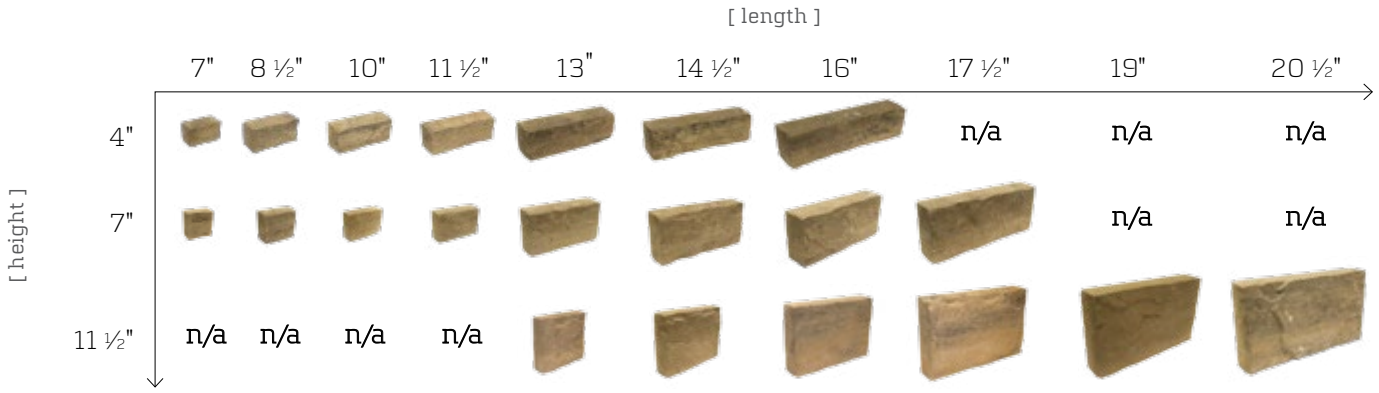
- May be paired with the EnduraMax™ High Performance Wall System.
- Integrated color throughout the entire unit.
- Hand-chiseled texture reminiscent of natural stone.
- Modular format means less cutting and waste.
- Integral water admixture repels water & resists mold.

Colors

We provide regional color options for Waterford Stone. Please refer to our product pages on EchelonMasonry.com for colors or ask your architectural representative for samples.

Shapes & Sizes

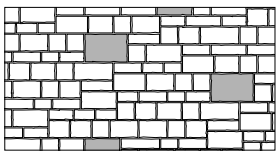
Stones of 4" and 7" height are shipped on the same pallet, and the 11½" height is shipped on a corresponding pallet. Stone face dimensions are nominal based on a mortar joint width of 1/2". All stones are approximately 3½" in depth.



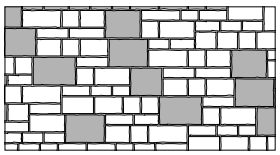
All units are 3 1/2" in depth.

Laying Patterns

Waterford Stone is a truly modular system and is easily adapted to suit the taste of the most discerning owners. By varying the ratio of 11½" large stones, you can alter the pattern to best suit your individual style.



10% Large Stones



25% Large Stones



Technical Information

Minimum compressive strength	2000 psi
Maximum absorption by weight	13 lbs./cu. ft. (by wt.)
Minimum density	125 lbs./cu. ft. or greater
4" & 7" piece pallet weight	3,564 lbs./104.8 sq.ft.
11 ½" piece pallet weight	3,496 lbs./92 sq.ft.
11 ½" chiseled piece pallet weight	4,048 lbs./92 sq.ft.

Artisan Masonry Stone Veneers™ meet or exceed all ASTM C90 specifications.
Individual product test results will vary depending on regional manufacturing.

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WESTERN BLENDED PRODUCTS
The Plasterer's Standard

Systems: Western 1-Kote

A stucco system assembly for residential & commercial buildings with Insulated & Crack Resistant Systems (CRS) optional components.

Consult the latest Western1-Kote Evaluation Report for all approved system components and available assemblies.

SYS Systems & Assemblies

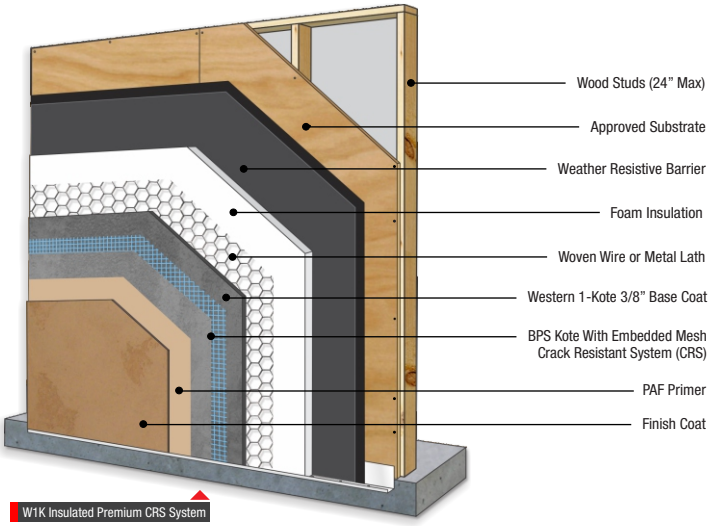
System description:
Western 1-Kote Systems are complete stucco assemblies for residential and commercial buildings. All W1K Systems are code compliant stucco assemblies that may be installed over open framing or various approved sheathing surfaces. Some of these assemblies provide improved energy efficiency and higher R-Values when combined with an approved continuous insulation board component. W1K Systems are impact resistant, and may be installed as a conventional system coating (scratch & brown) complying with ASTM C926. Fire resistant assemblies are available. Consult the latest Western 1-Kote Evaluation Report for further details.

Systems Recognition:
Western 1-Kote Exterior Stucco Systems have been evaluated as an exterior wall covering in compliance with Chapters 14 and 25 of the IBC and Chapter 7 of the IRC.

System Components.
Western 1-Kote systems may consist of following components:

- ***An approved substrate (or open framing).*** *Consult the latest Western 1-Kote Evaluation Report for approved substrate options.*
- ***A water-resistive barrier.*** *Weather-resistive barriers shall comply IBC with Sections 1404.2 and 2510.6, IRC Section R703.2" [AC11], or the ICC-ES Acceptance Criteria* for Water-resistive Barriers (AC38).
- ***A continuous Insulation Foam Board (optional).*** *(EPS) foam plastic insulation boards shall be Type II as set forth in ASTM C578, with a minimum nominal density of 1.5 pcf (24 kg/m3). Extruded polystyrene (XPS) foam plastic insulation boards shall be Type IV or Type V as set forth in ASTM C578, with a minimum nominal density of 1.5 pcf (24 kg/m3). Polyisocyanurate foam plastic insulation boards shall be Type II as set forth in ASTM C1289, with a minimum nominal density of 2.0 pcf (32 kg/m3).*
- ***Woven Wire or Metal Lath.*** *Lath shall be regular or self-furring wire fabric lath or metal lath and "shall comply with the ICC-ES Acceptance Criteria for Metal Plaster Bases (Lath) (Ac191).*
- ***A Western 1-Kote Cementitious Basecoat.*** *Available in a sanded presentation. When the Concentrated version is used, it shall be mixed with 250 Lbs of ASTM C144 or C897 graded aggregate.*
- ***A BPS Kote, Skim Coat with embedded fibermesh - Crack-Resistant System (CRS) (optional).*** *BPS Kote must be applied at a minimum thickness of 1/16" with an approved alkali-resistant reinforcing fibermesh fully embedded within the coating.*
- ***A PAF Primer Coat (optional).*** *PAF primer may be tinted to match the desired finish.*
- ***A Finish Coat.*** *Acceptable finishes for Western 1-Kote, and the products noted in the latest Western 1-Kote Evaluation Report include Western Blended Products (WBP), WBP Premium Acrylic Finishes (PAF), WBP Exterior Stucco Finishes, WBP Elastomeric Paints, and WBP PAF Specialty Products*

System Overview:
Typically, Western 1-Kote systems are stucco assemblies in which the water resistive barrier is installed over open framing or an approved sheathing substrate. An optional EPS, XPS or Polyisocyanurate Foam Plastic Insulation Board is then attached over the previously installed water resistive barrier. Woven Wire or Metal Lath is fastened to the optional continuous insulation board. A basecoat of Western 1-Kote is then applied over the wire or lath, at a minimum thickness of 3/8". Western 1-Kote products are available in Concentrated and Sanded presentations. An optional Skim Coat of BPS Kote with embedded fibermesh may be applied over the Western 1-Kote basecoat as part of a Crack Resistant System (CRS). A variety of finish coats may be applied over the Western 1-Kote basecoat or Crack Resistant System. All Western Blended Products Exterior Stucco Finishes: Base A & B Stucco and Paint Base Exterior Stucco Finish, as well as all Premium Acrylic Finishes (PAF) and PAF Specialty Finishes are suitable exterior finish coats for all Western 1-Kote systems. Please consult **Table 1** in this document for all available options.



System Limitations and Requirements:
Ensure the following is taking place before the application of the system components:

- All components must be installed per code requirements.
- Wood-based sheathing shall be gapped 1/4" to allow for expansion.
- Substrates are structurally sound, free of loose materials, voids, projections or other conditions that may interfere with the installation of the components.
- Substrates are dry, clean, free of oils, grease, efflorescence, or other liquid or solid debris.
- There are no projections or planar irregularities greater than 1/4" within any 4' radius in the substrate.
- Masonry or Concrete surfaces are sealed or prepared with a bonding agent prior to the application of any basecoat.
- All penetrations & openings are properly flashed.
- All components are stored above ground under optimal conditions, or if stored outdoors, shall be adequately covered to keep dry.
- Components shall be installed as instructed by the manufacturer and must be in compliance with the latest Evaluation report and stated references (if applicable).
- Components shall not be installed when surface or ambient temperatures are at or below 40°F / 4.4°C or above 100°F / 34°C.
- Cementitious components require a minimum of forty-eight (48) hours moist curing. Environmental conditions such a heat, wind and low humidity will require additional curing.
- Protect all installed components from freezing and inclement weather until dry.
- Consult the latest existing codes & regulations prior to the installation of any WBP System assembly.

System Assembly Options and Warranties:
All available Western 1-Kote systems assemblies are listed in the following Table. System Warranties are different and dependant upon the selected assembly. Contact WBP for more information.

Sacramento Stucco Co.
1550 Parkway Blvd. West Sacramento. CA 95691 / (916) 372-7442
Western Stucco Co.
6101 N. 53rd. Drive Glendale, AZ 85311 / (623) 939-9455
Rio Grande Stucco Co.
9151 Roseway Drive El Paso, TX 79907 / (915) 858-3494

Visit us on the web:
westernblended.com

WESTERN BLENDED PRODUCTS
SMA STUCCO MANUFACTURER'S ASSOCIATION

Western Blended Products are manufactured in the U.S.A. utilizing the strictest quality control processes to ensure consistent, high-performance products on every project.

Made in the USA

Table 1. Western 1-Kote System Components & Warranties.

Western 1 -Kote System	Components	Warranty.
W1K Standard	• Insulation Board: None. • Basecoat Admix: None. • Basecoat: W1K Gray Concentrate. • Crack Resistant System (CRS): None. • Primer Coat: None. • Finish Coat: Exterior Stucco Finish or Premium Acrylic Finish.	3 Years.
W1K Insulated	• Insulation Board: EPS / XPS / Polyisocyanurate • Basecoat Admix: None. • Basecoat: W1K Gray Concentrate. • Crack Resistant System (CRS): None. • Primer Coat: None. • Finish Coat: Exterior Stucco Finish or Premium Acrylic Finish.	3 Years.
W1K Standard SND	• Insulation Board: None. • Basecoat Admix: None. • Basecoat: W1K Premium Sanded or Sanded Gray. • Crack Resistant System (CRS): None. • Primer Coat: None. • Finish Coat: Exterior Stucco Finish or Premium Acrylic Finish.	5 Years.
W1K Insulated SND	• Insulation Board: EPS / XPS / Polyisocyanurate • Basecoat Admix: None. • Basecoat: W1K Premium Sanded or Sanded Gray. • Crack Resistant System (CRS): None. • Primer Coat: None. • Finish Coat: Exterior Stucco Finish or Premium Acrylic Finish.	5 Years.
W1K Standard SND - CRS	• Insulation Board: None. • Basecoat Admix: None. • Basecoat: W1K Premium Sanded or Sanded Gray. • Crack Resistant System (CRS): BPS Kote with embedded fibermesh. • Primer Coat: None. • Finish Coat: Exterior Stucco Finish or Premium Acrylic Finish.	7 Years.
W1K Insulated SND - CRS	• Insulation Board: EPS / XPS / Polyisocyanurate • Basecoat Admix: None. • Basecoat: W1K Premium Sanded or Sanded Gray. • Crack Resistant System (CRS): BPS Kote with embedded fibermesh. • Primer Coat: None. • Finish Coat: Exterior Stucco Finish or Premium Acrylic Finish.	7 Years.
W1K Standard Premium - CRS	• Insulation Board: None. • Basecoat Admix: Blackcap Admix (optional) • Basecoat: W1K Premium Sanded • Crack Resistant System (CRS): BPS Kote with embedded fibermesh. • Primer Coat: PAF Primer. • Finish Coat: Premium Acrylic Finish Plus, e2 or PAF Specialty Finishes.	10 Years. (+5 Years w/ Blackcap Admix & PAF e2)
W1K Insulated Premium - CRS	• Insulation Board: EPS / XPS / Polyisocyanurate • Basecoat Admix: Blackcap Admix (optional) • Basecoat: W1K Premium Sanded • Crack Resistant System (CRS): BPS Kote with embedded fibermesh. • Primer Coat: PAF Primer. • Finish Co at: Premium Acrylic Finish Plus, e2 or PAF Specialty Finishes.	10 Years. (+5 Years w/ Blackcap Admix & PAF e2)

Warranty:
Manufacturers or Western Blended Products (WBP) warrants its products to be of merchantable quality and suitable for the general purpose for which they were intended, when applied in accordance with WBP instructions. Manufacturers of WBP do not warrant its products to be suitable for any purpose or use other than for which they were intended. Liability under this warranty is limited to supplying new material without charge, or at manufacturers of WBP option, to a refund of the purchase price. In the event of a claim under this warranty, written notice must be given to the originating plant of the WBP goods at the address shown hereon. This limited warranty is issued and accepted in lieu of all other expressed warranties, and expressly excludes liability for consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, or limitations on how long an implied warranty lasts, so the above limitations and exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

Sacramento Stucco Co.
1550 Parkway Blvd. West Sacramento. CA 95691 / (916) 372-7442
Western Stucco Co.
6101 N. 53rd. Drive Glendale, AZ 85311 / (623) 939-9455
Rio Grande Stucco Co.
9151 Roseway Drive El Paso, TX 79907 / (915) 858-3494

Visit us on the web:
westernblended.com

Western Blended Products are manufactured in the U.S.A. utilizing the strictest quality control processes to ensure consistent, high-performance products on every project.

