March 29, 2016

Mr. Ed Baird
Lowe Enterprises
1424 Fifth Avenue
Suite 1030
Seattle, WA 98101

**Re: Level One Hydrogeologic Assessment - Updated**
**Redmond Town Center**
**Proposed Parcel Redmond 5B Development**
**Redmond, Washington**
19162-01

Dear Ed:

This letter presents an updated level one hydrogeologic assessment for the proposed Parcel 5B Development at Redmond Town Center, Redmond, Washington (Figure 1). The proposed project will be an eight-story mixed-use residential and commercial building development. The site is currently a paved parking lot.

Our work was completed to determine whether the proposed development complies with City of Redmond Zoning Code (RZC) Chapter 21.64.050 – Critical Aquifer Recharge Areas (CARAs). The site is within a Wellhead Protection Zone 1 area, as defined by the City.

## Purpose and Applicable Regulations

This assessment is intended to provide a hydrogeological evaluation and recommendations relevant to the proposed development activities at the project site, which is within a designated CARA.

A CARA is an area with a critical recharging effect on aquifers used for potable water, as defined by Washington Administration Code (WAC) 365-190-030(2). CARAs have prevailing geologic conditions associated with infiltration rates that have a high potential for contamination of groundwater resources or that contribute significantly to groundwater replenishment (Ecology 2005).

The scope of this assessment was to document and evaluate:

- Available information on geologic and hydrogeologic characteristics of the site, including the surface location of critical aquifer recharge areas on the site or immediately adjacent to the site, and the permeability of the unsaturated zone;

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- Groundwater depth, flow direction, and gradient based on available information;
- Currently available data on wells and springs within 1,300 feet of the project area;
- Location of other critical areas, including surface waters, within 1,300 feet of the project area;
- Available historical water quality data for the area to be affected by the proposed activity; and
- Best management practices (BMPs) proposed to be used during development of the site.

# Project Background

## Site Location and Description

The proposed development is at Redmond Town Center on Parcel 5-B, which is adjacent to and east of the existing Macy's store, south of NE 76th Street, and west of 168th Avenue NE in Redmond, Washington. The site is within the NW quarter of Section 12 of Township 25 North and Range 5 East (Willamette Meridian). The property comprises a 2.67 acre parcel (King County tax ID 7202410132). A map of the project site is presented on Figure 2.

The site has flat topography, with an elevation of approximately 40 feet (NAVD88), based on the GIS mapping provided by the City.

## Existing Site Use

The project site is currently an asphalt-paved parking lot. The site is bound by NE 74th Street to the south, NE 76th Street to the north, Macy's department store development to the west, and 168th Avenue NE to the east.

## Proposed Development

We understand that the project will be an eight-story mixed use residential and commercial building. The City will provide potable water and sewer for the development. Stormwater from the parking areas and from the roof will be conveyed through a detention and treatment system and discharged off site. Roof runoff is not required to be infiltrated on site.

Development will not result in any of the following:

- Addition of 5,000 square feet or more of impervious area (the area is already impervious, since the site is currently a parking lot);

- Diversion, alteration, or reduction of the flow of surface water or groundwater by permanent dewatering or by otherwise reducing aquifer recharge (however, temporary construction dewatering may be required to develop the site);

- Storage, handling, treatment, use, production, recycling, or disposal of deleterious substances or hazardous materials, other than fuel for a backup diesel generator and household chemicals used according to the directions specified on the packaging for domestic applications; or

- Use of injection wells, including on-site septic systems.

Based on our understanding of the preliminary development plans, the proposed project will not include any of the following activities or facilities that are subject to City Wellhead Protection restrictions:

- Vehicle repair and servicing;
- Gasoline service station;
- Aboveground or underground tanks for storage of petroleum products;
- Dry wells;
- Facilities that conduct biological research;
- Boat repair shops;
- Chemical research facilities;
- Pipelines;
- Printing and publishing shops (that use printing liquids);
- Belowground transformers and capacitors;
- Sawmills (producing over 10,000 board feet per day);
- Solid waste handling and processing;
- Vehicle recycling and recyclable materials – automotive;
- Funeral services;
- Furniture stripping;
- Photographic processing;
- Chemical manufacturing and reprocessing;
- Creosote and asphalt manufacture and treatment;
- Petroleum and petroleum products refining, including reprocessing;
- Wood products preserving;
- Golf course;
- Regulated waste treatment, storage, or disposal facilities that handle hazardous material;
- Medium-quantity generators (dangerous, acutely hazardous, or toxic extremely hazardous waste); or
- Large quantity generators (dangerous, acutely hazardous, or toxic extremely hazardous waste).

## Mapped CARAs

In Redmond, CARAs are defined by three Wellhead Protection Zones (Zones 1, 2, and 3). The zones are determined according to the time it takes water to travel from the point where it enters the aquifer to the point where it enters the nearest drinking water well. In Zone 1, groundwater takes 6 months or less to reach the nearest drinking water well. In Zone 2 it takes 1 year or less, and in Zone 3 it takes up to 10 years to travel to the nearest drinking water well.

The City's Wellhead Protection map (Redmond 2015) shows that the site is within a Zone 1 CARA, defined by presence of an unconsolidated sedimentary aquifer gravel aquifer. The site is within the capture zone of a Group A water well (Figure 3). Group A public water systems serve greater than 15 connections and greater than 25 people per day.

The site is not within an area designated as a sole source aquifer by the U.S. Environmental Protection Agency (EPA) pursuant to the Federal Safe Drinking Water Act (EPA 2013).

## Geology

We reviewed the relevant publicly available geologic and hydrogeologic maps and studies of the region (Liesch et. al. 1963; Richardson 1968; Minard 1982; DNR 2015) to determine geologic conditions around the site. The project site is in the northern portion of the Sammamish River Valley, which is not filled with any marine glacial sedimentary deposits. As the valley formed, it filled with fluvial and glacial sediments transported by streams associated with glacial activity.

