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DRAINAGE TECHNICAL MEMORANDUM

ATTENTION:	**Christopher Jordan**
FROM:	**Pamela Dalcin-Walling**
SUBJECT:	**WRD052 Southeast Industrial Area Storm Drain Improvements**
DATE:	**December 8, 2021**

The purpose of this memorandum is to document the interim and ultimate condition drainage improvements needed to accommodate the initial developments and the Mahon watershed of the Southeast Industrial Area in the City of Elk Grove.

1. INTRODUCTION

1.1 Background

The City of Elk Grove (City) is planning for the development of an area referred to as the Southeast Industrial Area (SEIA) located at the southern limits of the City and north of Deer Creek. The SEIA is comprised of three watersheds (the Mosher, Grant Line, and Mahon Watersheds) and encompasses an area along Grant Line Road (GLR) that spans from the Union Pacific Railroad to approximately 700 feet northeast of Mosher Road. All of the privately owned parcels in the SEIA are currently undeveloped or used for agricultural purposes. The City owns an undeveloped 100-acre parcel within the Mahon watershed that is zoned for light industrial land use. This parcel, which was previously being considered for a sports park complex, has been subdivided and sold for private development. See **Figure 1** for a vicinity map of the project area and the adjacent developments.

As part of the development planning process for the SEIA and the City parcel, the City prepared the Multi-Sport Park Complex Drainage Master Plan (DMP).

The DMP studied the SEIA to develop the preliminary designs of the regional drainage and water quality facilities required to accommodate the developed condition. Specifically, the DMP determined the following:

- Allowable discharge rates to Deer Creek based on the historic predeveloped discharge rates
- Preliminary alignments and sizes of the storm drain trunklines
- Preliminary locations and sizes of multi-purpose basins for flow attenuation, hydromodification, and stormwater treatment
- Impacts to the Deer Creek hydraulics based on the proposed discharge rates from the SEIA

Within the DMP, three alternatives were analyzed based on the different land use configurations under consideration for the City parcel:

- Alternative A - Land use for the entire 100-acre City parcel would be an open space sports park.

City of Elk Grove

Southeast Industrial Area Storm Drain Improvements

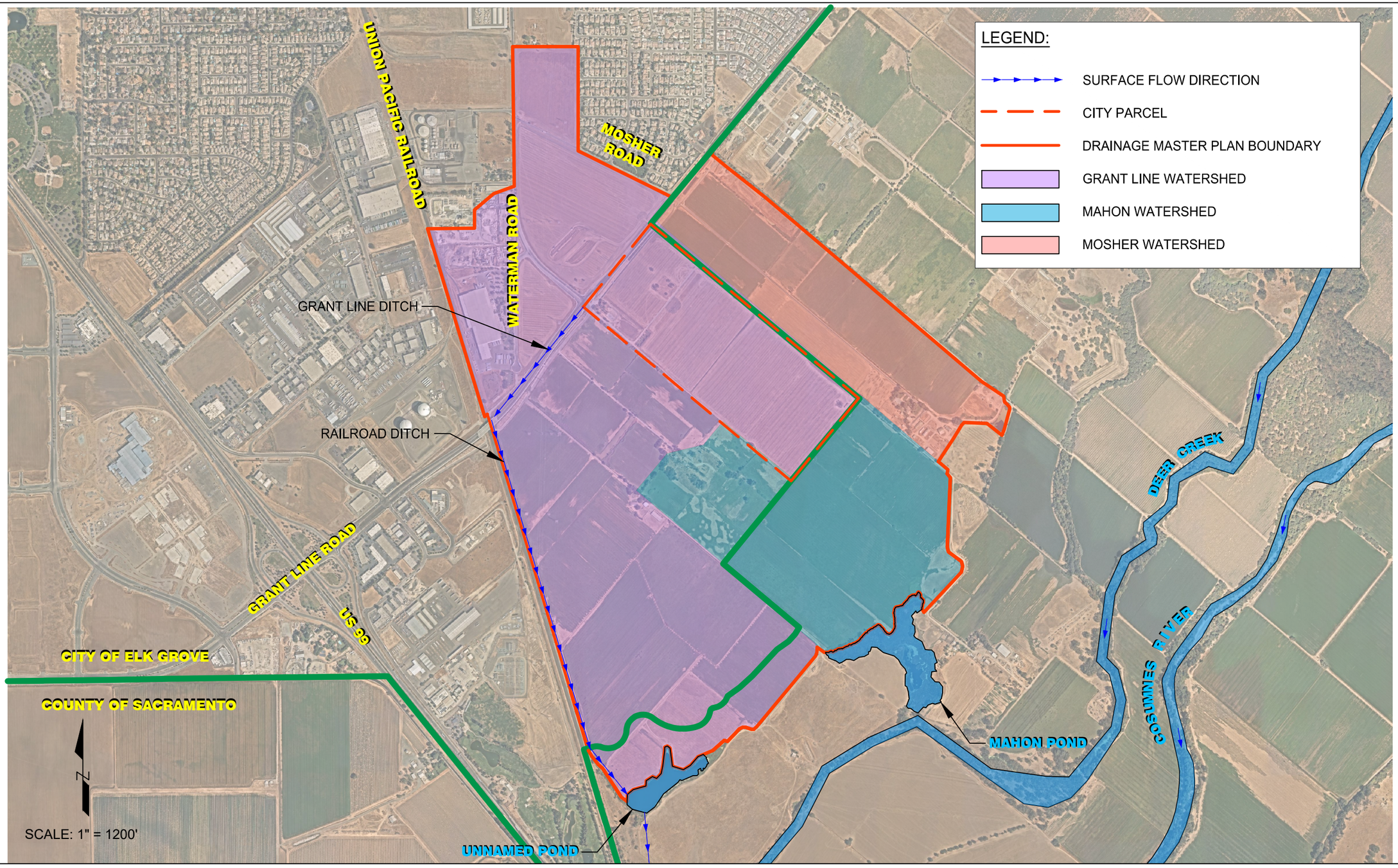

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Figure 1 - Project Vicinity Map

- Alternative B – Land use for the City parcel would be a mix of open space sports park and light industrial land uses.
- Alternative C – Land use for the City parcel would be light industrial.

The DMP analyzed Alternatives A and B quantitatively, while Alternative C was analyzed qualitatively. Subsequent to the DMP being finalized, the City decided it would no longer pursue the development of a sports complex and is now planning for full development of the City parcel as a light industrial land use (Alternative C).

The DMP concluded that to adequately support the various developments within the SEIA, the City would need to construct a municipal storm drain trunkline along the future Waterman Road Extension, traversing the Mahon Ranch and ultimately discharging into the Mahon Pond. Each of the storm drain systems for the adjacent developments would tie in and discharge to this trunkline.

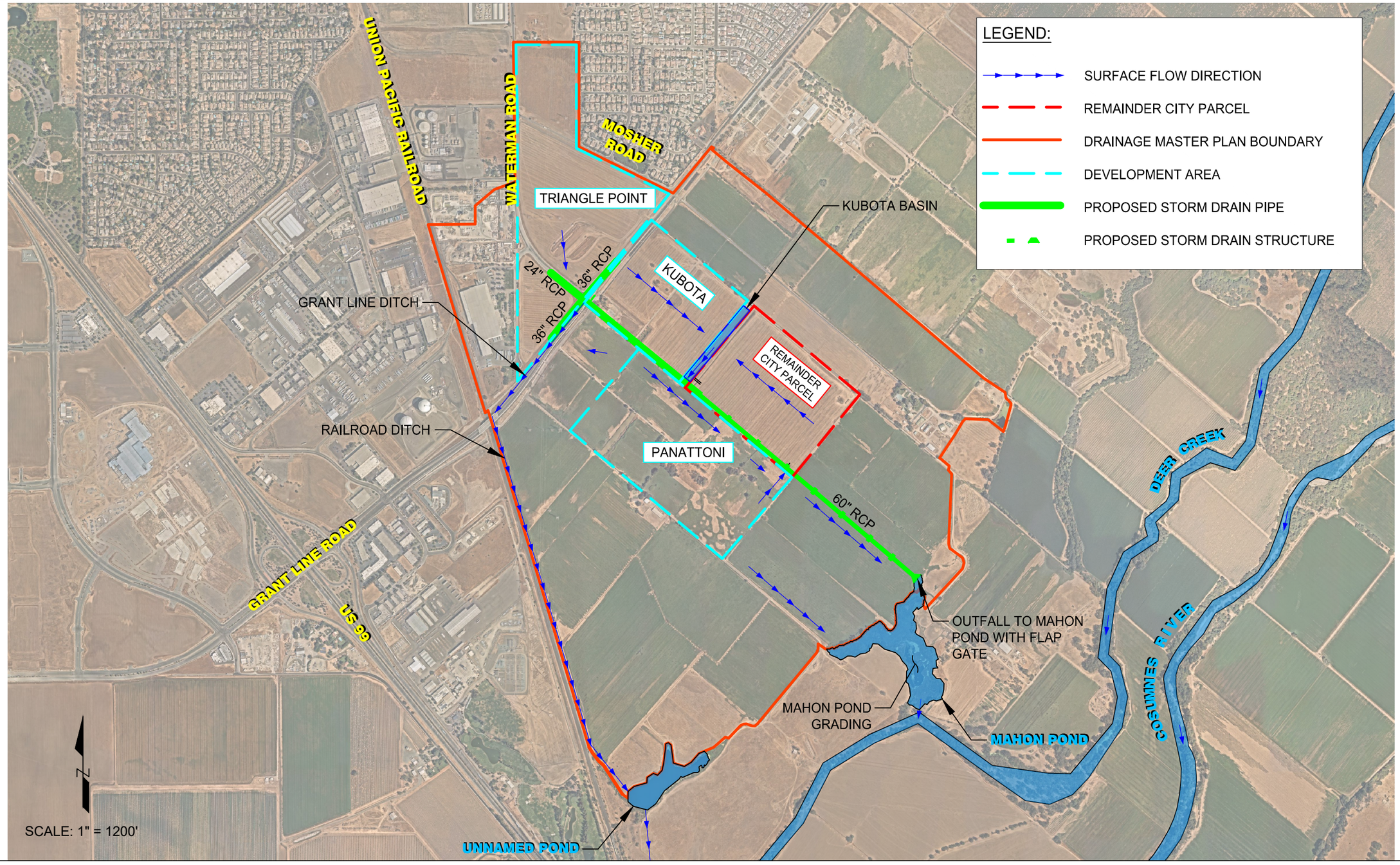
1.2 Project Description

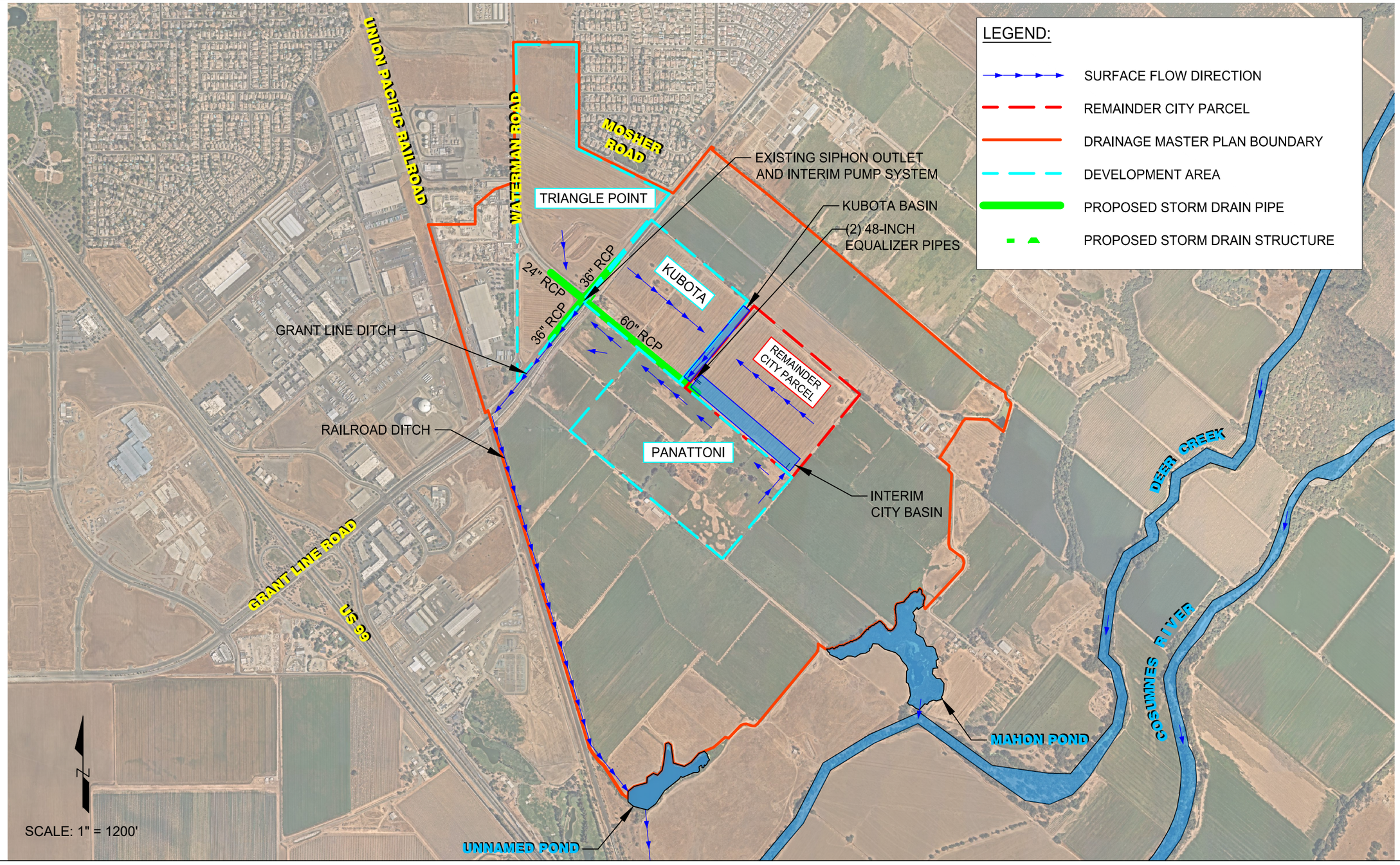
The ultimate municipal storm drain improvements associated with the Mahon watershed include a 24- to 36-inch storm drain system under GLR, which discharges to a 60-inch storm drain trunkline aligned from the intersection of GLR and Waterman Road to the southwest to an outfall at the Mahon Pond. These improvements are shown in **Figure 2**.

This storm drain system will serve the initial SEIA developments, including the Triangle Point, Kubota, and Panattoni sites. The Kubota site is located within the northwest half of the City's 100-acre parcel. Kubota has purchased this portion of the City's parcel. These three developments are located in the Mahon watershed as described in the DMP and are planned for construction in the summer of 2022 (see Figure 2). Each of the initial SEIA developments include private storm drain systems and basins, which will connect to the City's storm drain trunkline.

The lead time required to complete design and right of way (ROW) acquisition may exceed the time remaining before the SEIA initial developments will be in place. If that ends up being the case, the City is prepared to implement an interim condition where runoff would be pumped to ditches in the adjacent Grant Line watershed. The Grant Line watershed is tributary to Deer Creek, similar to the Mahon watershed. The interim improvements, as originally developed by the Kubota and Triangle Point developers, and subsequently modified to accommodate the Panattoni development, include a segment of the City's storm drain trunkline spanning from GLR to the Panattoni site outfall, an interim City basin adjacent to the Kubota basin connected by equalizer pipes, and an interim pump system to discharge runoff generated at the developed sites to the GLR ditch. These improvements are shown in **Figure 3**.

The interim drainage facilities, if needed, will utilize portions of the ultimate trunkline and are envisioned to be in place for one season, until such time as the final design and ROW acquisition are completed and the ultimate Mahon watershed storm drain facilities are constructed.


LEGEND:
SURFACE FLOW DIRECTION
REMAINDER CITY PARCEL
DRAINAGE MASTER PLAN BOUNDARY
DEVELOPMENT AREA
PROPOSED STORM DRAIN PIPE
PROPOSED STORM DRAIN STRUCTURE
UNION PACIFIC RAILROAD
WATERMAN ROAD
MOSHER ROAD
TRIANGLE POINT
KUBOTA BASIN
KUBOTA
24" RCP
36" RCP
36" RCP
GRANT LINE DITCH
RAILROAD DITCH
REMAINDER CITY PARCEL
PANATTONI
60" RCP
DEER CREEK
GRANT LINE ROAD
US 99
OUTFALL TO MAHON POND WITH FLAP GATE
MAHON POND GRADING
MAHON POND
COSUMNES RIVER
N
SCALE: 1" = 1200'
UNNAMED POND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MOSHER ROAD
TRIANGLE POINT
EXISTING SIPHON OUTLET AND INTERIM PUMP SYSTEM
KUBOTA BASIN
(2) 48-INCH EQUALIZER PIPES
KUBOTA
24" RCP
36" RCP
36" RCP
60" RCP
GRANT LINE DITCH
RAILROAD DITCH
REMAINDER CITY PARCEL
PANATTONI
INTERIM CITY BASIN
GRANT LINE ROAD
US 99
DEER CREEK
COSUMNES RIVER
MAHON POND
UNNAMED POND
N
SCALE: 1" = 1200'

2. EXISTING CONDITION

2.1 Land Uses

The project is located near the intersection of GLR and Waterman Road in the City of Elk Grove. The surrounding land in the project site consists of mostly agricultural properties with a few single residence homes and undeveloped land. Deer Creek and the Cosumnes River are located south of the project site. The land in the surrounding area is primarily covered with grasses and supports a few small shrubs and trees.

2.2 Soils, Infiltration Rates, and Groundwater

Geocon conducted a geotechnical investigation for the Panattoni site that analyzed the soil of the surrounding area in April 2021. Six borings and fifteen test pits were analyzed. Based on the preliminary geotechnical report prepared by Geocon, the soil samples primarily were found to consist of lean clays, fat clays, and silt. The project area is representative of hydrologic soil groups C and D, which are characterized by high runoff potential and low infiltration and water transmission rates.

Geocon also performed twelve additional borings on the City parcel to verify infiltration rates. Ten of the twelve test results showed infiltration rates between 0.00 and 1.75 inches per hour. Two tests taken at depths of 9 to 11 feet and 12.5 to 14.5 feet resulted in infiltration rates between 22.67 and 80.10 inches per hour. The two tests resulting in high infiltration rates were considered to be anomalies and the site was characterized as having little to no infiltration capabilities.

The California Department of Water resources (DWR) database indicates that the nearest well to the project site, Well 06N06E16E001M, has had an average groundwater depth of 65.9 feet from 1989 to 2017. Groundwater flow direction is expected to be locally variable based upon specific topography, drainage patterns, and geologic conditions.

2.3 Flooding

As illustrated in the FEMA Flood Insurance Rate Maps (FIRM) #06067C0339H and #06067C0475H, the project is located in areas designated as Zones AE and X. Zone AE is defined as a 100-year floodplain area with based flood elevations determined. Zone X is defined as an area of minimal flooding hazard. The northern portion of the project site is not located within the 100-year floodplain, but the southern portion of the project including Mahon Pond is located within the 100-year floodplain. The sources of flooding are the adjacent Cosumnes River and Deer Creek. See **Figure 4** for the FEMA FIRM.

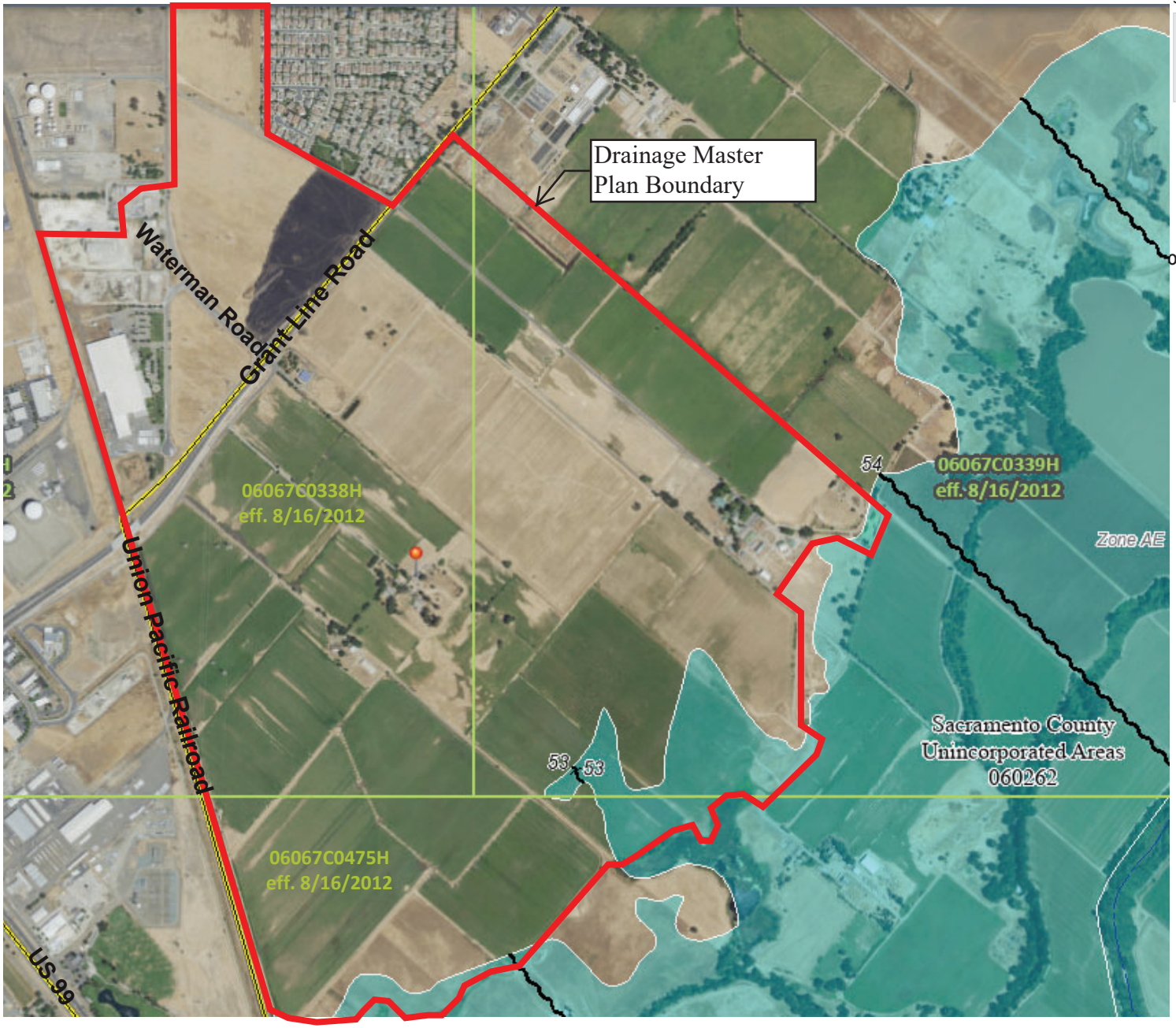
2.4 Watersheds, Drainage Patterns, and Drainage Facilities

The SEIA consists of three major watersheds including the Mosher, Grant Line, and Mahon Watersheds as described in the DMP. Each watershed generally drains south as overland flow to Deer Creek.

Runoff generated in the Mahon watershed, which is the focus of this memorandum, drains from north to south as overland flow to the Mahon Pond. The existing surrounding land is relatively flat with elevations ranging from 45 feet to 55 feet. Mahon Pond is approximately 8 feet deep with a bottom elevation of 39 feet and a top elevation of 47 feet (NAVD88). The Mahon Pond discharges to Deer Creek through a 36-inch culvert and secondarily via weir in high flow conditions.

National Flood Hazard Layer FIRMette

FEMA



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 / 17.5 — Cross Sections with 1% Annual Chance 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

PROJECT AREA

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 11/15/2021 at 5:53 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.

FIGURE 4 - FEMA Firmette

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

The existing Grant Line watershed is generally located northwest and west of the Mahon watershed. Runoff generated in the Grant Line watershed drains to the southwest in ditches that parallel GLR. These ditches then angle to the south paralleling the Union Pacific Railroad before discharging to an unnamed pond. Runoff that leaves the unnamed pond flows directly into Deer Creek.

See **Figure 5** for an exhibit showing the SEIA existing drainage patterns.

3. INTERIM CONDITION

3.1 Land Uses

In the interim condition, the Panattoni and Kubota sites would be fully developed as light industrial land use areas. The Triangle Point site will be a mix of light industrial and medium-density residential land uses. The remainder of the City parcel has also been assumed to be developed as a light industrial land use area. The remainder of the SEIA would remain undeveloped.

3.2 Watersheds, Drainage Patterns, and Drainage Facilities

The interim condition watersheds and overall drainage patterns would remain similar to the existing condition. Only a small portion of the Mahon watershed that overlaps with the Panattoni site would be diverted to the Grant Line watershed. The interim storm drain facilities, should they be needed, include a segment of the City's storm drain trunkline spanning from GLR to the Panattoni site outfall, an interim City basin adjacent to the Kubota basin connected by equalizer pipes, and an interim pump system to discharge runoff generated at the developed sites to the GLR ditch.

The Mahon and Mosher watersheds would remain generally unchanged in the interim condition.

4. ULTIMATE CONDITION

4.1 Land Uses

In the ultimate condition, the Panattoni, Kubota, and remainder City parcel sites would be fully developed as light industrial land use areas. The Triangle Point site will be a mix of light industrial and medium-density residential land uses. The remainder of the SEIA would be developed consistent with the DMP, including a mix of public right-of-way, heavy industrial, light industrial, mixed use, parks and open space, and regional commercial.

4.2 Watersheds, Drainage Patterns, and Drainage Facilities

The ultimate condition drainage patterns are generally consistent with Alternative C of the DMP with the exception that two areas planned as part of the proposed Grant Line watershed in the DMP will be shifted into the Mahon watershed. The two areas that will be shifted into the Mahon watershed include the Panattoni site and the portion of the Triangle Point site west of Waterman Road.

City of Elk Grove

Southeast Industrial Area Storm Drain Improvements

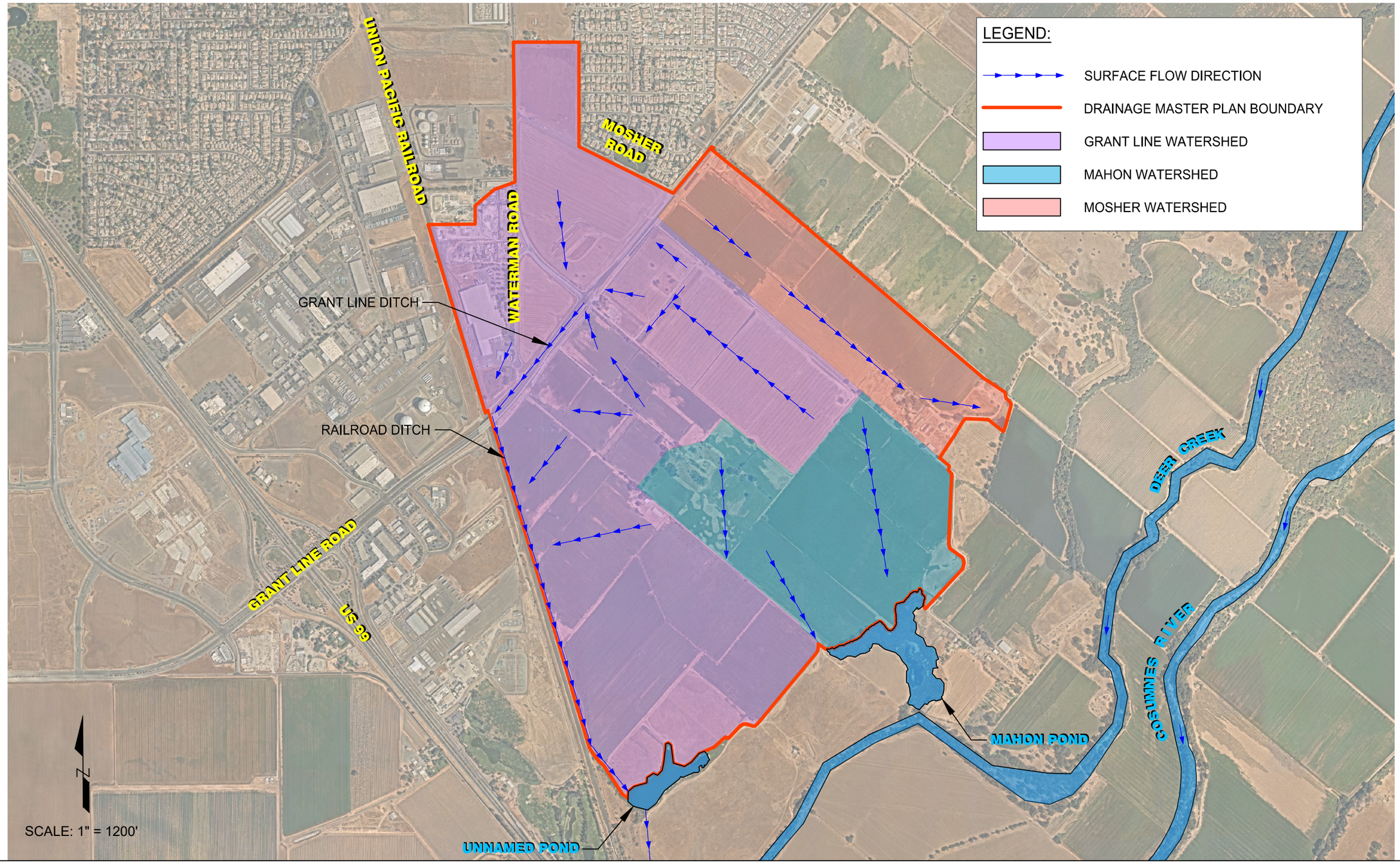


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Figure 5 - Existing Drainage Patterns

Runoff generated in the Mahon watershed will flow southeasterly to the Mahon Pond via two main drainage pathways.

1. Runoff generated by the majority of the Mahon watershed, including the initial developer sites, will drain through a 60-inch storm drain trunkline, which will outfall to Mahon Pond.
2. Runoff generated by a parcel northwest of the Mahon Pond will drain through a separate storm drain system and discharge at a separate outfall location to the Mahon Pond.

The 60-inch storm drain trunkline will span from GLR to the Mahon Pond with connections from the Kubota and Panattoni developers. The trunkline will be aligned from the intersection of GLR and Waterman Road to the southwest in a generally straight path to the Mahon Pond outfall. Due to the Mahon Pond being located in the FEMA Zone AE area with relatively high base flood elevations, the 60-inch outfall will require a flap gate to prevent backflow and flooding of the upstream developments.

Due to the existing grades of the Mahon Pond, minor grading is required to extend the bottom of the pond to the trunkline outfall location. The owner of the Mahon Pond and the City have expressed interest in grading and/or dredging the pond. The extent of the grading is currently being determined and is discussed in more detail in Section 6.

See **Figure 6** for an exhibit showing the SEIA ultimate watersheds.

5. HYDROLOGIC ANALYSIS

The hydrologic analysis was performed using Innovyze's XP SWMM software based on the Sacramento Method consistent with the DMP and the Sacramento City/County Drainage Manual. The DMP XP SWMM models served as the baseline models, which were revised to reflect the current plans including the DMP Alternative C City parcel land use and flow diversions of the Triangle Point and Panattoni developments. The revised XP SWMM model is referred to as the Master Model since it incorporates the City's and the developer's improvements into a single model.

5.1 Criteria

The DMP provided a baseline approved preliminary design with specific peak flow discharge limitations to Deer Creek. The project has the potential to increase peak flows discharged to Deer Creek from the Grant Line watershed in the interim condition and the Mahon watershed in the ultimate conditions. Based on the DMP, the Grant Line and Mahon watershed maximum allowable discharge rates to Deer Creek are 235 cfs and 85 cfs, respectively.

5.2 Developer's Hydrology

The Sacramento Method hydrologic analysis of the SEIA initial developments was performed by each respective developer. The City provided the developer models and approved their use to incorporate the developers hydrology into the Master Model. The developer hydrology was incorporated into the Master Model in the form of flow hydrographs at their respective points of connection to the City's storm drain trunkline.

City of Elk Grove

Southeast Industrial Area Storm Drain Improvements

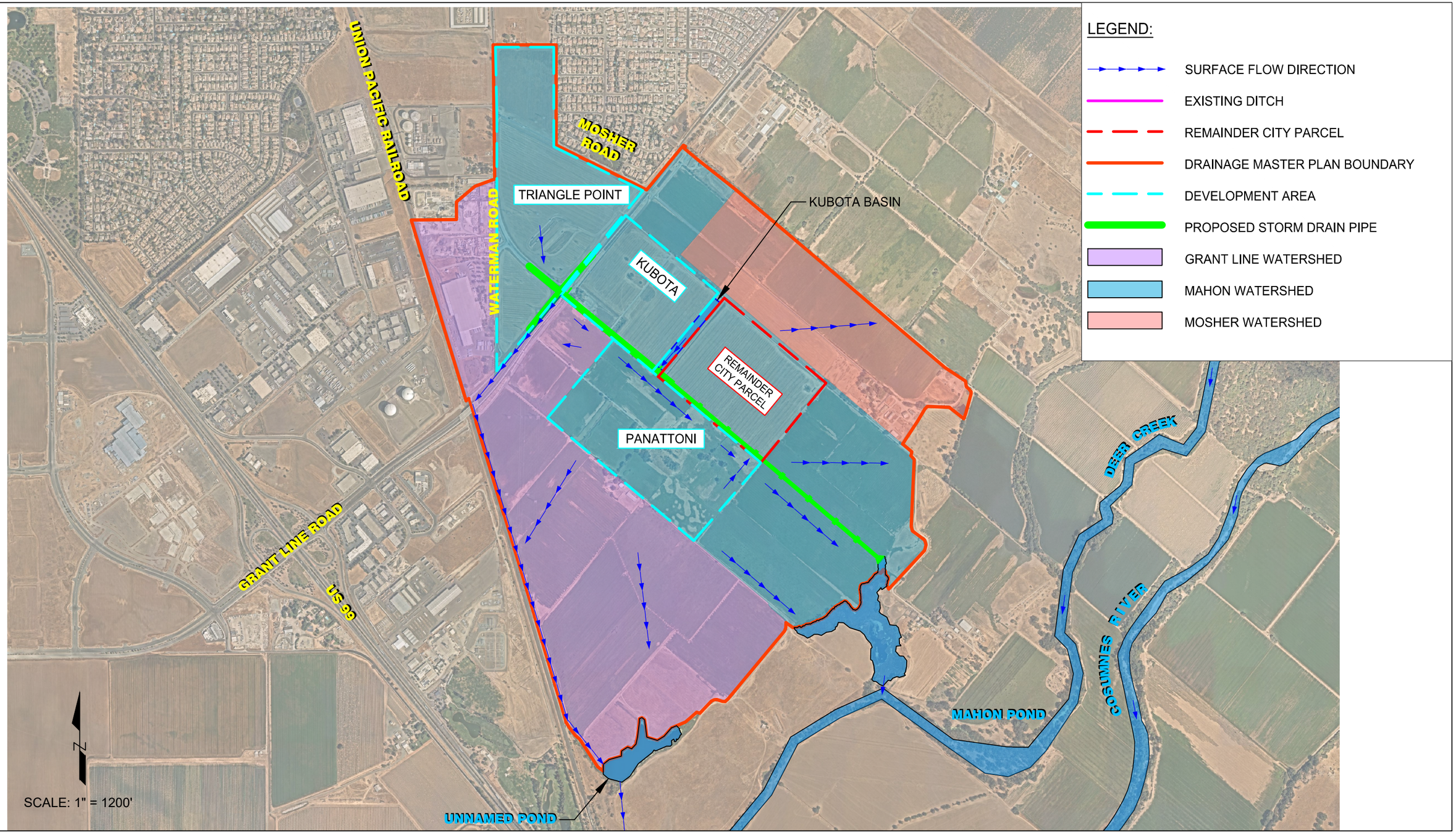

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Figure 6 - Ultimate Condition Watersheds

The Triangle Point/Kubota flow hydrograph was entered at the City's proposed manhole adjacent to the Kubota basin, which includes runoff from areas along GLR and the light industrial remainder of the City parcel. The Panattoni flow hydrograph was entered at the City's proposed manhole adjacent to the Panattoni basin located in the east corner of their development, which includes runoff solely from the Panattoni site.