Made in the USA

SNAP-CLAD PANELS

Snap-Clad panels feature architectural aesthetics as well as structural performance. Snap-Clad panels, produced in continuous lengths, are leveled to provide superior flatness and feature an optional factory-applied sealant bead for improved weather resistance. Maximum panel length is 64′ and minimum panel length is 4′. Consult factory for longer lengths.

Snap-Clad panels feature a 1-¾" leg height and a continuous interlock for improved structural performance and wind resistance. A concealed-fastener clip system allows for thermal expansion/contraction while providing extraordinary hold-down strength. Two clips are available: a standard clip for most mansard and fascia applications, and a high-performance clip for roofing applications and UL 90-rated assemblies.

TRIM

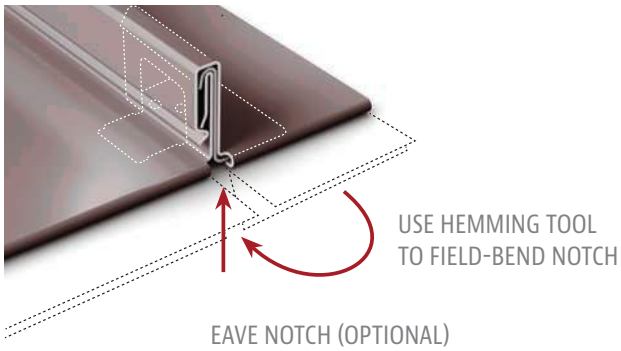
All flashing and trim shall be fabricated by manufacturer or qualified fabricator. Flashing shall be PAC-CLAD aluminum (.032 - .063 gauge as specified) or PAC-CLAD steel (24 gauge or 22 gauge as specified). A 30-year non-prorated finish warranty can be supplied covering finish performance. Vinyl masking is recommended on all fabrication applications where extra handling is expected. NOTE: The strippable film must be removed immediately after installation.

INSTALLATION

Snap-Clad panels are intended for use in roofing, mansard and fascia applications. Substrates may include ⅝" (min.) plywood, nailboard insulation or equal with an underlayment of ice and water shield applied horizontally from eave to ridge. Other substrates may include metal decking or rigid insulation in conjunction with bearing plates. A minimum 2:12 pitch is recommended in most applications. Contact Petersen for assistance with details on projects requiring lower slopes. For coastal applications, aluminum panels along with stainless steel clips must be used for warranty. Consult a local architect/engineer for compliance with local codes and conditions.

EAVE NOTCHING

Factory-produced eave notching is available at nominal additional cost on Snap-Clad panels and Redi-Roof standing seam panels. Factory eave notching saves on labor cost by eliminating the need for field cutting to produce a properly trimmed eave detail.



EAVE NOTCH (OPTIONAL)
AT FORMED SEAMS

PRODUCT FEATURES

- Architectural/structural panel
- Factory-applied sealant available
- Continuous interlock
- Labor-saving one-piece design
- Stiffener beads upon request
- Striations upon request
- Factory eave notching available
- 30-year non-prorated finish warranty
- Maximum factory-produced panel length is 64′ (check w/factory for longer lengths)
- Weathertightness warranty available
- 43 stocked colors (24 gauge steel)
- 16 stocked colors (22 gauge steel)
- 36 stocked colors (.032 aluminum)
- 22 stocked colors (.040 aluminum)
- Panels available in Galvalume Plus

UL CLASSIFICATION

- UL-580 Class 90 wind uplift
- UL-1897 wind uplift
- UL-790 Class A fire rated
- UL-263 fire resistance rated
- UL-2218 impact resistance rated
- UL-90 rated aluminum panel up to 16" O.C.
- UL-90 rated steel panel up to 18" O.C.

ASTM TESTS

- ASTM E1592 tested
- ASTM E283/1680 tested
- ASTM E331/1646 tested

FLORIDA BUILDING & MIAMI-DADE PRODUCT APPROVALS

Please refer to pac-clad.com or your local factory for specific product approval numbers for Snap-Clad.



Cabela's, Gainesville, VA
Installing contractor: Orndorff & Spaid
Architect: CR Architecture + Design
General contractor: L.F. Jennings
Owner: Cabela's Inc.
Photographer: hortonphotoinc.com
Profiles: Snap-Clad, S-5! ColorGard
Color: Custom East Georgia Green



UL 90

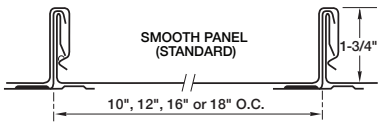
SNAP-CLAD

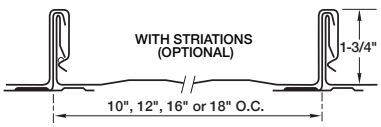
MATERIALS

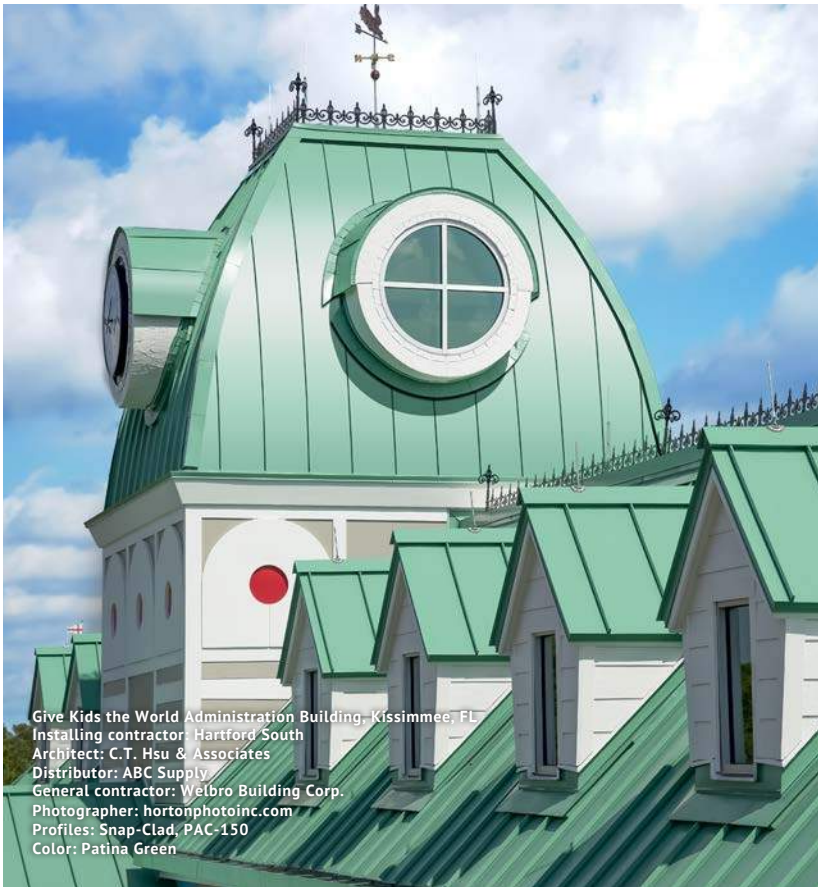
.032 aluminum	24 gauge steel
.040 aluminum	22 gauge steel

SPECS

10", 12", 16" or 18" O.C.	1-3/4" High







Give Kids the World Administration Building, Kissimmee, FL
Installing contractor: Hartford South
Architect: C.T. Hsu & Associates
Distributor: ABC Supply
General contractor: Welbro Building Corp.
Photographer: hortonphotoinc.com
Profiles: Snap-Clad, PAC-150
Color: Patina Green

PAC-CLAD® COLOR CHART

TRIM

PAC-CLAD products are available in prime quality aluminum (.032 - .063), 24 gauge G-90 galvanized steel and 22 gauge Galvalume steel, finished with a 70% PVDF (Kynar) finish on the top side, with a washcoat on the bottom. Other metals available include mill finish aluminum, bare galvanized steel, stainless steel, Galvalume Plus and anodized aluminum.

A strippable vinyl film can be applied to coil, flat sheet or fabricated parts to protect painted surfaces. Vinyl masking is recommended where extra handling is expected. NOTE: Film must be removed immediately after installation.

FINISH WARRANTY

Life expectancy is 30-years plus on 70% PVDF-finished materials. A 30-year, non-prorated warranty covering color fade, chalking and film integrity is available at no extra charge. Warranty terms vary slightly for Cardinal Red, Award Blue, Weathered Steel and Weathered Copper.

PAC-CLAD METALLICS

Petersen can supply metallic finishes with the economy of a one-pass, two-coat system at a moderate additional cost. These colors are ideal for all building envelope applications. A PAC-CLAD metallic 30-year, non-prorated finish warranty applies. Proper orientation is required as this is a directional finish.

COMMITMENT TO SUSTAINABILITY

PAC-CLAD products provide unmatched aesthetics and performance, plus an element of sustainability. Where possible, Petersen products include a high percentage of recycled material, which lowers their environmental footprint. Additionally, PAC products are 100% recyclable which may reduce the solid waste stream to landfills.

Petersen also offers the industry's widest range of 45 colors, most of which feature outstanding SRI (Solar Reflectance Index) values for improved cooling and e savings performance. PAC-CLAD offers 35 finishes that are rated by the Cool Roof Ratings Council, and 31 colors that are Energy Star®-approved. In addition, 30 PAC-CLAD finishes have an SRI of 29 or higher for steep slope roofs, to allow a building to qualify for credits in the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System. Refer to pacgreeninfo.com for more information on sustainable cool metal roofing.

SHERWIN-WILLIAMS. Coil Coatings

Petersen Aluminum has been a proud partner with Sherwin-Williams Coil Coatings since 1972

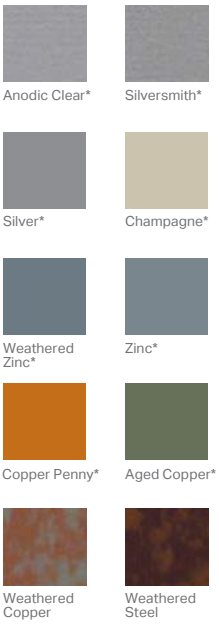
NOTE: Colors below are not exact representations of actual PAC-CLAD colors. Ask a PAC representative for a color-chip chart or painted metal samples before making final color selection.