Relatively shallow geotechnical borings have been completed at the site and at nearby sites (Hart Crowser 2015). Based on subsurface explorations, two soil units identified are:

- **Fill Unit** – The uppermost unit is fill consisting of a mix of native soil (primarily silt and sand) and import material. At the project site, the fill unit is less than 5 feet thick.

- **Recessional Outwash Glacial Deposits** – Underlying the fill unit are native deposits consisting of very permeable sands and gravels. The City water supply wells are completed in this unit at depths of approximately 30 to 70 feet. The bottom of the Recessional Outwash unit was not encountered at the site.

## Groundwater

Shallow groundwater at the site occurs in the Recessional Outwash deposits at depths of 8 to 12 feet. City Depth to Water Maps (B3 and B4; accessed November 24, 2015) show that the depth to water across the site ranges from 8 to 12 feet, corresponding to elevation 28 to 31 feet. Groundwater flow is west toward the Sammamish River. City monitoring of Well MW332 (data accessed November 24,

2015), which is just south of the project site, indicates that water levels vary seasonally by as much as 4 feet.

The shallow aquifer system is recharged by infiltrating precipitation and surface water.

### Local Water Supply Wells

We used the Washington State Department of Ecology (Ecology) Well Log database (Ecology 2015) to search for water wells within 1,300 feet of the project site. Our initial search area consisted of NW Quarter of Section 22 and Section 12, NW Quarter of Section 26, and North Half of Section 27 (T25N R5E).

Approximately 1,000 well records were located in the initial search area. Most of the wells are identified as resource protection or wells that have been formally decommissioned. Within the 1,300-foot search area, we identified three potential water supply wells; all were City of Redmond wells in Anderson Park (Figure 3).

Redmond operates five shallow municipal wells that pump between 3 and 4 million gallons of clean groundwater from the shallow Recessional Outwash aquifer daily.

Readily available public water quality data indicated that water produced from the Recessional Outwash aquifer is good and meets all drinking water criteria. We do not expect the project to significantly affect water supply or quality in the Recessional Outwash aquifer.

### Surface Water Hydrology

The Redmond 7.5’ USGS topographic map and City GIS data indicate that Bear Creek and associated wetlands are located south of the project site.

## Findings and Recommendations

In summary, our findings and recommendations are:

- The proposed Redmond Parcel 5-B project will be an eight-story mixed use residential and commercial building. The City will provide potable water and sewer. Stormwater from parking areas and from the roof will be conveyed through a detention and treatment system and discharged off site using an existing stormwater drainage system. Roof runoff is not required to be infiltrated on site. Impervious surfaces will cover a majority of the proposed development.

- A diesel generator will be provided for a backup power source. The generator will comply with all code requirements for fuel containment and storage and take all appropriate measures to protect groundwater.

- The site is in a CARA within City-defined Wellhead Protection Zone 1 and within the capture zone of a Group A water well.
- Shallow groundwater occurs at depths of 8 to 12 feet below the site within the very permeable Recessional Outwash aquifer. Groundwater flow is toward the west. City water supply wells produce drinking water from shallow wells in the Recessional Outwash aquifer.
- City Group A water supply wells are within 1,300 feet of the project site.
- The proposed development will not significantly impact groundwater supply or water quality beneath the site.
- Based on our review of available information and our understanding of proposed site activities, no prohibited activities are planned as part of the proposed development.
- Proposed site activities must follow the City's general performance requirements to ensure that construction activities will not contaminate the aquifer, will not adversely affect aquifer recharge, and will comply with the appropriate water source protection requirements and surface water design manual.
- If the proposed development is designed, constructed, operated, and maintained in conformance with the appropriate construction practices and City regulations, groundwater is unlikely to be degraded by the development, and City requirements for CARAs will be satisfied.

Sincerely,

**HART CROWSER, INC.**

State of Washington
Hydrogeologist
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Licensed Geologist
Roy E. Jensen

**GARRY HORVITZ, PE**
Senior Principal Geotechnical Engineer

**ROY E. JENSEN, LHG**
Senior Hydrogeologist

Attachments:
Figure 1 – Vicinity Map
Figure 2 – Site Map
Figure 3 – Wellhead Protection Map