5.3 Hydrology for Additional Contributing Areas

The hydrologic analysis for the remaining areas of the Mahon Watershed was performed based on the original DMP XP SWMM models, with the following exception:

The DMP assumed that the runoff generated in the area southeast of the City parcel would drain to a proposed Basin B, which would discharge into the City's storm drain trunkline. The City indicated that this parcel may remain undeveloped for the foreseeable future and requested alternative analyses that included the removal of the basin from the Master Model.

5.4 Storm Frequencies

Interim and ultimate condition peak flows were developed for the following frequencies and purposes in accordance with the City's Improvement Standards and the City/County Drainage Design Manual:

- 10-year, 24-hour: 10-year flows were developed for the purpose of designing drainage facilities to satisfy all City hydraulic criteria. Based on the proposed improvements, the primary hydraulic criteria includes hydraulic grade line (HGL) requirements at manholes and minimum pipe flow velocities to provide a self-cleansing condition. 10-year flows were also developed to evaluate how the interim basins and storm drain systems would behave based on successive storm events.
- 100-year, 24-hour: 100-year flows were developed to confirm the project results in acceptable flooding extents and maximum water surface elevations. 100-year flows were also developed to confirm the project peak flows discharged to Deer Creek will not exceed the allowable discharge rates determined in the DMP.

5.5 Flow Diversions

The hydrology and runoff routing developed for the ultimate analysis were identical to the DMP with the exception of two flow diversions. Two areas planned as part of the proposed Grant Line watershed in the DMP were shifted into the Mahon watershed, including the Panattoni site and the portion of the Triangle Point west of Waterman Road. The flow diversions have the potential to increase peak flows discharged to Deer Creek. The XP SWMM model that developed the ultimate condition hydrology, routed the runoff through the Mahon Pond and its outfall to Deer Creek. The Mahon Pond and its outfall attenuate peak flows, mitigating the effects of the flow diversions.

5.6 Results

Results of the hydrologic analysis indicate that the interim and ultimate condition peak flows discharged to Deer Creek will not exceed the allowable discharge rates determined in the DMP. Table 1 below provides a summary of the interim and ultimate peak flows discharged to Deer Creek:

Table 1 –100-Year Peak Flows Discharged to Deer Creek

Condition Analyzed	Calculated Peak Flow (cfs)		Maximum Permissible Peak Flow (cfs)		Satisfies Criteria
	Grant Line Watershed	Mahon Watershed	Grant Line Watershed	Mahon Watershed	
Interim	64.6	No Impact	235	No Impact	Yes
Ultimate Alternative 1	No Impact	74.4	No Impact	85.0	Yes
Ultimate Alternative 2	No Impact	82.0	No Impact	85.0	Yes
Ultimate Alternative 3	No Impact	82.0	No Impact	85.0	Yes

6. HYDRAULIC ANALYSIS

The proposed on-site drainage facilities have been designed to convey runoff from the planned development of the Mahon Watershed to Deer Creek in accordance with the City's Improvement Standards and the Sacramento City/County Drainage Manual. The hydraulic design analyses were performed using Innovyze's XP SWMM software. The following sections discuss the specific criteria and assumptions that were used and how each of the drainage facilities were analyzed and designed.

6.1 Criteria & Assumptions

The City's Improvement Standards served as the primary design guidance and were supplemented by the Sacramento City/County Drainage Design Manual as necessary. The DMP provided a baseline approved preliminary design with specific drainage limitations, which was superseded based on detailed site investigations, research of available studies, and direction provided by the City. The proposed storm drain system was designed to satisfy the following criteria:

- The maximum allowable 10-year hydraulic grade line elevation shall be 1-foot below the rim elevation at manholes based on a 10-year tailwater condition.
- Minor losses were calculated based on City Standards Method 1, which uses conservative Manning's "n" values to account for minor losses. The only exceptions to the use of Method 1 were the analysis of the Mahon Pond outlet and equalizer culverts, which used City Standards Method 2 for Manning's "n" values and City Improvement Standards Table 9-3 to account for the entrance and exit losses.
- The minimum inside diameter for City storm drain pipes shall be 12-inch diameter.
- Interim pipes that will be removed during the ultimate construction were assumed to be High Density Polyethylene (HDPE). Proposed pipes that are part of the ultimate drainage configuration were assumed to be reinforced concrete pipe (RCP).
- The minimum cover for reinforced concrete pipe in unpaved areas shall be 1/8th the diameter but not less than 12 inches. The minimum cover for typical reinforced concrete pipe (Classes II and III) in paved areas shall be 1/8th the diameter but not less than 24 inches.
- The minimum full-pipe flow velocity shall be 2 feet per second to ensure a self-cleansing condition.
- Minimum manhole spacing is 600 feet for pipes 36 inches in diameter or greater.

- The 100-year storm analysis shall be based on the 100-year tailwater condition to ensure areas served by a given storm drain system do not result in objectionable water surface elevations or flooding extents.
- 100-Year Water Surface Elevations: Critical locations with specific limitations to water surface elevations include the Mahon Pond and the developer tie-in points along the proposed storm drain trunkline. Water surface elevations exceeding those summarized in Table 2 were considered objectionable based on the potential impacts to the SEIA initial developer's properties. The maximum allowable water surface elevation at the Mahon Pond was set at 1.5 feet below the approximate ground elevations of adjacent structures based on lidar topographic surveys prepared by the Department of Water Resources in 2007. The maximum allowable water surface elevations at the developer tie-in locations were set equal to their respective top of basin elevations based on their preliminary design plans.

Table 2 – Maximum Allowable Water Surface Elevations (NAVD88)

Kubota Tie-In	Panattoni Tie-In	Mahon Pond
ft	ft	ft
53.4	49.5*	51.5

*The Panattoni preliminary plans provided to date do not reflect their most recent design changes, which involved raising their proposed site elevations. A higher maximum water surface elevation at the Panattoni tie-in may be allowable. Further coordination is required to determine if a higher allowable maximum WSE is appropriate.

6.2 Model Development

The Master Model development involved updating hydraulic elements in addition to the incorporation of the SEIA initial developers' hydrology.

A topographic survey of the project area was performed in 2021, which provided more detailed grades of the Mahon Pond and identified a 36-inch culvert at the pond outfall. Both of these elements were largely unknown in the development of the DMP and were updated in the Master Model.

The DMP analysis utilized a free-outfall boundary condition at the Mahon watershed outfall to Deer Creek. In order to better represent the effects of the Deer Creek and Cosumnes River, a time-series boundary condition was developed using results from the HEC-RAS model prepared with the *200-Year Floodplain Mapping for Laguna Creek and Deer Creek* study by West Yost in 2015. The time-series boundary condition indicates that the Deer Creek and Cosumnes River do not begin to rise and impact outflow from the Mahon Pond until after the Mahon watershed peak flows have passed.

6.3 Interim Condition Analysis

The interim condition concept analyzed includes the Kubota basin and pump system as currently designed, the ultimate 60-inch storm drain trunkline from GLR to the Panattoni outfall, a 52-acre-foot City basin, an interim 30-inch pipe at the Panattoni trunkline connection that discharges into the City basin, and two 48-inch equalizer pipes connecting the Kubota and City basins.

Interim condition analyses were performed to evaluate how the basins and storm drain systems would behave based on the following conditions:

- 100-year, 24-hour storm occurs when the City basin is initially empty
- 10-year, 24-hour storm occurs when the City basin is initially half full
- 10-year, 24-hour storm occurs when the City basin is initially full

6.3.1 Storm Drain Trunkline (GLR to Panattoni)

In the interim condition, the ultimate storm drain pipe trunkline segments from the intersection of GLR and Waterman Road to the Panattoni connection to the trunkline will be constructed. The storm drain trunkline follows the future Waterman Road extension, which is also referred to as "B" Street in the Draft Multi-Sport Complex and Southeast Industrial Annexation Area Supplemental Environmental Impact Report. This trunkline will be utilized in both the interim and ultimate condition. In the interim condition, it will serve as a hydraulic link connecting the Kubota, Panattoni, and City basins to the interim pump system located along GLR. The required pipe diameters and slopes for the storm drain trunkline were determined as part of the ultimate condition analysis and were verified to work as part of the interim condition.

6.3.2 City Basin & Equalizer Pipes

In order to provide an interim drainage solution for the Panattoni development with minimal impacts to the Kubota interim drainage design, the project will provide a temporary 52-acre-foot retention basin adjacent to the Kubota basin. The Panattoni site would discharge to the City's temporary basin, which in turn would be connected to the Kubota basin with equalizer pipes. This interim configuration would result in no increase in maximum water surface elevations at the Kubota site and would utilize the current Kubota interim pump system to draw down the basins.

Due to the proposed Panattoni outfall elevation to the storm drain trunkline, the City basin must be graded lower than the Kubota basin. The City basin will be approximately 180 feet wide by 1,600 feet long and 15.5 feet deep on the southeast end near the Panattoni outfall. The basin would include 2:1 slopes down to the bottom of the basin, which would be approximately 100 feet wide. The City basin would be connected to the Kubota basin by two 48-inch equalizer pipes, which were sized to reduce the frequency and duration of large differences in water surface elevations between the two basins.

A hydraulic analysis of the City basin and equalizer pipes as part of the broader interim condition drainage system was performed to determine the required basin grading and equalizer pipe diameters.

6.3.3 Pump Design

The Kubota developer has designed an interim pump system as documented in the *Triangle Point and Kubota WDC – Storm Drainage Interim Pumping Station Conceptual Design Memorandum*. The following is a summary of the interim pump station design as it relates to the interim condition improvements being considered.

The interim pump system will be located next to an existing grated drainage structure at the upstream end of the GLR ditch southwest of the intersection of GLR and Waterman Road. The grated drainage structure acts as a siphon outlet into the GLR ditch for an existing 36-inch underground storm drain system. The interim pump system will draw runoff from the adjacent siphon outlet structure through intake pipes. Based on the invert of the siphon structure compared to the Kubota and City basins, the configuration will allow for the runoff in the hydraulically connected Kubota and City basins to be pumped upgradient through the storm drain trunkline and discharged to the Grant Line ditch. The siphon outlet structure invert is higher than the Kubota and City basin inverts, which prohibits the pumps from fully draining the Kubota and City basins.

Since the soils in the project area exhibit little to no infiltration based on the tests performed, the proposed interim concept would result in a wet basin condition for extended time periods in excess of the City's 72-hour basin drawdown criteria. The constant ponded depth will be approximately 5.5 feet deep. Given the short duration that the interim conditions are anticipated to be in place, the City has confirmed that an exception to their drawdown criteria would be granted.

The temporary pump system includes two pumps each with a capacity of approximately 2.2 cfs. A third pump will be located on-site or at a nearby City facility for redundancy. The combined pump flow was modeled as a constant flow of 4 cfs to the Grant Line ditch per the developer's design. The Grant Line ditch has a capacity of approximately 10.5 cfs, which was considered in the development of the Kubota and City interim condition designs. A hydraulic analysis of the interim condition was performed to determine if any changes to the Kubota pump design would be needed.

6.3.4 Alternatives Considered

To accommodate the runoff from the Panattoni site in the interim condition, several alternatives of the interim drainage concept were considered including adjustments to the pump capacity and timing, retention capacity of the City basin, equalizer pipe sizing, and retention capacity of the Kubota basin. Based on City input, adjustments to the City basin capacity were prioritized over adjustments to the Kubota interim condition design. The capacity of the GLR ditch limits the discharge rate from the developments during the interim condition, which limits the flow range considered for the pump system. Existing grades of the GLR ditch coupled with the Kubota pump concept also limited the timing and drawdown ability of the pumps.

Based on input provided by the City, the interim condition alternative analyzed involve the least impact to the Kubota developer interim condition design and results in water surface elevations that can be accommodated by the Panattoni development.

6.3.5 Results

Results of the analysis indicate that the water surface elevations that can be accommodated by the Panattoni development. Table 3 below summarizes the results of the interim analyses:

Table 3 – Interim Hydraulic Analysis Summary

Interim Condition Analyzed	Kubota Tie-In Max WSE (ft)	Panattoni Tie-In Max WSE (ft)	Peak Flow to GLR Ditch (cfs)	Basin Drawdown Time (days)	Satisfies Criteria?
100-Year, 24-Hour Storm Starting with an Empty City Basin	49.0	49.0	4.3	13	Yes
10-Year, 24-Hour Storm Starting with a Half Full City Basin	50.0	50.0*	4.2	16	No*
10-Year, 24-Hour Storm Starting with a Full City Basin	51.3	51.3*	5.1	16	No*

*The Panattoni preliminary plans provided to date do not reflect their most recent design changes where the site was raised. A higher maximum water surface elevation at the Panattoni tie-in may be allowable. Further coordination is required to determine if a higher allowable maximum WSE is appropriate.

The results show that the interim system will provide adequate storage under a single 100-year event. If subsequent storm events occur during the 13-day drawdown period, there is a potential for flooding on the

Panattoni site (see Table 2 footnote). See **Appendix A** for detailed results of the interim condition hydraulic analysis.

6.4 Ultimate Condition Analysis

The Ultimate Condition storm drain system includes the following elements: 6,660 feet of storm drain trunkline (GLR to Mahon Pond), outfall structure, and grading at the Mahon Pond.

6.4.1 Storm Drain Trunkline (GLR to Mahon Pond)

The ultimate condition storm drain trunkline improvements will consist of the 3,160-feet of trunkline constructed for the interim condition (GLR to Panattoni) and a 3,500-foot extension of the storm drain trunkline from the Panattoni tie-in to the Mahon Pond. The trunkline diameter will be 60 inches, based on the preliminary findings from the DMP. Based on the size and length of the storm drain trunkline, eight manholes were assumed along the storm drain trunkline segment between the Panattoni trunkline tie-in to the Mahon Pond. Variations to the storm drain trunkline that were considered in the overall analysis included the use of a 60-inch storm drain trunkline for the entire length of trunkline from the Panattoni tie-in to the Mahon Pond (3,500 feet) and a combination of a 60-inch pipe for 3,200 feet combined with a 300-foot segment 72-inch pipe. Hydraulic analyses of the ultimate storm drain trunkline were performed to determine the required pipe diameters and slopes.

6.4.2 Storm Drain Trunkline Outfall Structure

The storm drain trunkline will outfall to the Mahon Pond with a headwall structure. Since the Mahon Pond is located within the 100-year floodplain, the ultimate storm drain trunkline would provide a conduit for backwater to flood upstream developments during 100-year storm events. Therefore, the ultimate condition analysis assumes a flap gate will be installed at the storm drain trunkline outfall to the Mahon Pond. Based on the size and response of Deer Creek and Cosumnes River watersheds, the peak flood stage is experienced after most runoff generated from the Mahon watershed has drained to Deer Creek. This phenomenon allows the flap gate to remain open during the critical time period when the Mahon watershed is draining and does not require excessive upstream storage when the flap gate is forced closed.

Due to grade limitations, the storm drain outfall invert at the Mahon Pond will be higher than the Mahon Pond culvert outfall invert that controls the minimum pond water surface elevation. As a result, the flap gate will never allow the storm drain trunkline to fully drain after a storm. For this reason, lowering of the pond was considered, although ultimately not recommended to minimize impacts to the existing pond outfall and discharge rates to Deer Creek. Hydraulic analyses of the ultimate condition alternatives were performed to confirm the tailwater conditions would not cause objectionable water surface elevations or flooding extents within the Mahon watershed due to a flap gate-controlled storm drain trunkline outfall.

6.4.3 Pond/Outfall Modifications

Based on the outfall elevation of the storm drain trunkline, minor grading will need to be performed to extend the pond's bottom elevation to the trunkline outfall location for all alternatives analyzed.

Beyond the grading needed at the outfall, the owner of the Mahon Pond has expressed interest in performing pond maintenance in the form of dredging. This maintenance would be conducted separately from the project, but exact depths of dredging are unknown. For the purposes of this analysis the alternatives considered included no maintenance dredging and maintenance dredging of 1.5 feet. In all cases, the existing pond outfall to Deer Creek is maintained in its existing condition.

6.4.4 Alternatives Considered

Several alternatives of the ultimate drainage concept were considered including adjustments to the storm drain slope and diameter, the outfall location and the maintenance dredging at the Mahon Pond. The inclusion and exclusion of a few key ultimate condition drainage components was also considered including Basin B as described in the DMP, a flap gate at the Mahon Pond outfall, and the Triangle Point and Panattoni flow diversions. Dozens of alternative combinations of these factors were considered to optimize the hydraulic conditions at the Mahon Pond, storm drain trunkline, and upstream developments.

The number of alternatives under consideration has been narrowed down to three based on input from the City. These three alternatives are described as follows:

1. Alternative 1 – No maintenance dredging of the pond and a segment of 72-inch pipe at the trunkline outfall equipped with a flap gate.
2. Alternative 2 – Same as Alternative 1 except that the Mahon Pond will be dredged 1.5 feet deeper
3. Alternative 3 – Same as Alternative 1 except that the Mahon Pond will be dredged 1.5 feet deeper and the entire storm drain trunkline will be 60 inches in diameter.

Ultimate condition analyses were performed assuming an initial condition where the Mahon Pond is full of water up to the pond's culvert outlet invert elevation.

6.4.5 Results

Results of the analysis indicates that three preferred alternatives satisfy City criteria and the goals of the project. Table 4 below summarizes the results of the ultimate condition analysis of the preferred alternatives:

Table 4 – Ultimate Hydraulic Analysis Summary

Alternative	Pond Grading	Pond Outfall	Storm Drain Trunkline	Includes Flow from Basin B	Kubota Tie-In Max WSE	Panattoni Tie-in Max WSE	Mahon Pond Max WSE	Satisfies Criteria?
					ft	ft	ft	
1	No Change	No Change	60"/72"	Yes	51.3	49.5	45.5	Yes
2	1.5' Lower	No Change	60"/72"	No	50.8	48.9	45.6	Yes
3	1.5' Lower	No Change	60"	No	51.3	49.5	45.5	Yes

See **Appendix B** for detailed results of the ultimate condition hydraulic analysis.

7. CONCLUSIONS & RECOMMENDATIONS

The recommended interim condition improvements include a 60-inch storm drain trunkline from GLR to the Panattoni tie-in, a 52-acre-foot City basin, two 48-inch equalizer pipes to connect the City and Kubota basins, and a 30-inch outfall pipe from the Panattoni tie-in to the City basin. No changes are required of the Kubota site or pump system designs. Coordination with the SEIA initial developers will allow the City to evaluate the risks associated with the condition where a significant storm is experienced when the City basin has residual water from previous storms.

The recommended ultimate condition improvements include a 60-inch storm drain trunkline that increases to a 72-inch pipe along the downstream 300-foot segment. The 72-inch outfall is recommended with a flap gate to prevent backflow and flooding of the upstream developments when the Cosumnes River and Deer Creek experience extreme storm events. Although the City intends to dredge the Mahon Pond, the Pond's outfall does not require modifications.

Further coordination with the initial private developers is required to confirm the recommended improvements can accommodate their current designs due to the assumptions described in Section 6.1 of this memorandum.

8. Interim & Ultimate Preliminary Cost Estimates

Preliminary cost estimates were developed for the interim and ultimate conditions. The total cost for the interim condition improvements is approximately $900,000. The total cost for the ultimate condition improvements ranges between approximately $4,000,000 and $4,200,000 for the three alternatives analyzed. See **Appendix C** for the detailed breakdown of the preliminary cost estimate.

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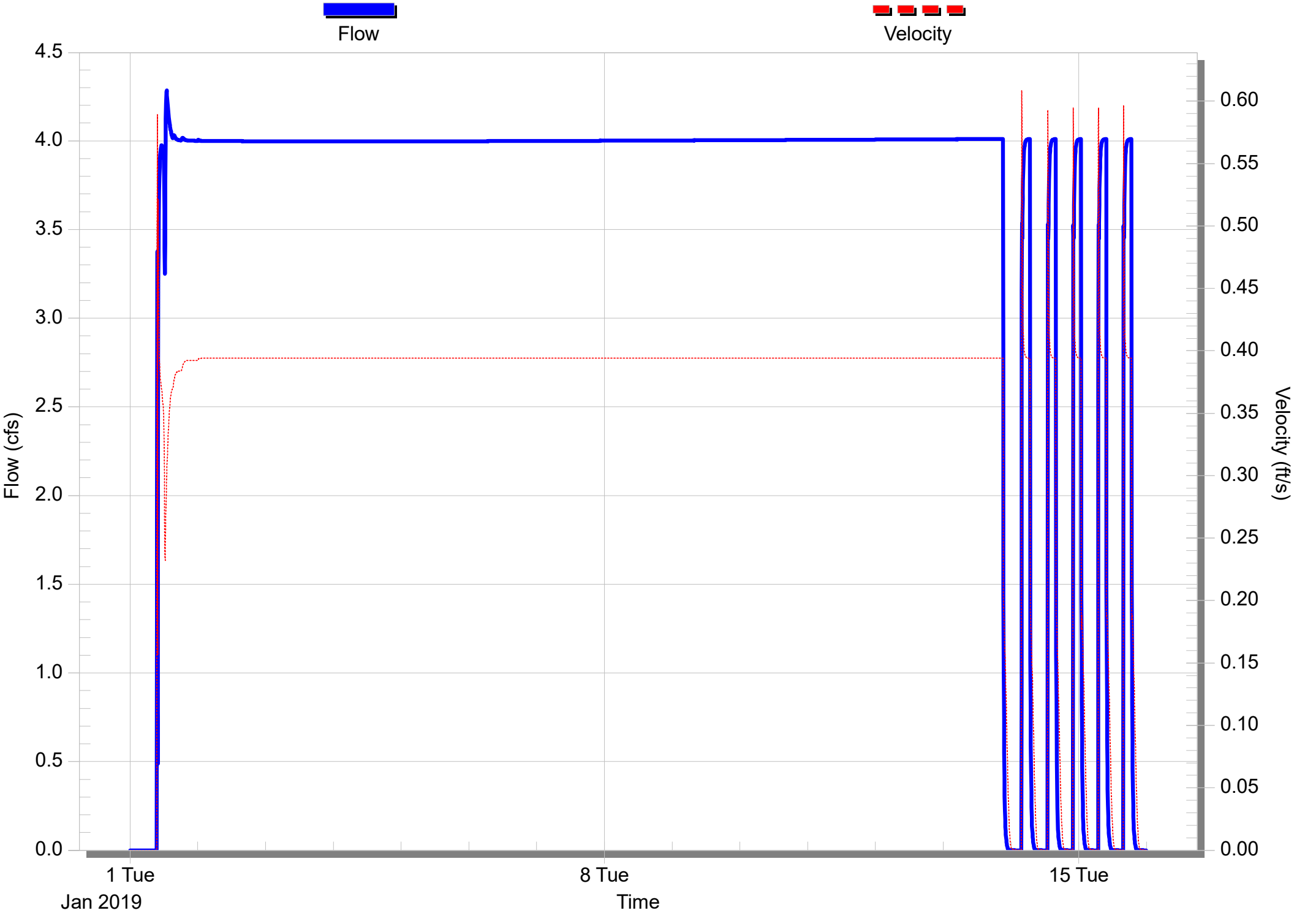
APPENDIX A

Interim Hydraulic Analysis

100-Year, 24-Hour Storm
Starting with an Empty City Basin

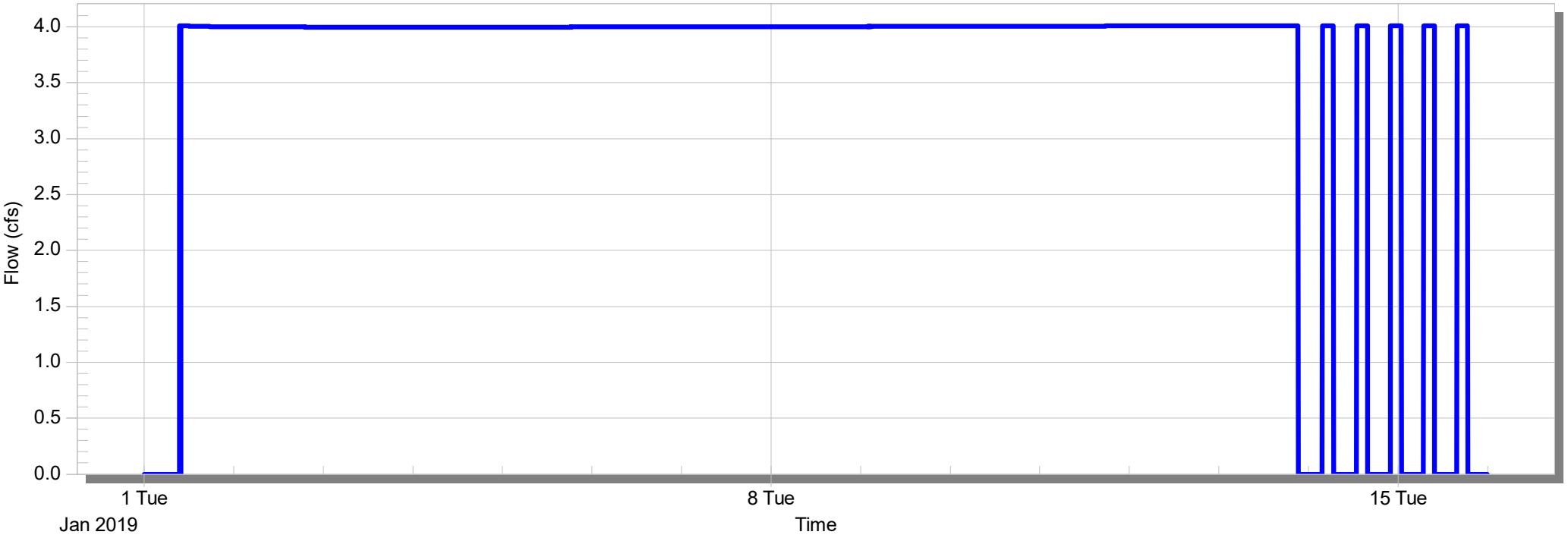
Conduit Grant Line Rd Ditch from DC040 to DC037

[Max Flow = 4.2836][Max Velocity = 0.61]



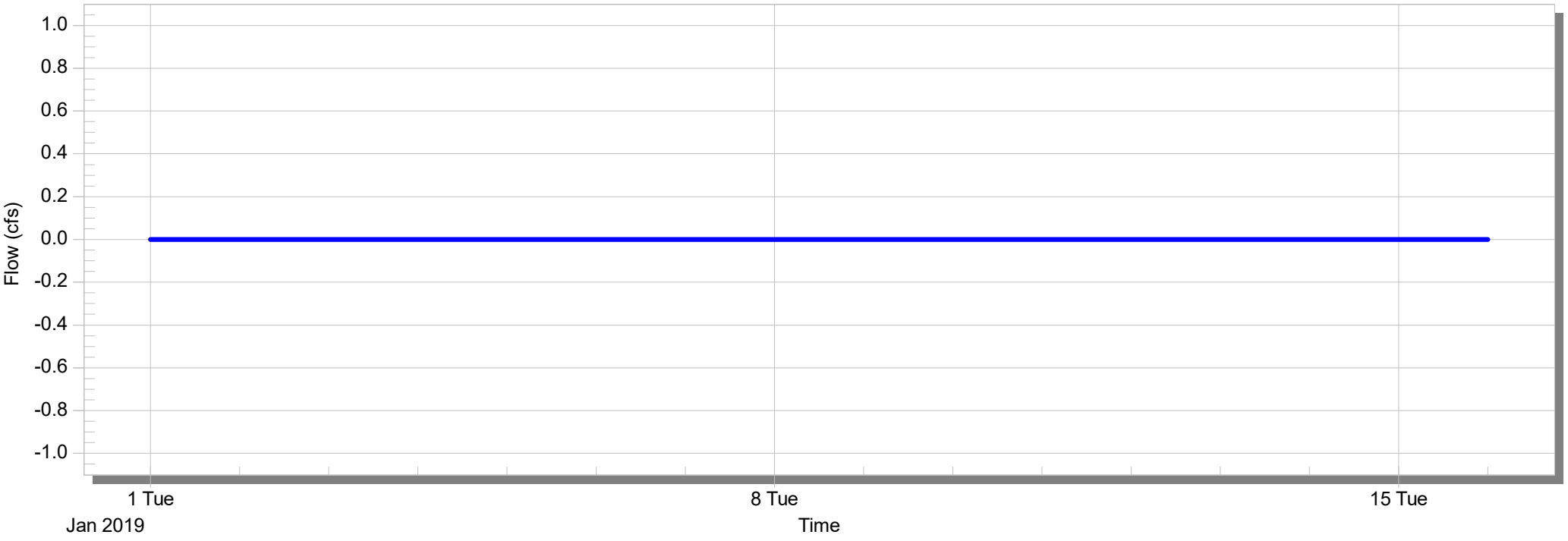
Diversion Interim Pump System.1 from Tri Point & GLR Hydrograph at GLR MH to DC040

[Max Flow = 4.0100]



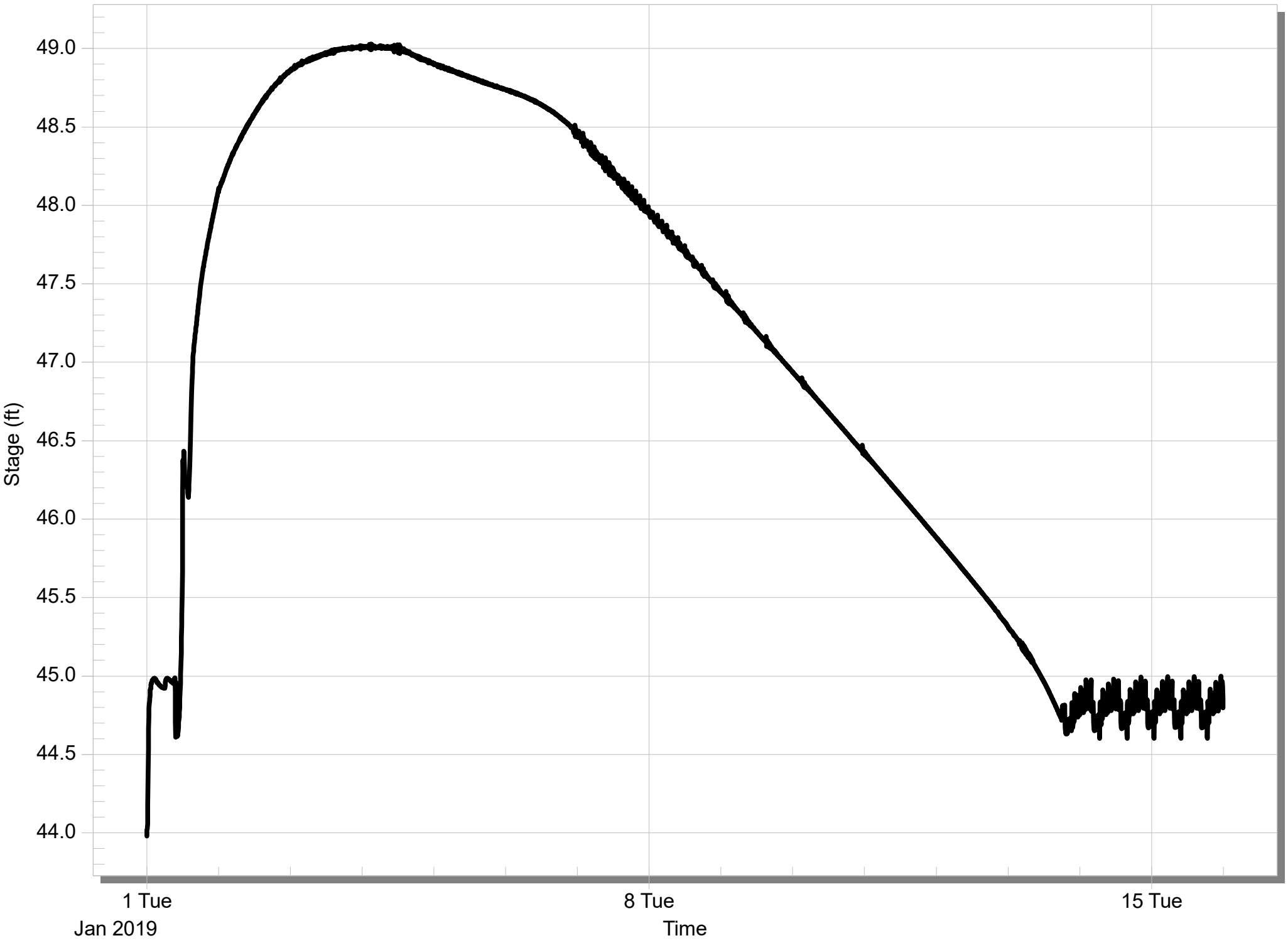
Diversion Siphon Outlet.2 from Tri Point & GLR Hydrograph at GLR MH to DC040

[Max Flow = 0.0000]



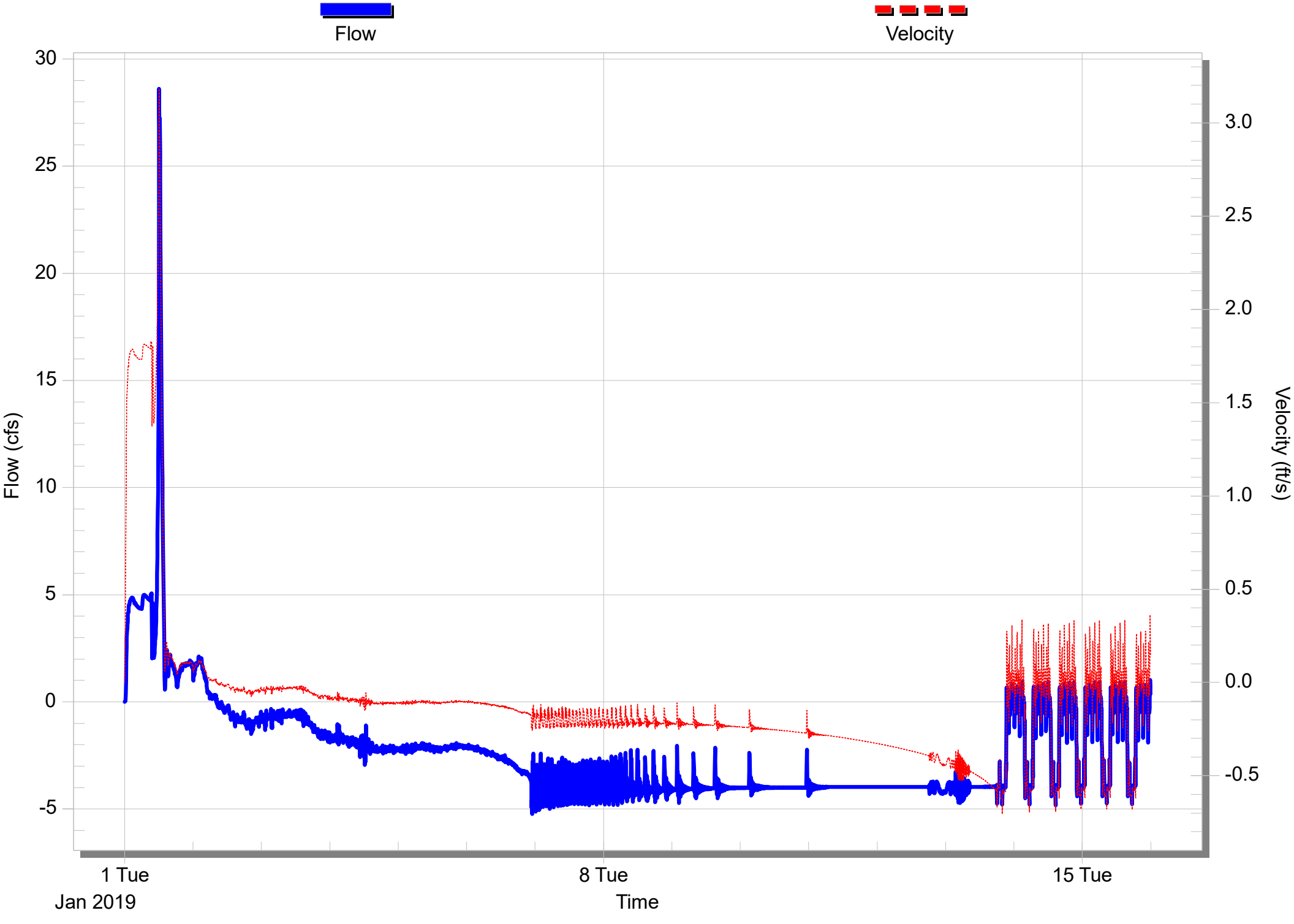
Node - Tri Point & GLR Hydrograph at GLR MH