STANDARD COLORS



* Denotes PAC-CLAD Cool Color

PREMIUM COLORS



PAC-CLAD® COLOR AVAILABILITY

PAC-CLAD STANDARD COLORS	REFLECTIVITY	EMISSIVITY	3 YEAR EXPOSURE	SRI	STEEL		ALUMINUM				ENERGY STAR
					24 GA.	22 GA.	.032	.040	.050	.063	
AGED BRONZE	0.28	0.86	N/A	27	✔						
ALMOND	0.53	0.87	0.52	62	✔	✔	✔	✔	✔		★
ARCADIA GREEN	0.30	0.88	0.30	31	✔		✔				★
AWARD BLUE	0.21	0.86	0.20	18	✔		✔		✔		
BERKSHIRE BLUE*	0.26	0.87	0.25	25	✔						
BLACK ALUMINUM**	0.20	0.86	0.19	17			✔	✔	✔	✔	
MATTE BLACK STEEL**	0.23	0.87	0.22	21	✔	✔					
BONE WHITE	0.65	0.86	0.64	78	✔	✔	✔	✔	✔	✔	★
BURGUNDY	0.23	0.87	0.22	21	✔		✔		✔		
BURNISHED SLATE	0.29	0.85	N/A	28	✔						
CARDINAL RED	0.36	0.86	0.36	38	✔		✔		✔		★
CHARCOAL	0.26	0.87	0.26	25	✔		✔		✔		★
CITYSCAPE	0.43	0.87	0.43	48	✔	✔	✔	✔	✔		★
COLONIAL RED	0.32	0.88	0.32	34	✔		✔	✔	✔		★
DARK BRONZE	0.26	0.88	0.26	26	✔	✔	✔	✔	✔	✔	★
EVERGREEN	0.25	0.86	0.23	24	✔		✔				★
FOREST GREEN	0.10	0.87	0.10	5	✔	✔	✔	✔	✔		
GRANITE*	0.36	0.87	0.36	39	✔	✔	✔	✔	✔		★
GRAPHITE	0.27	0.86	N/A	26	✔						
HARTFORD GREEN	0.09	0.88	0.09	4	✔		✔	✔	✔		
HEMLOCK GREEN	0.30	0.85	0.31	30	✔		✔		✔		★
HUNTER GREEN	0.26	0.86	0.25	25	✔		✔				★
INTERSTATE BLUE	0.13	0.87	0.12	8	✔		✔		✔		
MANSARD BROWN	0.28	0.85	0.28	27	✔	✔	✔	✔	✔		★
MEDIUM BRONZE	0.25	0.88	0.24	24	✔	✔	✔	✔	✔	✔	★
MIDNIGHT BRONZE	0.06	0.88	N/A	0	✔			✔			
MILITARY BLUE	0.29	0.87	0.28	30	✔		✔				★
MUSKET GRAY	0.28	0.87	0.27	28	✔	✔	✔		✔		★
PATINA GREEN	0.34	0.86	0.33	35	✔		✔				★
SANDSTONE	0.46	0.87	0.46	52	✔	✔	✔	✔	✔	✔	★
SIERRA TAN	0.31	0.87	0.31	32	✔	✔	✔	✔	✔		★
SLATE BLUE	0.23	0.87	0.22	21	✔		✔				★
SLATE GRAY	0.35	0.88	0.34	38	✔	✔	✔	✔	✔		★
STONE WHITE	0.67	0.85	0.65	80	✔	✔	✔	✔	✔	✔	★
TEAL	0.26	0.87	0.26	25	✔		✔				★
TERRA COTTA	0.36	0.88	0.35	39	✔		✔		✔		★
PAC-CLAD PREMIUM COLORS											
AGED COPPER	0.25	0.87	0.24	24	✔		✔		✔		★
ANODIC CLEAR	0.55	0.80	N/A	62				✔			
CHAMPAGNE	0.40	0.82	0.36	42	✔		✔	✔	✔		★
COPPER PENNY	0.45	0.87	0.44	51	✔		✔	✔	✔		★
SILVER	0.48	0.81	0.46	53	✔	✔	✔	✔	✔		★
SILVERSMITH	0.52	0.81	N/A	58				✔			
WEATHERED COPPER	0.45	0.88	N/A	51	✔						
WEATHERED STEEL	0.32	0.89	N/A	34	✔						
WEATHERED ZINC	0.25	0.82	0.24	22	✔	✔	✔		✔		★
ZINC	0.30	0.88	0.29	31	✔		✔	✔	✔		★
CLEAR-COAT ACRYLIC FINISH (NON-KYNAR)											
GALVALUME PLUS	0.68	0.14	0.55	57	✔	✔					★

PAC-CLAD Premium finishes are available from stock at a moderate extra cost. PAC-CLAD Copper Penny is a Non-Weathering finish. Solar Reflectance Index calculated according to ASTM E-1980.
*Low Gloss/Low Sheen, 70% PVDF finish ** Appearance differs for Black Aluminum and Matte Black Steel

ENERGY STAR PERFORMANCE CRITERIA:
Emissivity uses ASTM C1371 Reflectivity uses ASTM C1549.

TECHNICAL DATA FOR KYNAR 500/HYLAR 5000 COATING:

- South Florida Exposure: Color (ASTM D 2244) - No more than 5ΔE Hunter units at 20 years; Chalk (ASTM D 4214) – Rating no less than 8 at 20 years; Film integrity – 20 years.
- Accelerated Weathering (ASTM D 4587, ASTM G 154): 5000 Hours; Chalk, per ASTM D 4214, rating of 6 or better; Color, per ASTM D 2244, < 5ΔE (Hunter Units) color change.
- Humidity Resistance (ASTM D 2247): Galvalume or HDG, 100% RH, 2000 hours – No field blisters; Aluminum, 100% RH, 3000 hours – No field blisters
- Salt Spray Resistance (ASTM B 117): Aluminum, 3000 hours, Galvalume or HDG, 1000 hours – Creep from scribe no more than 1/16", no field blisters
- Chemical/Acid Pollution Resistance (ASTM D 1308): Pass
- T-Bend (ASTM D 4145): 1T – 3T with no loss of adhesion
- Pencil hardness (ASTM D 3363): HB – 2H
- Specular Gloss (ASTM D 523) @ 60 degrees: Typical – 20 – 35
- Abrasion Resistance (ASTM D 968): 67 +/- 10 liters
- Cross Hatch Adhesion (ASTM D 3359): No loss of adhesion
- Reverse Impact (ASTM D 2794): Galvalume or HDG, 2x metal thickness inch-pounds, no loss of adhesion; Aluminum, 1.5x metal thickness inch-pounds, no loss of adhesion
- Flame Test (ASTM E 84): Class A Coating

PAC-CLAD is a registered trademark of Petersen Aluminum Corp. Kynar 500 is a registered trademark of Arkema Inc. Hylar 5000 is a registered trademark of Solvay Solexis. 12/2018

COLORGARD® SNOW RETENTION SYSTEM



Petersen is stocking the patented ColorGard snow retention system. ColorGard is the only product available which will precisely match the color of any Petersen roof panel. ColorGard achieves this by utilizing a strip of the actual roof material, which is then mounted directly into ColorGard for a perfect match. This strip can be cut in the field or at Petersen's factory.

ColorGard utilizes the patented S-5! Clamp for its strength. The S-5! technology involves gripping the seam in such a way that there is no penetration to the panel material. S-5! utilizes round-point set screws for attachment which are specially made for the S-5! ColorGard or SnoFence™ snow retention system. These systems eliminate minimum temperature installation requirements and messy adhesives to apply. ColorGard can be installed at any temperature. For more information regarding ColorGard please contact your local Petersen representative.

COIL AND FLAT SHEET

In addition to offering the industry's widest selection of 70% PVDF (Kynar) finishes in steel and aluminum, Petersen also provides mill finish sheet and coil in a variety of gauges and widths. Anodizing-quality 5005-H34, as well as 3003-H14, is stocked in gauges .032 to .125 for all applications that require fabrication and post-finishing. With its state-of-the-art, cut-to-length and slitting equipment, Petersen can provide flat sheet and coil to exact specifications.



GENERAL CONSIDERATIONS

The following is a summary of conditions and considerations that Petersen considers important when specifying PAC-CLAD metal products. For more project-specific information, please contact 800-PAC-CLAD.

FINISHES

PAC-CLAD panels are available standard with a 70% PVDF (Kynar) finish. Please refer to the color information on pages 8 and 9 for color selection. Samples and photo-accurate color charts are available for your assistance.

SPECIAL COLORS

Special colors are available for most applications of greater than 10,000 sq. ft. and may be applied to either aluminum or G-90 galvanized steel. Contact Petersen for information concerning costs and availability.

INSTALLATION

Special care must be taken to ensure that panels are installed over a flat substrate. For roofing applications, panels typically must be installed over ⅝" or ¾" plywood decking with ice and water shield horizontally overlayed from the eave to the ridge. It is recommended that clips be installed on 18" centers for all applications except Snap-Clad, Tite-Loc Plus and Tite-Loc (consult specific UL Construction assemblies for clip spacing). Consult a local architect/engineer for requirements of local codes and conditions.

ACCESSORIES

Most applications require additional metalwork including fascia, storefront trim, copings, gravel stops, downspouts, etc. Such metalwork may be specified for fabrication by manufacturer or for fabrication from flat sheet as provided by manufacturer. Flashings fabricated from PAC-CLAD flat sheet are fully covered under Petersen's 30-year finish warranty.

PAC-CLAD flat sheet provides an exact color match to PAC-CLAD panels. PAC-CLAD flat sheets, coil and fabricated trim accessories are available with a strippable masking applied. This masking is recommended on all applications requiring extra handling. NOTE: This strippable film must be removed immediately after installation.

PANEL CONDITIONS/VARIATIONS

Pencil ribs (also known as stiffening beads) and striations must be requested by the customer.



LENGTHS

All panels are cut to custom lengths before roll-forming and are available in lengths up to 64'. See specific product pages for maximum panel lengths. Minimum length is 4'. Consult factory for longer lengths. Lengths are accurate to ¼". Custom cut-to-length service is available at no cost and helps to improve project economy.

PANEL WIDTHS

Most PAC-CLAD panels are available in non-standard on-center dimensions. Contact Petersen for product availability and cost. PAC-CLAD panel standard widths are nominal and could vary.

PITCH

Tite-Loc panels are designed for a roof pitch of ½:12 or greater. Snap-Clad panels have been designed to be installed on applications as low as 2:12 pitch. Redi-Roof panels and Snap-On panels have been designed for a minimum 3:12 pitch. Greater pitch may be required in snow country and in areas of extreme climate conditions.

Photo above:
Private Residence, Florida
Installing contractor: Cartercraft Roofing
Architect: T. S. Adams Studio Architects
General Contractor: Ray Jackson Construction
Photographer: hortonphotoinc.com
Profiles: PAC-150, Flush Panels
Colors: Weathered Zinc, Champagne

FIRE RATINGS

PAC-CLAD panels have been evaluated by Underwriters Laboratories for inclusion in a variety of fire-rated "P-Assemblies" and are classified in section CETW of the UL Fire Resistance Directory - Vol. 1. Several panel assemblies have been evaluated as Class A fire-rated. Contact PAC for complete information on components and assemblies.

OIL CANNING

All Petersen material is prime-quality aluminum, G-90 galvanized or galvalume steel. All materials are specified for roll-forming applications. Panels are inspected in the plant for flatness before shipment. Jobsite conditions such as temperature variation, unlevel substrate and/or improper installation may promote oil canning. Oil canning does not affect the finish or structural integrity of the panel and is therefore not cause for rejection.

WARRANTY

A 30-year finish warranty is available covering cracking, peeling and color fade on all PAC-CLAD applications. PAC-CLAD is a 70% PVDF (Kynar) finish and therefore carries the highest-quality 30-year non-prorated finish warranty available. Finish warranty terms for Cardinal Red, Award Blue , Weathered Copper, Weathered Steel and all metallic finishes vary slightly. Please refer to pac-clad.com for further details.

Petersen also offers a coastal finish warranty for projects located in the vicinity of the coast or within saltwater environments. Aluminum substrates, with stainless steel clips and fasteners, must be used to qualify for the coastal warranty.

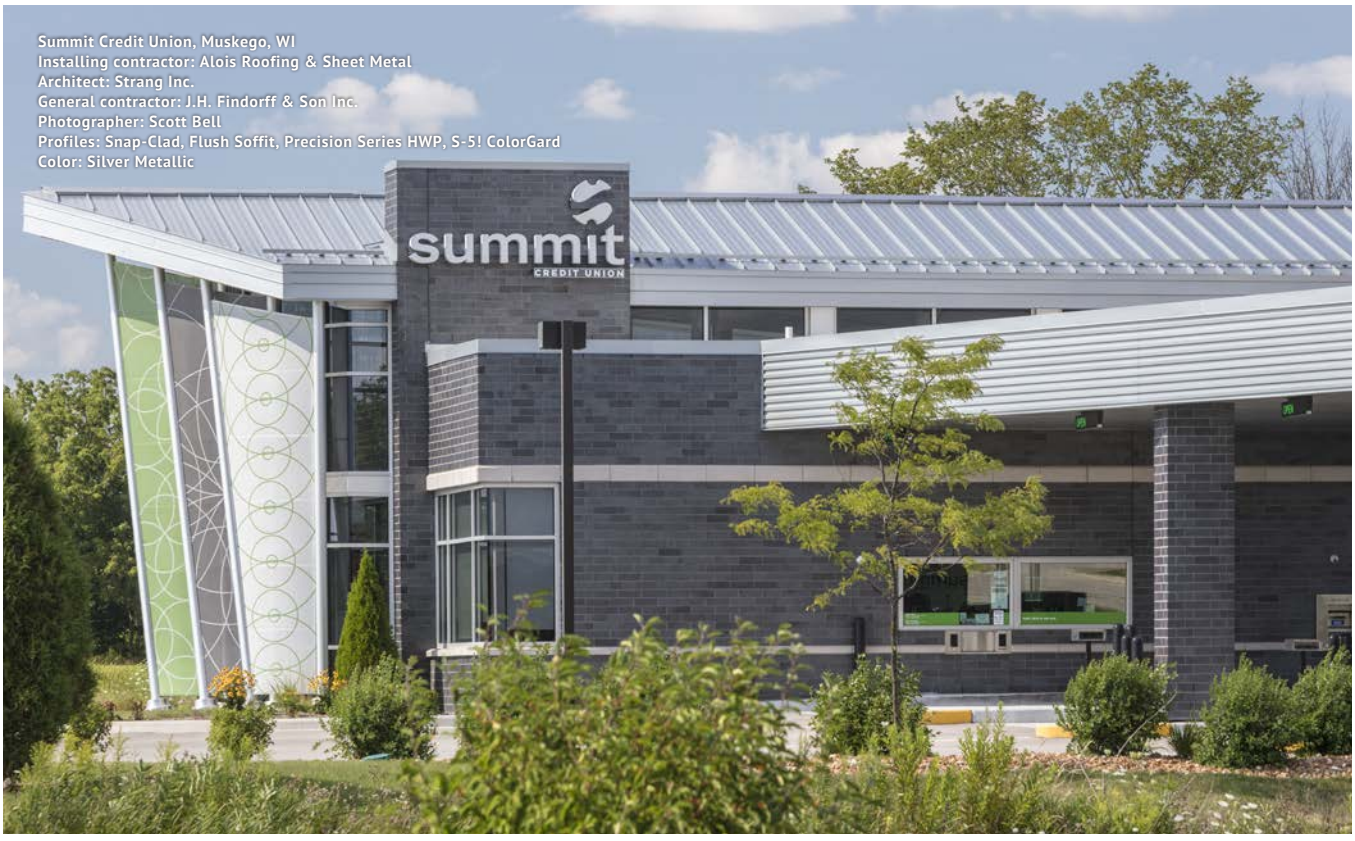
For projects utilizing Snap-Clad, Tite-Loc or Tite-Loc Plus factory-formed standing-seam panels, weathertightness warranties for terms up to 20-years are available. Projects must be submitted and pre-approved by PAC technical personnel prior to ordering.