## References

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N

1,000 500 0 1,000

Scale in Feet

Redmond Town Center Parcel 5-B
Redmond, Washington

**Vicinity Map**

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Figure

1

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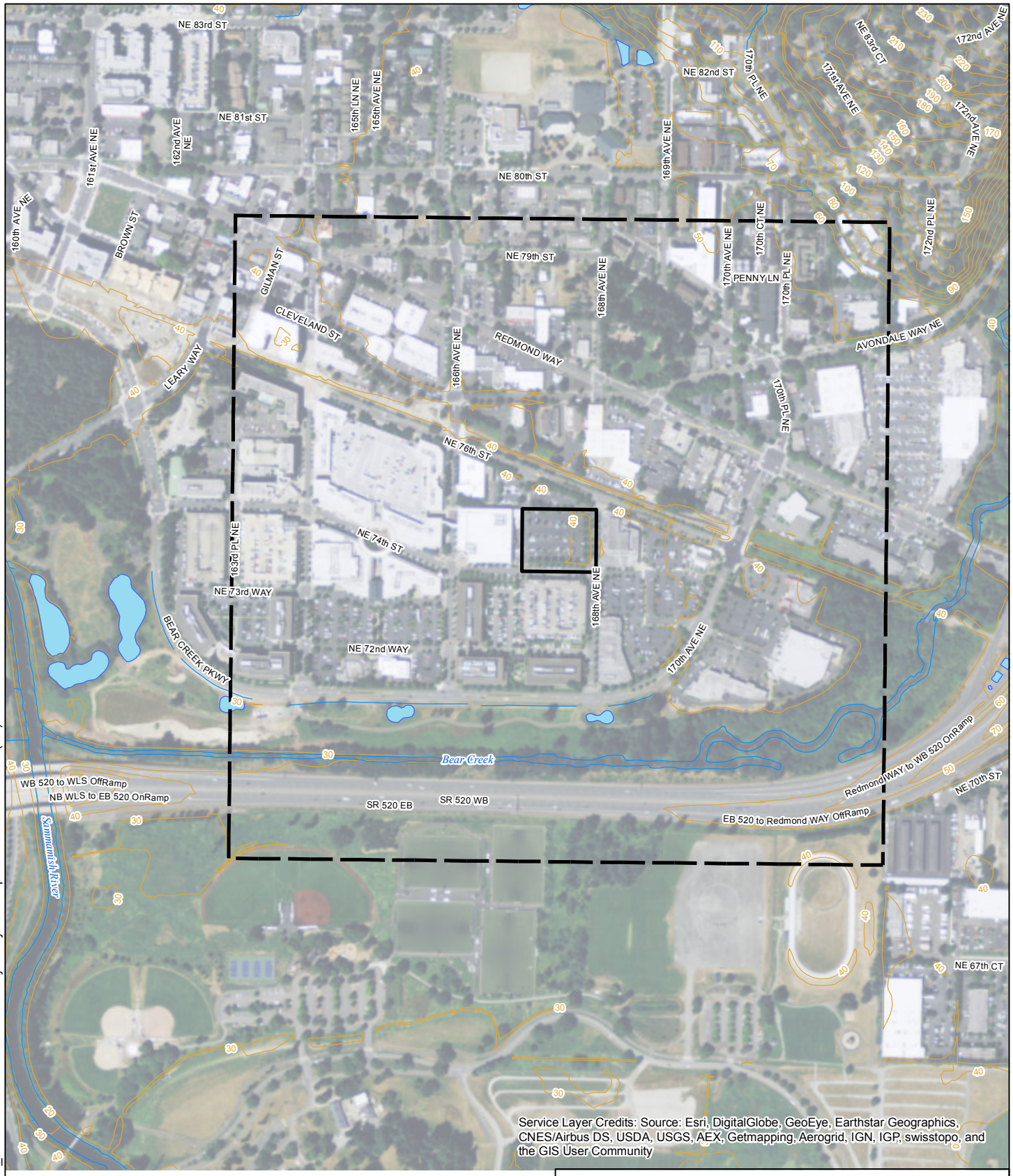


**LEGEND**

- Project Site
- 1,300-Foot Boundary
- Pond
- Stream
- Elevation Contour

Note: Data obtained from City of Redmond.

600 300 0 600

Scale in Feet

N

Redmond Town Center Parcel 5-B
Redmond, Washington

**Site Map**

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Figure
**2**

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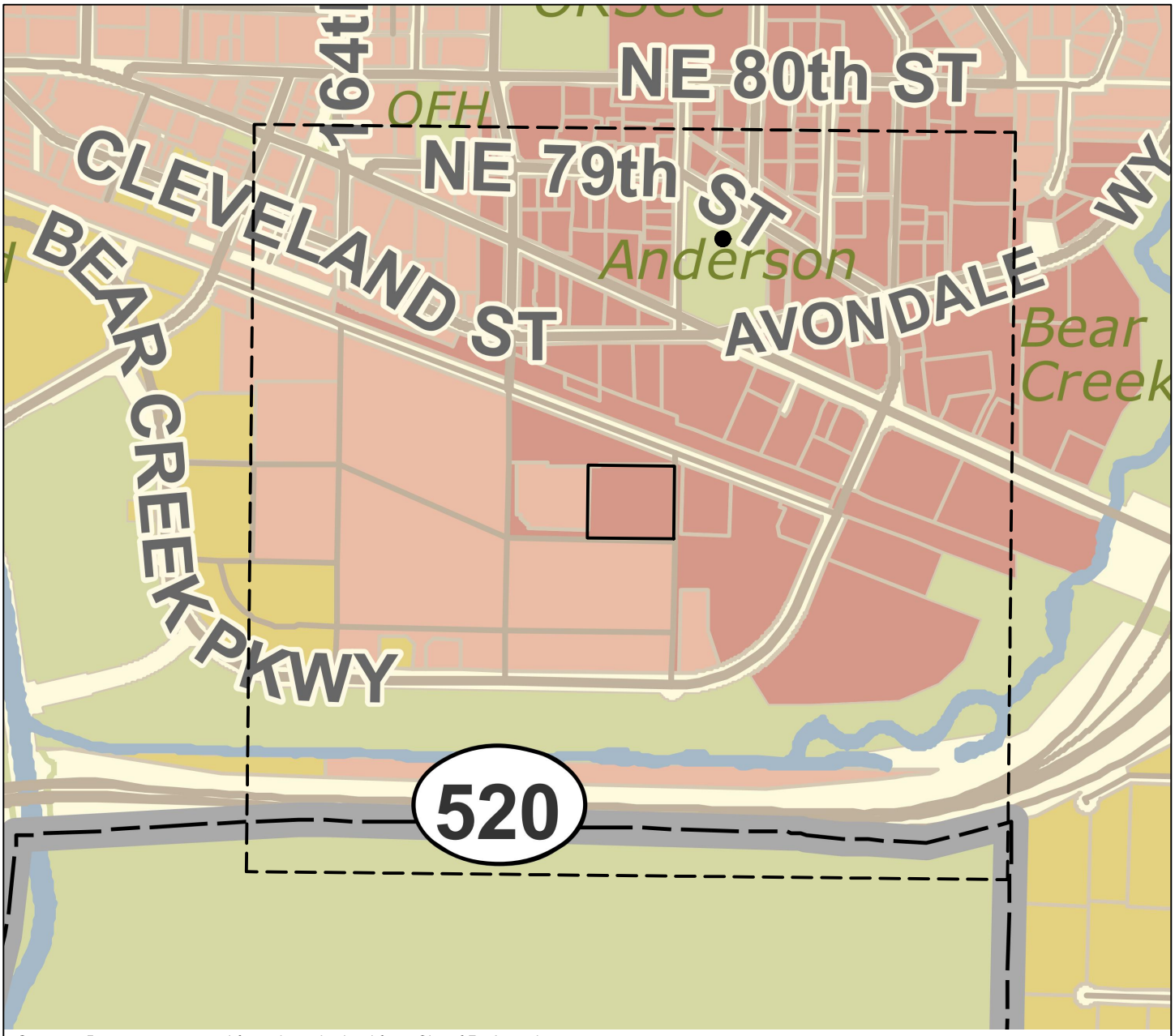


***Source:*** Base map prepared from data obtained from City of Redmond.

**LEGEND**

- Project Site
- 1,300-Foot Boundary
- Redmond Water Supply Well
- Wellhead Zone 1
- Wellhead Zone 2
- Wellhead Zone 3
- Wellhead Zone 4
- City Limit
- Park and Open Space
- Water

0 600 1200

Scale in Feet

Note: Feature locations are approximate.