[Max Stage = 49.029]



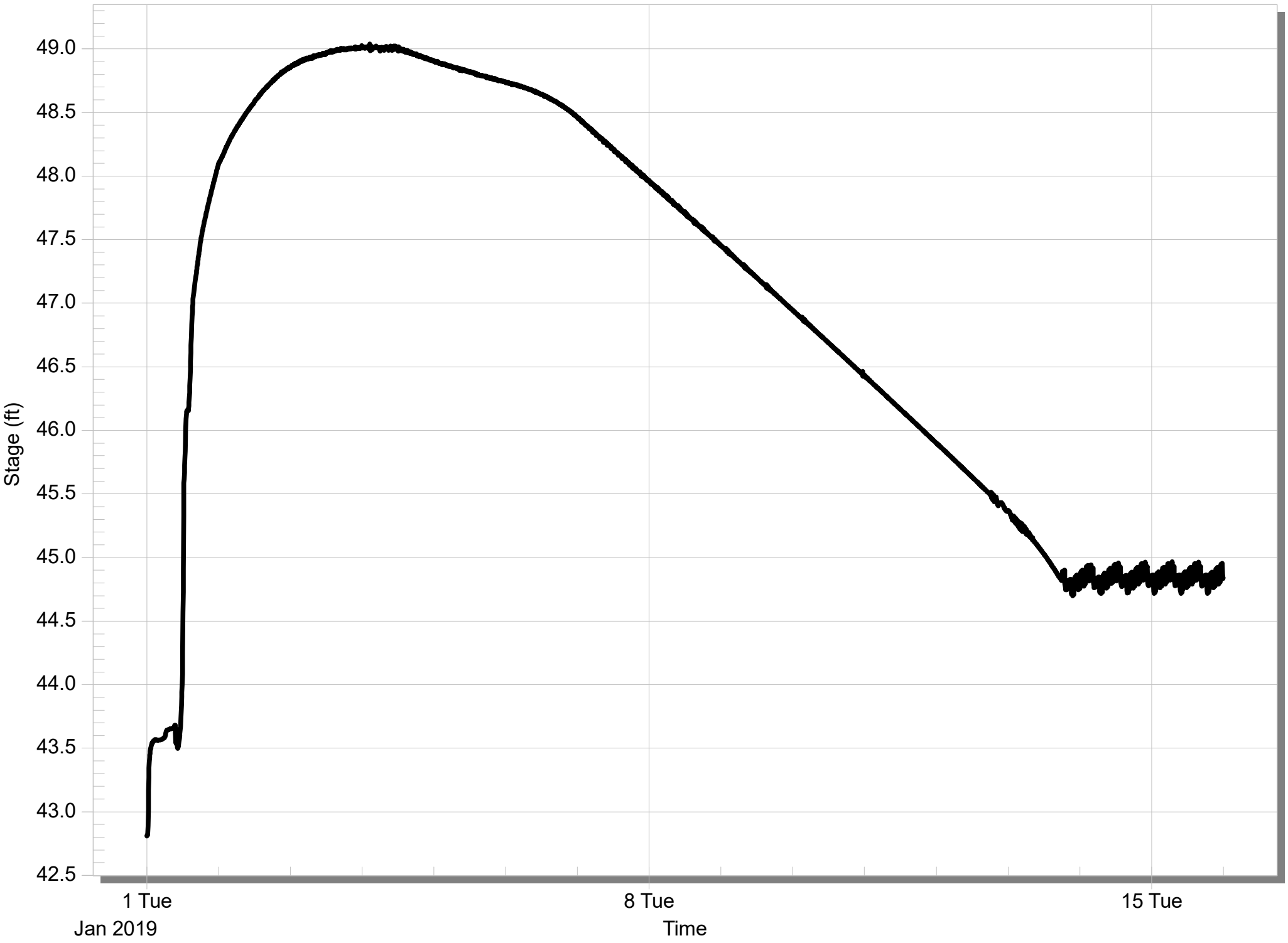
Conduit 60-In SD Pipe 1 from Tri Point & GLR Hydrograph at GLR MH to Kubota Tie-In MH

[Max Flow = 28.6094][Max Velocity = 3.18]



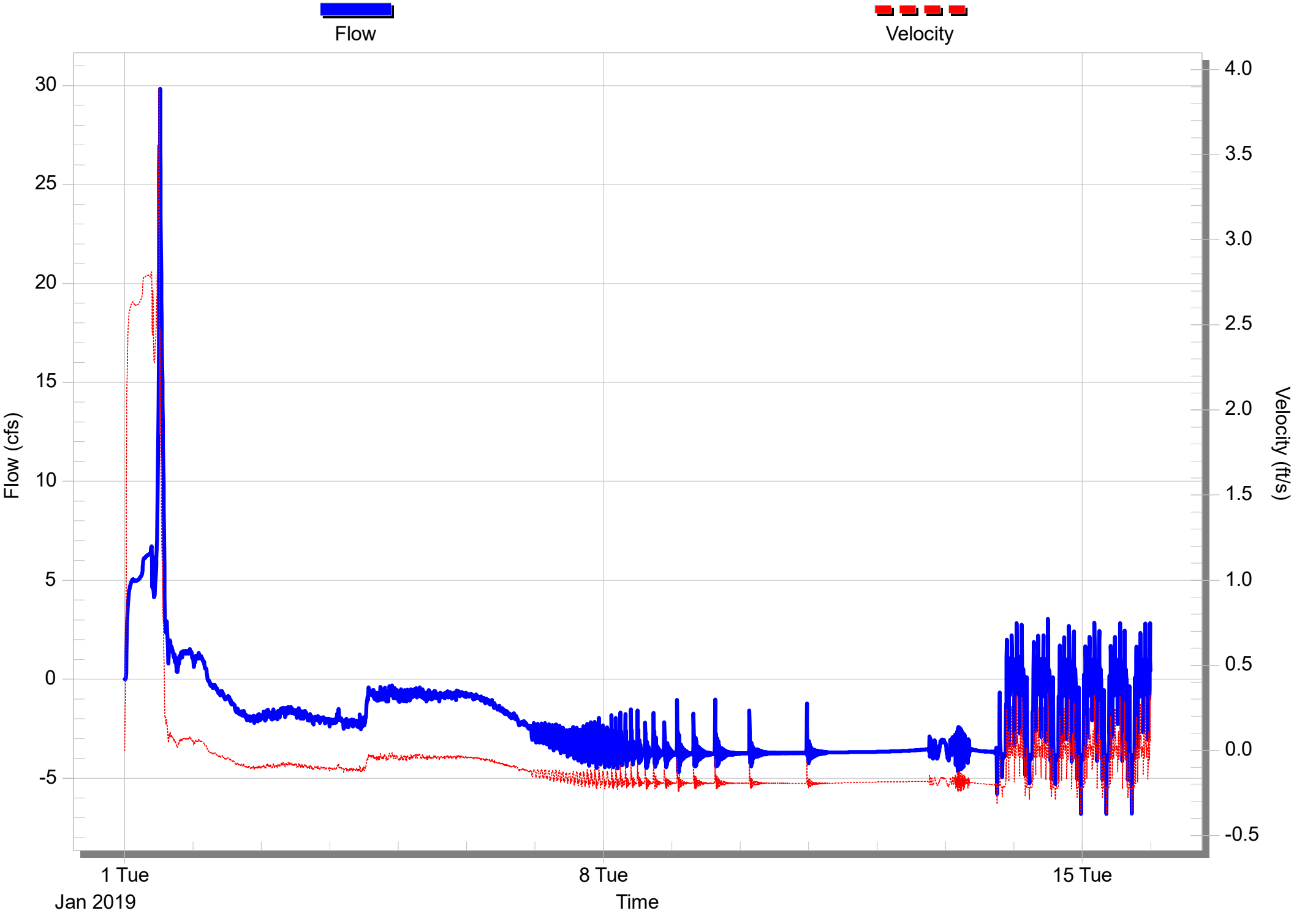
Node - Kubota Tie-In MH

[Max Stage = 49.039]



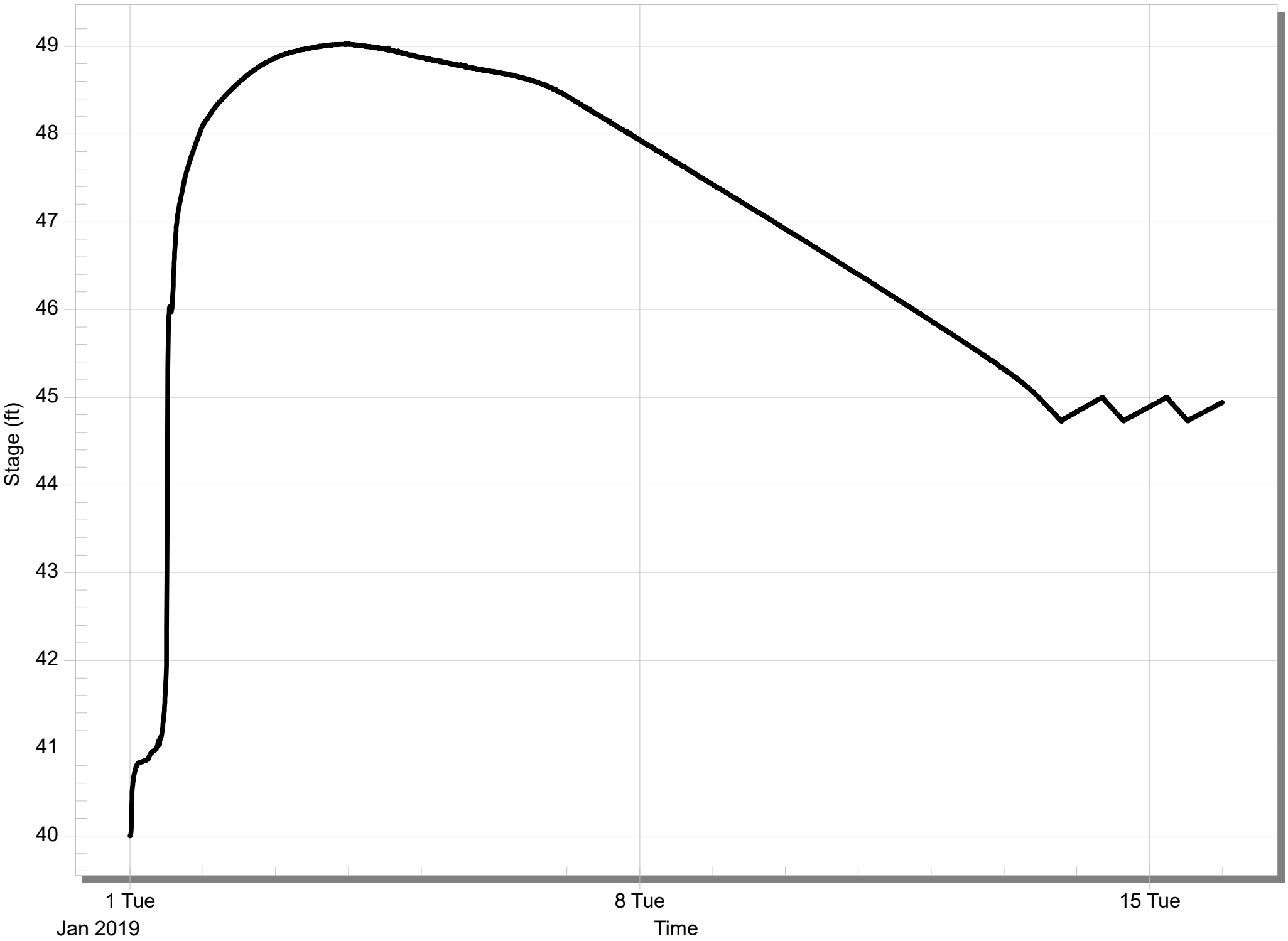
Conduit 60-In SD Pipe 2 from Kubota Tie-In MH to Panattoni Tie-In MH

[Max Flow = 29.8359][Max Velocity = 3.89]



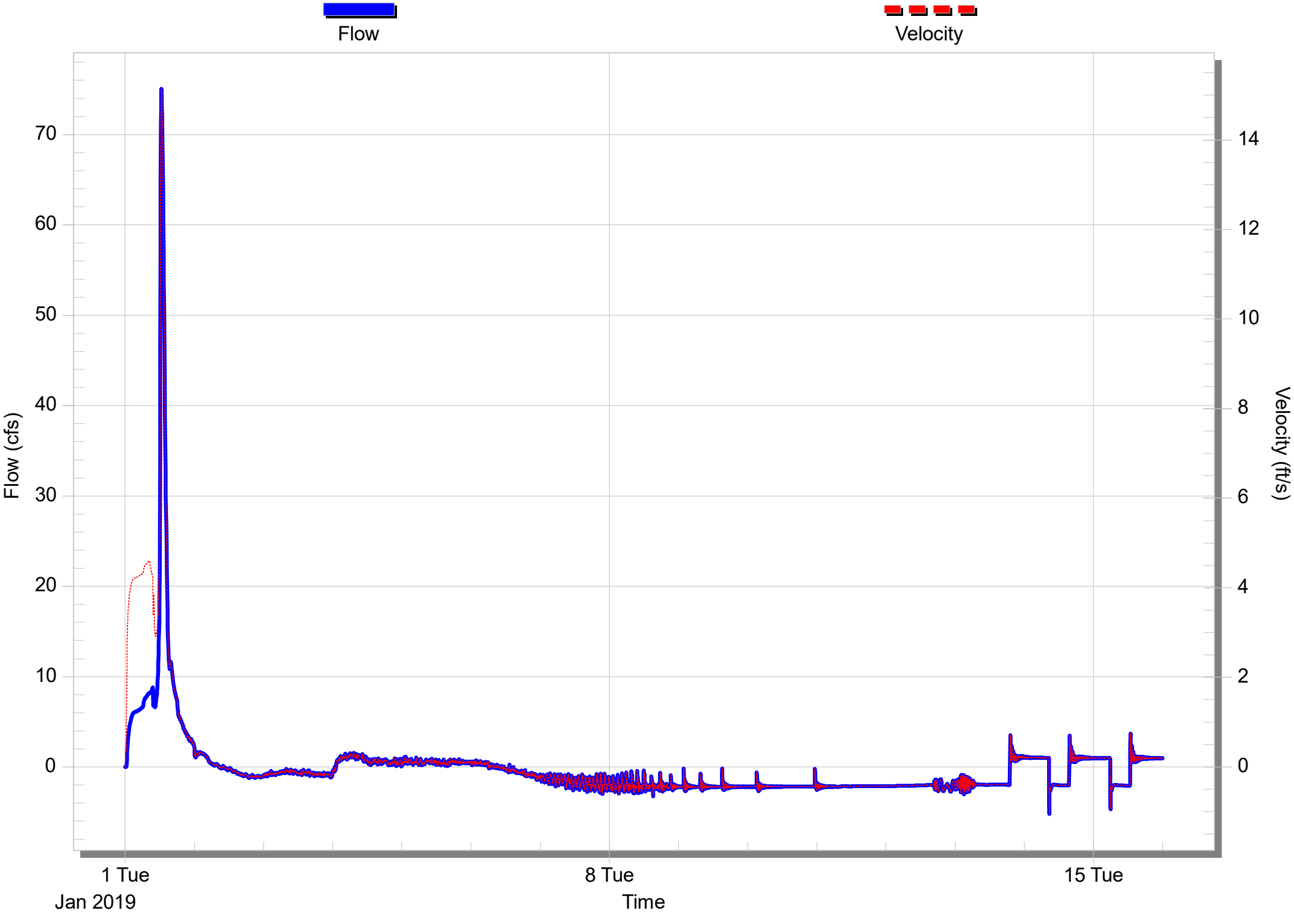
Node - Panattoni Tie-In MH

[Max Stage = 49.025]



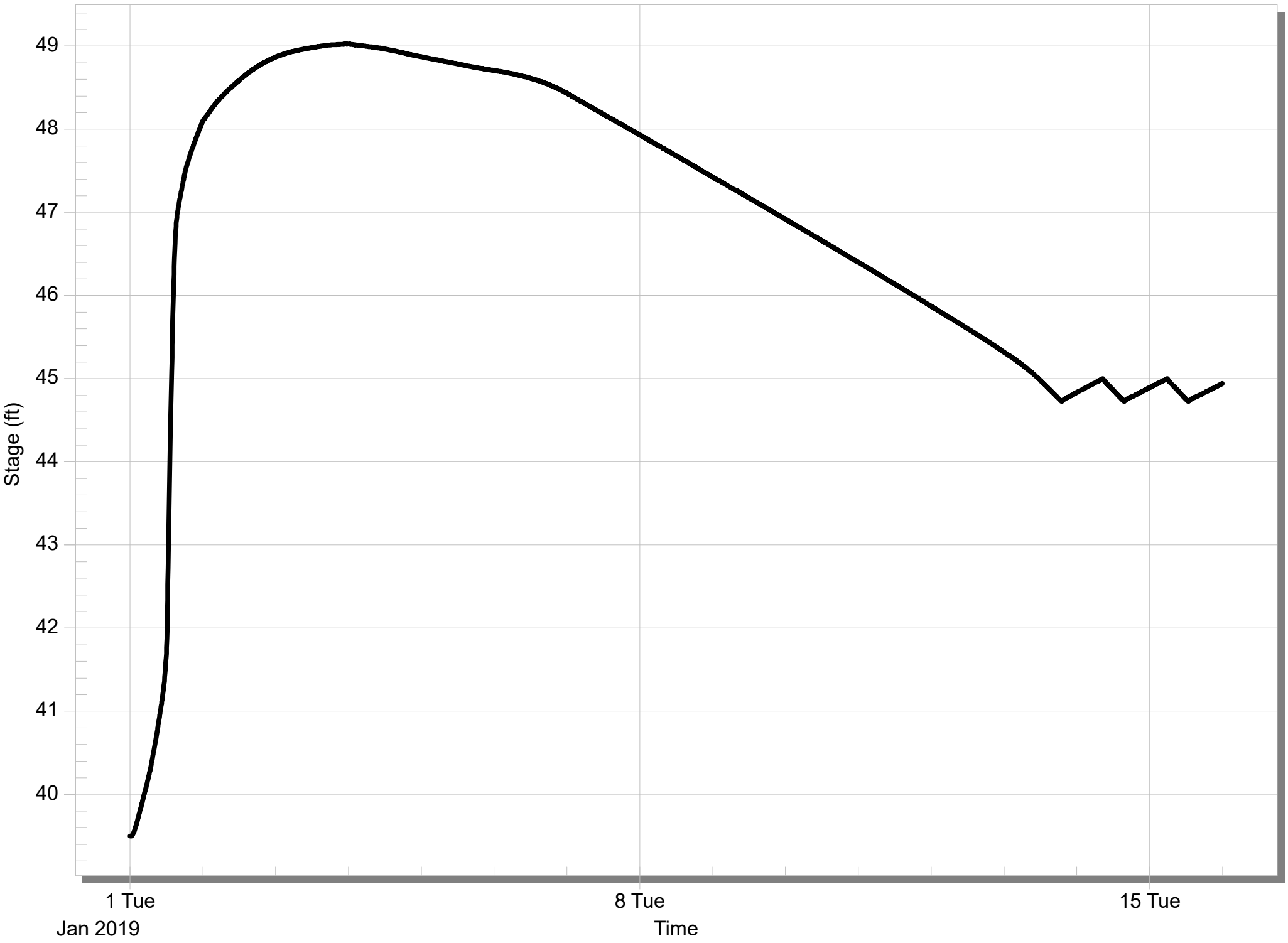
Conduit Interim 30-In SD from Panattoni Tie-In MH to Interim City Basin

[Max Flow = 75.0653][Max Velocity = 15.14]



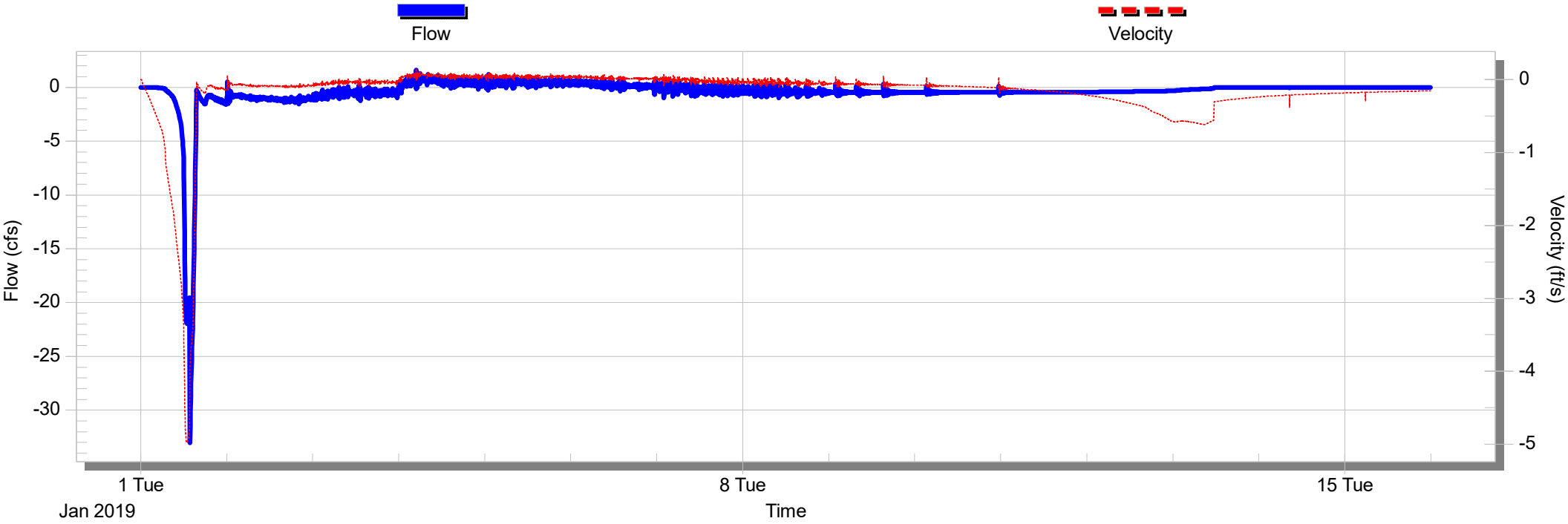
Node - Interim City Basin

[Max Stage = 49.026]



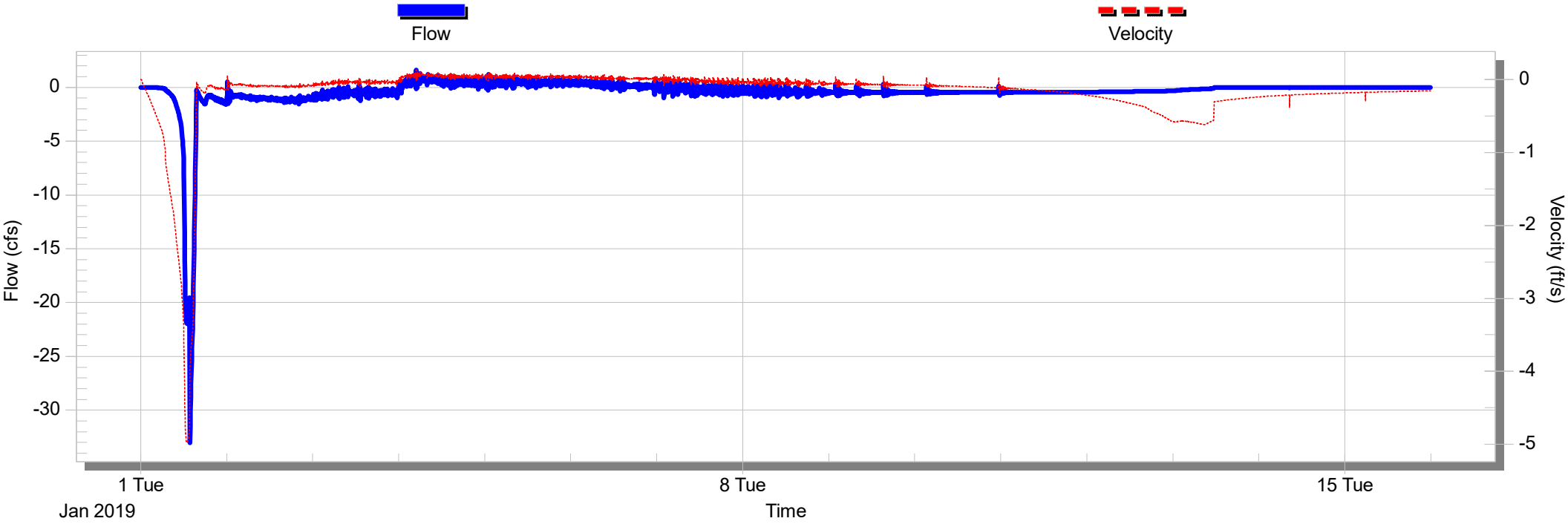
Conduit 48-In Equalizer SD 1 from Interim City Basin to Kubota Basin

[Max Flow = -33.0355][Max Velocity = -4.98]



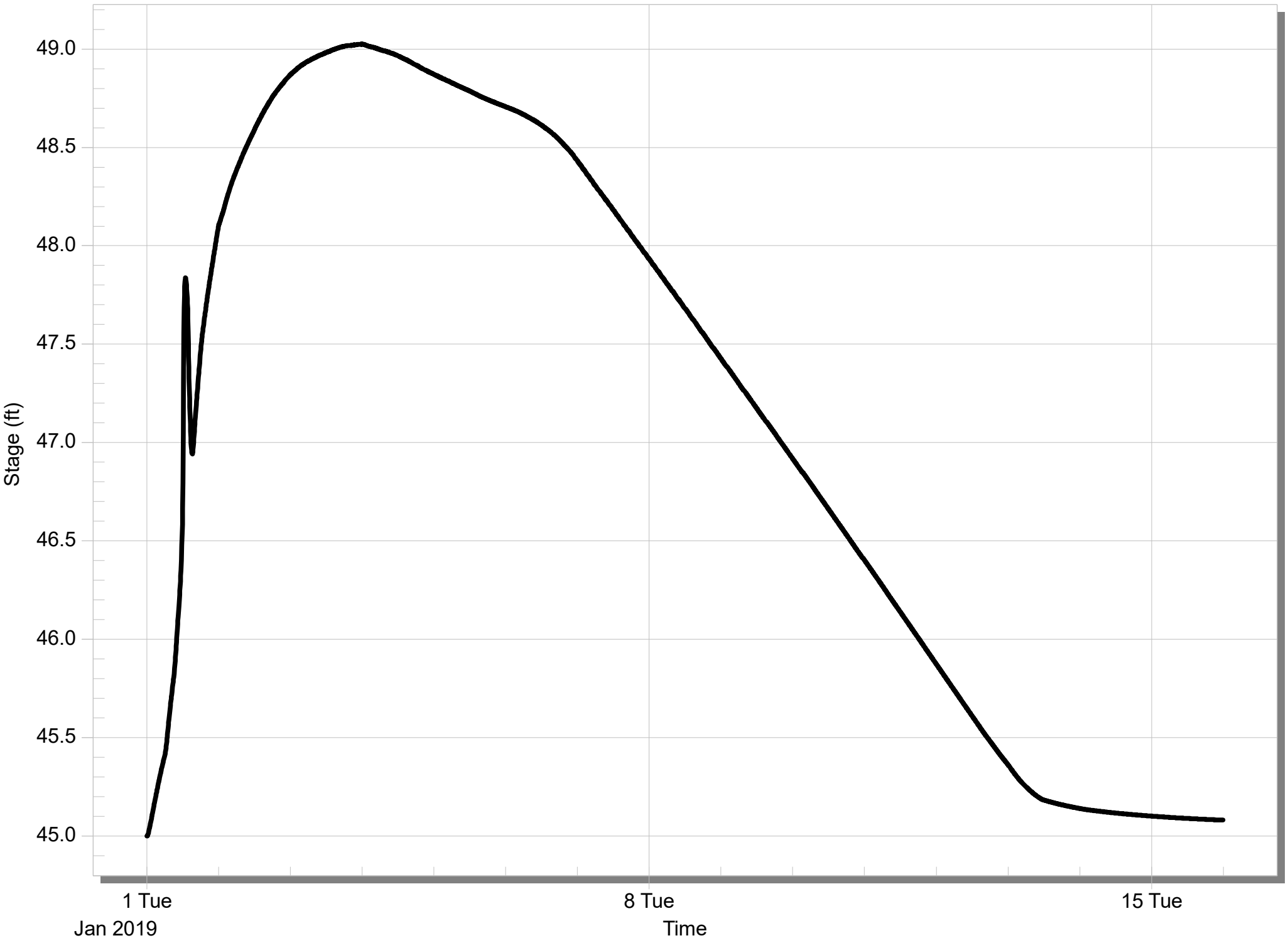
Conduit 48-In Equalizer SD 2 from Interim City Basin to Kubota Basin

[Max Flow = -33.0355][Max Velocity = -4.98]



Node - Kubota Basin

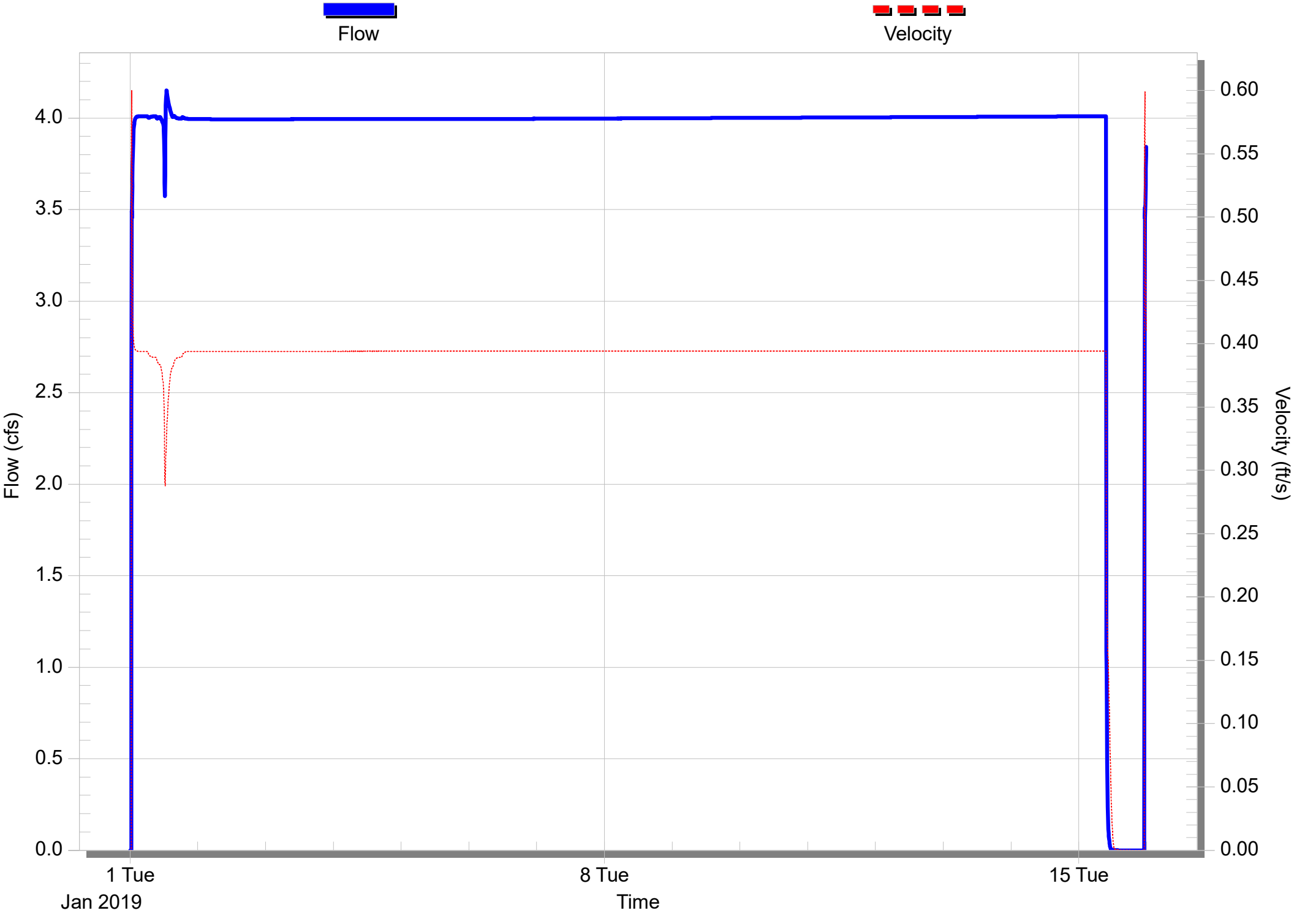
[Max Stage = 49.026]



10-Year, 24-Hour Storm
Starting with a Half Full City Basin

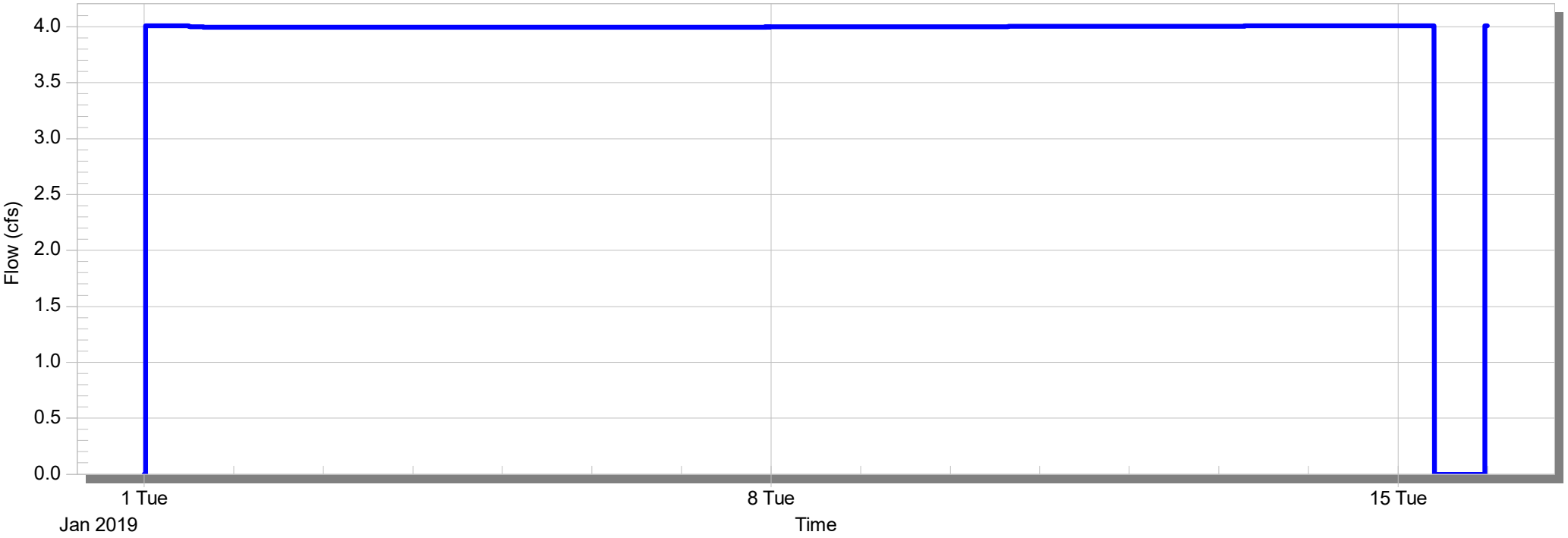
Conduit GLR Ditch from DC040 to DC037

[Max Flow = 4.1507][Max Velocity = 0.60]