STORAGE

Materials should be stored in a clean, dry place. Suitable facilities for storage and protection of material should be provided at the job site. Store materials out of traffic areas to prevent dents, bending, abrasion, etc.

LIMITATIONS ON LIABILITY

Neither Petersen nor its customer shall be liable for special, indirect or consequential damages. The liability of Petersen in the event of the sale of its products shall be limited to replacement of any defective or nonconforming products or refund of the purchase price.



Summit Credit Union, Muskego, WI
Installing contractor: Alois Roofing & Sheet Metal
Architect: Strang Inc.
General contractor: J.H. Findorff & Son Inc.
Photographer: Scott Bell
Profiles: Snap-Clad, Flush Soffit, Precision Series HWP, S-5! ColorGard
Color: Silver Metallic

HardieSoffit®

A home is only as strong as its weakest point. HardieSoffit® panels reinforce your work by protecting the vulnerable gap between eaves and exterior walls.

Available in vented, non-vented and a range of pre-cut sizes, these panels complete your design and help protect it from moisture and pests.

VENTILATION BENEFITS

Using vented soffit improves ventilation in the attic space and reduces the chance of water vapor condensation that can lead to issues such as mold and mildew growth, stained ceilings and damage to the framing of the house.

In warm climates, HardieSoffit panels allow hot, humid air to escape, which not only helps prevent condensation in the attic, but can also help reduce air conditioning costs.

In cool climates, HardieSoffit panels help prevent condensation from forming on the interior side of the roof sheathing and reduce the chances of roof-damaging ice dams.



HardieSoffit®

Thickness 1/4 in

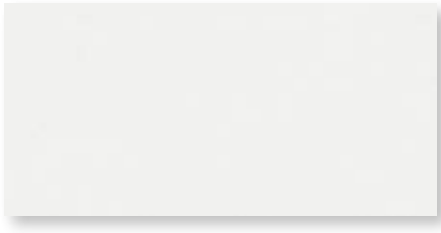
VENTED SMOOTH



VENTED SELECT CEDARMILL©



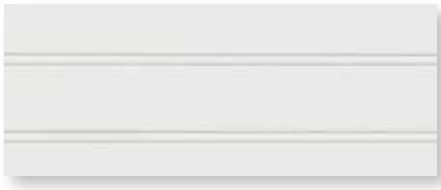
NON-VENTED SMOOTH



NON-VENTED SELECT CEDARMILL©



BEADED PORCH PANEL



VENTED SMOOTH & SELECT CEDARMILL©

Length	12 ft	12 ft	8 ft
Width	12 in	16 in	24 in
Prime Pcs/Pallet	200	150	100
ColorPlus Pcs/Pallet	216	156	108

Size	12 ft x 12 in	12 ft x 16 in	8 ft x 24 in
STATEMENT COLLECTION™	✓	✓	
DREAM COLLECTION™	✓	✓	✓
PRIME	✓	✓	✓

Size	12 ft x 12 in	12 ft x 16 in	8 ft x 24 in
STATEMENT COLLECTION™			
DREAM COLLECTION™	✓	✓	✓
PRIME	✓	✓	✓

NON-VENTED SMOOTH & SELECT CEDARMILL©

Length	12 ft	12 ft	8 ft	8 ft
Width	12 in	16 in	24 in	48 in
Prime Pcs/Pallet	200	150	100	50
ColorPlus Pcs/Pallet	216	156	108	–

Size	12 ft x 12 in	12 ft x 16 in	8 ft x 24 in	8 ft x 48 in
STATEMENT COLLECTION™	✓	✓		
DREAM COLLECTION™	✓	✓	✓	
PRIME	✓	✓	✓	✓

Size	12 ft x 12 in	12 ft x 16 in	8 ft x 24 in	8 ft x 48 in
STATEMENT COLLECTION™				
DREAM COLLECTION™	✓	✓	✓	
PRIME	✓	✓	✓	✓

BEADED PORCH PANEL

Thickness	1/4 in
Length	8 ft
Width	48 in
Prime Pcs/Pallet	50

STATEMENT COLLECTION™	
DREAM COLLECTION™	✓
PRIME	✓

STATEMENT COLLECTION™

Make your next home stand out with our *Statement Collection™* products. Carefully curated by our design experts specifically for your market, the collection brings together the most popular James Hardie ColorPlus® siding and trim styles, textures, and colors. This stunning selection is locally stocked and designed for simplicity - making it easier than ever to get a beautiful, long-lasting home exterior.

ColorPlus® Technology

Plank, Panel, Shingle and Batten Color Offering



ARCTIC WHITE | COBBLE STONE | NAVAJO BEIGE | KHAKI BROWN



MONTEREY TAUPE | TIMBER BARK | LIGHT MIST | PEARL GRAY

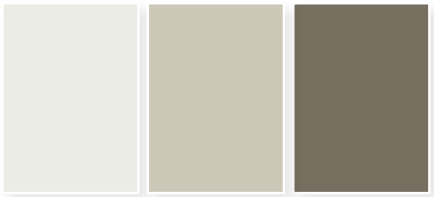


GRAY SLATE | BOOTHBAY BLUE | EVENING BLUE | AGED PEWTER



NIGHT GRAY | IRON GRAY | MOUNTAIN SAGE

Trim and Soffit Color Offering



ARCTIC WHITE | COBBLE STONE | TIMBER BARK

Selecting a color? Request a product sample at **jameshardiepros.com/samples**

Colors shown are as accurate as printing methods will permit.
Please see actual product sample for true color.

HardiePlank®



SELECT CEDARMILL©

Width	8.25 in
Exposure	7 in



SMOOTH

Width	8.25 in
Exposure	7 in

HardiePanel®



SELECT CEDARMILL©

Size	4 ft x 10 ft



SMOOTH

Size	4 ft x 10 ft

HardieShingle®



STRAIGHT EDGE PANEL

Height	15.25 in
Exposure	7 in



STAGGERED EDGE PANEL

Height	15.25 in
Exposure	6 in

HardieSoffit®



VENTED SMOOTH

Size	12 ft x 12 in
	12 ft x 16 in

NON-VENTED SMOOTH

Size	12 ft x 12 in
	12 ft x 16 in

HardieTrim®

4/4 SMOOTH & RUSTIC GRAIN©



Thickness	.75 in
Length	12 ft boards
Width	3.5 in 5.5 in 7.25 in

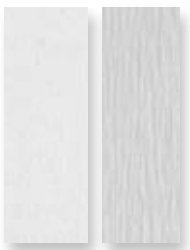
5/4 SMOOTH & RUSTIC GRAIN©



	1 in
	12 ft boards
	3.5 in 5.5 in 7.25 in 9.25 in 11.25 in

BATTEN BOARDS

4/4 SMOOTH & RUSTIC GRAIN©



	.75 in
	12 ft boards
	2.5 in

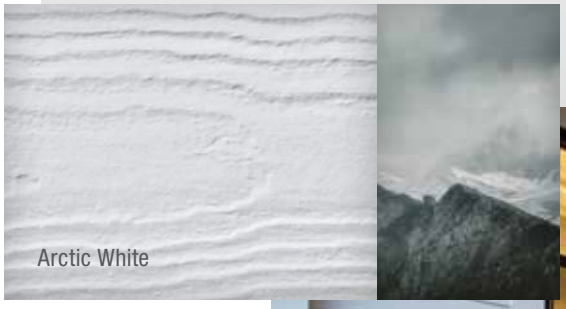
Get Inspired



SIMPLE LIVING

LIGHT COLORS

Whites and soft pastels are pure, clean, new and bright. Combine with other hues to add interest, personality and contrast. Works well on houses with Colonial Inspiration. A pastel A-frame cottage can look sweet and charming.









LIVE WITH SOPHISTICATION

NEUTRAL COLORS

Neutral rules the suburbs. These shades are safe, but also sophisticated. When accessorized with black or a darker color, a neutral can look fashionably stylish. Play with textures and use different tones for trim.

CABRIO | ALUMINUM STORM DOORS



GERKIN™ WINDOWS & DOORS

CA CABRIO SERIES™

Gerkin Windows and Doors introduces a new generation of storm doors called Cabrio. The Cabrio is highlighted by a retractable screen, which is hidden away in the head of the door when ventilation isn't needed, thus giving a beautiful clear view!

The Cabrio is a newly designed door with beautifully rounded features outlining the 1 3/4" thick doorframe. This attractive (convertible) door offers an easy operating sash, which runs on a smooth block and tackle balance system to ensure effortless operation. The sash relies on the balances, not the screen. For protection against insects, the screen overlaps and seals the interior frame opening and has a sweep seal on the bottom of the sash. The screen will reset itself to the proper position if pushed or blown in.



MODEL 809

- Full-view
- Retractable screen
- Built in balances offers an easy-to-operate sash
- Heavy duty 1-3/4" extruded mainframe
- Heavy overlapping weather-strip for a tight seal
- Stylish ergonomically friendly handle looks and feels great
- Available in White, Sandstone and Almond, 36" x 81"
- All hardware is color-matched to the door



MODEL 802

- Self-storing high view
- Retractable screen
- Convenient self-storing ventilation; no glass to store
- Aluminum clad polyethylene core kick panel withstands damage from pets and children
- Stylish ergonomically friendly handle looks and feels great
- Heavy-duty extruded mainframe for long trouble-free life
- White, Sandstone and Almond, 32" and 36"
- All hardware is color-matched to the door







SHARE

Smooth-Star®

2 Panel 3/4 Top | Style No. S93

★★★★★ 5.0 (1) Write a review

3 Available Sizes >

THERMA-TRU VIBRANT PAINT OPTIONS



Want to see other finishing options? Visit our finishing page to view all paint and stain options available through Therma-Tru.

DESIGN YOUR DOOR | WHERE TO BUY



MOLDED INTERIOR DOORS

JELD-WEN WINDOWS & DOORS

OPEN UP A NEW LOOK

Just as a coat of paint can change the look of a room, interior doors can have a dramatic effect. And no one understands that better than JELD-WEN.

We offer a wide array of interior doors designed to highlight your personal style and add interest to any home. A JELD-WEN® molded interior door can create a focal point in a room and accent a pantry or hallway closet, all while providing privacy and blocking sound.

The beauty goes far beyond the surface, with quality that is tangible. You'll feel it in the way these well-crafted doors open and close. You'll notice the quality and security of the hardware. And you'll come to appreciate the design, construction and flawless operation of these doors for years to come.

To us, a door is much more than an entryway. It's a design statement and part of the bigger picture of what makes your house a home.





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WHY BUY JELD-WEN® INTERIOR DOORS

JELD-WEN has long been a leader in setting trends, most notably for the quality of our products. A deeper look reveals what makes these molded interior doors truly special.

Sustainable Materials



Including sawmill chips, field chips and leftover wood, JELD-WEN® molded interior doors are made from wood that is the by-product of other operations. It's a sound logging practice that minimizes waste, enables forests to flourish and has been recognized with numerous certifications by Scientific Certification Systems (SCS). This engineered wood fiber is molded under intense heat and pressure into a high-density fiberboard, assuring consistent quality from door to door, room to room and home to home. The doors resist shrinking, swelling, cracking and joint separation. All doors are available primed with a low VOC, water-based primer, ready to paint and can be specified in 1 3/8" and 1 3/4" thicknesses. All 1 3/4"-thick doors are available with 20-minute fire ratings and most designs are available with 45- and 60-minute fire ratings. And we back them up with one of the best warranties in the industry. More information can be found at **jeld-wen.com**.

Engineered for High Performance

A commitment to excellence and innovation inspires everything we build. Each door is designed for ease of operation, low maintenance and beauty that stands the test of time. A wide range of colors, hardware and hardware finishes help you make the statement you want, in styles ranging from contemporary to classic.

ProCore®

The solid core construction of this upgrade option reduces transmission of sound by up to 50 percent as compared to a hollow core door. A ProCore door adds privacy, peace and quiet, and stands up better to the dents and dings of daily life. It helps create a sanctuary for any room in your home.

For the full line of interior doors, visit jeld-wen.com.

* For full warranty details please visit **jeld-wen.com**.



CAMBRIDGE™ SMOOTH

Squared panels give this door a clean, precise look, while its ovolo sticking profile adds dimension. Simplicity adds to its versatility, making this a great choice for most home styles. For noise reduction, choose the ProCore® solid core option.