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Redmond Town Center Parcel 5-B
Redmond, Washington

**Wellhead Protection Map**

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Figure **3**

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February 24, 2016

Edward Baird
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**Re: Level II Hydrogeologic Assessment**
**Temporary Construction Dewatering Feasibility Assessment**
**Redmond Town Center**
**Redmond 5B**
**Redmond, Washington**
19162-01

Dear Ed:

Attached find a copy of our letter report "Level II Hydrogeologic Assessment, Temporary Construction Dewatering Feasibility Assessment, Redmond Town Center, Proposed Parcel Redmond 5B Development, Redmond, Washington". This report was prepared for the project to address Critical Aquifer Areas requirements of the City of Redmond (City) and in response to City comments on the "Critical Areas Report – Level I Hydrogeologic Assessment." dated December 1, 2015. The specific City comments addressed by this report are provided below.

**Comment 1:** Per Appendix 1 of the RZC, a Level II Hydrogeological Assessment is required for the project. Per Section F. 3. a. and F.3.b.: (a) the site activity will result in the replacement of over 5000 sqft of impervious area and (b) the excavation, dewatering, and subsequent subsurface parking garage may alter or reduce the flow of groundwater and the project includes dewatering. A dewatering feasibility study is also required per the City of Redmond Draft Temporary Construction Dewatering Policy (7-14-2015 latest revision).

**Comment 2:** A temporary construction dewatering feasibility study is required for the project. This can be included as part of the Level II Hydrological analysis or within the geotech report for the project. Refer to the City of Redmond Draft Temporary Construction Dewatering Policy (7-14-2015 latest revision) for guidance.

**Response to Comments 1 and 2:** We prepared a Level II Hydrogeological Assessment per City Draft Temporary Construction Dewatering Policy (7-14-2015 latest revision). It is provided with this letter.

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Sincerely,

**HART CROWSER, INC.**

**ROY E JENSEN**
Senior Hydrogeologist

Attachments:
Level II Hydrogeologic Assessment, Temporary Construction Dewatering Feasibility Assessment

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February 24, 2016

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**Re: Level II Hydrogeologic Assessment**
**Temporary Construction Dewatering Feasibility Assessment**
**Redmond Town Center**
**Proposed Parcel 5B Development**
**Redmond, Washington**
19162-01

Dear Ed:

This letter presents a temporary construction dewatering feasibility assessment for the proposed Parcel 5B Development at Redmond Town Center, Redmond, Washington (Figure 1). The proposed project will be an eight-story mixed-use residential and commercial building development. The project site is currently a paved parking lot. This assessment follows the scope provided in the City of Redmond draft Temporary Construction Dewatering Policy dated July 13, 2015 (Redmond 2015a), and is based in part on Level 1 Hydrogeologic Assessment, dated December 1, 2015 (Redmond 2015b), prepared for the project.

## *GEOTECHNICAL*

### Describe site stratigraphy to a depth at least 10 feet below lowest point of excavation.

The project site is in the northern portion of the Sammamish River Valley. Historically, the valley as it formed filled with fluvial and glacial sediments transported by streams associated with glacial activity. Subsurface explorations completed to a depth of 62 feet at the site identified two general soil units:

- **Fill Unit**. The uppermost unit is fill consisting of a mix of native soil (primarily silt and sand) and imported material. At the project site, the Fill unit is less than 5 feet thick.

- **Recessional Outwash Glacial Deposits**. Underlying the Fill unit are native deposits consisting of very permeable sands and gravels. Gravelly sand to sandy gravel are present to a depth of about 30 to 37 feet (elevation 4 to 10 feet). This soil unit contains varying amounts of cobbles and boulders. Below this unit, the borings encountered medium dense to very dense fine to coarse sand with trace to

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slight gravel and intermittent slightly silty zones below elevation 0 feet. The bottom of the Recessional Outwash unit was not encountered at the site.

### Describe thickness of the primary aquifer providing groundwater to the site.

The primary shallow aquifer at the site is the Recessional Outwash unit. The bottom of the unit was not encountered at the site. The City water supply wells are completed in the Recessional Outwash unit at depths of 30 to 70 feet.

### Describe seasonal high and low groundwater stages.

Shallow groundwater at the site occurs in the Recessional Outwash deposits at depths of 8 to 12 feet. City Depth to Water Maps (B3 and B4; Redmond 2015c; accessed November 24, 2015) show that the depth to water across the site ranges from 8 to 12 feet, corresponding to elevation 28 to 31 feet. Groundwater flow is west toward the Sammamish River. City monitoring of Well MW332 (Redmond 2015d; data accessed November 24, 2015), which is just south of the project site, indicates water levels vary seasonally by as much as 4 feet.

### Calculate the transmissivity of the dominant strata and method of calculation.

The Recessional Outwash aquifer is very productive, with transmissivities reported ranging from 50,000 to 100,000 square feet per day ($ft^2$/day) (Parametrix 1997). Assuming a saturated thickness of 50 feet, the hydraulic conductivity ranges from 1,000 to 2,000 feet per day (ft/day).