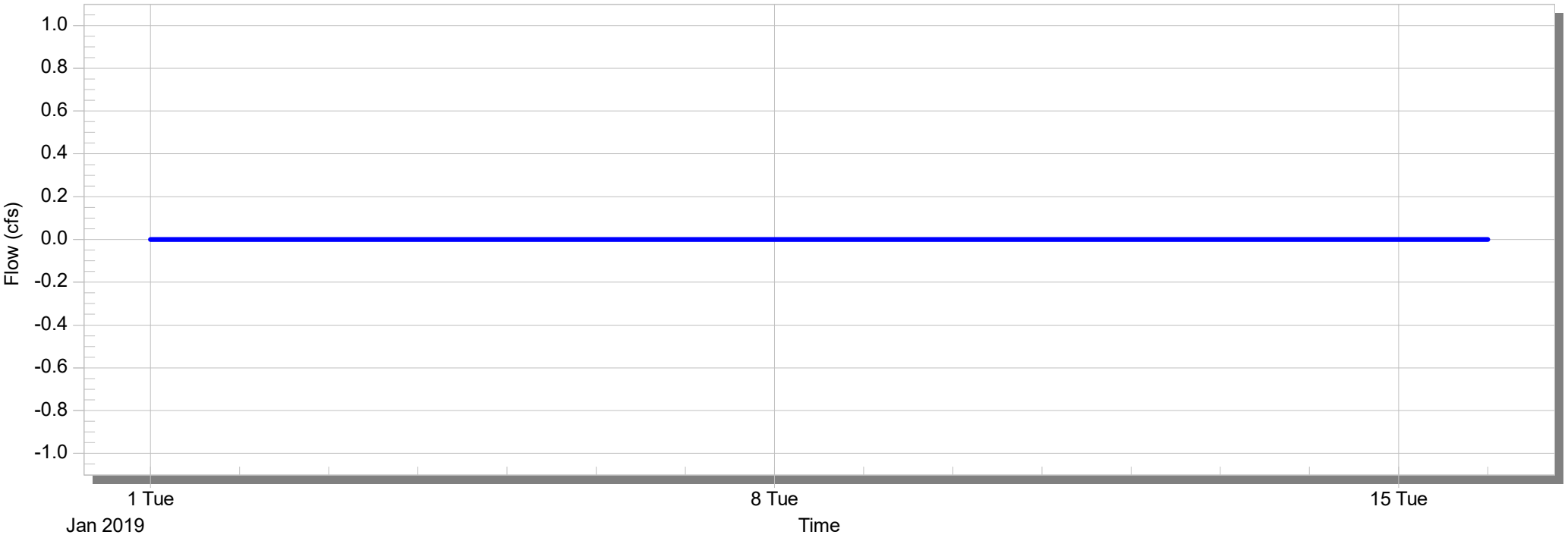
Diversion Temporary Pump System.1 from Tri Point GLR Hydrograph MH to DC040

[Max Flow = 4.0100]



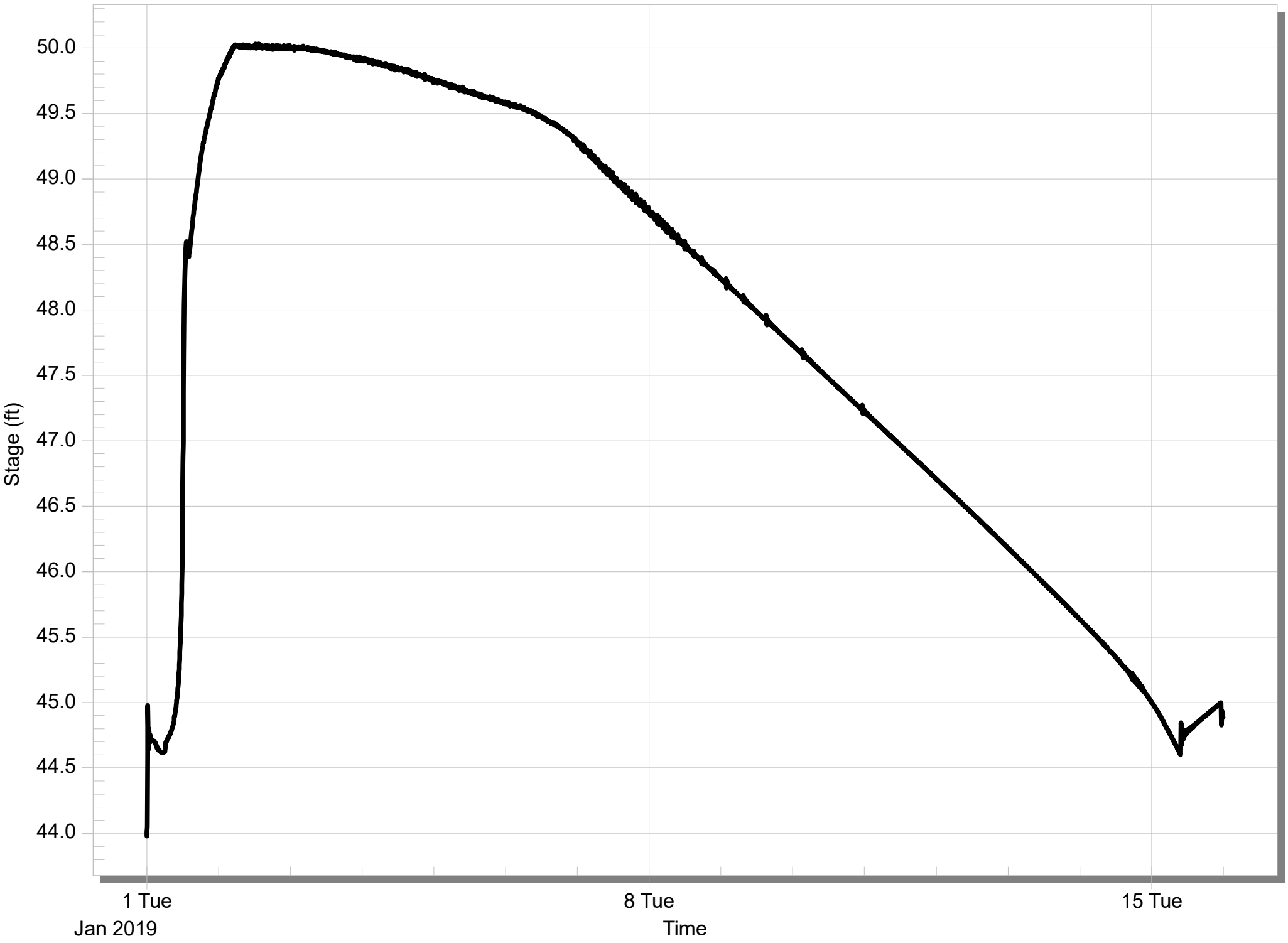
Diversion Siphon Weir.1 from Tri Point GLR Hydrograph MH to DC040

[Max Flow = 0.0000]



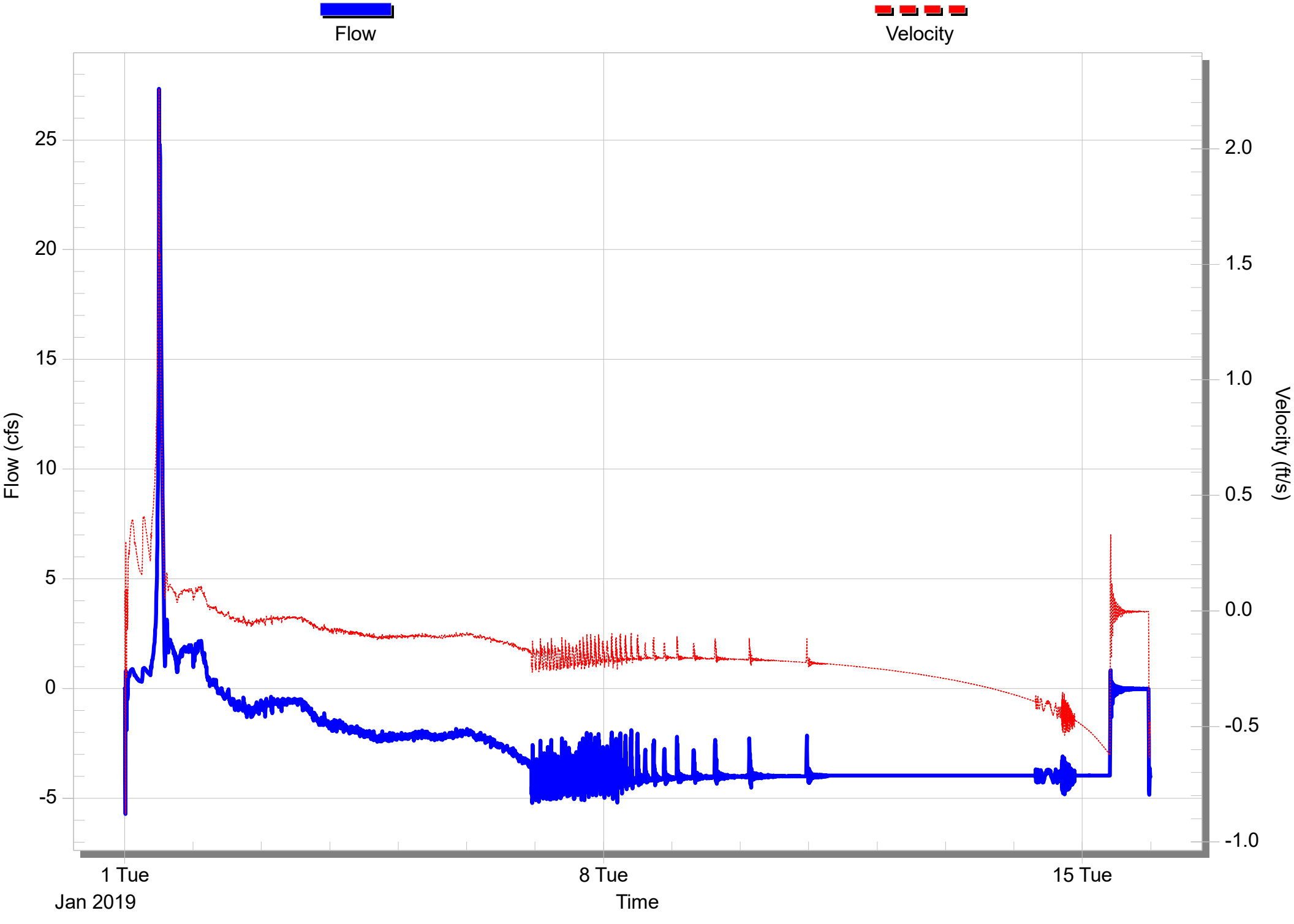
Node - Tri Point GLR Hydrograph MH

[Max Stage = 50.031]



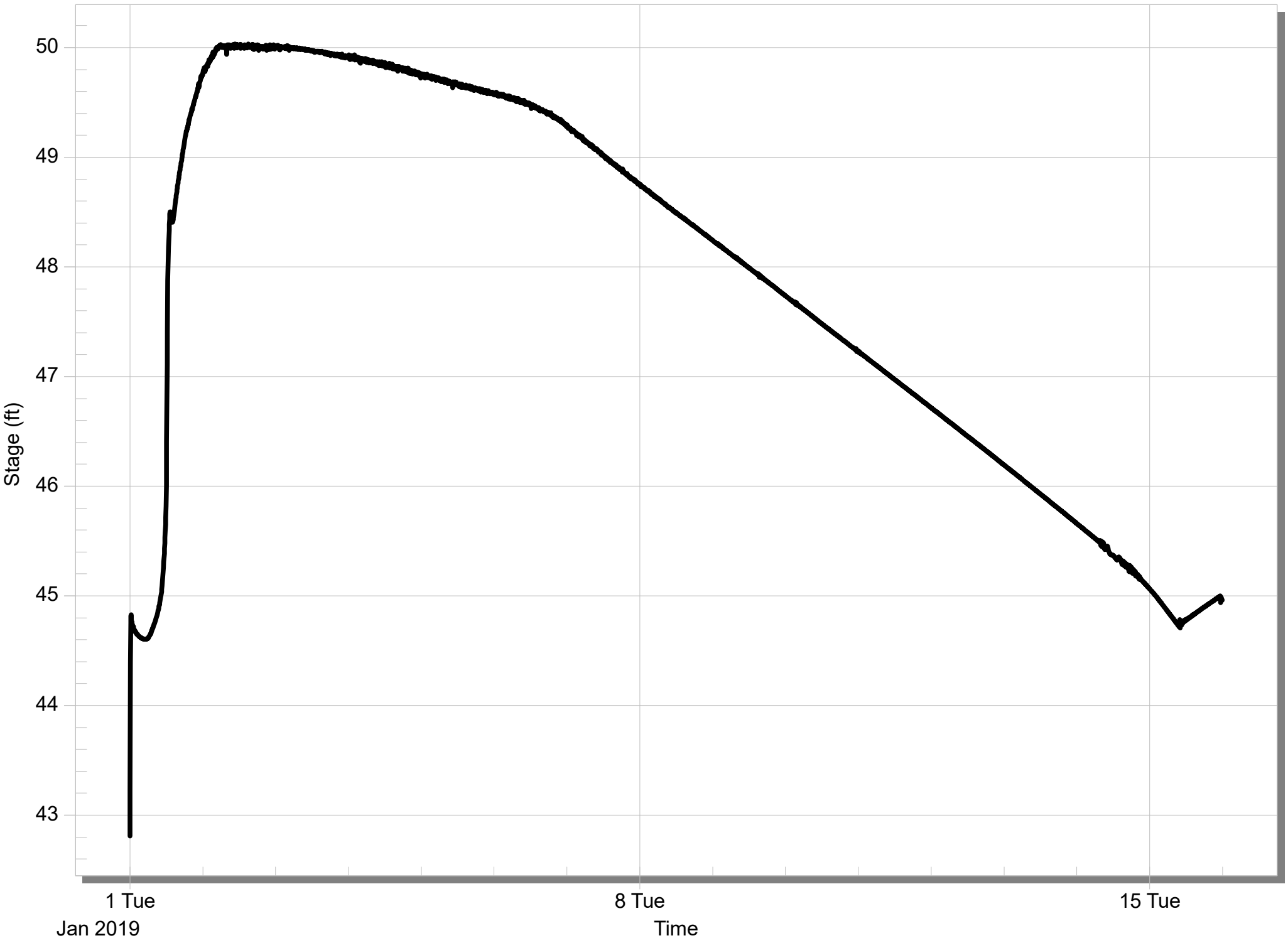
Conduit 60-In SD 1 from Tri Point GLR Hydrograph MH to Kubota Tie-In MH

[Max Flow = 27.3320][Max Velocity = 2.26]



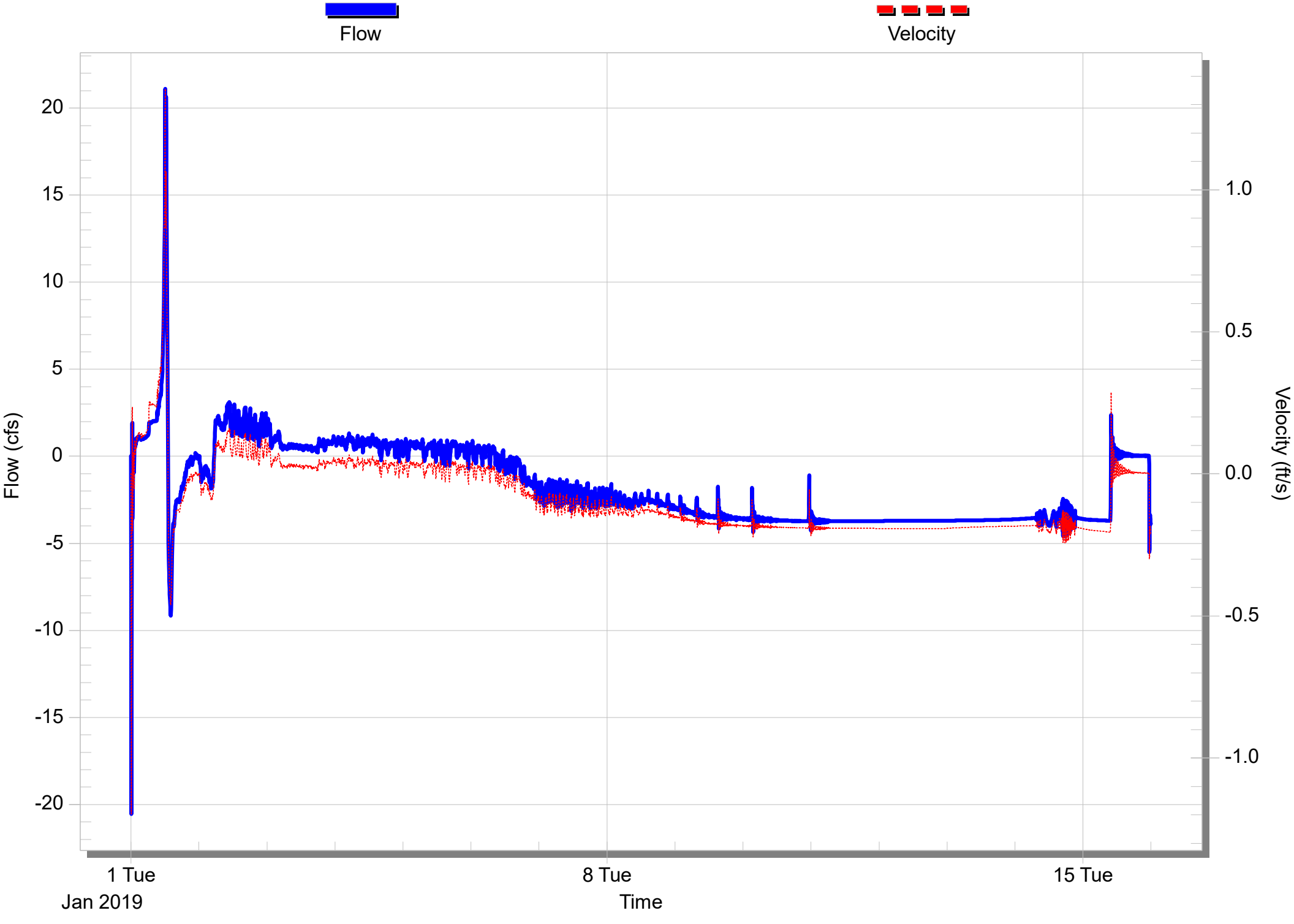
Node - Kubota Tie-In MH

[Max Stage = 50.033]



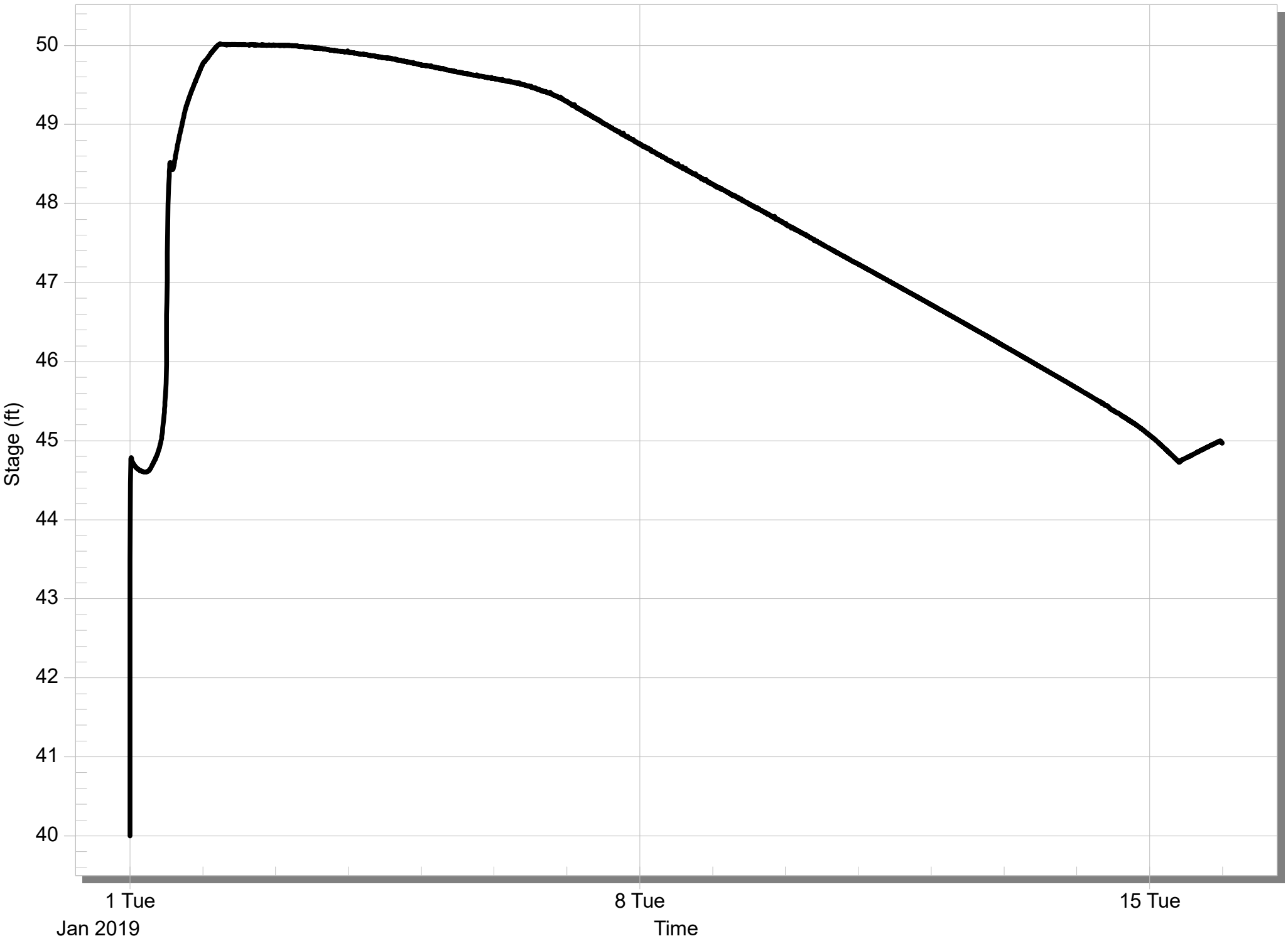
Conduit 60-In SD 2 from Kubota Tie-In MH to Panattoni Tie-In MH

[Max Flow = 21.1062][Max Velocity = 1.36]



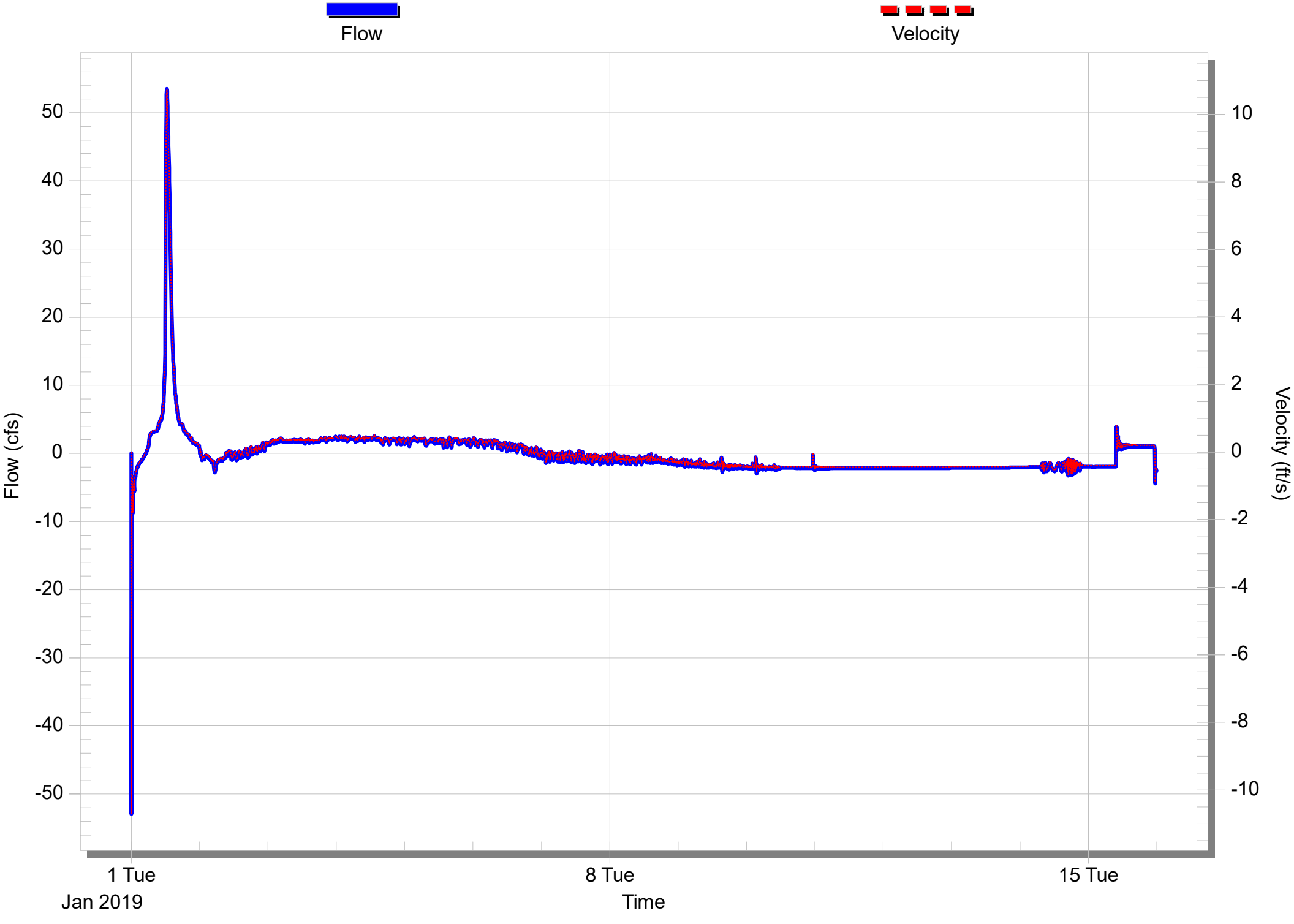
Node - Panattoni Tie-In MH

[Max Stage = 50.018]



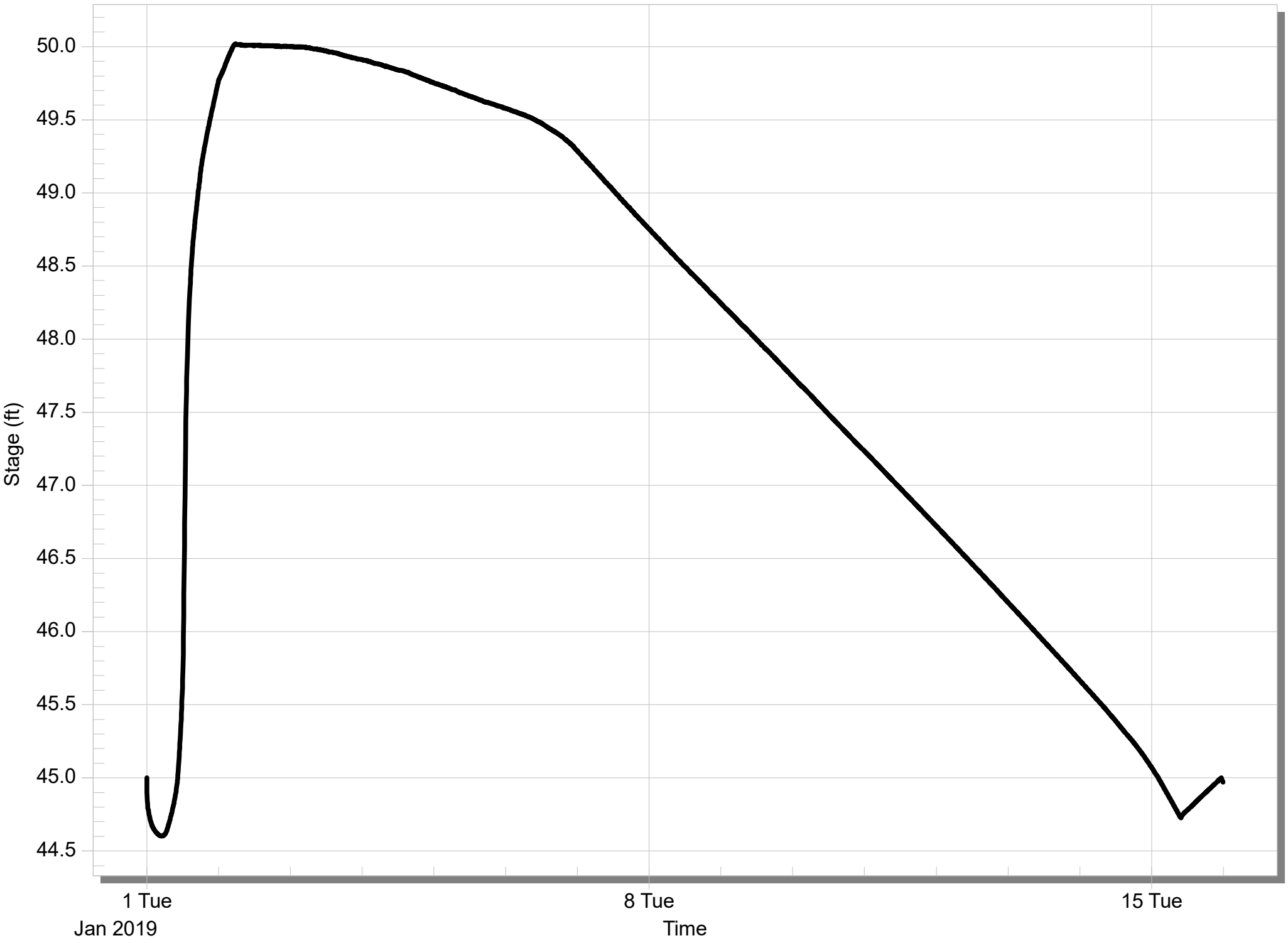
Conduit Interim 30-In SD from Panattoni Tie-In MH to Interim City Basin

[Max Flow = 53.5185][Max Velocity = 10.76]



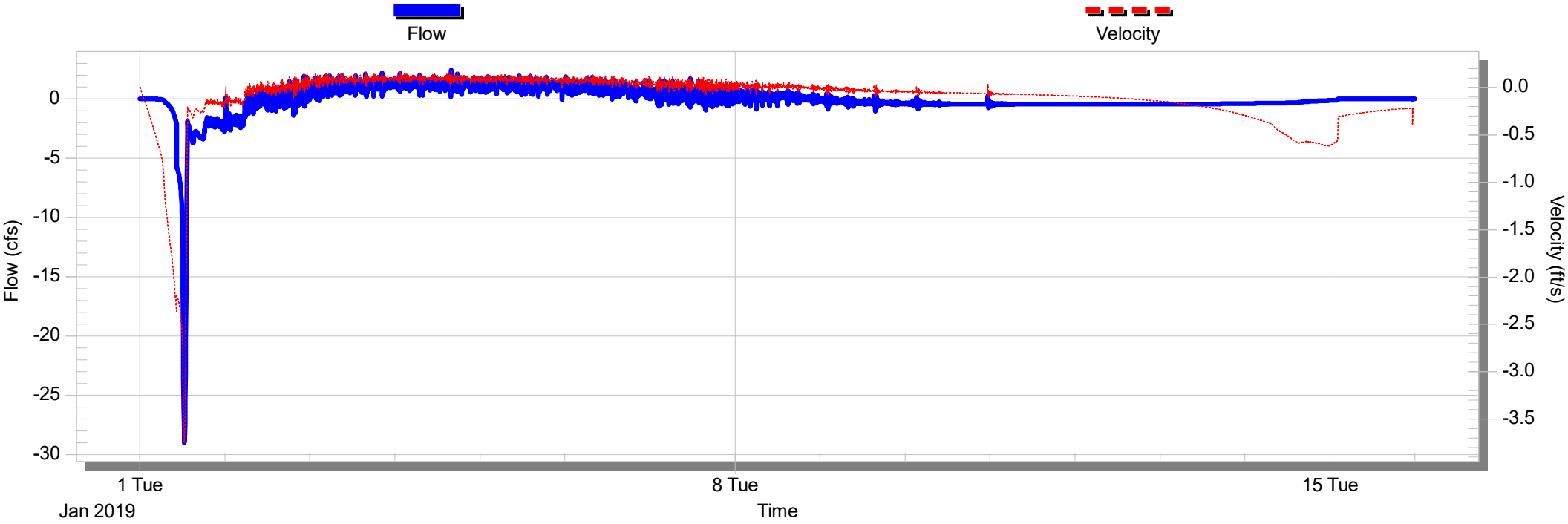
Node - Interim City Basin

[Max Stage = 50.019]



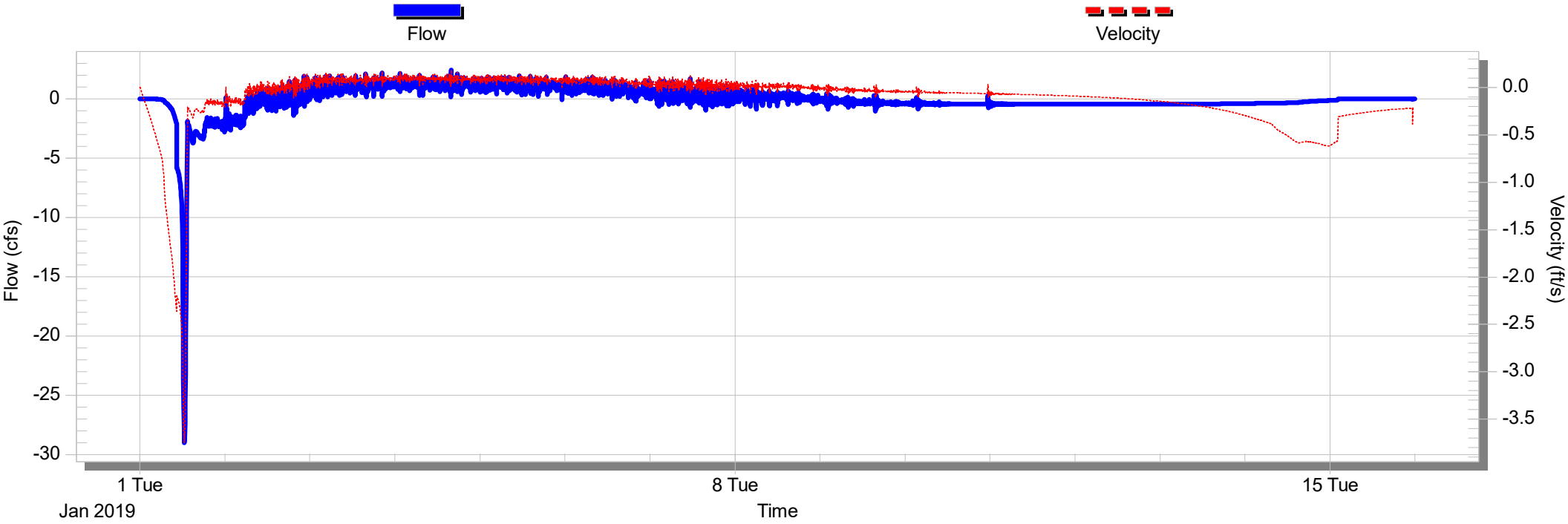
Conduit 48-In Equalizer SD 1 from Interim City Basin to Kubota Basin