AVAILABLE DOOR SIZES

SMOOTH SURFACE MOLDED DOORS

Craftsman III™	1'0"	1'2"	1'3"	1'4"	1'6"	1'8"	1'10"	2'0"	2'2"	2'4"	2'6"	2'8"	2'10"	3'0"	Sticking Profile	ProCore®	Bifolds
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	X	X
7'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	X	X
Madison®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	X	X
7'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	X	X
8'0" Smooth				X	X	X	X	X	X	X	X	X	X	X	C	X	X
Rockport™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth					X	X		X	X	X	X	X	X	X	CB	X	X
7'0" Smooth								X	X	X	X	X	X	X	CB	X	X
8'0" Smooth					X	X		X	X	X	X	X	X	X	CB	X	
Conmore®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth					X	X		X	X	X	X	X	X	X	S	X	X
7'0" Smooth					X	X		X	X	X	X	X	X	X	S	X	X
Carrara®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
7'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
8'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
Cambridge™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
7'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
8'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
Princeton™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
7'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
8'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
Caiman®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
7'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
8'0" Smooth					X	X		X	X	X	X	X	X	X	CB		
Continental™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
7'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
8'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
Cashal®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
7'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
8'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
Santa Fe™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
7'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
8'0" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
Corvado®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
7'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
8'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
Coventry®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
7'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X
8'0" Smooth	X	X	X	X	X	X		X	X	X	X	X	X	X	CB	X	X

Sticking Profile: B=Beaded, CB=Cove and Bead, C=Craftsman, S=Stepped, O=Ovolo

SMOOTH SURFACE MOLDED DOORS (CONTINUED)

Colonist®	1'0"	1'2"	1'3"	1'4"	1'6"	1'8"	1'10"	2'0"	2'2"	2'4"	2'6"	2'8"	2'10"	3'0"	Sticking Profile	ProCore®	Bifolds
6'8" Smooth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
7'0" Smooth					X	X	X	X	X	X	X	X	X	X	CB	X	X
8'0" Smooth					X	X	X	X	X	X	X	X	X	X	CB	X	X

TEXTURED SURFACE MOLDED DOORS

Camden®	1'0"	1'2"	1'3"	1'4"	1'6"	1'8"	1'10"	2'0"	2'2"	2'4"	2'6"	2'8"	2'10"	3'0"	Sticking Profile	ProCore®	Bifolds
6'8" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
7'0" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
Avalon®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
7'0" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
Provincial®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
7'0" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
Colonist®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
7'0" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
8'0" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	CB	X	X
Colonial™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
7'0" Textured	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O	X	X
8'0" Textured					X	X	X	X	X	X	X	X	X	X	O	X	X
Sticking Profile: B=Beaded, CB=Cove and Bead, C=Craftsman, S=Stepped, O=Ovolo																	

MIRROR MOLDED DOORS

Impression™ Mirror	1'0"	1'2"	1'3"	1'4"	1'6"	1'8"	1'10"	2'0"	2'2"	2'4"	2'6"	2'8"	2'10"	3'0"	Sticking Profile	ProCore®	Bifolds
6'8" Colonist® Textured								X		X	X	X		X	O		

WIDE-STILE* LIGHT COMMERCIAL DOORS

Colonial™	1'0"	1'2"	1'3"	1'4"	1'6"	1'8"	1'10"	2'0"	2'2"	2'4"	2'6"	2'8"	2'10"	3'0"	Sticking Profile	ProCore®	Bifolds
6'8" Textured														X	O	X	
7'0" Textured														X	O	X	
Colonist®	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth														X	CB	X	
7'0" Smooth														X	CB	X	
Continental™	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth														X	O	X	
7'0" Smooth														X	O	X	
Cambridge™ Beaded	**1'0"**	**1'2"**	**1'3"**	**1'4"**	**1'6"**	**1'8"**	**1'10"**	**2'0"**	**2'2"**	**2'4"**	**2'6"**	**2'8"**	**2'10"**	**3'0"**	**Sticking Profile**	**ProCore®**	**Bifolds**
6'8" Smooth														X	B	X	
7'0" Smooth														X	B	X	
Sticking Profile: B=Beaded, CB=Cove and Bead, C=Craftsman, S=Stepped, O=Ovolo																	

* Assuming standard bore machining (2 1/8" diameter bore), outer stile measurements listed above must be no less than 3 3/4" in order to accommodate a 2 3/8" backset on the lock hole. For 2 3/4" backsets, outer stile measurements must be no less than 3 13/16". If lock bore machining is less than the outer stile measurements listed above, all lock bore drilling must be done within the lock rail for best appearance and performance. Outer stile dimension may vary 1/4" from the measurements listed above.

JELD-WEN® LIMITED WARRANTY

JELD-WEN® Products[1] are designed to create lasting value for your home. This warranty is effective for JELD-WEN products manufactured on or after **May 1, 2012,** for use in the United States and Canada. Any previous warranties will continue to apply to products manufactured by JELD-WEN prior to this date. For additional information, including care and maintenance information, refer to **jeld-wen.com** or **jeld-wen.ca.**

What This Warranty Covers:

We warrant to the original owner[2] that if your JELD-WEN Product exhibits a defect in material or workmanship within the time periods from the date of purchase as specified below, we will, at our option, repair, replace or refund the purchase price of the product or component part. Skilled labor[3] (where deemed necessary by us) to repair or replace any component is provided for one (1) year from the date of purchase.

Owner-Occupied Single-Family Residence Limited Warranty

Door Slabs: Except as set forth below, we warrant our door slabs, including any glass inserts, miscellaneous hardware and accessories provided and installed by us, as follows:

DOOR SLAB	COVERAGE
Fiberglass Exterior Doors	As long as you own and occupy your residence
FiberLast® Engineered Composite Exterior Doors	As long as you own and occupy your residence
Steel Exterior Doors	Ten (10) years
Wood Exterior Doors	Five (5) years
Interior Doors	Five (5) years

Factory Prefinish: We warrant the factory applied prefinish on our doors against peeling, checking or cracking for periods listed below. Should the factory prefinish be proven defective, we will at our option, replace or refinish the door or pay up to the credit indicated per opening to the current owner. (Note: this coverage applies to factory applied finish coat options only; standard factory applied primer is not a finish coat.)

PRODUCT	COVERAGE	REFINISH CREDIT
Aurora® Fiberglass Doors	5 years	$350 per opening
Custom Exterior Wood Doors	1 year	$250 per opening
Custom Interior Wood Doors	1 year	$150 per opening
All Other Doors	1 year	$100 per opening

Door Frames: We warrant our door frames for one (1) year from the date of purchase.

AuraLast® Protection for Door Slabs and Frames: Our AuraLast® pine wood door slabs will be free from wood decay and/or termite damage for twenty (20) years from the date of initial purchase. Our AuraLast® pine door frame components will be free from wood decay and/or termite damage for as long as the original consumer owns the home in which the AuraLast® wood frames are originally installed. Warranty coverage outside Canada, the contiguous 48 states and Alaska is contingent upon approval from the JELD-WEN Customer Care Department. Please contact us.

Severe Weather Glass: We warrant each Severe Weather glass unit for ten (10) years.

Retractable Screens: We warrant retractable roll screens for five (5) years.

Spontaneous Glass Breakage: We warrant sealed glass units installed in exterior doors (excluding laminated glass, and special glazings) for spontaneous breakage for one (1) year (including free replacement glass and skilled labor[3] necessary to replace the glass for one (1) year). Spontaneous breakage occurs when the glass develops a crack without sign of impact.

Commercial Limited Warranty (Other than Owner-Occupied Single-Family Residence)

Fiberglass, FiberLast®, Steel, Wood and Interior Door Slabs: We warrant our door slabs for five (5) years from the date of initial purchase.

All Other Products, Components, Prefinishes and Options as Listed Above: Coverage is the same as for Owner-Occupied Single-Family Residences as listed above.

Transferability

This warranty is not transferable.

How to Get Assistance

If you have a problem with your JELD-WEN door immediately upon discovery, contact the distributor or dealer from whom you purchased our product or contact us directly:

IN THE UNITED STATES:	IN EASTERN CANADA:	IN WESTERN CANADA:	IN ONTARIO CANADA
JELD-WEN Customer Care Attn: Warranty Claims P.O. Box 1329 Klamath Falls, OR 97601	JELD-WEN Service Department 90, rue Industrielle Saint-Appollinaire, Quebec Canada GOS 2EO	JELD-WEN Service Department 550 Munroe Avenue Winnipeg, Manitoba Canada R2K 4H3	JELD-WEN Service Department 90 Stone Ridge Road Vaughan, Ontario Canada L4H 3G9
PHONE 888-JW-Help-U 888-594-3578 FAX 800-436-5954	PHONE 888-JW-Help-U 888-594-3578 FAX 800-436-5954	PHONE 888-JW-Help-U 888-594-3578 FAX 800-436-5954	PHONE 888-JW-Help-U 888-594-3578 FAX 800-436-5954
EMAIL jeldwenwarranty@jeldwen.com		EMAIL wpgservice@jeld-wen.com	
jeld-wen.com/contact-us			

We can respond quickly and efficiently if you provide the following: a) date and location of purchase, or product identification from the tag on the top edge of the slab, b) how to contact you, c) the address where the product can be inspected, and d) a description of the apparent problem and the product (photographs are helpful).

What We Will Do

Upon receiving your notification, within three business days we will send out an acknowledgement to the contact which you have provided. We will investigate your claim and will begin to take appropriate action within 30 days after receipt of notification. If your warranty claim is denied, we may charge a fee for an on-site inspection that is required or requested by you.

If your claim is accepted, and we choose to repair or replace the product or a component of the product, the replacement product/component will be provided in the same specification as the original product. Replacement products, components and services are warranted for the balance of the original product or service warranty, or 90 days, whichever is longer.

If the claimed nonconformity is warp of a door slab, we may defer repairing or replacing the door slab for a period of up to 12 months from the date of claim. It is not uncommon for a temporary warp condition to occur as the door slab adjusts to local humidity and temperature conditions. This deferral will not be counted against the warranty period.

What This Warranty Does NOT Cover

JELD-WEN manufactures and sells both individual door slabs and complete door systems. This warranty does not cover parts or components (e.g., locksets, handles, etc.) not sold by JELD-WEN to the original owner. See your distributor or dealer regarding the warranty on the entire door system and/or these other components.

We Are Not Liable For:

- Normal wear and tear, including normal wear and tear of weatherstrip; and natural weathering of surfaces or variations in the color or texture of wood or finish; surface cracks that are less than 1/32" in width and/or 2" in length; for knotty alder and juniper: surface checks that are less than 1/8" in width and/or 5" in length and knot placement, quantity or size.
- Problems due to misuse or abuse; failure to follow the care and maintenance instructions; or as a result of any cause beyond our reasonable control (e.g., fire, flood, earthquake, other acts of nature and acts of third parties outside of our control).
- Problems related to: improper field finishing of all surfaces (front and back) and edges (top, bottom and sides) of the door slab and frame (See our Finishing Instructions at **jeld-wen.com/resources**); variation or unsatisfactory results in sheen or texture resulting from the field application of paint or any other finishing material.
- Failure to provide an adequate overhang for exterior doors; damage caused by extreme temperature buildup where storm doors are present. For general guidelines, see our "Appropriate Protection for Exterior Doors" in our product literature or at **jeld-wen.com/resources**; for specific information pertaining to your structure, consult your contractor or other building professional.
- Warp for any 3'6" wide by 8' 0" high by 1 3/4", or smaller door slab, which does not exceed 1/4" in the plane of the door slab itself; door slabs wider and/or higher are not guaranteed for warp.
- Bow or misalignment in the frame or jamb in which the door slab is hung (if such is purchased from JELD-WEN unmachined and not prehung).
- Slight expansion or contraction due to varying environmental conditions; slab movement (shrinkage or swelling) of 1/4" or less due to temperature and humidity; consult our Care and Maintenance documents on how to work with this natural movement.
- Wood decay for wood components other than of AuraLast® pine; and wood decay for any wood components (including pine) that come in direct contact with soil. Note: superficial mold/mildew does not indicate wood decay.
- Problems related to water and/or air infiltration due to improper assembly; installation errors or flaws in building design and construction; installation must be in strict conformance with the installation instructions provided by the manufacturer of the door entry system.
- Structural integrity issues or other problems caused by improper field fitting of the hardware, improper sizing of the door slab or other assembly problems.
- Slight imperfections or wavy distortions in the glass that don't impair structural integrity. Note: wavy distortions in the glass (e.g., related to laminate interlayer or heat strengthening of glass) are not considered a defect. Slight color variations in glass are not considered a defect.
- Screen damage due to normal wear and tear, misuse, abuse or insect or animal activity.
- Condensation or damage as a result of condensation (Note: unless due to insulating glass failure, most condensation problems are related to excessive humidity levels in a structure; contact a heating/air conditioning specialist for help).
- Damage or poor product performance resulting from installation into a condition that exceeds product design standards and/or certified performance specifications and/or does not comply with applicable building codes.
- Hardware, accessories or inserts that are not provided by us.
- Discoloration or rusting of decorative metal accent options, such as grilles, clavos, straps, etc.; discoloration of wood sills provided by us.
- Cost for labor, removal or disposal of defective product(s), installation or finishing of the replacement door or component.
- Incidental or consequential damage. Some states/provinces do not allow the exclusion or limitation of incidental or consequential damages, so this may not apply to you.

IMPORTANT LEGAL INFORMATION—PLEASE READ THIS CAREFULLY. IT AFFECTS YOUR RIGHTS.

This Limited Warranty document sets forth our maximum liability for our products. We shall not be liable for special, indirect, consequential or incidental damages. Your sole and exclusive remedy with respect to any and all losses or damages resulting from any cause whatsoever shall be as specified above. We make no other warranty or guarantee, either express or implied, including implied warranties of merchantability and fitness for a particular purpose to the original purchaser or to any subsequent user of the Product, except as expressly contained herein. In the event state or provincial law precludes exclusion or limitation of implied warranties, the duration of any such warranties shall be no longer than, and the time and manner of presenting any claim thereon shall be the same as, that provided in the express warranty stated herein. This Limited Warranty document gives you specific legal rights, and you may have other rights that vary from state/province to state/province.