### Calculate the pump rate to dewater the project assuming the seasonal high and seasonal low groundwater stages.

We used the following general assumptions to evaluate dewatering requirements:

- The average ground surface elevation is 43 feet.
- The design groundwater elevation is 28 feet in summer and 31 feet in winter assuming groundwater could vary seasonally by 4 feet.
- The hydraulic conductivity of the water-bearing zone is 1,000 ft/day.
- The dewatering goal is to maintain water levels 2 feet below the bottom of the excavation.
- The bottom of excavation will be 28 feet (about 17 feet below grade).
- The dewatering goal will be to maintain water levels at an elevation of 26 feet continuously during construction.

- The building construction footprint is approximately 14,000 square feet. We assumed that the entire footprint of the building would require dewatering if the dewatering wells are located outside the construction footprint.

The following assessment of likely dewatering methods and estimate of dewatering discharge rates is based on our evaluation of how dewatering operations may be implemented at the site, considering conditions described in the geotechnical study (Hart Crowser 2015b). The actual dewatering rates will depend on the dewatering methods and schedule adopted by the contractor.

The construction excavation and dewatering design elevations used in our evaluation are summarized in Table 1.

Table 1 – Dewatering Design Assumptions

| Parameter | Assumption (feet unless indicated otherwise) |
|---|---|
| Ground surface elevation | 43 |
| Elevation of water table[a] | 28 to 31 |
| Elevation of the bottom structure | 30 |
| Depth of bottom excavation | 17 |
| Elevation of bottom excavation | 28 |
| Dewatering elevation | 26 |
| Drawdown required | 2 to 5 |
| Dewatering footprint | 14,000 ($ft^2$) |

Elevations are in NAVD88.

a. Water table elevation considered for design purposes; actual elevation will depend on tides, rainfall, seasons, and other factors.

## Groundwater Modeling

A steady-state groundwater flow model was developed using MODFLOW to provide planning-level estimates of dewatering required to maintain the water table at least 2 feet below the bottom of the excavation.

The model was developed as follows:

- A two-layer steady-state model was used. The model domain encompassed the site, an area approximately 4,000 by 4,000 feet. A rectangular grid was used, with a fixed-grid spacing of 10 feet.

- The top of the model corresponded generally to ground surface, or elevation 43 feet. The bottom of the model was at elevation –20 feet. Groundwater was modeled as an unconfined system.
- The western and eastern model boundary was defined as a constant head boundary with an elevation of 28 or 31 feet.
- Dewatering was simulated using a series of drain cells corresponding to the footprint of the excavation. To simulate dewatering conditions, the drain cells were assigned a groundwater elevation of 26 feet.
- Hydraulic conductivity values of 1,000 and 2,000 ft/day were used to evaluate the sensitivity of discharge to hydraulic conductivity.
- The dewatering volume required to maintain the lower water level in the computer model was used to estimate the amount of water that will need to be removed for temporary dewatering during construction.

Based on modeling of the most likely groundwater conditions, the estimated total rate for dewatering the entire construction excavation will range from 1,000 to 3,000 gallons per minute (gpm), depending on the elevation of the water. Discharges rates would vary with the season, with higher discharge rates expected during the winter and late spring and lower discharge rates during the summer and late fall.

### Provide a predictive calculation to determine the vertical and horizontal limits of groundwater drawdown.

Table 2 shows the drawdowns the dewatering program predicted based on the Theis equation. The following was assumed in analyzing drawdown:

- Transmissivity was 50,000 or 100,000 $ft^2$/day.
- The pumping rate for a transmissivity of 50,000 $ft^2$/day was 1,500 gallons per minute.
- The pumping rate for a transmissivity of 100,000 $ft^2$/day was 2,500 gallons per minute.
- The pumping period was 365 days.

Table 2 – Predicted Drawdown

| Distance from Excavation (feet) | T = 50,000 $ft^2$/day | T = 100,000 $ft^2$/day |
|---|---|---|
| 100 | 5 | 5.2 |
| 500 | 3.5 | 3.7 |
| 1,000 | 2.8 | 3.1 |
| 2,000 | 2.2 | 2.5 |
| 3,000 | 1.9 | 2.1 |
| 5,280 | 1.3 | 1.6 |

T = transmissivity.

The closest Redmond water supply wells are in Anderson Park, about 1,000 feet from the project site. We estimate the drawdown effect at the water supply wells from construction dewatering will be less than 3 feet.

**Review available environmental assessments and geotechnical data to determine whether groundwater contamination may adversely affect dewatering.**

Our assessment of potential environmental impacts is provided in the Water Quality section below. In our opinion temporary construction dewatering will not adversely impact groundwater contamination in the area.

**If this assessment identifies a known contamination plume or potential contamination based on past site use, further actions may be required during site entitlement. This may include treatment of pumped contaminated groundwater or alterations to the project so dewatering is not necessary.**

Comment noted. Impacts to potential groundwater contamination is not expected from construction dewatering.

**Identify the depth of the lowest floor/basement; include depth of construction crane base and elevator pits.**

The project will consist of constructing an eight-story mid-rise residential/commercial structure on Parcel 5B, which is east of the existing Macy's store just south of NE 76th Street and just west of 168th Avenue NE. Current plans show ground surface elevation ranging from 39 feet in the west to 45 feet in the east, with the lowest finished floor level at elevation 27 feet. Allowing for the thickness of the

foundations, we anticipate an excavation depth of about 16 to 22 feet below existing grade. The site is currently a paved parking lot.

### Identify the area that will need to have the groundwater lowered.

The excavation for the entire footprint of the building will be below the water table and require dewatering to support construction.

### Provide a preliminary figure showing number and depth of well points, or equivalent.

The project will be dewatered using a series of large-diameter wells installed around the perimeter of the excavation. The well spacing will range from 50 to 100 feet. Figure 2 shows potential locations of wells.

### Show the discharge path for the pump water to a receiving body (river or lake).

The discharge path for pump water is provided in the report in Attachment A.

### Provide preliminary conveyance calculations demonstrating the receiving conveyance can handle the dewatering flow rate and a 10-year storm flow.

The conveyance assessment and calculations are provided in Attachment A. The conveyance assessment demonstrates that the receiving conveyance can handle a dewatering flow rate of 3,000 gpm combined with a 10-year storm flow.