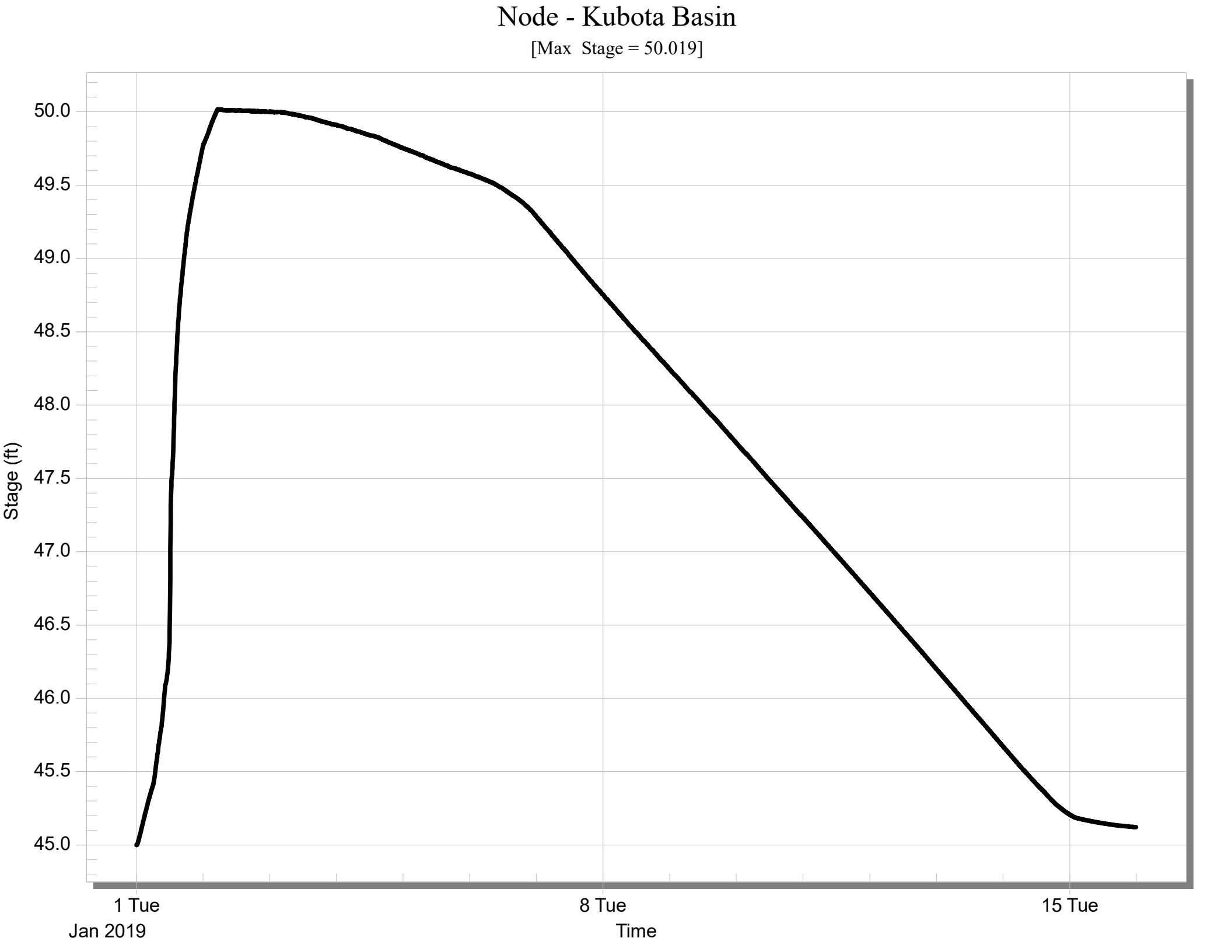
[Max Flow = -29.0006][Max Velocity = -3.75]



Conduit 48-In Equalizer SD 2 from Interim City Basin to Kubota Basin

[Max Flow = -29.0006][Max Velocity = -3.75]

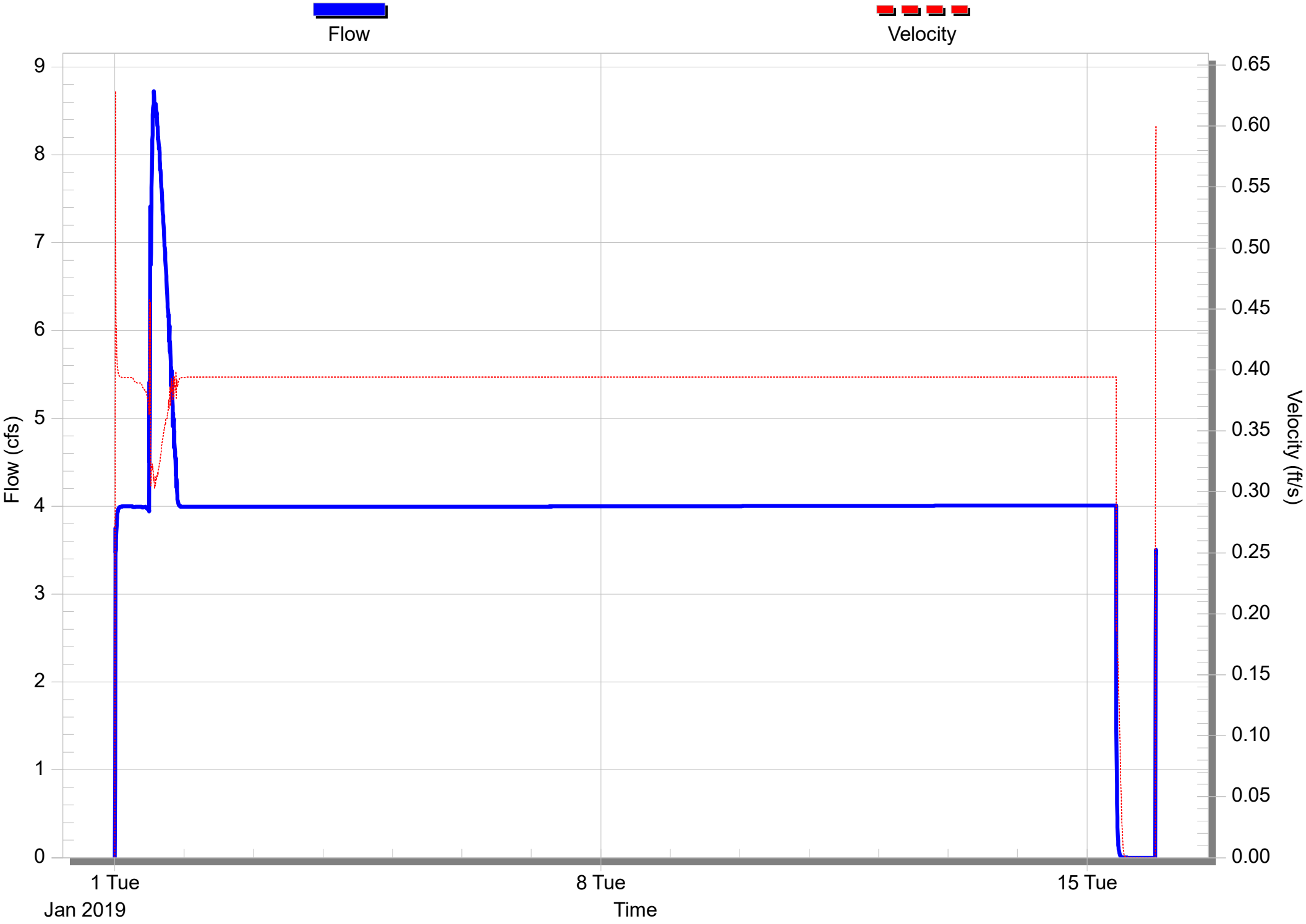



Node - Kubota Basin
[Max Stage = 50.019]
50.0
49.5
49.0
48.5
48.0
47.5
47.0
46.5
46.0
45.5
45.0
Stage (ft)
1 Tue
Jan 2019
8 Tue
15 Tue
Time

10-Year, 24-Hour Storm
Starting with a Full City Basin

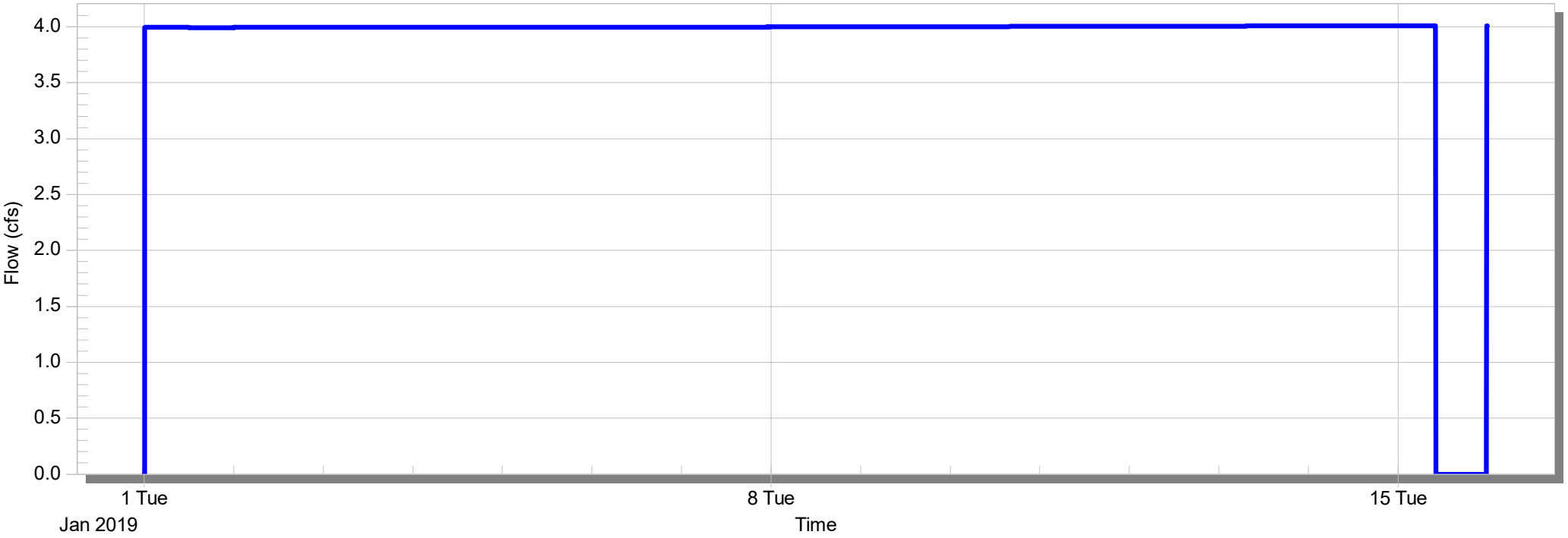
Conduit GLR Ditch from DC040 to DC037

[Max Flow = 8.7233][Max Velocity = 0.63]



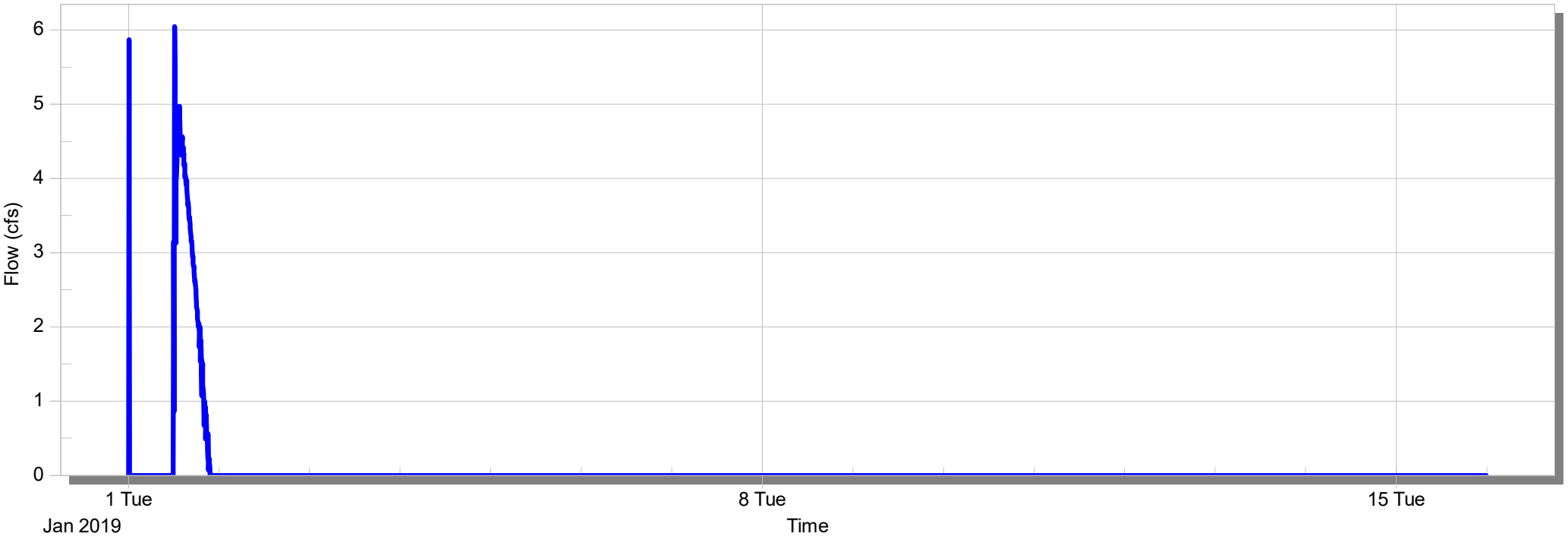
Diversion Temporary Pump System.1 from Tri Point GLR Hydrograph MH to DC040

[Max Flow = 4.0100]



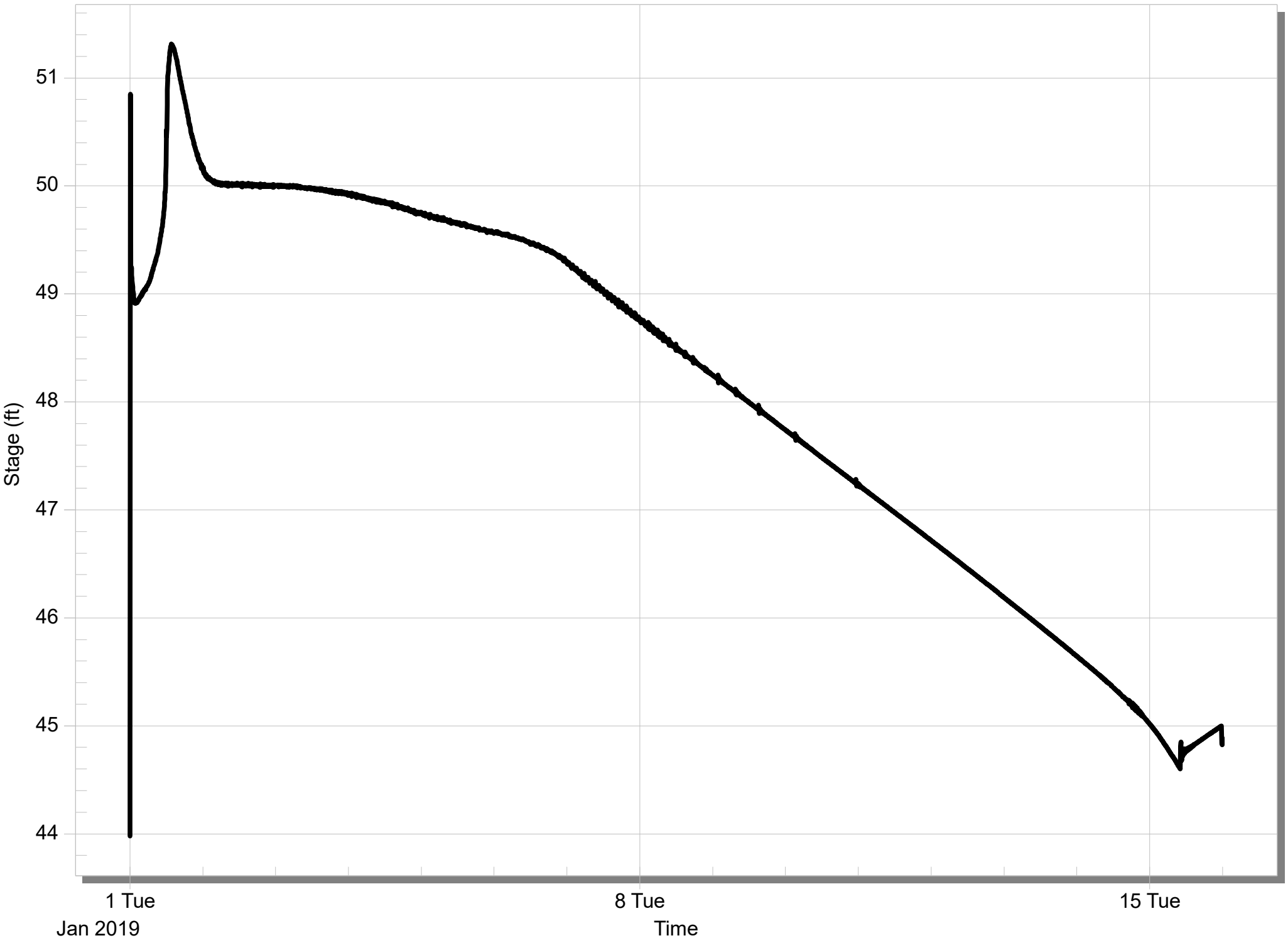
Diversion Siphon Weir.1 from Tri Point GLR Hydrograph MH to DC040

[Max Flow = 6.0490]



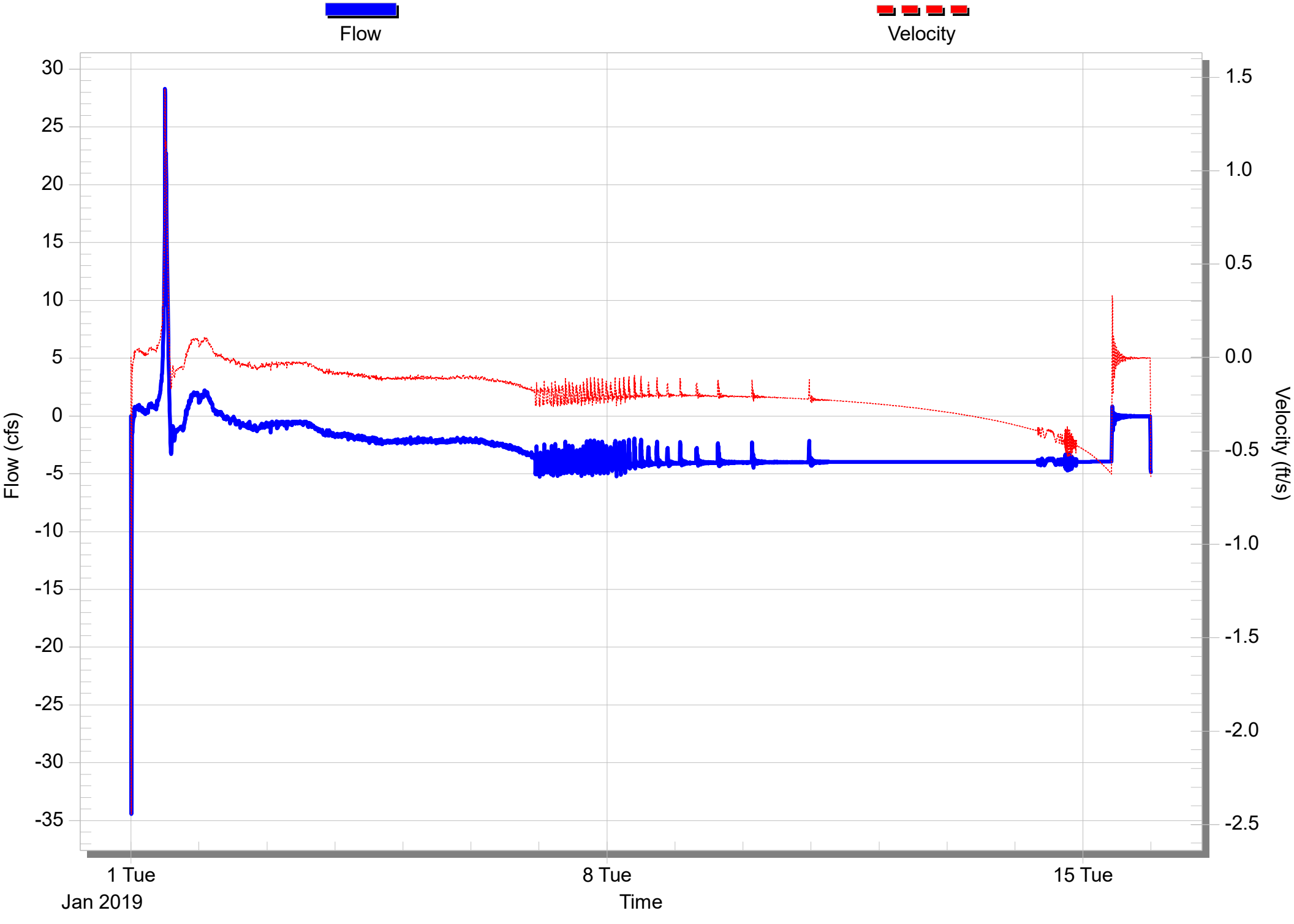
Node - Tri Point GLR Hydrograph MH

[Max Stage = 51.314]



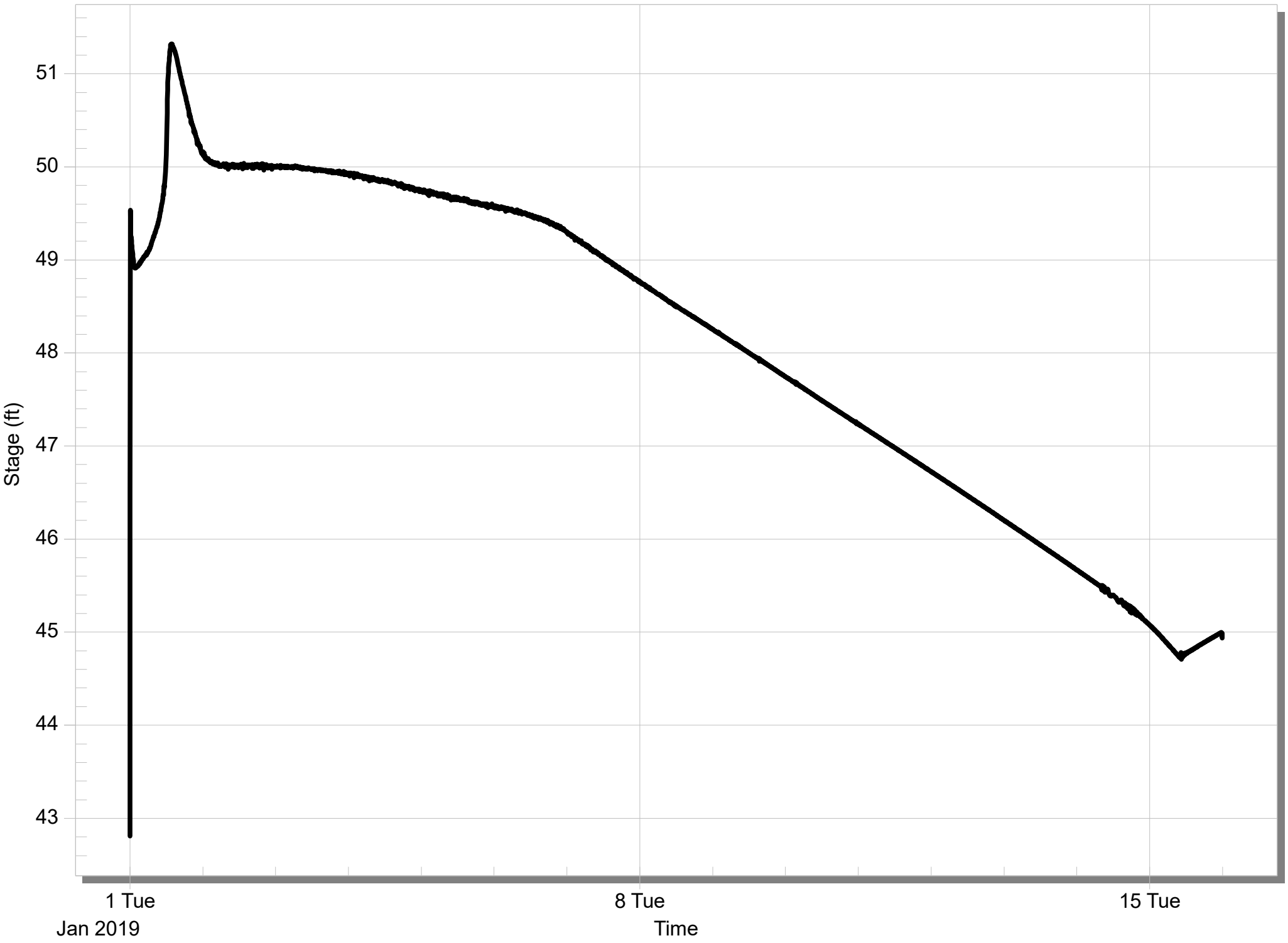
Conduit 60-In SD 1 from Tri Point GLR Hydrograph MH to Kubota Tie-In MH

[Max Flow = -34.4274][Max Velocity = -2.44]



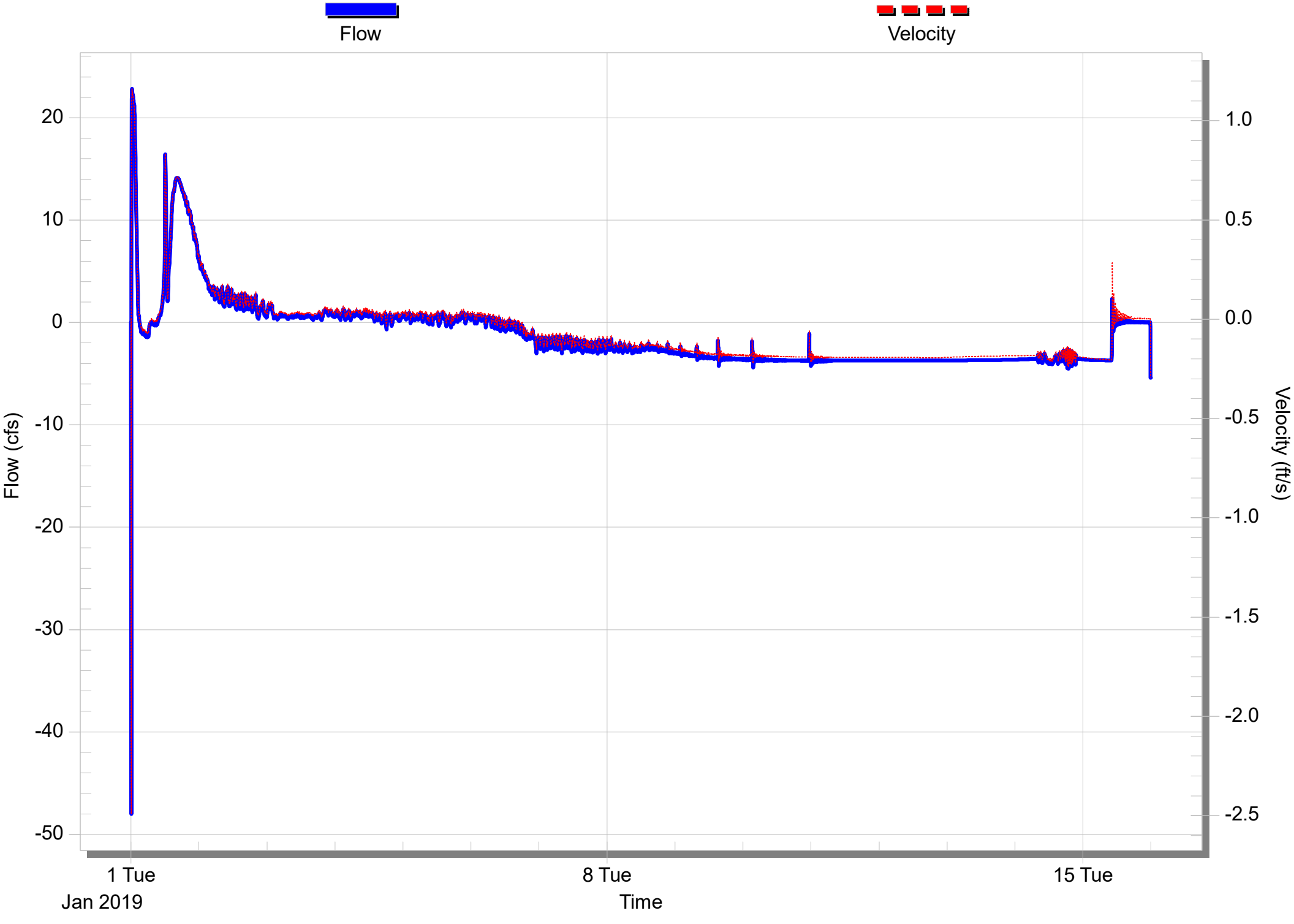
Node - Kubota Tie-In MH

[Max Stage = 51.320]



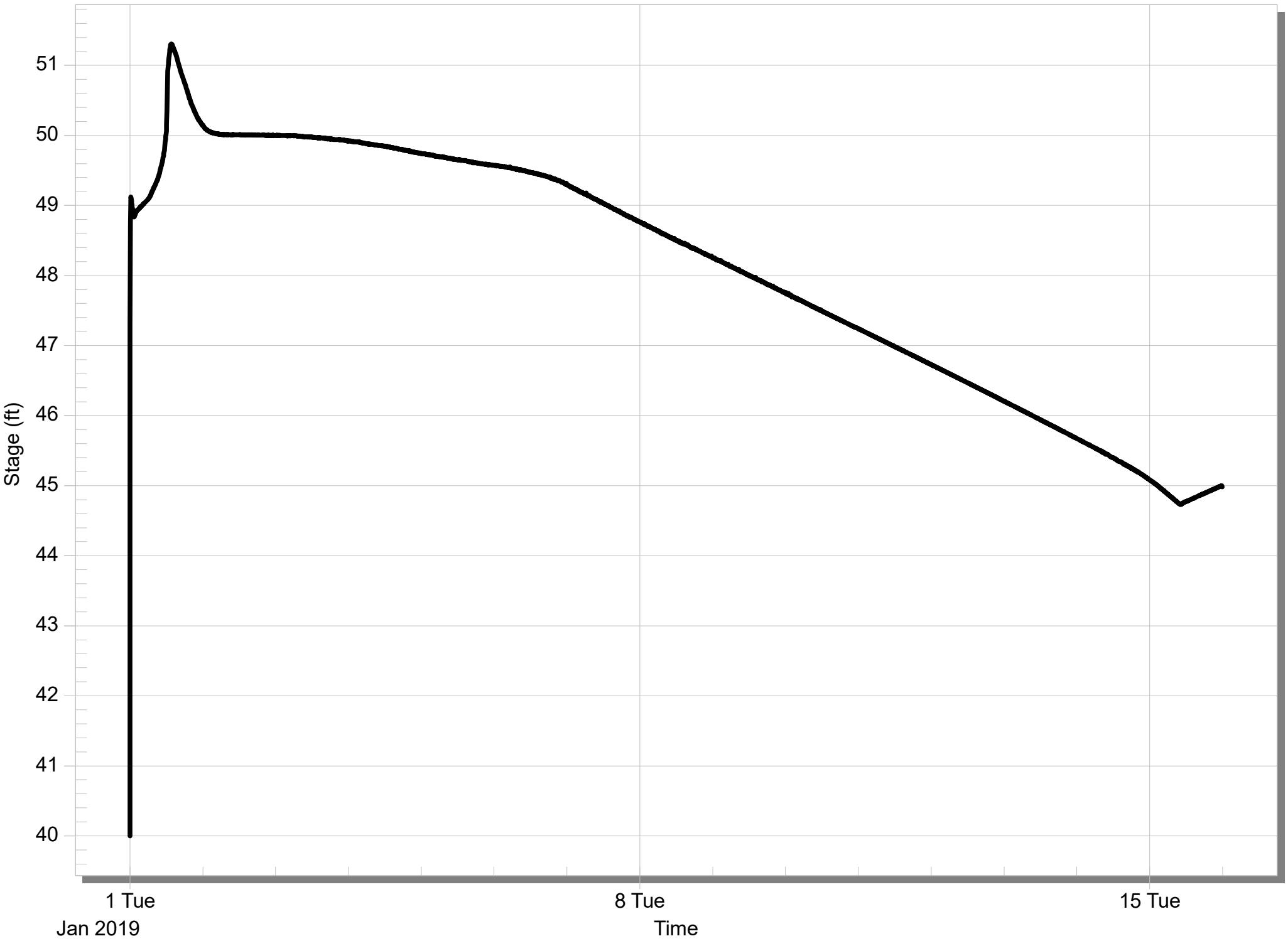
Conduit 60-In SD 2 from Kubota Tie-In MH to Panattoni Tie-In MH

[Max Flow = -48.0150][Max Velocity = -2.49]