Any dispute, controversy or claim arising out of or relating to this warranty, any alleged breach thereof, or the use or sale of the products to which this warranty applies shall be resolved by mandatory and binding arbitration administered by the American Arbitration Association in accordance with its commercial arbitration rules. Original purchaser agrees that they may assert claims against JELD-WEN in their individual capacity only, and not as a plaintiff or class member in any purported class action proceeding. Rejection of these dispute resolution provisions must be sent to JELD-WEN at the address provided herein within thirty (30) days of original purchaser's receipt of the Products to which this warranty applies.

No distributor, dealer or representative of JELD-WEN has the authority to change, modify or expand this warranty. The original purchaser of this Product acknowledges that they have read this warranty, understand it and are bound by its terms and agrees to provide this warranty to the original owner of the structure into which the Product is installed.

1 "JELD-WEN Products" shall refer to window and patio door products (except United Collection products) manufactured in the United States and/or Canada and marketed under the JELD-WEN brand name for use in the United States and/or Canada. See our separate United Collection warranty, or our Export Warranty for applicable coverage on products used outside the United States and Canada.

2 "Skilled labor" refers to tasks where specialized technical knowledge, experience, methods or tools are required to properly identify, diagnose and/or correct product-related problems.

3 "Chalking" of the exterior finish is not a defect unless it exceeds a numerical rating of eight (8) when measured in accordance with the standard procedures specified in ASTM D4214. Fading or changing in color of the exterior finish is not a defect unless it exceeds five (5) E units, calculated in accordance with ASTM D2244, paragraph 6.2. Color change shall be measured on an exposed area of finish that has been cleaned of surface soils and chalk, and the corresponding values measured on the original or unexposed area of finish. Fading or color changes may not be uniform if the surfaces are not equally exposed to the sun and elements. If the above ASTM standards change, the standard in effect at the time of purchase applies. As an option to replacement, we may choose to refinish the product.

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ABOUT JELD-WEN

Since 1960, when JELD-WEN began with one millwork plant, we've been dedicated to crafting windows and doors that enhance the beauty and functionality of your home. Today we continue that tradition with products that are durable and worry-free. It's the result of innovation being the driving force in all that we do.

It begins in the forests where we harvest our premium lumber. In addition to responsible reforestation practices, we reuse and recycle as much of our raw resources as possible. Innovation is also at the heart of our design and manufacturing process. With JELD-WEN, you can expect products that are more than just beautiful on the outside. The inner workings of our windows and doors are engineered to function flawlessly for years to come.

Our extensive product offering is available globally through multiple distribution channels, including retail home centers, wholesale distributors and building products dealers. Whether it's a modern or classic style, a unique hardware option or an advance in the way our products operate—great homes start with JELD-WEN.





JELD-WEN WINDOWS & DOORS

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For current information, please visit our website, **jeld-wen.com.**

10-92821 04/16 (Reprint 06/19)

JELD-WEN WINDOWS & DOORS

BUILDERS™ VINYL

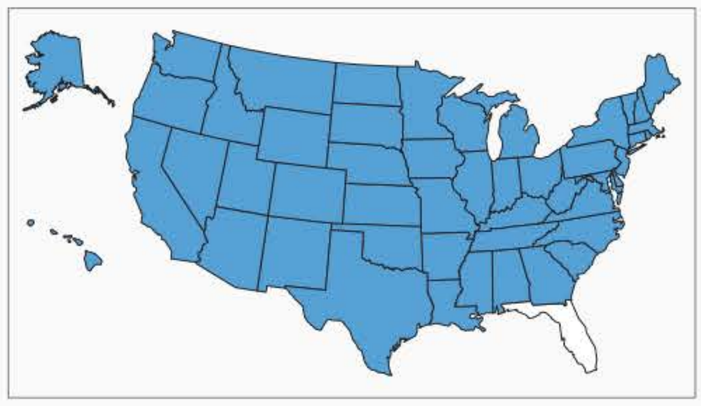
WINDOWS AND PATIO DOORS





ATTRACTIVE, VERSATILE, AND AFFORDABLE

JELD-WEN® Builders™ Vinyl windows and patio doors feature a narrow frame and sash profile for a streamlined appearance plus Low-E insulating glass for energy efficiency. Designed to be durable, Builders Vinyl styles resist fading and won't chip or peel. They also offer details that simplify maintenance, such as removable or tilt sashes for easy cleaning and high-quality extruded vinyl that retains its color all the way through. Best of all, every Builders Vinyl window and patio door is backed by a Limited Lifetime Warranty* for ultimate peace of mind.



AVAILABLE IN SELECT AREAS

MULTIPLE FRAME OPTIONS TO MAKE INSTALLATION EASY



Flush Fin



Integral Nailing Fin



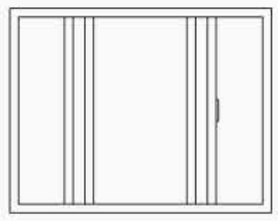
Pocket/Block Frame

OPERATING TYPES

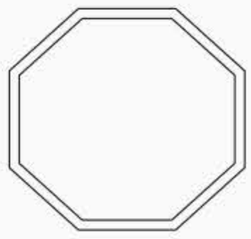
Single-Hung Tilt

Double-Hung

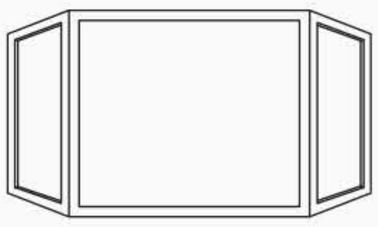
Single-Hung Side Load



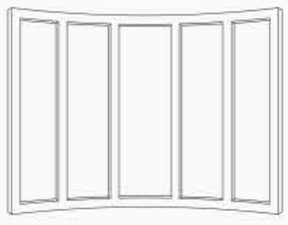
Sliding



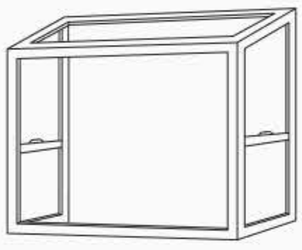
Fixed, Radius, Geometric



Bay



Bow



Garden



Sliding Patio Door

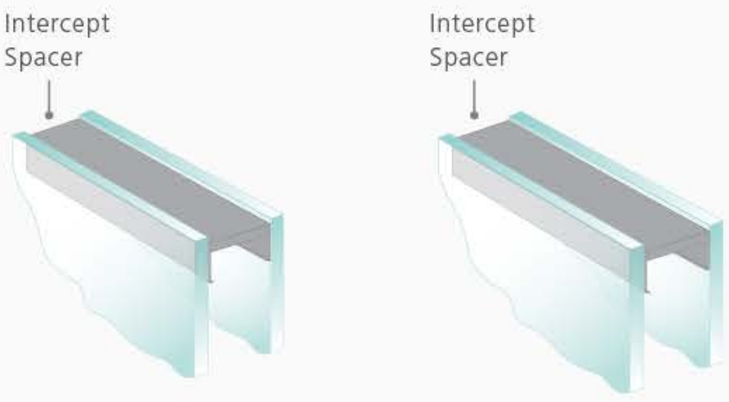
*For warranty details, visit jeld-wen.com, click Support, and select JELD-WEN Warranties.

GLASS

Choose from a variety of glass options that offer performance, privacy, and style.

- Double-pane clear insulating (with Low-E glass options)
- Dirt-resistant
- Laminated
- Tempered
- Tinted
- Textured
- Grilles between the glass (GBG)
- Simulated divided lites (SDL)
- Blinds between the glass (BBG)

DOUBLE-PANE PACKAGES



TEXTURED GLASS



Glue Chip | Rain | Obscure | Narrow Reed | Seedy Reamy

HARDWARE

Single Hung, Sliding, Bay	Double-Hung	Sliding Patio Doors
STYLE CAM-LOCK  WEN-LOCK®* 	STYLE CAM-LOCK  STYLE CAM-LOCK 	MULTIPOINT 

All options are subject to regional availability. Contact your local JELD-WEN dealer for more information.
*Available on ADA-compliant models only



NEW! FINISHIELD™ EXTERIOR FINISHES

This finish technology stands up to scratches and heat degradation and maintains consistent color across multiple window units. Available with white interior only.

COLOR

STANDARD INTERIOR & EXTERIOR FINISHES

White

Desert Sand

Almond

OPTIONAL FINISHIELD™ EXTERIOR COLORS

Bronze

Black

OPTIONAL HARDWARE FINISHES

Brushed Chrome

Polished Brass

Antique Brass

Bronze

Actual colors may vary from samples shown.

ADDITIONAL OPTIONS

- Insect screens
- Window opening control devices (WOCD)
- ADA-compliant hardware
- Pet panels for sliding patio doors

For more information, contact your JELD-WEN sales representative today.

For additional information, including a complete copy of JELD-WEN's Limited Warranty and care and maintenance information, please visit **jeld-wen.com** or **jeld-wen.ca** or contact JELD-WEN at 1-888-JWHelpU (1-888-594-3578).

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11-96996 2/19

PROMAR® 200 ZERO VOC

OUR PROFESSIONAL, TOP QUALITY, COMPLETE, ZERO VOC SOLUTION.



INTERIOR LATEX



EXCELLENT QUALITY. ZERO VOCS. SIX SHEENS. ALL COLORS. IT DOESN'T GET MORE COMPLETE THAN THIS.

Professional painters have it all with ProMar® 200 Zero VOC Interior Latex. A complete professional line that not only has zero VOCs, but is also available in six sheens and every color. All while delivering productivity with outstanding durability and touchup. And now, the flat sheen has improved hide and uniformity, and meets MPI certification.



PRODUCT CERTIFIED FOR
LOW CHEMICAL EMISSIONS
UL.COM/GG
UL 2818

PROMAR 200 ZERO VOC KEY BENEFITS

• **Exceptional durability, easy application and excellent hide.**	• **Outstanding touchup reduces repaint costs.**
• **Anti-microbial agents inhibit the growth of mold and mildew on the paint surface.**	• **Zero VOCs meets the most stringent VOC requirements. Complies with LEED v4, GREENGUARD Environmental Institute (GEI) and other green guidelines and regulations. ProMar 200 Zero VOC Flat meets MPI 53 and 143.**
• **Available in flat, low sheen eg-shel, low gloss eg-shel, eg-shel, semi-gloss and gloss.**	• **Available in all colors — including deep, vivid accents.**

PROMAR 200 ZERO VOC IS BROUGHT TO YOU BY A NAME YOU KNOW AND TRUST.

For 150 years, Sherwin-Williams has provided contractors, builders, property managers, architects and designers with the trusted products they need to build their business and satisfy customers. ProMar 200 Zero VOC Interior Latex is just one more way we bring you industry-leading paint technology — innovation you can pass on to your customers.

Plus, with more than 4,100 stores and 2,400 sales representatives across North America, personal service and expert advice is always available near jobsites. Find out more about ProMar 200 Zero VOC at your nearest Sherwin-Williams store or to have a sales representative contact you, call **800-524-5979**.



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Inspiring Great Spaces®

Armstrong® FLOORING

PRODUCT SPEC PAGE

Vivero™ Better with Diamond 10® Technology

Luxury Flooring

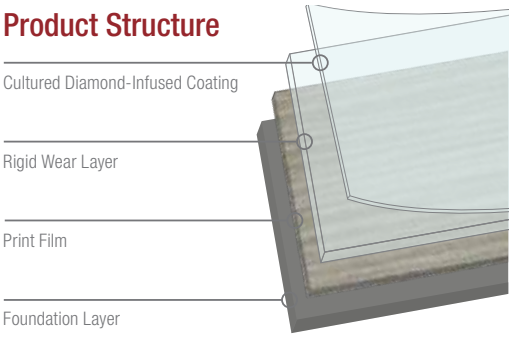
Product Information

Construction	Product Line	International Product Specifications	Overall Thickness Wear Layer Thickness	Factory Finish	Installation	Maintenance Options
Solid Vinyl Tile (a.k.a. Luxury Vinyl Tile - LVT)	Vivero™ Better	ASTM F 1700, Class III, Type B embossed surface	0.080 in. (2.0 mm) 0.012 in. (0.3 mm)	Diamond 10® Coating	Full Spread Adhesives: S-288 Premium, S-240 Epoxy, S-310 Roll Strong™, S-543 High-Moisture	No Polish – No Buff Polish

Packaging

Tile Sizes	Tiles per Carton/ Coverage	Shipping Weight per Carton
4.5 in. X 48 (114.3 mm X 1219.2 mm) 6 in. X 48 in. (152.4 mm X 1219.2 mm)	24 - 36 ft² (3.35 m²) 18 – 36.1 ft² (3.35 m²)	29.07 lbs./carton (13.18 kg) 29.03 lbs./carton (13.16 kg)

Product Structure



Testing

	Performance	Test Method	Requirement	Performance vs. Requirement
ASTM F 1700	Thickness	ASTM F 386	Nominal ± 0.005 in.	Meets
	Wear Layer Thickness	ASTM F 410	0.020 in. (0.5 mm) minimum for Commercial Use	Meets
	Size	ASTM F 2421	± 0.016 in. per linear foot	Meets
	Squareness	ASTM F 2421	0.010 in. maximum	Meets
	Residual Indentation	ASTM F 1914	Average less than 8%.	Meets
	Flexibility	ASTM F 137	≤ 1.0 in. diameter, no cracks or breaks	Meets
	Chemical Resistance	ASTM F 925	No more than slight change in surface dulling, attack or staining	Meets
	Heat Resistance	ASTM F 1514	ΔE < 8	Meets
	Light Resistance	ASTM F 1515	ΔE < 8	Meets
Additional Testing	Static Load Limit	ASTM F 970	≤ 0.005 in.	250 psi
	Dimensional Stability	Internal	≤ 0.018 in. per linear foot MD ≤ 0.012 in. per linear foot AMD	Meets
	Fire Test Data – Flame Spread	ASTM E 648	0.45 w/cm² or more Class I	Meets
	Fire Test Data – Smoke Evolution	ASTM E 662	450 or less	Meets
	ADA Standards for Accessible Design	Chapter 3 Section 302.1	Floor surfaces shall be stable, firm and slip resistant	Meets
	Static Coefficient of Friction*	ASTM D2047 UL 410	≥0.5	Meets

* Using the James Machine as described in D2047 and as directed in UL 410 for floor covering materials (FCM) using a leather foot under dry conditions. The application of site-applied floor sealers, polishes and other types of finishes routinely used to maintain resilient flooring materials will change the walking surface and consequently the SCOF value.