### Provide a backwater analysis that demonstrates the project dewatering discharge combined with the 10-year storm event storm flow does not cause a hydraulic grade to rise within 6 inches of the grate of any downstream catch basin.

The backwater analysis provided in Attachment A shows that a dewatering discharge of 3,000 gpm combined with the 10-year storm event storm flow will not cause a hydraulic grade to rise within 6 inches of the grate of any downstream catch basin.

## *WATER QUALITY*

### Review available environmental assessments and geotechnical data to determine whether groundwater contamination may adversely affect dewatering. (Part of your inquiry should include contacting Natural Resources for insight into contaminants in the vicinity of the project site.)

Hart Crowser (2015a) reviewed the regulatory databases and reports to identify adjacent and surrounding sites that were within 1 mile of the project site and (1) were in the apparent upgradient or cross-gradient groundwater flow direction of the project site, (2) had reported releases of contaminants to soil and/or groundwater, and/or (3) were listed as historical auto stations or dry cleaners. Table 3 (at end of text) is a list of sites posing environmental concerns within 1 mile of the project site. The site

locations are shown on Figure 3. Sites to the northeast are generally hydrologically upgradient of the project site. In our opinion, dewatering at the project site will not increase the footprint of groundwater contamination originating from (1) sites downgradient or cross-gradient of the project site, (2) sites with no groundwater contamination noted, or (3) sites Ecology has granted no further action (NFA) status.

The nearby agency-listed sites with highest potential for containing contaminated groundwater are discussed below.

**Kim Tailor & Dry Cleaning (formerly Clean Bee Cleaners) at 16720 Redmond Way**. This site is approximately 700 feet north of and upgradient of the project site. The RCRA NonGen listing indicates it no longer generates hazardous waste. The EDR Historical Dry Cleaners list indicates that Clean Bee Cleaners operated at this site in 2007 and 2012. This facility is listed as having spilled sewage/sludge in a catch basin in May 2015; however, an update from Ecology's Environmental Report Tracking System indicates that "there was no illicit discharge." The site is not listed on Ecology's Cleanup Site database. Based on the database information, risk that groundwater contamination from this site will be spread by dewatering at the project site is low.

**Luis Dry Cleaners (formerly Earth & Sun Cleaners) at 16671 Redmond Way** (EDR Historical Dry Cleaners list). This site is approximately 770 feet north-northwest and cross-gradient of the project site. The EDR Historical Dry Cleaners list indicates that Earth & Sun Cleaners operated at this site in 2001, 2002, and 2004, and Luis Dry Cleaners operated in 2005, 2007, and 2008. The site is not listed on Ecology's Cleanup Site database. Since the database record does not indicate a known release, risk that groundwater contamination from this site will be spread by dewatering at the project site is low.

**Overlake Cleaners at 16940 NE 79TH St.** This site is approximately 1,300 feet northeast and upgradient of the project site and 250 feet from Redmond water supply wells located in Anderson Park. Tetrachloroethene (PCE), a dry-cleaning solvent, has been detected in groundwater and soil at the site. The site is listed as being a hazardous waste generator from 1991 to 1997. The site is listed in Ecology's Confirmed and Suspected Contaminated Sites list. The database shows that cleanup activities began in 1997, but no additional entries have been made since 1999. Because of the limited cleanup activity at the site, the site's distance from the project site, and the fact that the site appears to be within the capture zone of City water supply wells at Anderson Park, risk that groundwater contamination from this site will be spread by dewatering at the project site is low.

**US National Bank at 17000 Avondale Way N.** This site is approximately 1,400 feet northeast and upgradient of the project site. A leaking underground storage tank was listed at the site in 1996. Releases of diesel-range petroleum hydrocarbons to soil and groundwater were confirmed. Based on the available information, risk that groundwater contamination from this site will be spread by dewatering at the project site is low.

**Bear Creek Village at 17210 Redmond Way.** This site is approximately 2,000 feet northeast and upgradient of the project site. A dry-cleaning business operated at the site, and releases of PCE and other solvents occurred to soil and groundwater. A letter in the Cleanup Site file from Ecology dated September 27, 2013, acknowledges progress made in cleanup, including cleanup of soil, but indicates that low-level solvent concentrations still remain in groundwater. Based on available information, risk that groundwater contamination from this site will be spread by dewatering at the project site is low.

**If this assessment identifies a known contamination plume or potential contamination based on past historical site use, further actions may be required during site entitlement. This may include treatment of pumped contaminated groundwater or alterations to the project so dewatering is not necessary.**

In our opinion, groundwater contamination from sites within 1 mile of the project will not be spread by dewatering at the project site.

**If a pollutant is identified within the proposed radius of influence of a dewatering area, the applicant must predict the transport of contaminants toward the site and its effect on receptors (City drinking water wells, other groundwater users.)**

In our opinion, groundwater contamination from sites within 1 mile of the project will not be spread by dewatering at the project site.

**Dewatering activities that draw pollution toward drinking water supply wells may require further action, such as, but not limited to, a reduction in the depth of excavations, a reduction of TCD dewatering activities, and an increase in monitoring to determine whether further actions, including the determination of whether a remediation plan is needed, are required.**

In our opinion, groundwater contamination from sites within 1 mile of the project will not be spread by dewatering at the project site.

Sincerely,

**HART CROWSER, INC.**

State of Washington
Hydrogeologist
909
Licensed Geologist
Roy E. Jensen

**GARRY HORVITZ, PE**
Senior Principal Geotechnical Engineer

**ROY E. JENSEN, LHG**
Senior Hydrogeologist

Attachments:
Table – Sites with Potential Groundwater Contamination
Figure 1 – Vicinity Map
Figure 2 – Site and Dewatering Plan
Figure 3 – Sites with Potential Environmental Concerns
Attachment A – Downstream Conveyance for Temporary Construction Dewatering Assessment

## References

Hart Crowser 2015a. Phase I Environmental Site Assessment, Lot 5B Property, Redmond Town Center, Redmond, Washington. October 22, 2015.