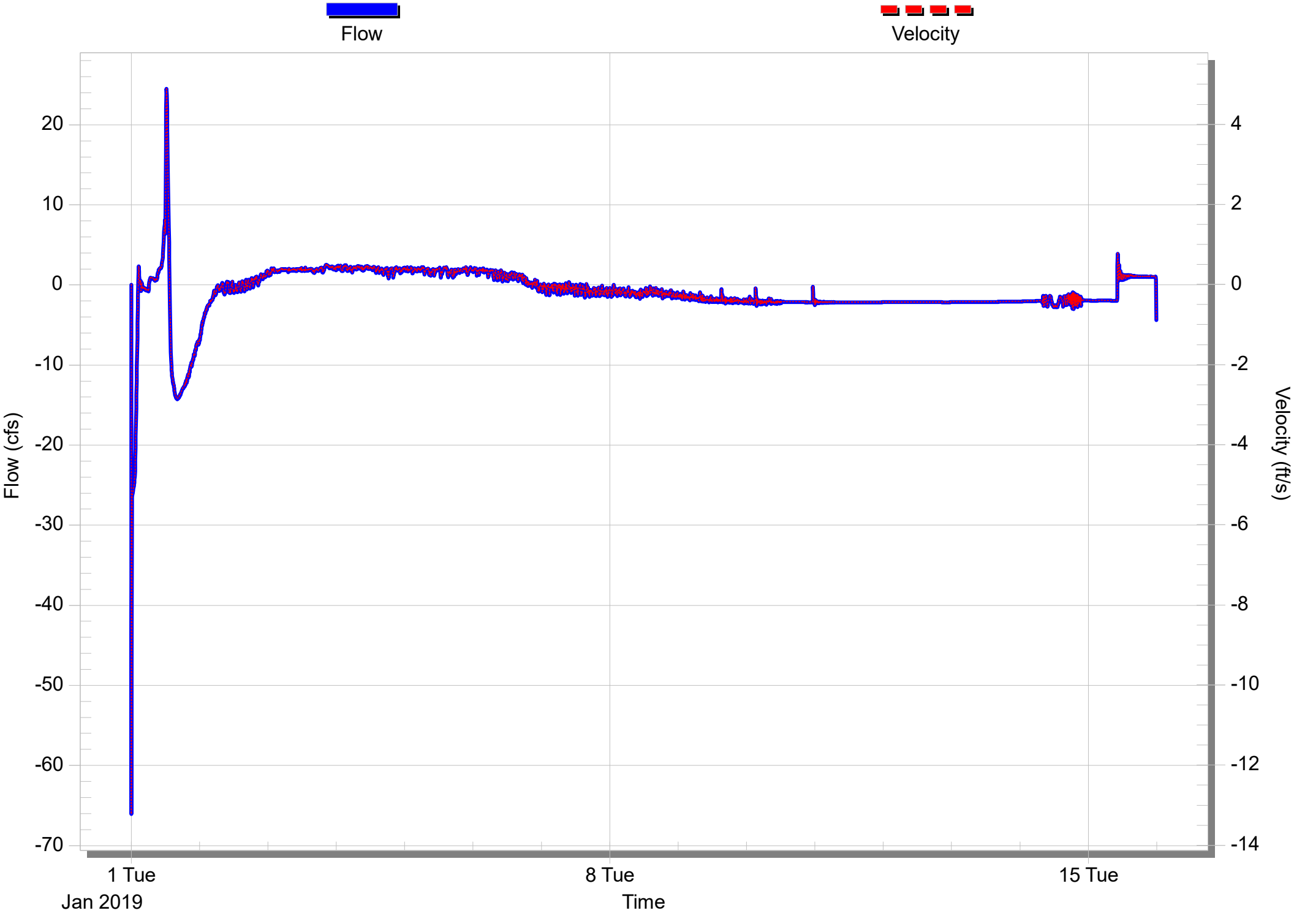
Node - Panattoni Tie-In MH

[Max Stage = 51.306]



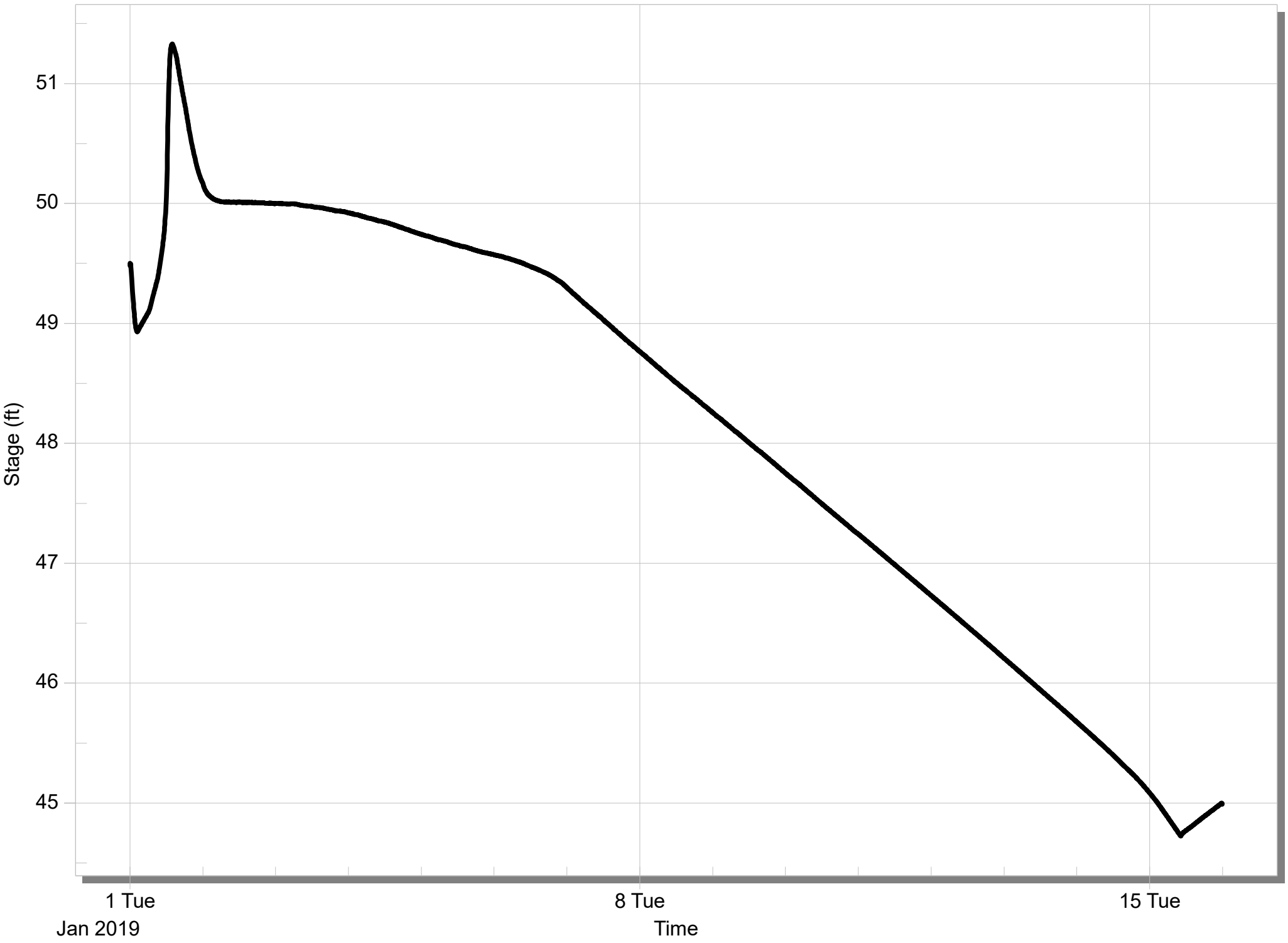
Conduit Interim 30-In SD from Panattoni Tie-In MH to Interim City Basin

[Max Flow = -66.0593][Max Velocity = -13.22]



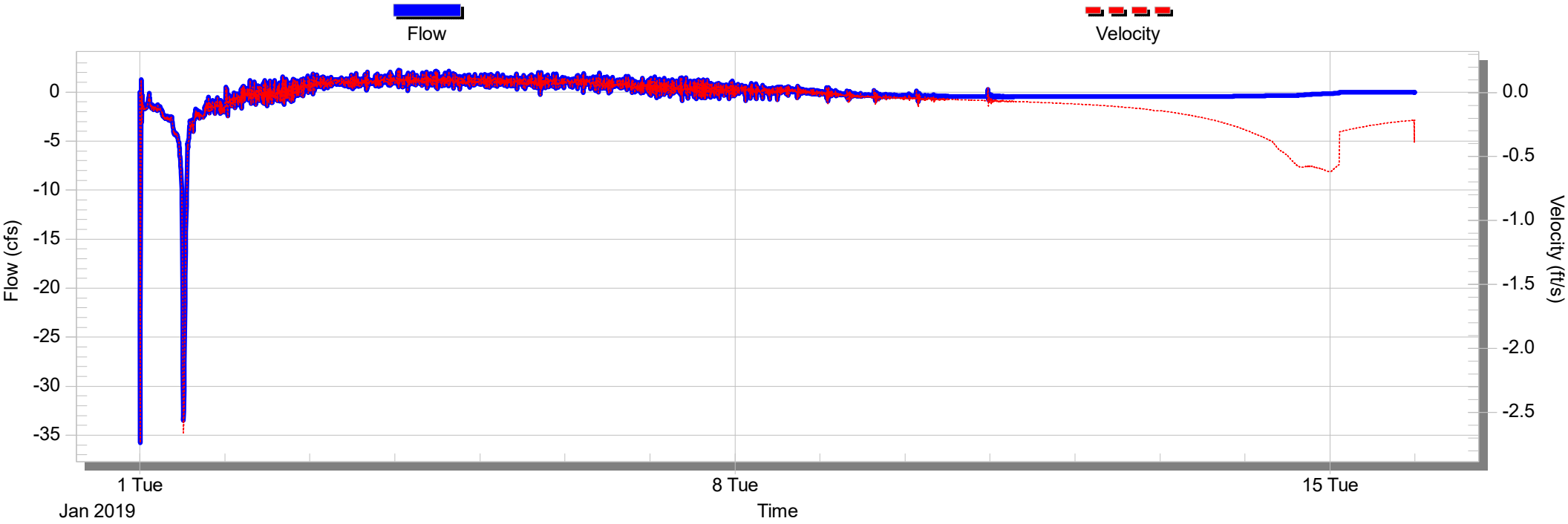
Node - Interim City Basin

[Max Stage = 51.330]



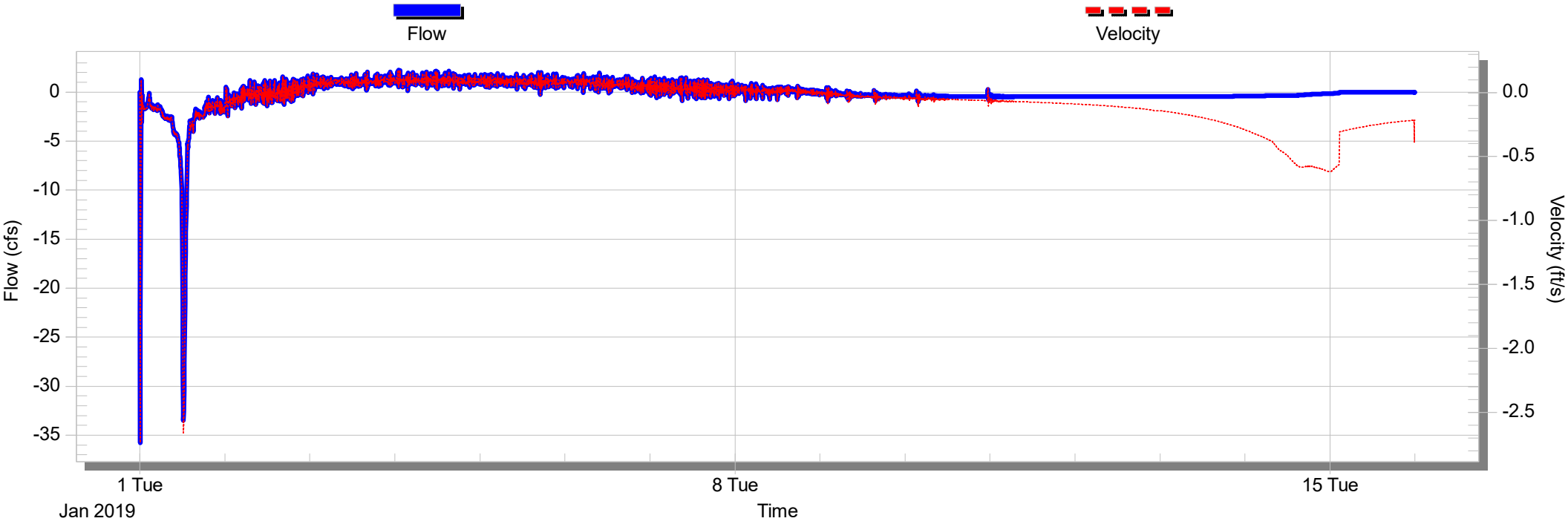
Conduit 48-In Equalizer SD 1 from Interim City Basin to Kubota Basin

[Max Flow = -35.7821][Max Velocity = -2.74]



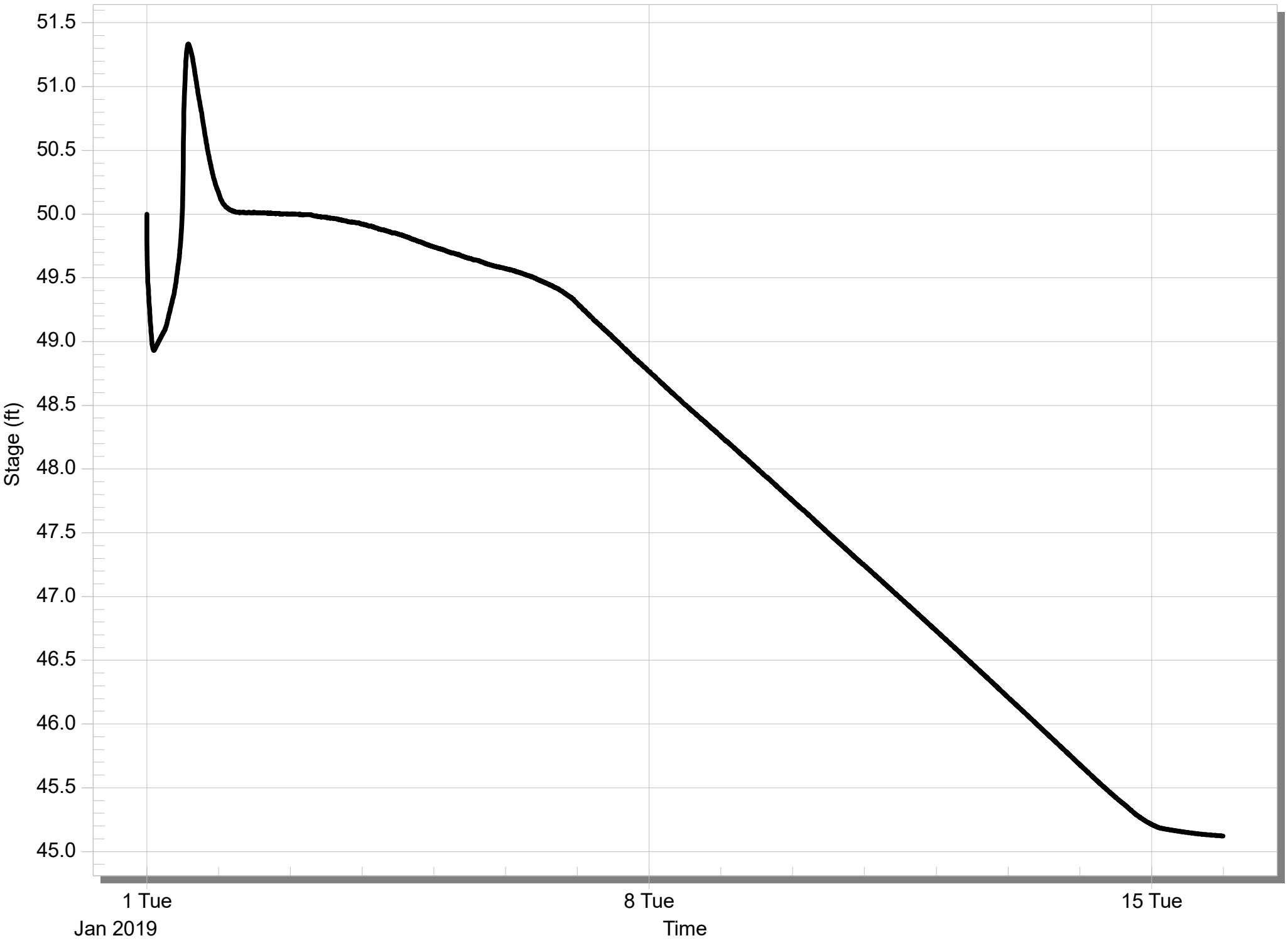
Conduit 48-In Equalizer SD 2 from Interim City Basin to Kubota Basin

[Max Flow = -35.7821][Max Velocity = -2.74]



Node - Kubota Basin

[Max Stage = 51.334]



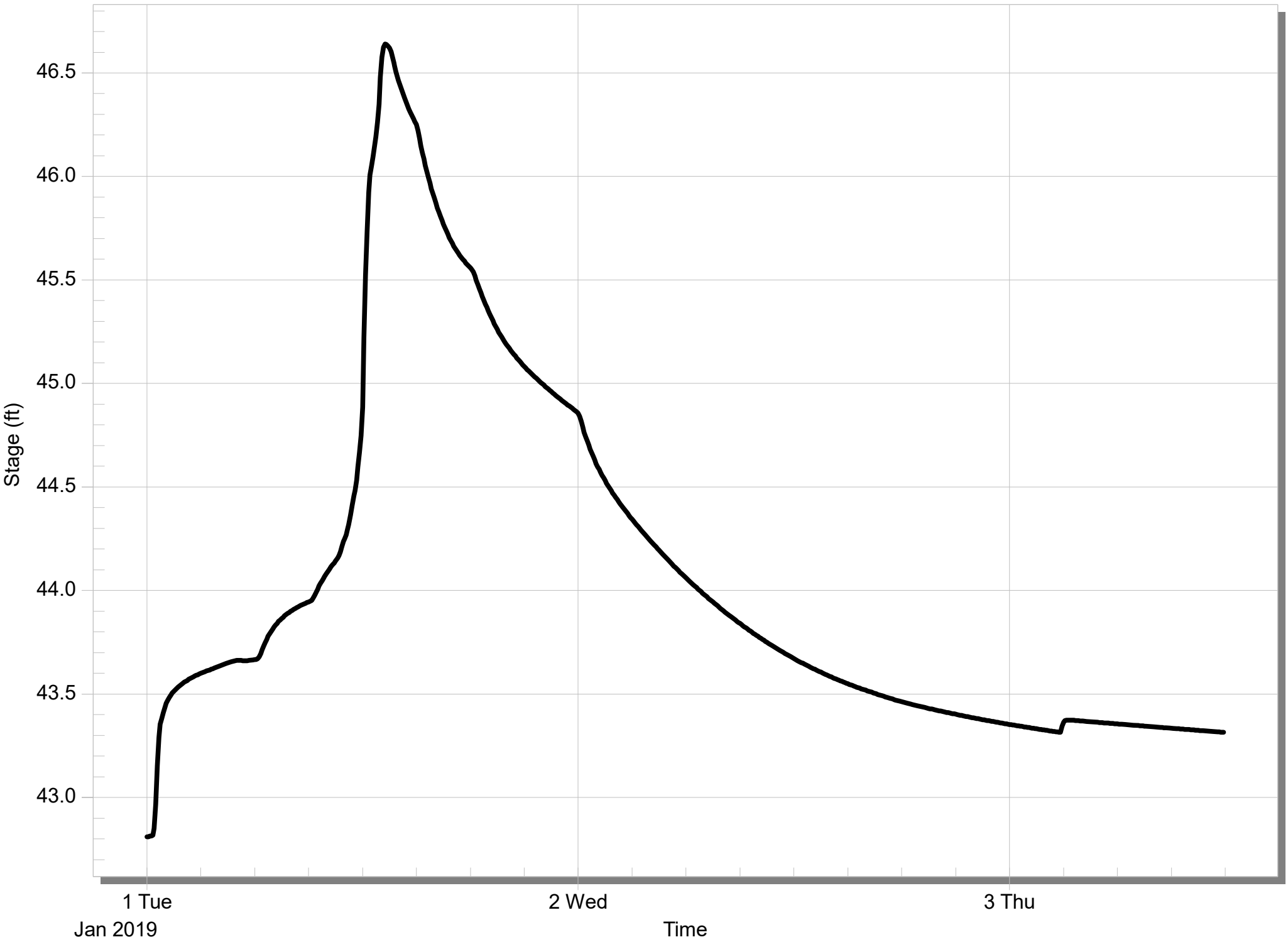
APPENDIX B

Ultimate Hydraulic Analysis

10-Year Analysis
Alternative 1

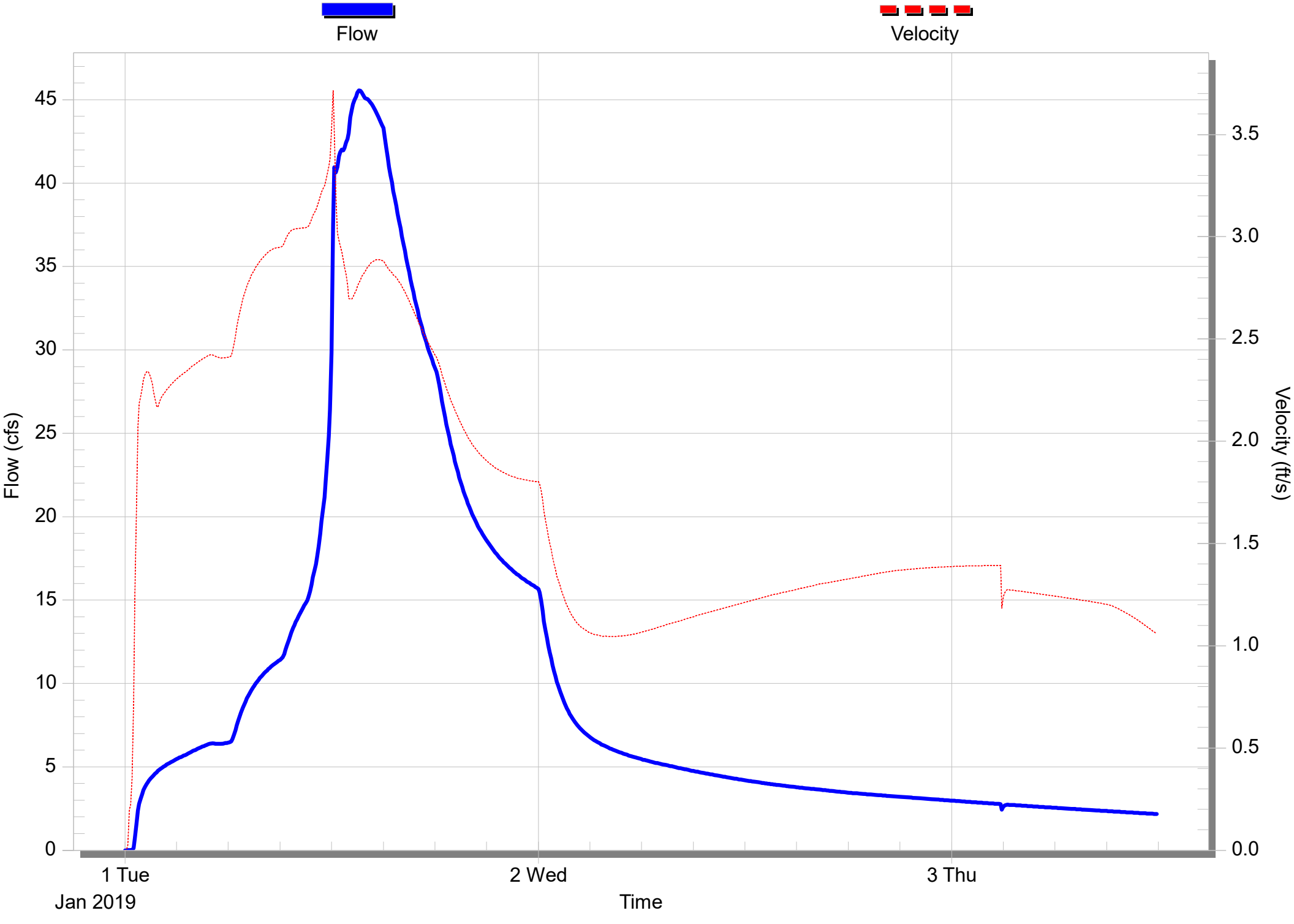
Node - Kubota Tie-In MH

[Max Stage = 46.640]



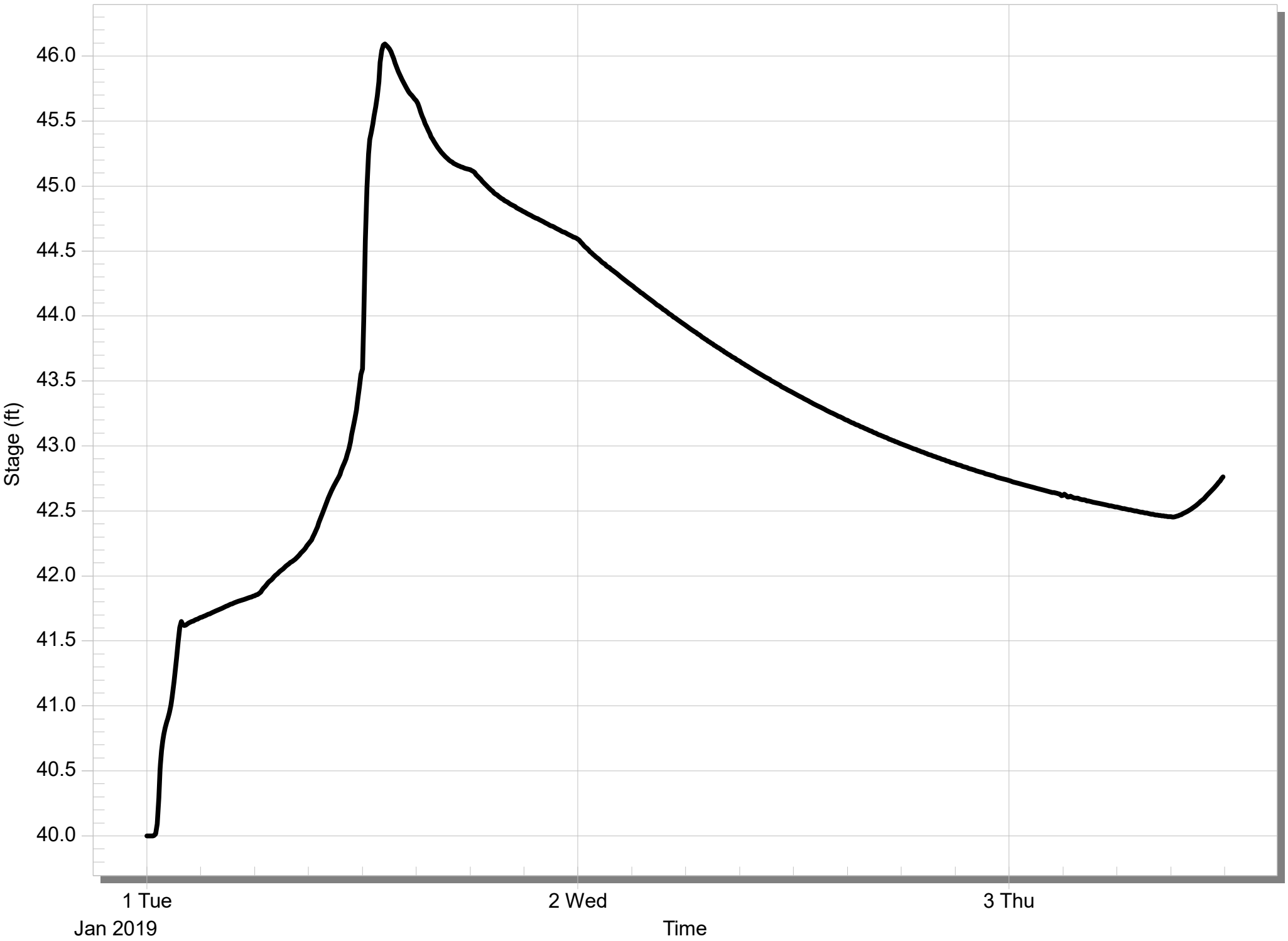
Conduit 60-In SD 1 from Kubota Tie-In MH to Panattoni Tie-In MH

[Max Flow = 45.5515][Max Velocity = 3.71]



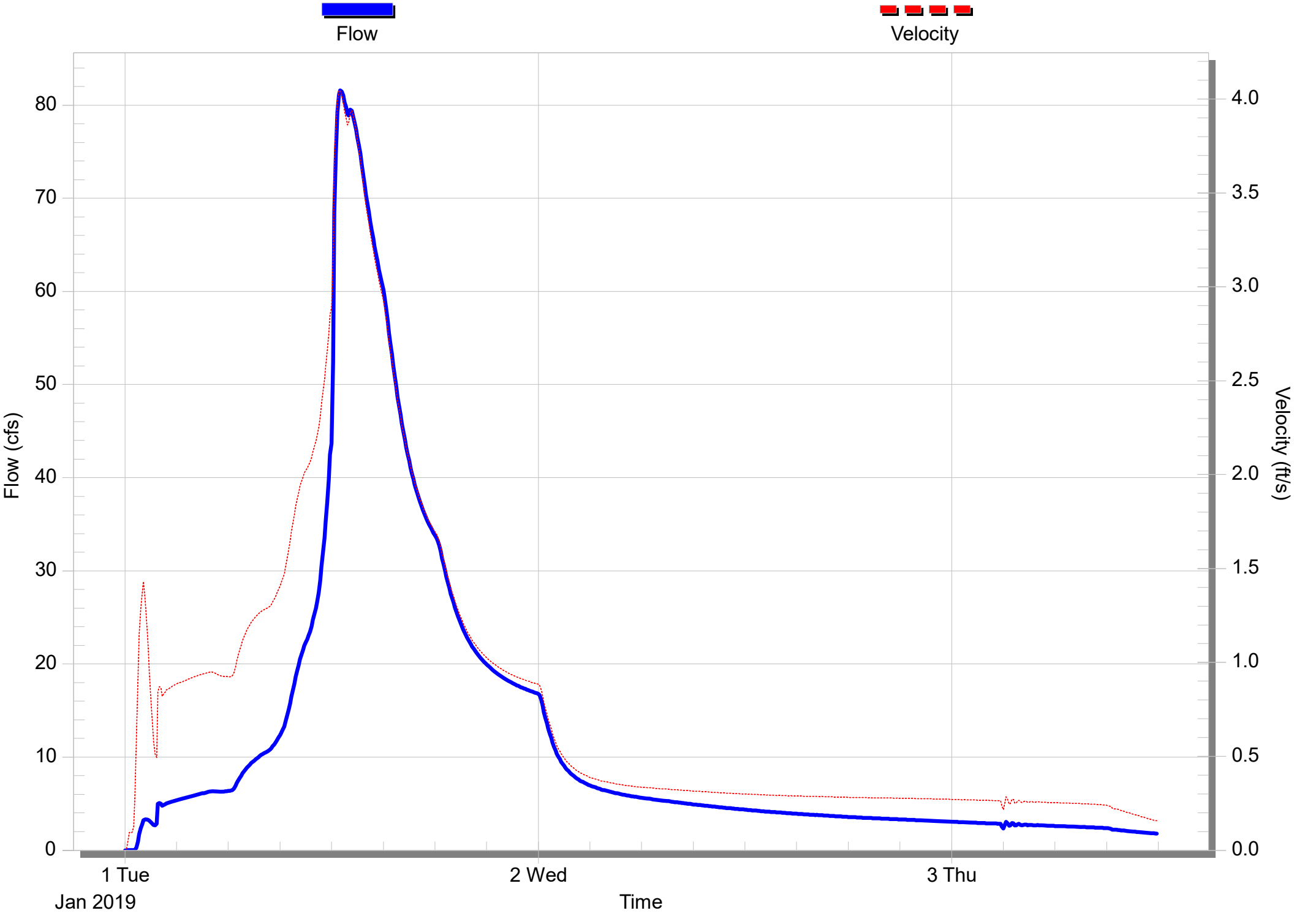
Node - Panattoni Tie-In MH

[Max Stage = 46.093]



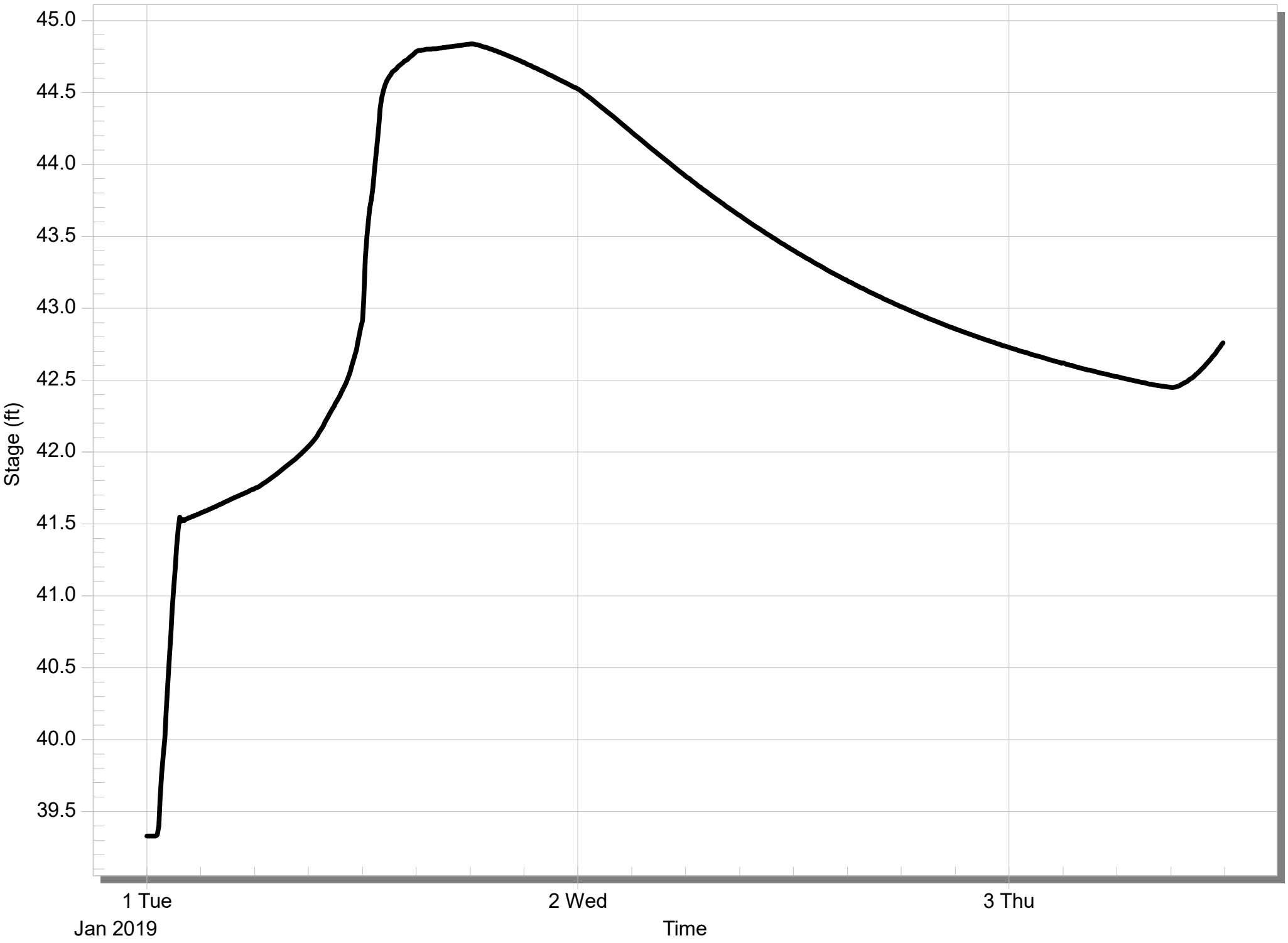
Conduit 60-In SD Pipe 2 from Panattoni Tie-In MH to Basin B Future Tie-In MH

[Max Flow = 81.5659][Max Velocity = 4.05]