PRODUCT SPEC PAGE

Vivero™ Better with Diamond 10® Technology

Luxury Flooring

Sustainability

Certification Attribute	Standard	3rd party Certification/Certifier
Low Emitting Material	CDPH v1.2 (2017) a.k.a CHPS 01350	FloorScore/SCS
Environmental Product Declaration (Industry EPD)	ISO 14025 and ISO 14040	Yes/ULE

Performance	Standard	Requirements	Performance vs. Requirements
TVOC Range	CDPH vl.2 (2017) a.k.a CHPS 01350	<0.5 mg/m^3	Meets
Low Emitting Adhesives S-288 S-240 S-310 Roll Strong™ S-543 Flip® Spray Adhesive	FloorScore®/SCAQMD	Less than 50 g/L	S-288 Exceeds - 14 g/L S-240 Exceeds - 10 g/L S-310 Roll Strong™ Exceeds - 0 g/L S-543 Exceeds - 0 g/L Flip® Spray Adhesive Exceeds - 0 g/L
Recycled Content	ISO 14021	Contains recycled content	29% pre-consumer recycled content
Material Ingredients/Transparency	LEED v4 (Option 1) WELL™ Feature 97	Content disclosure to 1000 ppm	Meets (See Armstrong Flooring Product Declaration)
Fundamental Material Safety Toxic Materials Reduction	WELL™ Feature 11 and 25	No asbestos, free of lead and phthalates (DEHP, DBP, BBP, DIDP, DNOP)	Meets

Limited Warranty

10-year Commercial Warranty when installed in accordance with the current edition of the Armstrong Flooring Guaranteed Installation Systems manual, F-5061.

Links

Product Transparency	www.ArmstrongFlooring.com/transparency
Email Techline	www.ArmstrongFlooring.com/flooring-techline
Visit Floor Expert	www.floorexpert.com
Installation Instructions	www.ArmstrongFlooring.com/flooring-downloads
Maintenance Instructions	www.ArmstrongFlooring.com/flooring-downloads
View Full Line	www.ArmstrongFlooring.com/lvt

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FloorScore® is a registered trademark of the Resilient Floor Covering Institute.
LEED® is a registered trademark of the United States Green Building Council

GE® 7.4 cu. ft. Capacity aluminized alloy drum Electric Dryer with HE Sensor Dry

Model# GTD65EBSJWS



- HE Sensor Dry - Keep your clothes looking and feeling their best. Dual thermistors continually monitor temperature with a sensor bar that measures moisture to prevent over-drying
- Up to 120 ft. venting capability - Provides flexible installation
- Extended Tumble - Tumble clothes without heat to help prevent creasing and wrinkling
- ENERGY STAR® qualified - Meets or exceeds federal guidelines for energy efficiency for year-round energy and money savings
- My Cycle Settings - Dry clothes with the settings you prefer on any cycle, rather than the defaults, and store your settings for later use
- Damp Alert - Alerts you when clothes are the ideal dampness for ironing, for perfectly wrinkle-free results

FEATURES

Heat Selections	4
Number of Cycles	12
Long Vent Capability	Up to 120 feet
Temperature Options	High/Medium/Low/Extra Low/No Heat
Control Type	Electronic
Moisture Sensor	HE Sensor Dry
Speed Dry	Yes
Style	Top-Loading
Dual Thermistors	Yes
Specialty Cycles	Anti-bacterial; Towels and Sheets
Additional Cycles	Antibacterial; Bulky Items; Damp Dry; Extended Tumble; Jeans; Mixed Load; My Cycle; Quick Fluff; Sanitize; Towels/ Sheets
Casuals Cycle	Cool Down; Less Dry; More Dry
Delicates Cycle	Less Dry; More Dry; Optional Wrinkle Care
Timed Dry	90 Minutes; Quick Fluff (no heat); Warm Up
Wrinkle Care Cycle	Yes
Adaptive Capabilities	Cycle Time
Cottons Cycle	Less Dry; More Dry; Optimum Dry; Towels
Quick Fluff (no heat)	Yes
Air Fluff (no heat)	Yes
Easy Care Cycle	Casuals
WiFi Connect	Optional (Requires part no. PBX23W00Y0)
Connected Capabilities	Amazon Alexa; IFTTT; The Google Assistant
Energy Saving Option	Yes - eDry
Removable Up-Front Lint Filter	Yes
Drum Type	Aluminized Alloy
Exhaust Options	4-Way (Rear; Right; Left & Bottom)
Fuel Type	Electric
Reverse-a-Door	Yes
Additional Dryer Features	Damp Alert; Extended Tumble; Front Serviceable; Glass Door; Interior Light; Lint Filter with Reminder; Removable Up-Front Lint Filter
Additional Optional Cycles	Damp Alert; Extended Tumble
Dryer Control Features	Damp Dry Signal; Delay Dry - Up to 24 hours; End-of-Cycle Signal; LED Cycle Countdown; LED Cycle Status Indicator Lights
Product Type	Top Load Matching

Have more questions? Please contact 1-800-626-2005

ENERGY STAR CERTIFIED

Residential Clothes Dryers

GE - GTD65EB*J*** : GTD65EB*J***

Specifications

CB Model Identifier:	ES_1123206_GTD65EB*J***_08242015154618_1178596
Brand Name:	GE
Model Name:	GTD65EB*J***
Model Number:	GTD65EB*J***
Type:	Electric
Drum Capacity (cu-ft):	7.4
Height (inches):	43.7
Width (inches):	26.96
Depth (inches):	30.48
Combined Energy Factor (CEF):	3.93
Estimated Annual Energy Use (kWh/yr):	608
Estimated Energy Test Cycle Time (min):	60
Paired ENERGY STAR Clothes Washer Available:	Yes
Paired ENERGY STAR Clothes Washer ENERGY STAR Model Identifier:	ES_1123206_GTW680BSJ***_07162015225809_7489368
Additional Dryer Features:	Drum light,Time remaining display,Energy monitor/indicator,Sanitization cycle
Vented or Ventless:	Vented
Connected:	No
Date Available on Market:	2015-09-01
Date Certified:	2015-08-23
Markets:	United States, Canada
ENERGY STAR Certified:	Yes

Additional Model Information

Captured On:
12/11/2019

GE® 4.6 cu. ft. Capacity Washer with Stainless Steel Basket

Model# GTW500ASNWS



- Stain PreTreat - Easily remove four common stains with preprogrammed settings that do the work for you
- Deep Clean Cycle - Achieve the ultimate deep clean for your toughest laundry loads with 67% more cleaning power than the most commonly used cycle*. *Colors, Normal cycle
- Deep Fill - Enjoy total control and customization of your water levels with the touch of a button that lets you add just a little extra water or fill the tub
- Speed Wash - Save time when you're in a hurry with a quick wash for lightly soiled items
- Deep Rinse - Ensure clothes are rinsed free of detergent, fabric softener and stubborn soils
- 2nd Rinse - Ensure removal of detergent, bleach and other additives with an optional extra rinse after the wash cycle
- Efficient Infusor - Optimize energy efficiency without sacrificing wash performance
- ENERGY STAR® Qualified - Meets or exceeds federal guidelines for energy efficiency for year-round energy and money savings
- Made in America - This appliance is made in America and contains 70 to 90% U.S. content.
- 5 Soil Levels - Take full control of your wash cycle with five soil levels to choose from
- 13 Wash Cycles - Choose from 13 wash cycles to accommodate any load type

FEATURES

Number of Cycles	13
Washer Cycles	Active Wear; Bulky Items; Casuals; Cold Wash; Colors; Dark Colors; Deep Clean; Delicates; Drain + Spin; Jeans; Speed Wash; Towels & Sheets; Whites
Washer Options/Settings	2nd Rinse; 2nd Rinse + Extra Spin; Auto Soak; Deep Fill; Deep Rinse (select when using fabric softener); Extra Spin; Soil Level; Stain Pretreat (Tomato, Dirt, Grass, Wine)
Dispenser	Bleach
Wash Mechanism	Infusor
Control Type	LED; Rotary-Electronic
Wash/Rinse Temperatures	6
Wash/Spin Speed Combinations	Variable
Washer Control Features	End-of-Cycle Signal; LED Cycle Status Lights
Water Levels	Adaptive Fill; Automatic Temperature Control
Water Temp System	Hot, Warm, Colors, Cool, Cold, Tap Cold
Whites Cycle	Extra Light, Light, Normal, Heavy, Extra Heavy
Colors Cycle	Extra Light, Light, Normal, Heavy, Extra Heavy
Optional Soil Levels	Extra Heavy; Extra Light; Heavy; Light; Normal
Delicates Cycle	Extra Light, Light, Normal, Heavy, Extra Heavy
Style	Top-Load High-Efficiency
Additional Washer Features	Auto Balance Suspension System; Deep Fill Option; Leveling Legs; Metal Transmission; Stain Pretreat
Maximum Spin Speed	800 RPM
Product Type	Top Load

ENERGY STAR CERTIFIED

Residential Clothes Washers

GE : GTW500A*N***

Specifications

Brand Name:	GE
Model Number:	GTW500A*N***
Load Configuration:	Top Load
Volume (cu. ft.):	4.6
Integrated Modified Energy Factor (IMEF):	2.06
US Federal Standard (IMEF):	1.29
Annual Energy Use (kWh/yr):	175
Integrated Water Factor (IWF):	4.3
US Federal Standard (IWF):	8.4
Annual Water Use (gallons/yr):	5860
Connected:	No
Date Certified:	2018-12-05
Markets:	United States, Canada
ENERGY STAR Model Identifier:	ES_1123206_GTW500A*N***_12052018194545_9145154
ENERGY STAR Certified:	Yes

Additional Model Information

,GTW500ASNWS,Color: White / Silver

Captured On:
12/11/2019

GE® Built-In Dishwasher

Model# GSD3300KBB



- 3-level wash system - Powerful wash cleans dishes thoroughly
- Two-stage filtration with Extra Fine filter - Extra filtration keeps water clean
- Piranha™ hard food disposer - Grinds food into small particles that are washed away
- Hot Start option - Provides optimal water temperature for dependable performance
- Insulation blanket - Adds improved sound performance
- Standard upper rack with tower - Rack is designed for simple loading and unloading
- Up to 12-place setting capacity racking - Provides flexibility to wash a variety of dishes at once
- ENERGY STAR® qualified - Meets or exceeds federal guidelines for energy efficiency for year-round energy and money savings
- 62 dBA - Motor runs quietly to keep kitchen peaceful
- Heavy wash - Great for heavily soiled dishes and cookware

FEATURES

Style	Built-In Front Control
Tub and Door Liner	Permatuf™ Plastic
Tub Type	Standard Tub
Control Type	5 Touchpads; Front Controls; TouchTap™; Turn-To-Start
Dishwasher Control Features	Cycle Progress Indicator Dial; Start/ Reset Pad
Wash System	3-Level
Wash System Features	Piranha™ Hard Food Disposer
Wash Arms	Lower - Wash Arm; Middle Tower; Upper - Dome
Water Filtration System	2-Stage Self-Cleaning Filtration with Extra Fine Filter
Dispenser	Rinse Aid
Number of Cycles	5
Dishwasher Cycles	Heavy Wash; Normal Wash; Plate Warmer; Pots & Pans; Rinse Only
Number of Options	3
Dishwasher Options	Heated Dry On/Off; Hi-Temp Wash; Hot Start
Rack Features	Deluxe Silverware Basket
Number of Place Settings	Up to 12
Upper Rack	Standard with tower
Lower Rack	Standard
Leveling System	Leveling Legs
Latch	Center Throw
Exterior Style	Traditional

Have more questions? Please contact 1-800-626-2005

ENERGY STAR CERTIFIED

Residential Dishwashers

GE : GSD33**K****

Specifications

Brand Name:	GE
Model Number:	GSD33**K****
Type:	Standard
Annual Energy Use (kWh/yr):	270
US Federal Standard (kWh/yr):	307
% Better than US Federal Standard (kWh/yr):	12
Water Use (gallons/cycle):	3.5
US Federal Standard (gallons/cycle):	5
% Better than US Federal Standard (gallons/cycle):	30
Connected Functionality:	No
Markets:	United States, Canada
ENERGY STAR Certified:	Yes

Additional Model Information

Captured On:
12/11/2019

GE® 1.6 Cu. Ft. Over-the-Range Microwave Oven

Model# JVM3160DFBB



- Charcoal filter replacement for microwaves with behind the door grille - Easily install your new charcoal odor filter
- 1.6 cu. ft. capacity - 1000 Watts (IEC-705 test procedure)
- Convenience cooking controls - Operating made quick and easy
- Auto and time defrost - Defrosting times and power levels are programmed automatically or manually for optimal results
- Turntable On/Off - Controls turntable operation
- Two-speed, 300-CFM venting system - Removes smoke, steam and odors