Hart Crowser 2015b. Geotechnical Feasibility Study, Redmond Town Center Parcel 5-B Development Redmond, Washington. October 28, 2015.

Redmond 2015a. Draft Temporary Construction Dewatering Policy. City of Redmond. July 13, 2015.

Redmond 2015b. Level 1 Hydrogeologic Assessment. December 1, 2015.

Redmond 2015c. Depth to Water Maps. https://www.redmond.gov/common/pages/UserFile.aspx?fileId=153249. Accessed November 24, 2015.

Redmond 2015d. GIS Maps Online. https://www.redmond.gov/Government/MapsGISservices/InteractiveMaps/ Accessed November 24, 2015.

Parametrix 1997. Wellhead Protection Report. Prepared for the City of Redmond. October 30, 1997.

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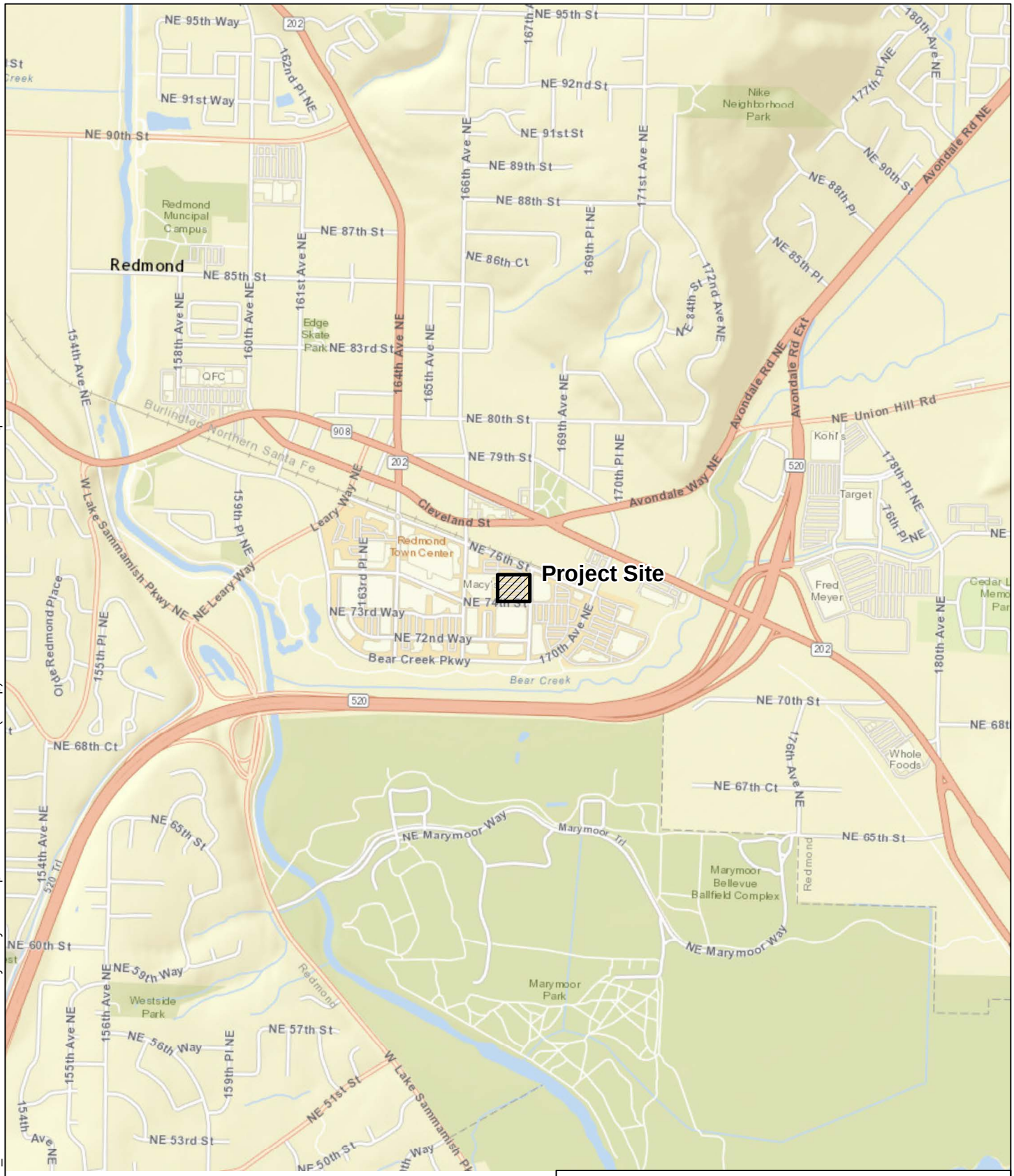
Table: Sites with Potential Groundwater Contamination