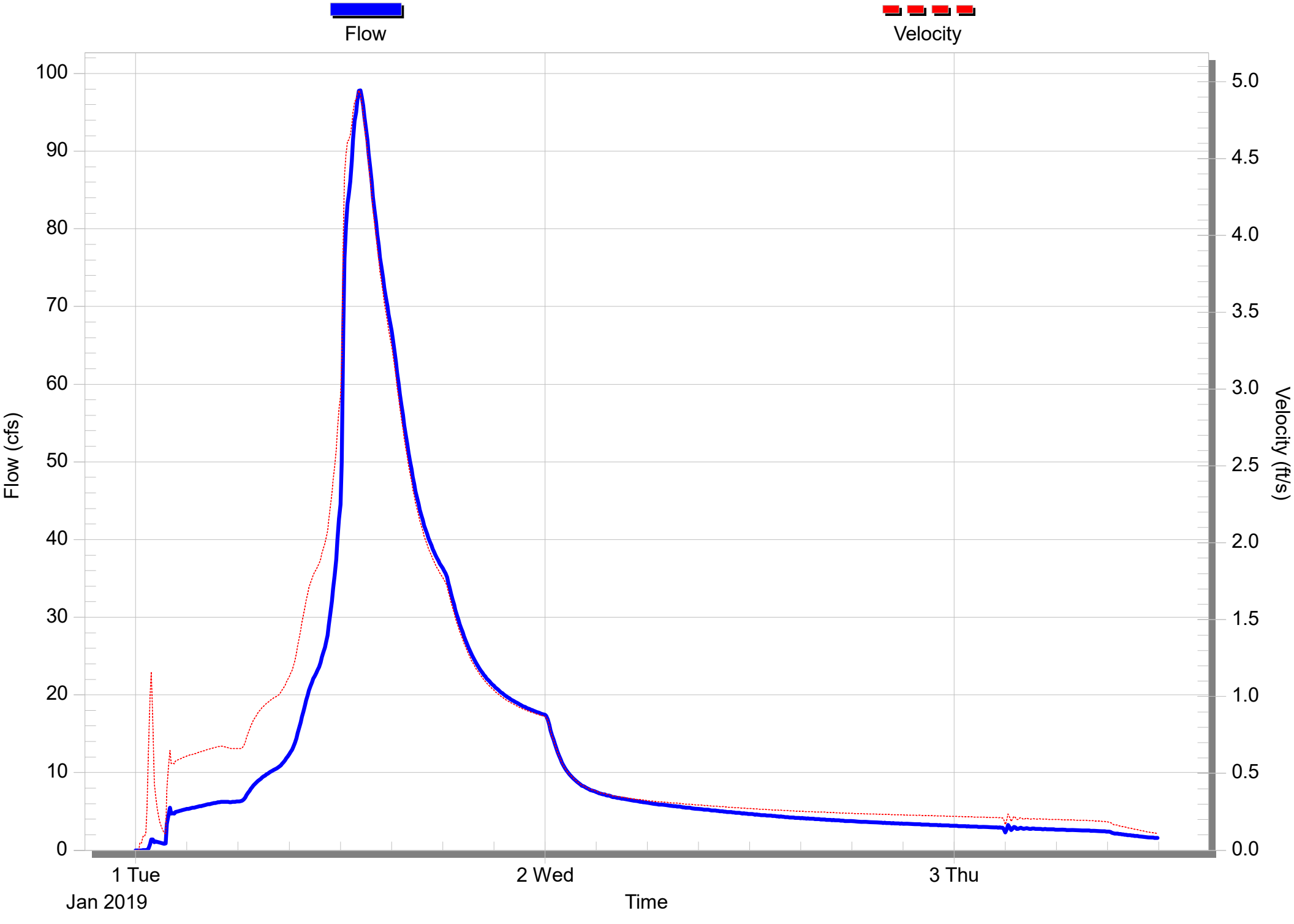
Node - Basin B Future Tie-In MH

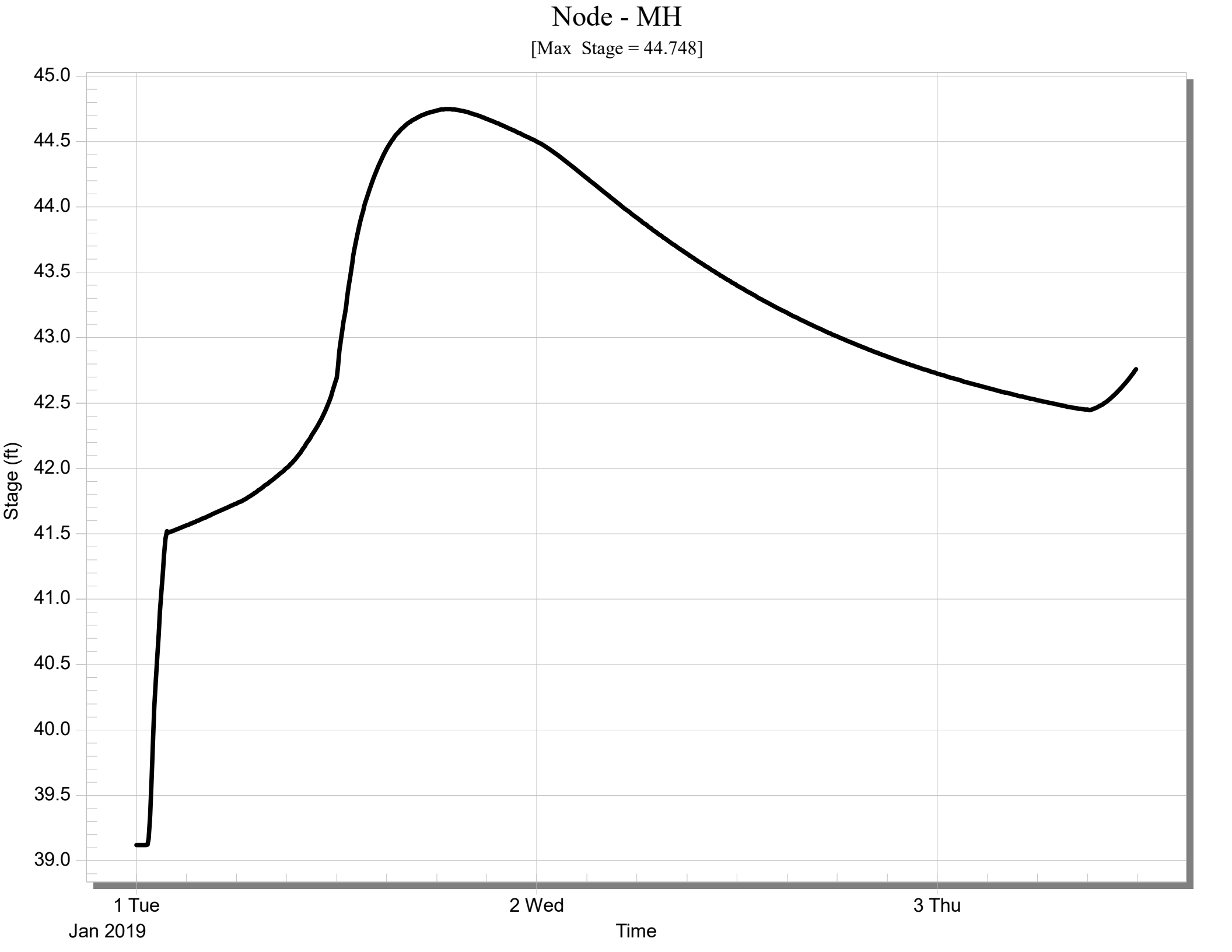
[Max Stage = 44.837]



Conduit 60-In SD Pipe 3 from Basin B Future Tie-In MH to MH

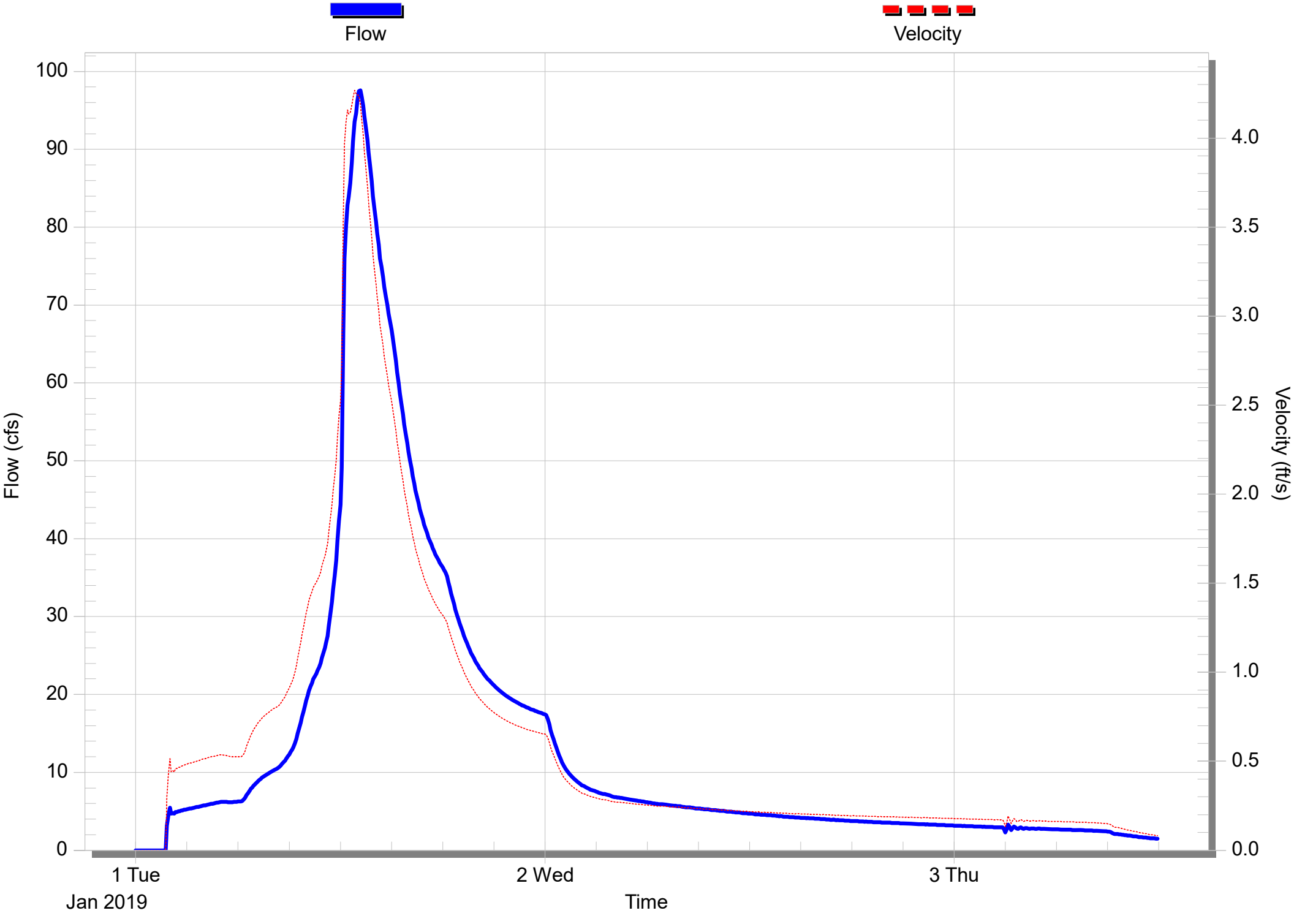
[Max Flow = 97.8091][Max Velocity = 4.94]




Node - MH
[Max Stage = 44.748]
45.0
44.5
44.0
43.5
43.0
42.5
42.0
41.5
41.0
40.5
40.0
39.5
39.0
Stage (ft)
1 Tue
Jan 2019
2 Wed
3 Thu
Time

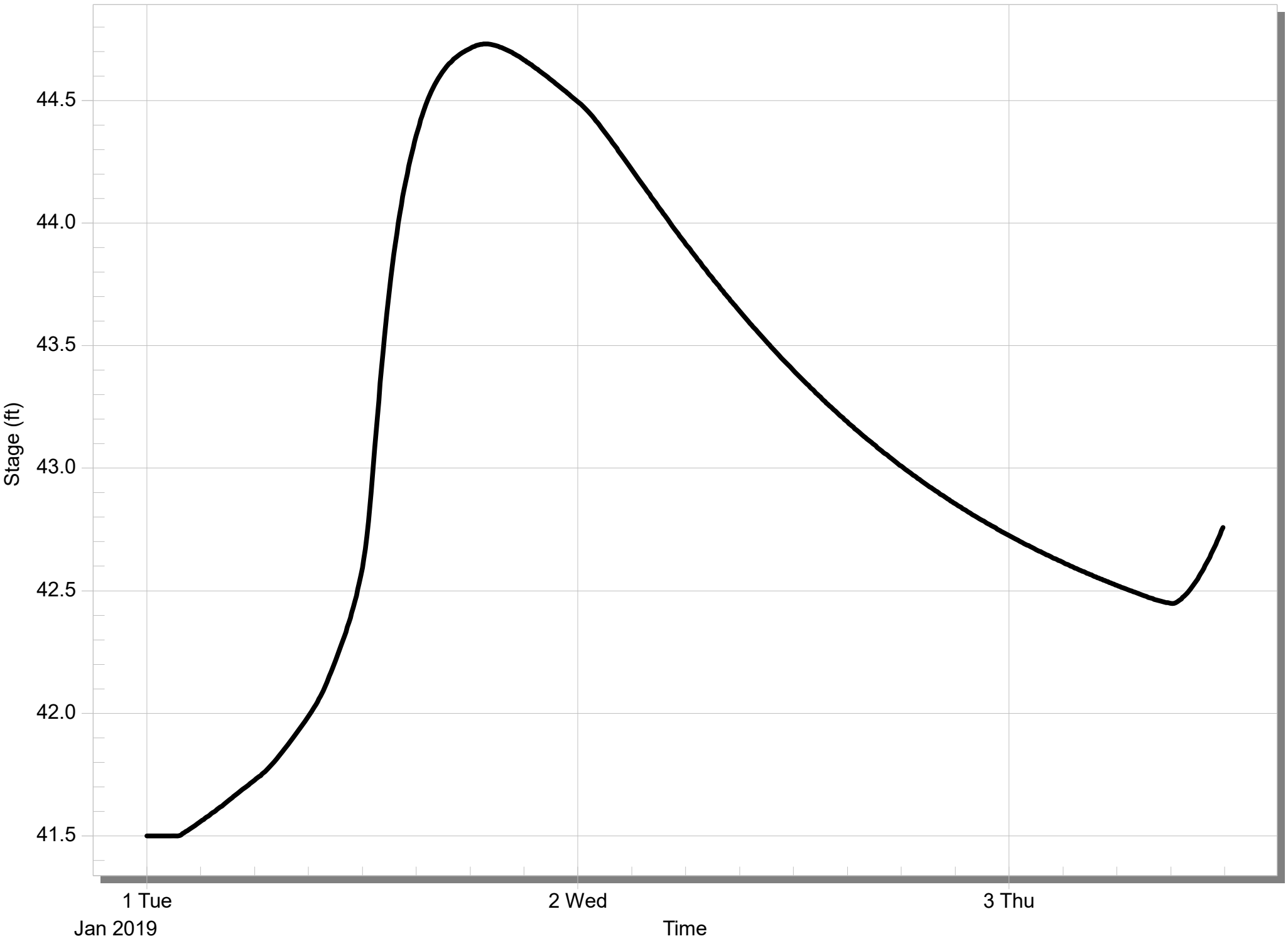
Conduit 60-In SD Pipe 4 from MH to Mahon Pond

[Max Flow = 97.5495][Max Velocity = 4.27]



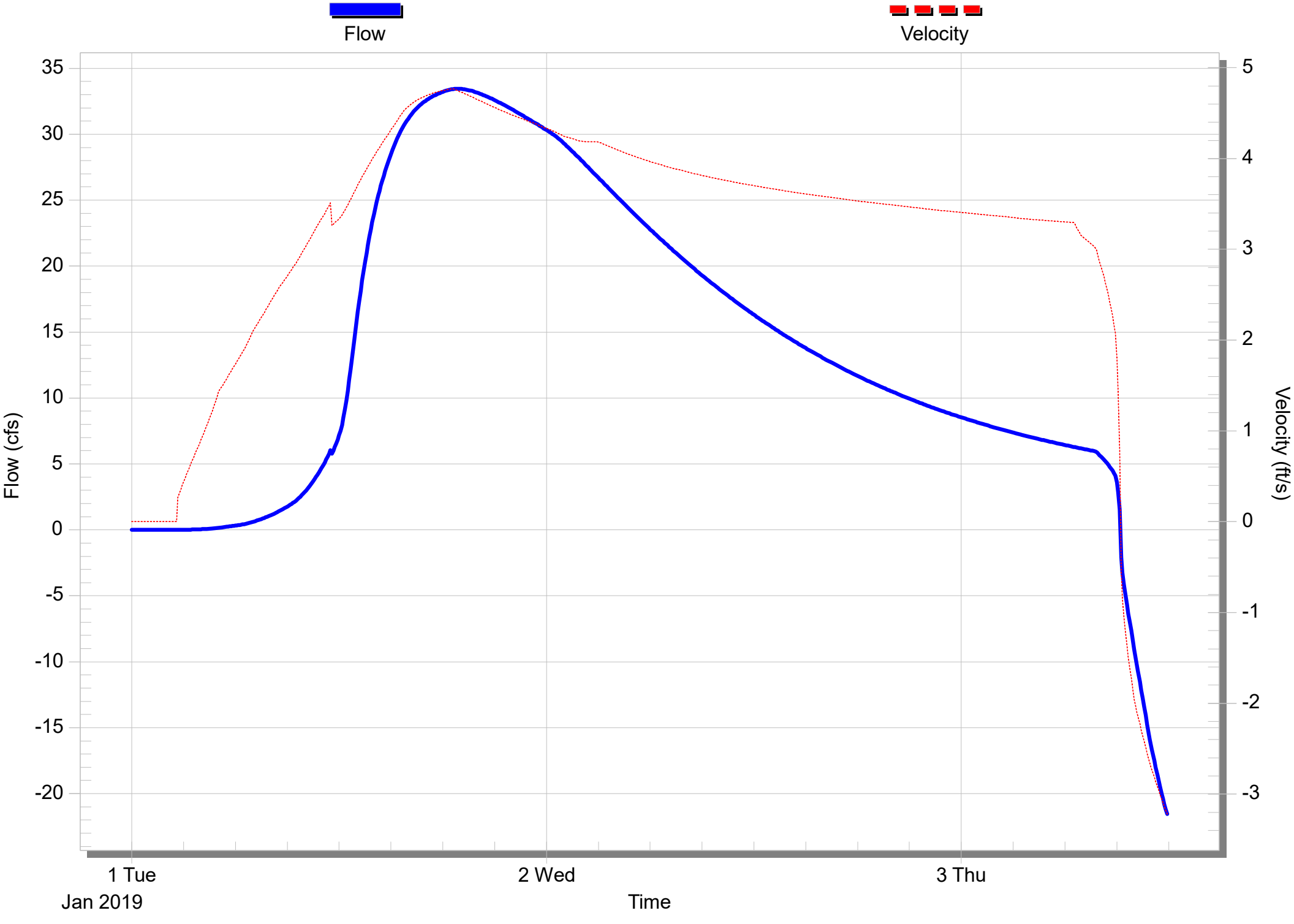
Node - Mahon Pond

[Max Stage = 44.730]



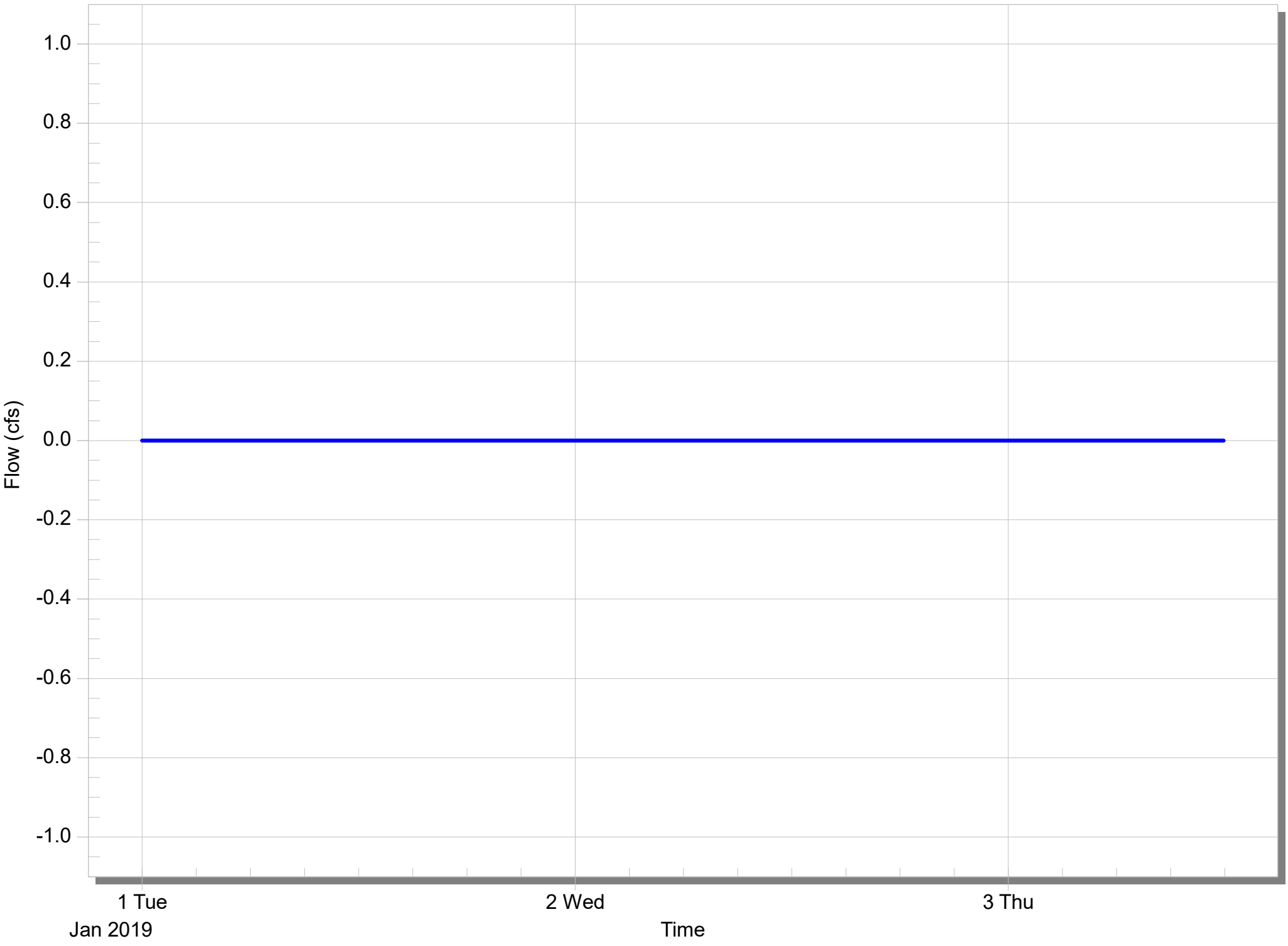
Conduit Mahon Pond 36-In Culvert from Mahon Pond to Channel to Deer Creek

[Max Flow = 33.4435][Max Velocity = 4.77]



Diversion Mahon Pond Outfall Weir from Mahon Pond to Channel to Deer Creek

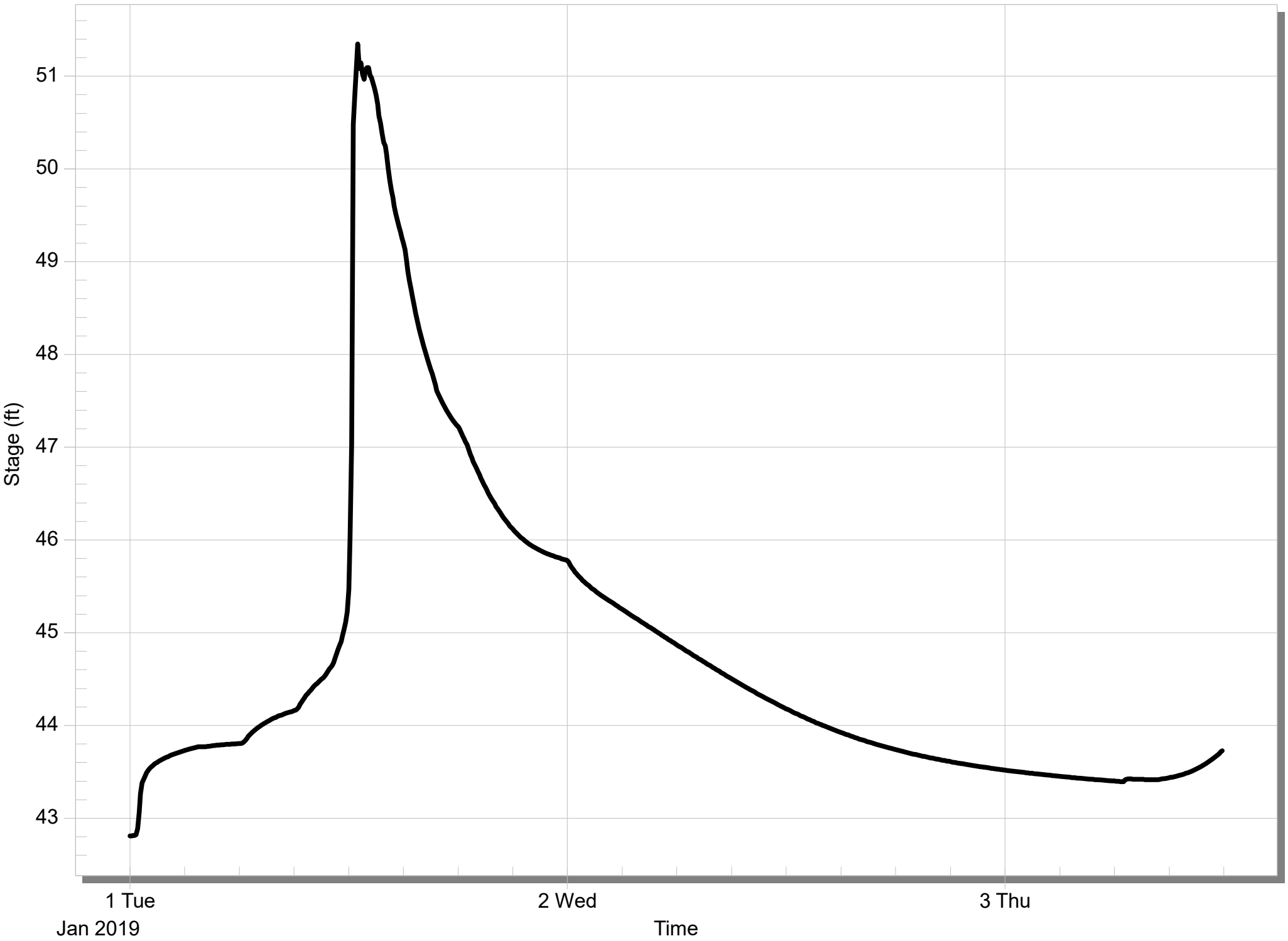
[Max Flow = 0.0000]



100-Year Analysis
Alternative 1

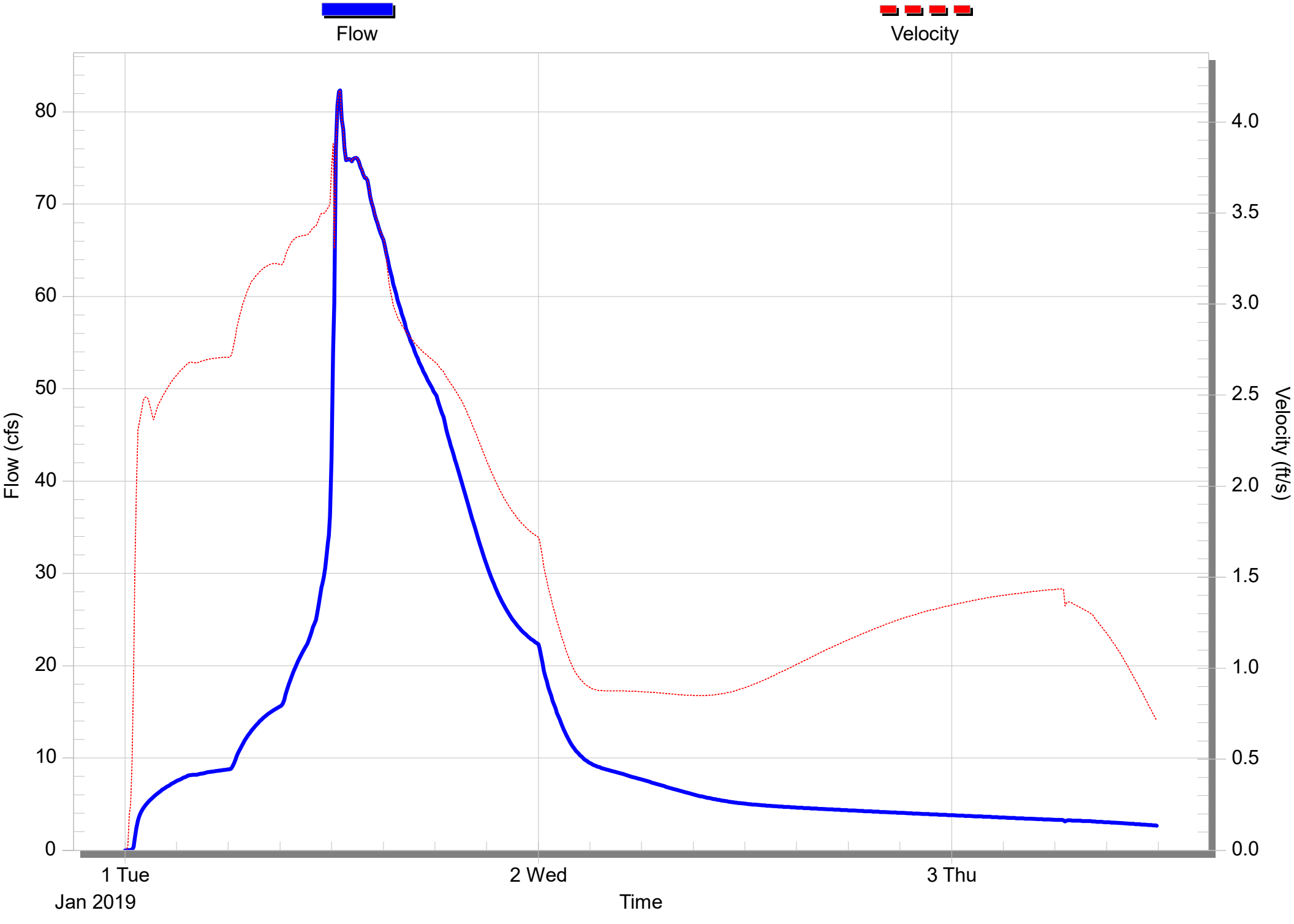
Node - Kubota Tie-In MH

[Max Stage = 51.346]



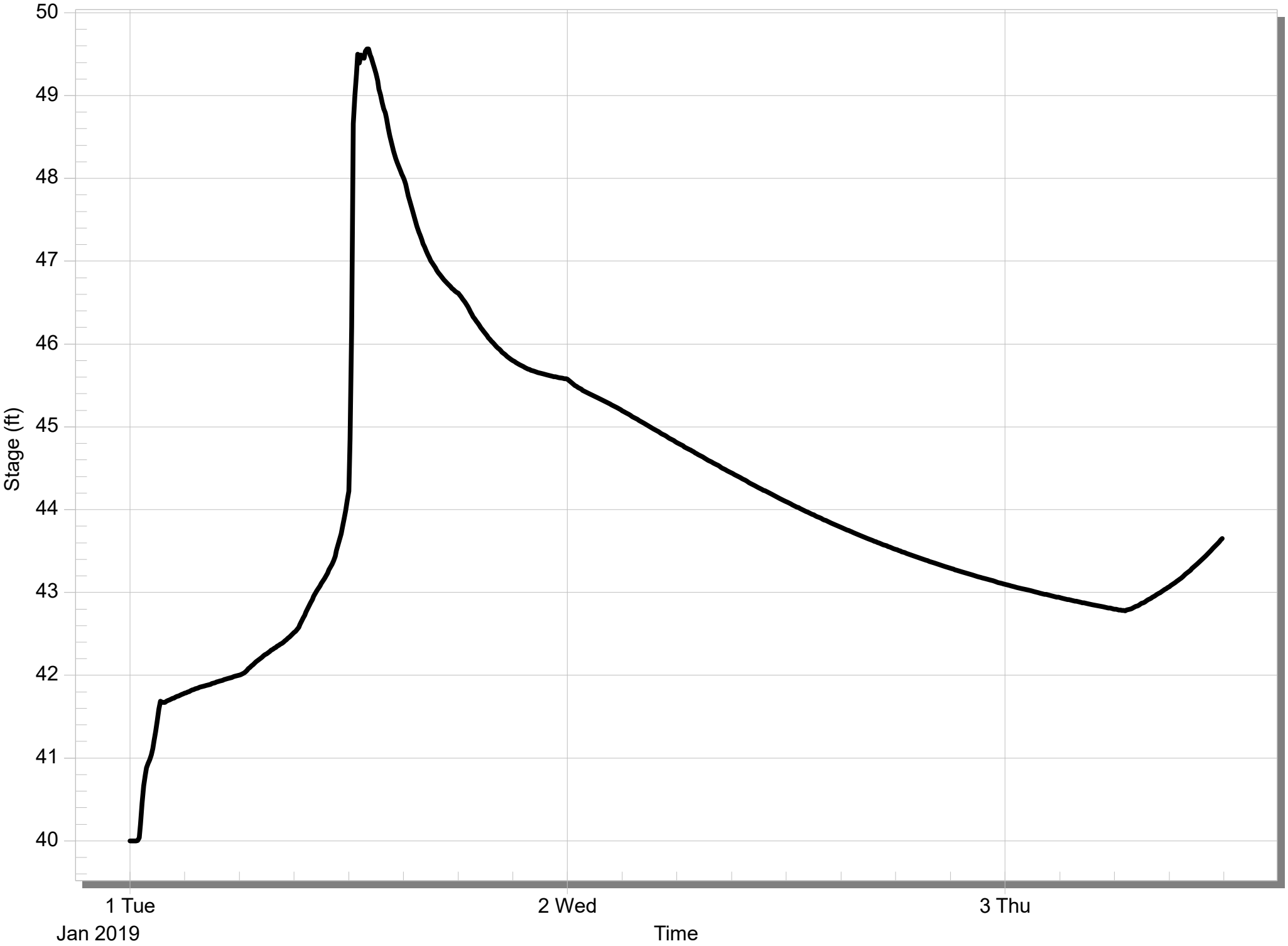
Conduit 60-In SD 1 from Kubota Tie-In MH to Panattoni Tie-In MH

[Max Flow = 82.3214][Max Velocity = 4.17]