FEATURES

Control Type	Electronic Touch
Electronic Digital Display with Clock	Yes
Cooking Modes	Microwave
Cooking Technology	Microwave
Style	Over-The-Range
Cooktop Lighting	Bright/Night/Off
Exhaust Fan	2-Speed; 300-CFM
Express Cook	1-6 Minutes
Interior Oven Light	Incandescent
Power Levels	10
Turntable	Glass
Turntable On / Off	Yes
Turntable Size	13.50 in
Microwave Convenience Cooking Controls	Beverage; Cook Time; Defrost: Weight/Time; Popcorn; Potato; Reheat
Control Features	Add 30 Seconds; Cancel/Off; Lock Controls; Power Level; Set Clock; Start/Pause; Surface Light; Timer On/Off; Turntable On/Off; Vent Fan
Product Type	Over-the-range Microwave
Microwave Watts (IEC-705)	1000.00 W

Have more questions? Please contact 1-800-626-2005

GE® ENERGY STAR® 25.3 Cu. Ft. Side-By-Side Refrigerator

Model# GSE25GGHBB



- LED lighting - Find all your favorite foods under natural-looking light
- Integrated shelf support system - Provides strong, flexible support
- Adjustable slide-out, spillproof glass shelves - Raised edges help contain spills and make clean up quick and easy
- Fresh food multi-level drawers - Provide the ideal environment for storing your fruits and vegetables
- Adjustable door bins - Creates additional storage space for milk and other gallon-size containers
- Arctica icemaker - A special access door puts ice within reach
- Advanced water filtration uses MWF replacement filter - Reduces trace pharmaceuticals from water and ice* (* Removes 98% of ibuprofen, atenolol, fluoxetine, progesterone and trimethoprim. These pharmaceuticals are not necessarily in all users' water)

FEATURES

Temperature Management Features	4 Electronic Sensors
Control Type	Actual Temperature Display; Upfront Electronic Touch Temperature Controls
Defrost Type	Frost Guard
Icemaker	Factory-Installed
Dispenser	Cubes, Crushed Ice and Chilled Water
Dispenser Features	Child Lock; Door Alarm; LED Dispenser Light; Water Filter Indicator Light
Water Filtration	GE Water Filtration 6 Month; MWF; XWF (on select models manufactured after June 2018)
Filter Location	Upper right corner
Fresh Food Cabinet Shelves	2 Slide-Out; 3 Adjustable; 3 Spill Proof; 4 Total - Glass
Fresh Food Door Bins	2 Adjustable with Gallon Storage; 2 Fixed; 4 Total
Fresh Food Door Features	Dairy Compartment
Fresh Food Cabinet Drawers	2-Stack drawer system; Multi-Level Drawers
Top Drawer	Snack Drawer
Middle Drawer	Adjustable Humidity
Freezer Cabinet Shelves	2 Adjustable; 3 Total
Freezer Cabinet Shelf Features	Sweet Spot Shelf - 1/2 Fixed
Freezer Door Bins	2 Adjustable; 4 Total
Freezer Storage Baskets	1 Slide-Out; 1 Total
Freezer Features	Ice Storage Bin; Interior Light
Leveling System	2 Point
Door Liner	ABS
Performance Features	Easily Removable Door Gaskets; Never Clean Condenser; Vacation Mode
Exterior Style	Free-Standing
Product Type	Side-by-Side Refrigerator

Have more questions? Please contact 1-800-626-2005

ENERGY STAR CERTIFIED

Residential Refrigerators

GE : GSE25GGH****

Specifications

Brand Name:	GE
Model Number:	GSE25GGH****
Type:	Side-by-Side
Defrost Type:	Automatic
Compact:	No
Built-in:	No
Thru the Door Dispenser:	Yes
Ice Maker:	Yes
Counter Depth:	No
Height (in):	69.8
Width (in):	31.3
Capacity (Total Volume) (ft3):	25.4
Annual Energy Use (kWh/yr):	645
US Federal Standard (kWh/yr):	709
Connected Functionality:	No
Date Available On Market:	2014-09-01
Date Certified:	2014-08-27
Markets:	United States, Canada
ENERGY STAR Certified:	Yes

Additional Model Information

Captured On:
12/11/2019

GE® 30" Free-Standing Electric Range

Model# JB645DKBB



- Two 9"/6" Power Boil elements - Two powerful elements boil water 25% faster than standard GE elements and adjust to fit cookware
- Self-clean oven - Cleans the oven cavity without the need for scrubbing
- Dual-element Bake - Upper and lower elements produce even heat and great results
- Ceramic glass cooktop - Smooth cooktop easily wipes clean
- Removable full-width storage drawer - Store cookware or kitchen accessories
- 5.3 cu. ft. oven capacity - Enough room to cook an entire meal at once

FEATURES

Configuration	Range with Storage Drawer
Cooktop Burner Type	Radiant; Smoothtop
Cooktop Surface	Black Ceramic Glass; One-Piece Upswept
Control Location	Backsplash
Element - Left Front	9"/6" 3100W Power Boil
Element - Left Rear	6" 1200W
Element - Right Front	9"/6" 3100W Power Boil
Element - Right Rear	6" 1200W
Control Type	Digital Temperature Display; Electronic; Touchpads
Cooking System	Traditional
Product Type	Free-Standing Single Oven
Melt Setting	Yes
Heating Element "ON" Indicator Light	1
Hot Surface Indicator Lights	1
Interior Oven Light	1 Incandescent
Oven Cleaning Type	Self-Clean
Oven Control Features	Audible Preheat Signal; Auto Oven Shut-Off with Override; Auto Self Clean; Control Lock Capability; Delay Bake Option (Time Bake); Delay Clean Option; Electronic Clock & Kitchen Timer; Hi / Low Broil; Oven "ON" Light; Self-Clean Cool Down Time Display; Self-Cleaning Cycling Light
Oven Features	4-Pass Bake Element; 4-Pass Broil Element
Oven Rack Features	2 Oven Racks; 6 Rack Positions
Storage Drawer Features	Removable Full-Width
Cooking Technology	Traditional
Cooktop Type	Radiant Smoothtop
Drawer Type	Storage
Fuel Type	Electric

Have more questions? Please contact 1-800-626-2005

iHouse 19 Unit Apartment Building

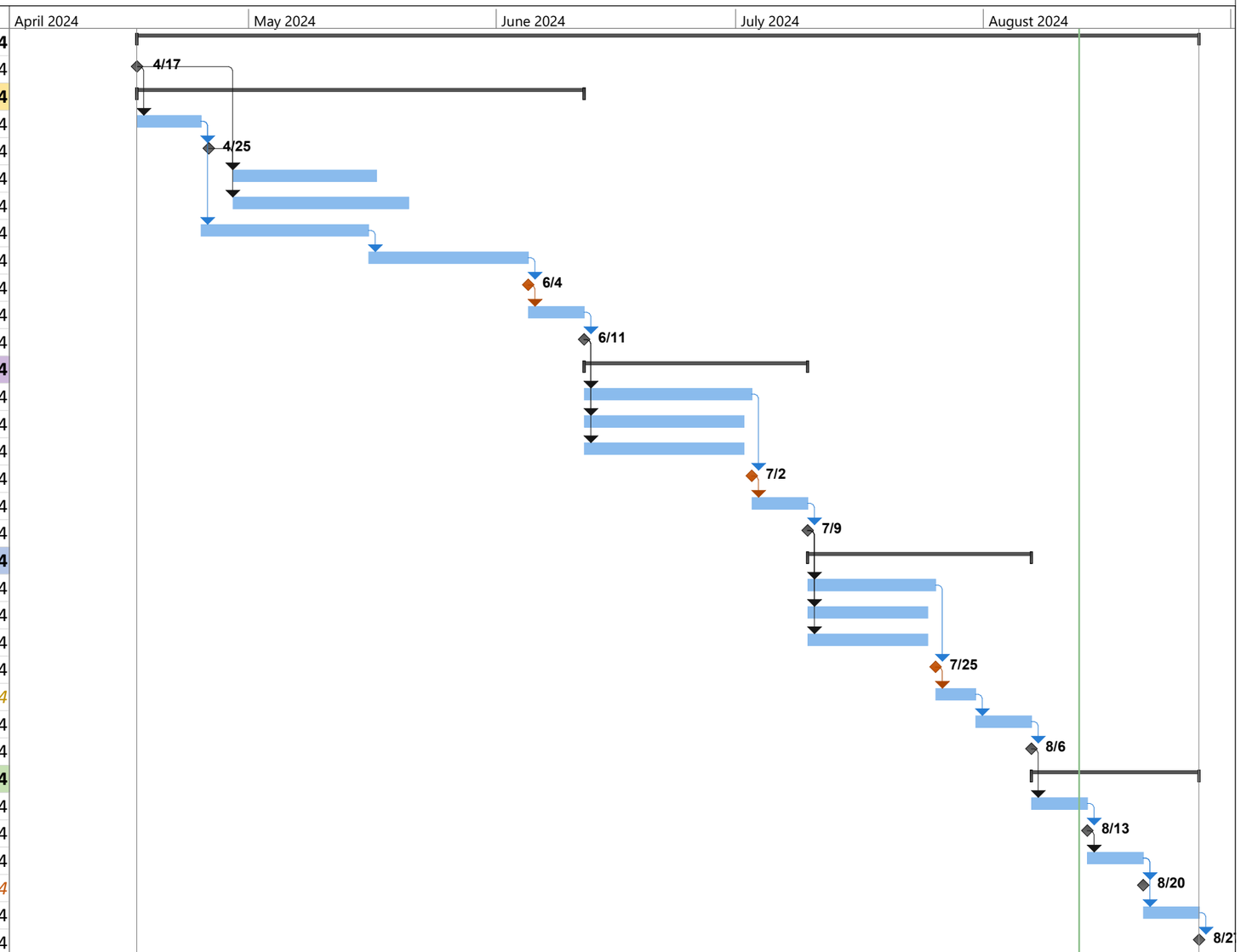
Tonalea, AZ

Appendix A7
Design Schedule

JSRa
JOHNSON SMITTHIPONG & ROSAMOND ASSOCIATES, INC.
5210 E Williams Circle, Suite 600 ▪ Tucson, AZ 85711 ▪ v:520.547.7904 ▪ f:520.547.7905 ▪ www.jsra.com

iHouse Apartment Project

ID	Task Name	Duration	Start	Finish
1	**Overall Project**	**133 days**	**Wed 4/17/24**	**Tue 8/27/24**
2	Notice to Proceed	0 days	Wed 4/17/24	Wed 4/17/24
3	**Ph I - Site Development (Pre-Design)**	**56 days**	**Wed 4/17/24**	**Tue 6/11/24**
4	Pre-Design Misc Task	8 days	Wed 4/17/24	Wed 4/24/24
5	Pre-Design Conference	0 days	Thu 4/25/24	Thu 4/25/24
6	On Site Investigation	18 days	Mon 4/29/24	Thu 5/16/24
7	GeoTech	22 days	Mon 4/29/24	Mon 5/20/24
8	Survey	21 days	Thu 4/25/24	Wed 5/15/24
9	Site Planning & Development	20 days	Thu 5/16/24	Tue 6/4/24
10	Site Planning & Development Submittal	0 days	Tue 6/4/24	Tue 6/4/24
11	SPD Government Review	7 days	Wed 6/5/24	Tue 6/11/24
12	Site Dev Review via TEAMS	0 days	Tue 6/11/24	Tue 6/11/24
13	**Ph II - Housing Details (50%)**	**28 days**	**Wed 6/12/24**	**Tue 7/9/24**
14	Architectural Drawings	21 days	Wed 6/12/24	Tue 7/2/24
15	Consultants Drawings	20 days	Wed 6/12/24	Mon 7/1/24
16	Specifications	20 days	Wed 6/12/24	Mon 7/1/24
17	Housing Details Submittal	0 days	Tue 7/2/24	Tue 7/2/24
18	HD Government Review	7 days	Wed 7/3/24	Tue 7/9/24
19	HD Review at JSRa	0 days	Tue 7/9/24	Tue 7/9/24
20	**Ph IV - Construction Documents (90%CD)**	**28 days**	**Wed 7/10/24**	**Tue 8/6/24**
21	Architectural Drawings	16 days	Wed 7/10/24	Thu 7/25/24
22	Consultant's Drawings	15 days	Wed 7/10/24	Wed 7/24/24
23	Specifications	15 days	Wed 7/10/24	Wed 7/24/24
24	CD 95% Submittal	0 days	Thu 7/25/24	Thu 7/25/24
25	*Team Coordination*	*5 days*	*Fri 7/26/24*	*Tue 7/30/24*
26	Government Review	7 days	Wed 7/31/24	Tue 8/6/24
27	CD 95% Review via TEAMS	0 days	Tue 8/6/24	Tue 8/6/24
28	**Final Design (PH IV Cont)**	**21 days**	**Wed 8/7/24**	**Tue 8/27/24**
29	Final CD Corrections	7 days	Wed 8/7/24	Tue 8/13/24
30	Final CD Submission	0 days	Tue 8/13/24	Tue 8/13/24
31	Governement Review	7 days	Wed 8/14/24	Tue 8/20/24
32	*Receive Comments*	*0 days*	*Tue 8/20/24*	*Tue 8/20/24*
33	Complete Final CD	7 days	Wed 8/21/24	Tue 8/27/24
34	Final Signed CD Submittal	0 days	Tue 8/27/24	Tue 8/27/24



Project: iHouse Apartment
Date: Tue 8/13/24

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		