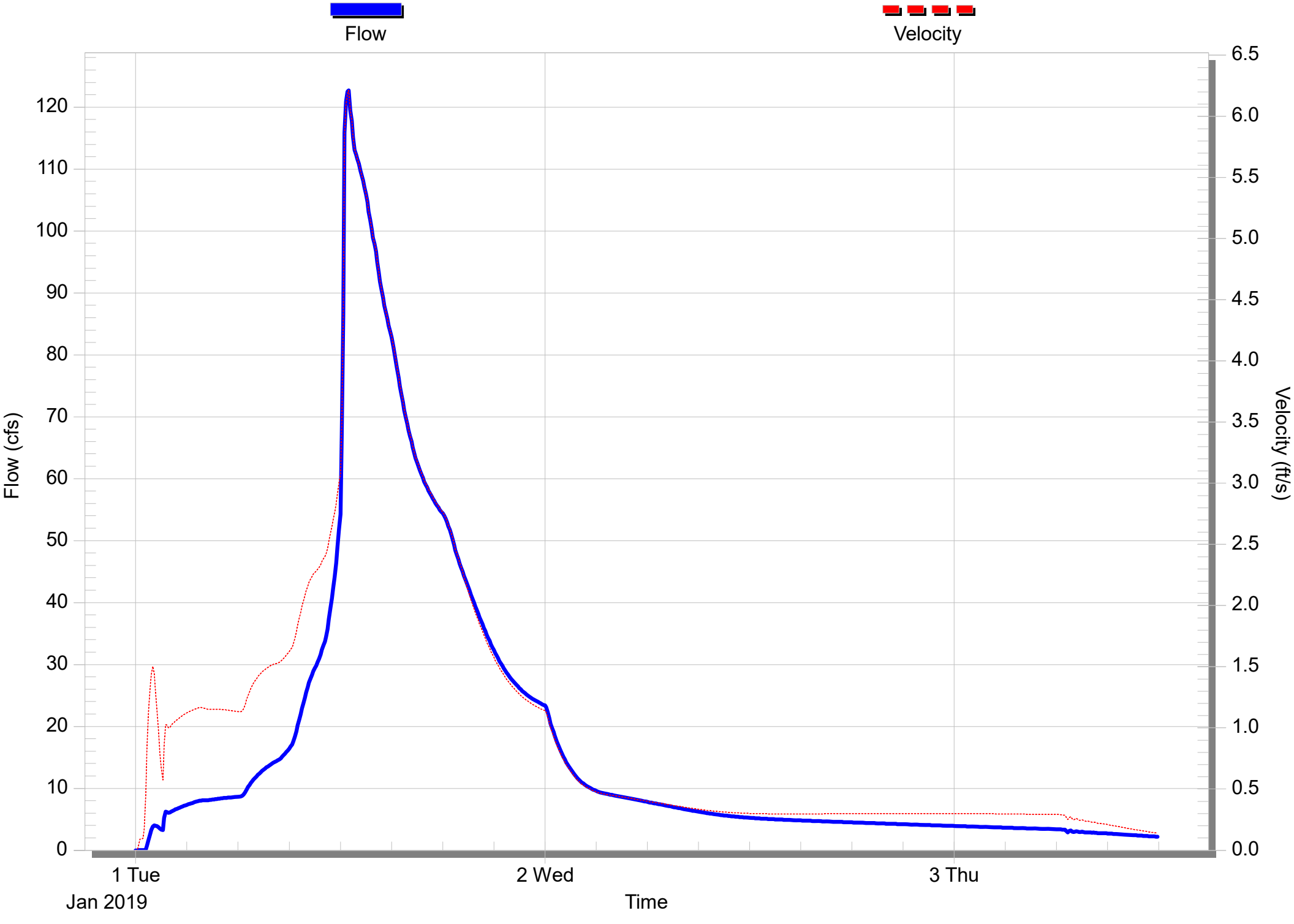
Node - Panattoni Tie-In MH

[Max Stage = 49.562]



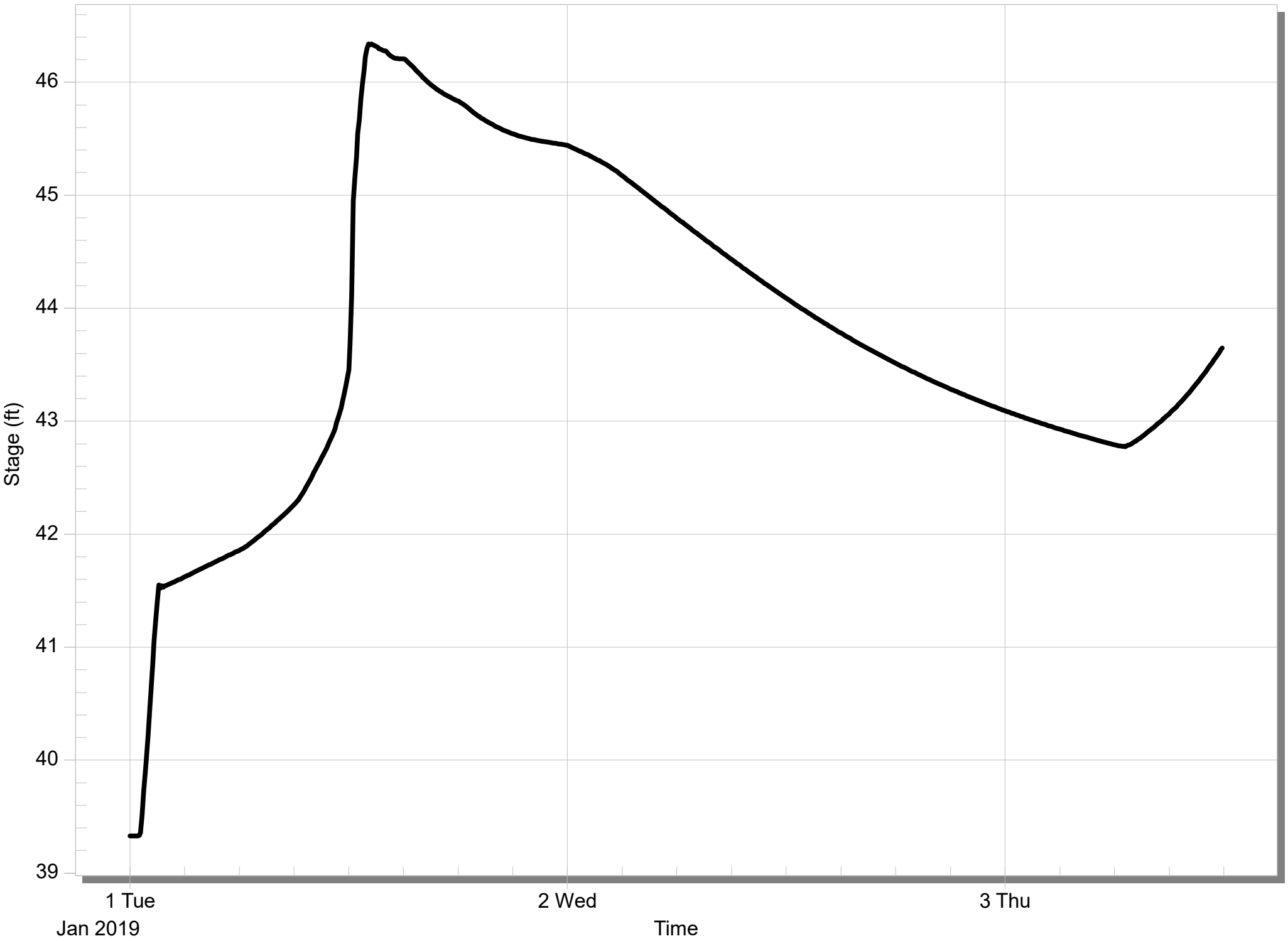
Conduit 60-In SD Pipe 2 from Panattoni Tie-In MH to Basin B Future Tie-In MH

[Max Flow = 122.6873][Max Velocity = 6.21]



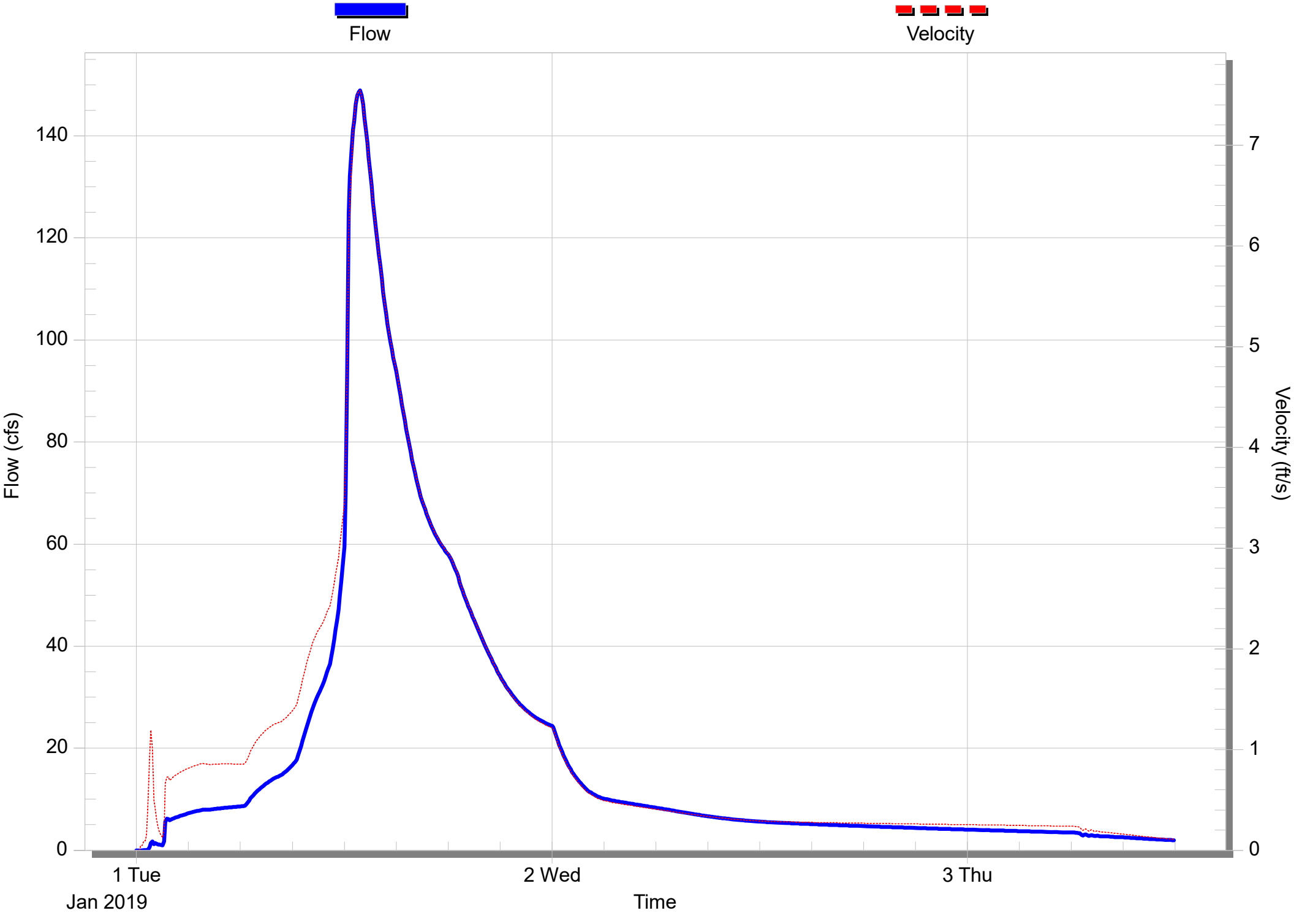
Node - Basin B Future Tie-In MH

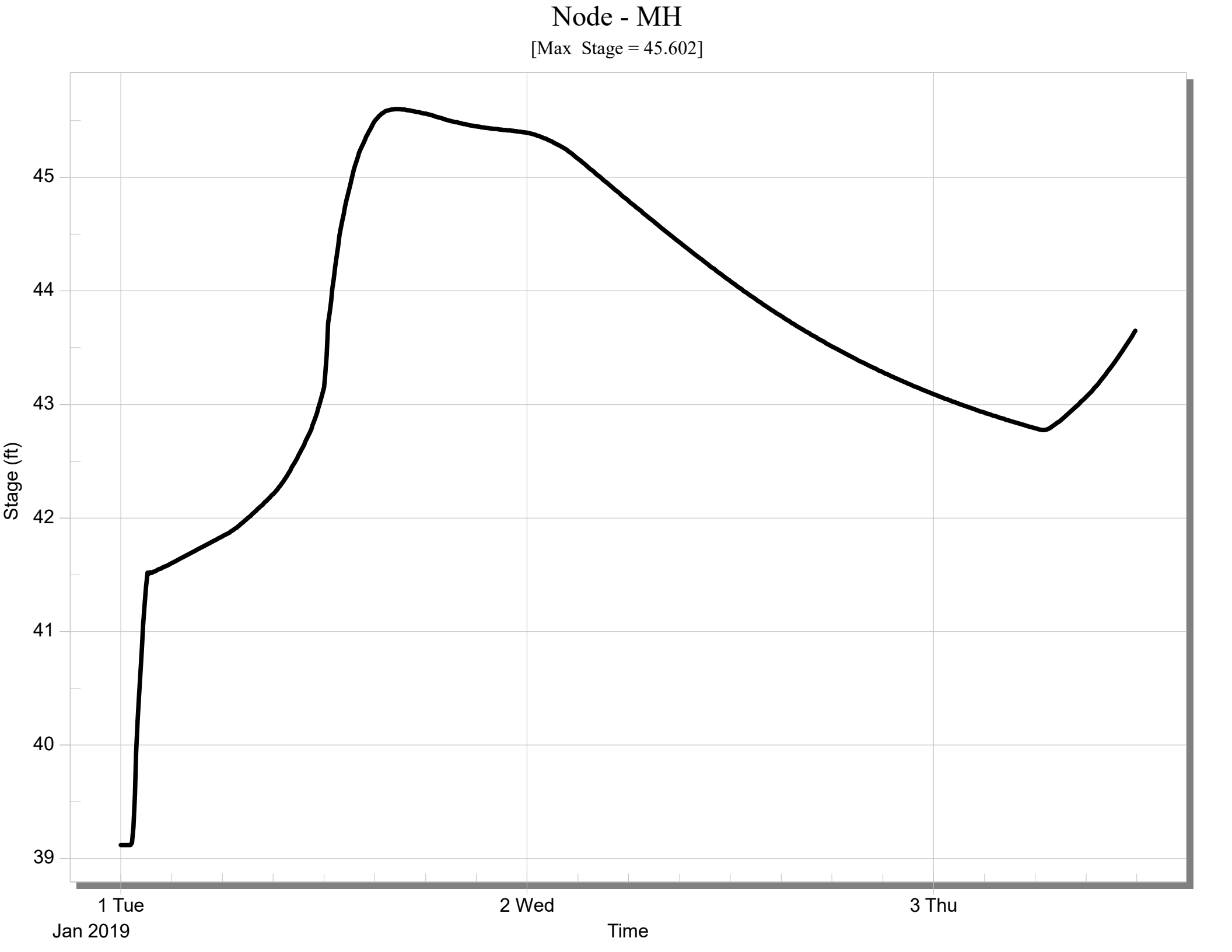
[Max Stage = 46.339]



Conduit 60-In SD Pipe 3 from Basin B Future Tie-In MH to MH

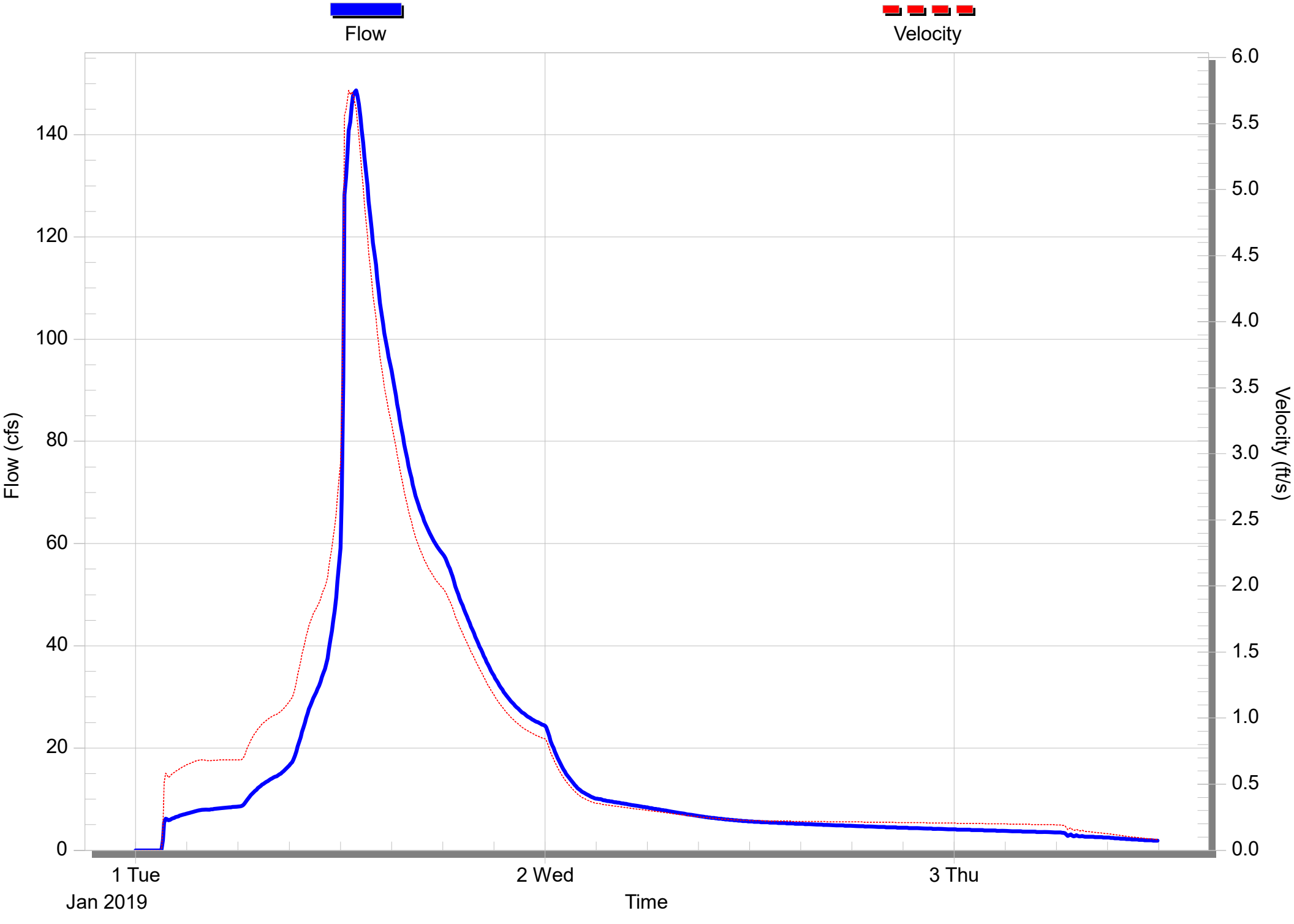
[Max Flow = 148.8934][Max Velocity = 7.54]




Node - MH
[Max Stage = 45.602]
45
44
43
42
41
40
39
Stage (ft)
1 Tue
Jan 2019
2 Wed
3 Thu
Time

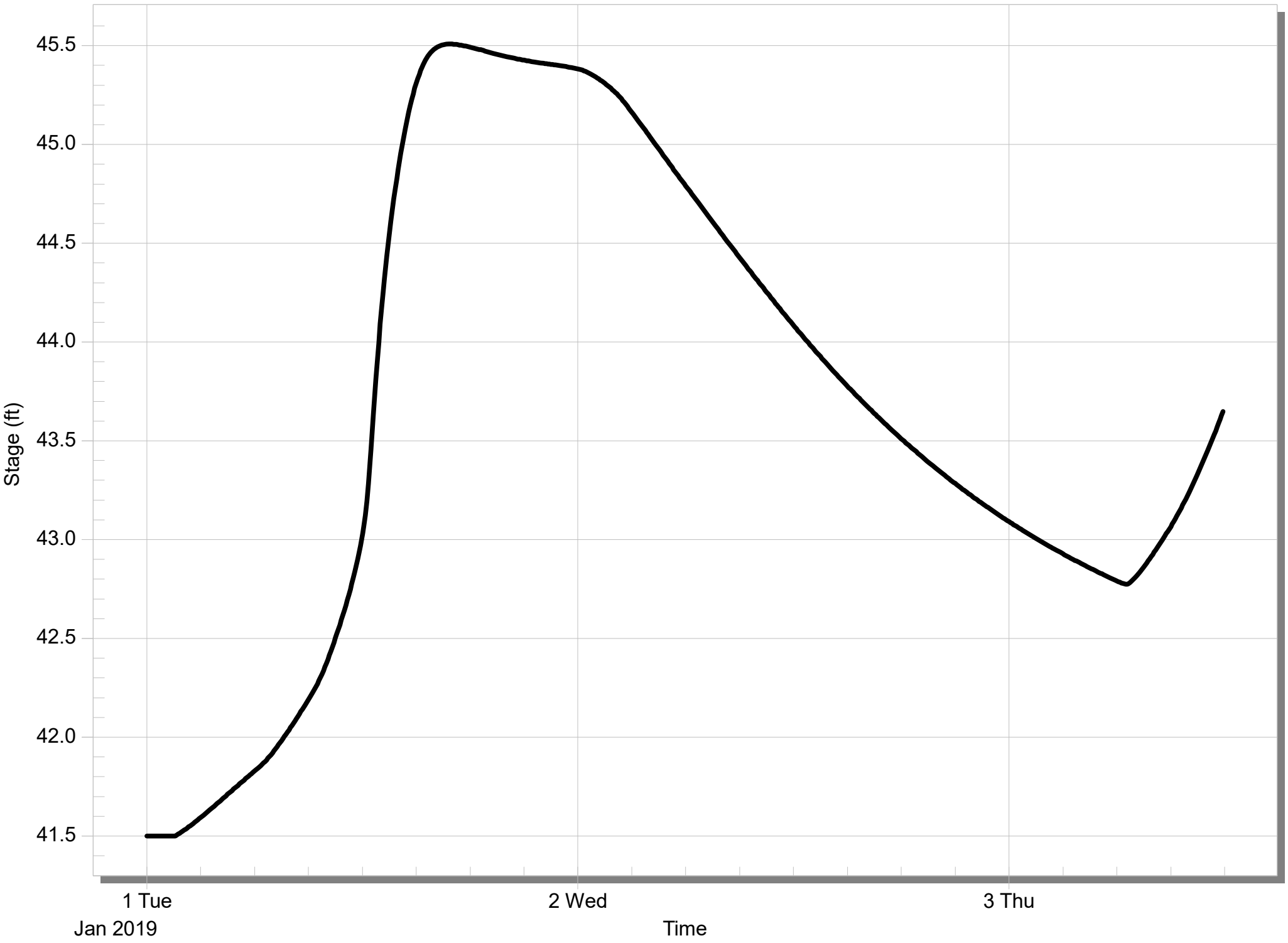
Conduit 60-In SD Pipe 4 from MH to Mahon Pond

[Max Flow = 148.6521][Max Velocity = 5.75]



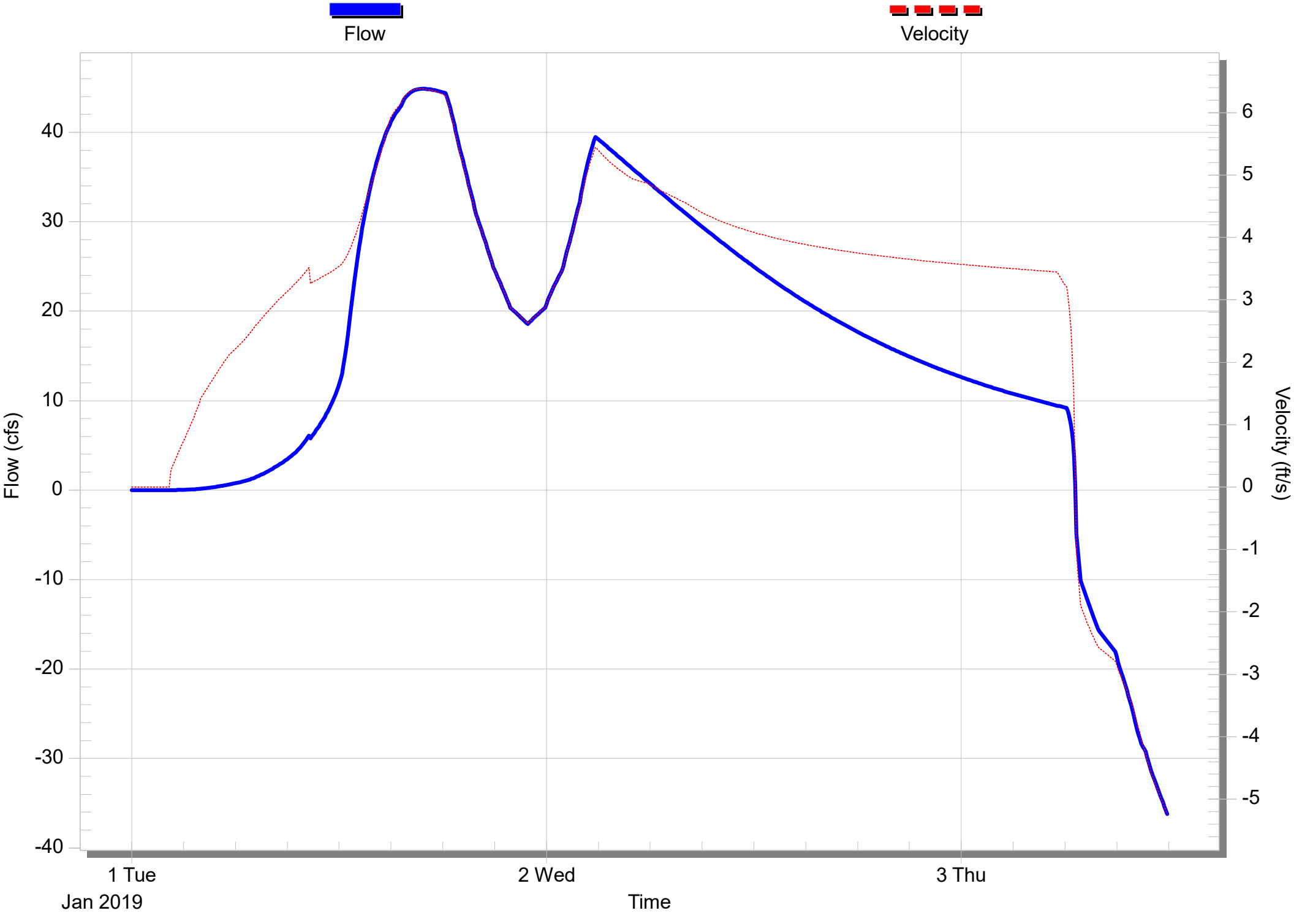
Node - Mahon Pond

[Max Stage = 45.508]



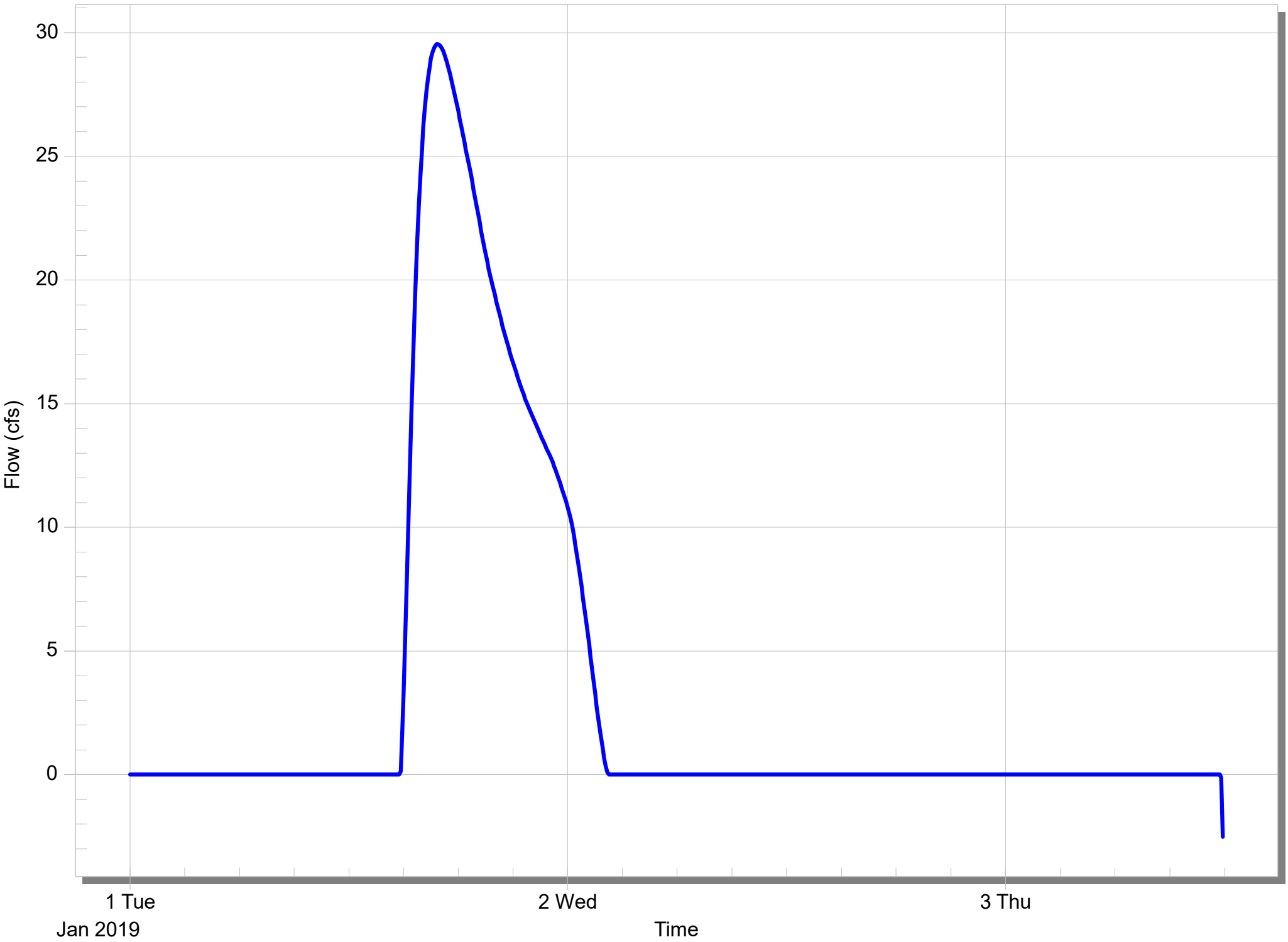
Conduit Mahon Pond 36-In Culvert from Mahon Pond to Channel to Deer Creek

[Max Flow = 44.8597][Max Velocity = 6.38]



Diversion Mahon Pond Outfall Weir from Mahon Pond to Channel to Deer Creek

[Max Flow = 29.5422]



APPENDIX C

Preliminary Cost Estimates

Preliminary Engineer's Estimate
WDR052 Southeast Industrial Area Storm Drain Project
Ultimate Improvements - Alternative 1

ITEM NO.	ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	CONSTRUCTION AREA SIGNS	LS	1	$2,000.00	$2,000
2	TRAFFIC CONTROL SYSTEM	LS	1	$10,000.00	$10,000
3	JOB SITE MANAGEMENT	LS	1	$10,000.00	$10,000
4	PREPARE & IMPLEMENT STORM WATER POLLUTION PREVENTION PLAN	LS	1	$50,000.00	$50,000
5	CLEARING AND GRUBBING	LS	1	$10,000.00	$10,000
6	EXCAVATION & DISPOSAL	LS	1	$10,000.00	$10,000
7	ACCESS ROAD	SF	19100	$2.10	$40,000
8	WINGWALL	EA	1	$12,000.00	$12,000
9	TRASH RACK	EA	1	$10,000.00	$10,000
10	72" FLAP GATE	EA	1	$35,000.00	$35,000
11	60" REINFORCED CONCRETE PIPE	LF	3200	$700.00	$2,240,000
12	72" REINFORCED CONCRETE PIPE	LF	300	$850.00	$255,000
13	CONRETE APRON	EA	1	$5,000.00	$5,000
14	ROCK SLOPE PROTECTION	EA	1	$6,000.00	$6,000
15	MANHOLE	EA	8	$7,000.00	$56,000
16	LANDSCAPING/PLANTING	LS	1	$40,000.00	$40,000
		MOBILIZATION (@ 10 %)			**$279,000**
			SUBTOTAL		**$3,070,000**
			CONTINGENCY	**30%**	**$921,000**
			GRAND TOTAL		**$3,991,000**

Preliminary Engineer's Estimate
WDR052 Southeast Industrial Area Storm Drain Project
Ultimate Improvements - Alternative 2

ITEM NO.	ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	CONSTRUCTION AREA SIGNS	LS	1	$2,000.00	$2,000
2	TRAFFIC CONTROL SYSTEM	LS	1	$10,000.00	$10,000
3	JOB SITE MANAGEMENT	LS	1	$10,000.00	$10,000
4	PREPARE & IMPLEMENT STORM WATER POLLUTION PREVENTION PLAN	LS	1	$60,000.00	$60,000
5	CLEARING AND GRUBBING	LS	1	$30,000.00	$30,000
6	EXCAVATION & DISPOSAL	LS	1	$100,000.00	$100,000
7	ACCESS ROAD	SF	19100	$2.10	$40,000
8	WINGWALL	EA	1	$12,000.00	$12,000
9	TRASH RACK	EA	1	$10,000.00	$10,000
10	72" FLAP GATE	EA	1	$35,000.00	$35,000
11	60" REINFORCED CONCRETE PIPE	LF	3200	$700.00	$2,240,000
12	72" REINFORCED CONCRETE PIPE	LF	300	$850.00	$255,000
13	CONRETE APRON	EA	1	$5,000.00	$5,000
14	ROCK SLOPE PROTECTION	EA	1	$6,000.00	$6,000
15	MANHOLE	EA	8	$10,000.00	$80,000
16	LANDSCAPING/PLANTING	LS	1	$40,000.00	$40,000
		MOBILIZATION (@ 10 %)			**$290,000**
			SUBTOTAL		**$3,225,000**
			CONTINGENCY	**30%**	**$968,000**
			GRAND TOTAL		**$4,193,000**

Preliminary Engineer's Estimate
WDR052 Southeast Industrial Area Storm Drain Project
Ultimate Improvements - Alternative 3

ITEM NO.	ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	CONSTRUCTION AREA SIGNS	LS	1	$2,000.00	$2,000
2	TRAFFIC CONTROL SYSTEM	LS	1	$10,000.00	$10,000
3	JOB SITE MANAGEMENT	LS	1	$10,000.00	$10,000
4	PREPARE & IMPLEMENT STORM WATER POLLUTION PREVENTION PLAN	LS	1	$60,000.00	$60,000
5	CLEARING AND GRUBBING	LS	1	$30,000.00	$30,000
6	EXCAVATION & DISPOSAL	LS	1	$100,000.00	$100,000
7	ACCESS ROAD	SF	19100	$2.10	$40,000
8	WINGWALL	EA	1	$12,000.00	$12,000
9	TRASH RACK	EA	1	$10,000.00	$10,000
10	60" FLAP GATE	EA	1	$30,000.00	$30,000
11	60" REINFORCED CONCRETE PIPE	LF	3500	$700.00	$2,450,000
12	CONRETE APRON	EA	1	$5,000.00	$5,000
13	ROCK SLOPE PROTECTION	EA	1	$6,000.00	$6,000
14	MANHOLE	EA	8	$10,000.00	$80,000
15	LANDSCAPING/PLANTING	LS	1	$40,000.00	$40,000
		MOBILIZATION (@ 10 %)			**$285,000**
			SUBTOTAL		**$3,170,000**
			CONTINGENCY	**30%**	**$951,000**
			GRAND TOTAL		**$4,121,000**

Preliminary Engineer's Estimate
WDR052 Southeast Industrial Area Storm Drain Project
Interim Improvements

ITEM NO.	ITEM DESCRIPTION	UNIT OF MEASURE	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT
1	CONSTRUCTION AREA SIGNS	LS	1	$2,000.00	$2,000
2	TRAFFIC CONTROL SYSTEM	LS	1	$10,000.00	$10,000
3	JOB SITE MANAGEMENT	LS	1	$10,000.00	$10,000
4	PREPARE & IMPLEMENT STORM WATER POLLUTION PREVENTION PLAN	LS	1	$18,000.00	$18,000
5	CLEARING AND GRUBBING	LS	1	$10,000.00	$10,000
6	EXCAVATION & STOCKPILING	LS	1	$500,000.00	$500,000
7	30" HDPE PIPE	LF	70	$200.00	$14,000
8	48" HDPE PIPE	LF	300	$250.00	$75,000
9	HYDROSEED	LS	1	$60,000.00	$60,000
		MOBILIZATION (@ 10 %)			**$64,000**
			SUBTOTAL		**$763,000**
			CONTINGENCY	**20%**	**$153,000**
			GRAND TOTAL		**$916,000**

Note: 60" RCP paid for by outside developers.