| # | Name | Address | Database | Relative Elev. | Distance (ft) | Distance (miles) | Direction | Relative Location | Status - Potential Groundwater Contamination |
|---|---|---|---|---|---|---|---|---|---|
| A2 | UNOCAL REDMOND BULK | 16631 CLEVELAND ST | CSCSL NFA, VCP | Higher | 594 | 0.112 | North | Upgradient | No - NFA |
| 5 | SAVERS RECYCLING, IN | 16771 REDMOND WAY | SWRCY | Higher | 776 | 0.147 | ENE | Upgradient | No evidence of GW contamination |
| B6 | KIM TAILOR & DRY CLE | 16720 REDMOND WAY | Historical Dry Cleaners | Higher | 824 | 0.156 | NNE | Upgradient | No evidence of GW contamination |
| C8 | LUCKS FOOD MART 305 | 16757 REDMOND WAY NE | CSCSL NFA, UST, VCP | Higher | 829 | 0.157 | NNE | Upgradient | No - NFA |
| 9 | | 16671 REDMOND WAY | Historical Dry Cleaners | Higher | 838 | 0.159 | North | Upgradient | No evidence of GW contamination |
| C10 | CHEVRON #9 6388 | 16760 REDMOND WAY | UST, CSCSL. NFA, VCP, ICR | Higher | 839 | 0.159 | NNE | Upgradient | No - NFA |
| D15 | UNOCAL #4870 | 16909 REDMOND WAY | CSCSL NFA, VCP, UST | Higher | 1044 | 0.198 | ENE | Upgradient | No - NFA |
| 20 | LIGHTRECYCLE WASHING | 7370 170TH AVE NE | SWRCY | Lower | 1074 | 0.203 | East | Upgradient | No evidence of GW contamination |
| 21 | | 16311 NE 74TH ST | Historical Dry Cleaners | Lower | 1112 | 0.211 | West | Downgradient | No evidence of GW contamination |
| 22 | | 15904 BEAR CREEK PK | Historical Auto Station | Lower | 1143 | 0.216 | SW | Downgradient | No evidence of GW contamination |
| 23 | T&D FEEDS RAILROAD S | 164TH AVE NE | CSCSL NFA, VCP | Higher | 1160 | 0.22 | NW | Cross gradient | No - NFA |
| E25 | KELLEY REALTY INC | 16450 REDMOND WAY | CSCSL NFA, UST | Higher | 1206 | 0.228 | NNW | Cross gradient | No - NFA |
| 26 | TD FEEDS | 16355 CLEVELAND ST | CSCSL NFA, VCP | Higher | 1257 | 0.238 | NW | Cross gradient | No - NFA |
| 27 | | 16450 REDMOND WAY | Historical Dry Cleaners | Higher | 1275 | 0.241 | NNW | Cross gradient | No evidence of GW contamination |
| 29 | PHILLIPS 66 COMPANY | 16401 REDMOND WAY | UST | Higher | 1307 | 0.248 | NNW | Cross gradient | No evidence of GW contamination |
| 30 | OVERLAKE CLEANERS | 16940 NE 79TH ST | CSCSL, HSL | Higher | 1335 | 0.253 | NE | Upgradient | Confirmed PCE, Cleanup ongoing |
| 31 | LINDER PARCEL | 7800 GILMAN ST | CSCSL NFA, VCP | Higher | 1390 | 0.263 | NW | Cross gradient | No - NFA |
| F33 | US NATIONAL BANK OF | 17000 AVONDALE WAY N | CSCSL, LUST, UST, ICR | Higher | 1441 | 0.273 | ENE | Upgradient | Petroleum in GW, Awaiting Cleanup |
| F34 | MINIT LUBE 1109 | 17015 AVONDALE WAY N | CSCSL NFA, UST | Higher | 1533 | 0.29 | ENE | Upgradient | No - NFA |
| G35 | REDMOND | 7733 LEARY WAY NE | CSCSL,NFA, LUST, UST, VCP | Lower | 1549 | 0.293 | WNW | Cross gradient | No - NFA |
| 39 | BEAR CREEK VILLAGE S | 17210 REDMOND WAY | CSCSL, VCP | Higher | 1618 | 0.306 | ENE | Upgradient | PCE in GW, Monitoring |
| 40 | PREMIUM TUNE N LUBE | 16311 REDMOND WAY | CSCSL | Higher | 1714 | 0.325 | NW | Cross gradient | Suspected TPH in GW |
| H47 | ARCO STATION 6067 | 8009 164TH AVE NE | CSCSL, LUST, VCP, ICR | Higher | 1825 | 0.346 | NNW | Cross gradient | No evidence of GW contamination |
| 48 | | 7981 LEARY WAY NE | UST | Higher | 1865 | 0.353 | NW | Cross gradient | No evidence of GW contamination |
| I49 | RITE AID 5199 | 17220 REDMOND WAY NE | SPILLS | Higher | 1899 | 0.36 | East | Upgradient | No evidence of GW contamination |
| I54 | SAFEWAY STORE 464 | 17246 REDMOND WAY NE | SPILLS | Higher | 1972 | 0.373 | East | Upgradient | No evidence of GW contamination |
| 56 | BEAR CREEK CLEANERS | 17260 REDMOND WAY | ICR | Higher | 2013 | 0.381 | East | Upgradient | Solvents - low risk of GW contamination |
| J57 | REDMOND CYCLE SHOP | 16205 REDMOND WAY | CSCSL NFA | Higher | 2016 | 0.382 | NW | Cross gradient | Petroleum - Low risk of GW contamination |
| K58 | THE MAIL BOX AND SHI | 16149 REDMOND WAY NE | SWRCY | Lower | 2184 | 0.414 | NW | Cross gradient | No evidence of GW contamination |
| K59 | REDMOND SHOPPING SQU | 16101 16119 16149 NE | CSCSL NFA, VCP | Lower | 2184 | 0.414 | NW | Cross gradient | No - NFA |
| N73 | | 17301 NE 70TH ST | CSCSL NFA, UST | Higher | 2549 | 0.483 | ESE | Cross gradient | No - NFA |
| P76 | JACKPOT COUNTRY STOR | 7725 159TH PL NE | CSCSL NFA, VCP | Lower | 2587 | 0.49 | WNW | Cross gradient | No - NFA |
| 78 | REDMOND CHEVRON | 16010 REDMOND WAY | CSCSL, LUST, UST, VCP | Lower | 2725 | 0.516 | NW | Cross gradient | Petroleum, low risk of GW contamination |
| 81 | A & A FOREIGN AUTO R | 8004 AVONDALE RD NE | CSCSL, LUST, UST | Higher | 3459 | 0.655 | ENE | Upgradient | Petroleum, solvents, metals suspected - low risk |
| 83 | ASSOCIATED PETROLEUM | 7822 180TH AVE NE | CSCSL, HSL, LUST, UST | Higher | 4153 | 0.787 | ENE | Upgradient | Petroleum - Low risk of GW contamination |
| 85 | UPS REDMOND | 18001 NE UNION HILL | CSCSL, LUST | Higher | 4568 | 0.865 | ENE | Upgradient | Petroleum - Low risk of GW contamination |




Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

1,000 500 0 1,000

Scale in Feet

N

Redmond 5B Construction Dewatering Assessment
Redmond, Washington

**Vicinity Map**

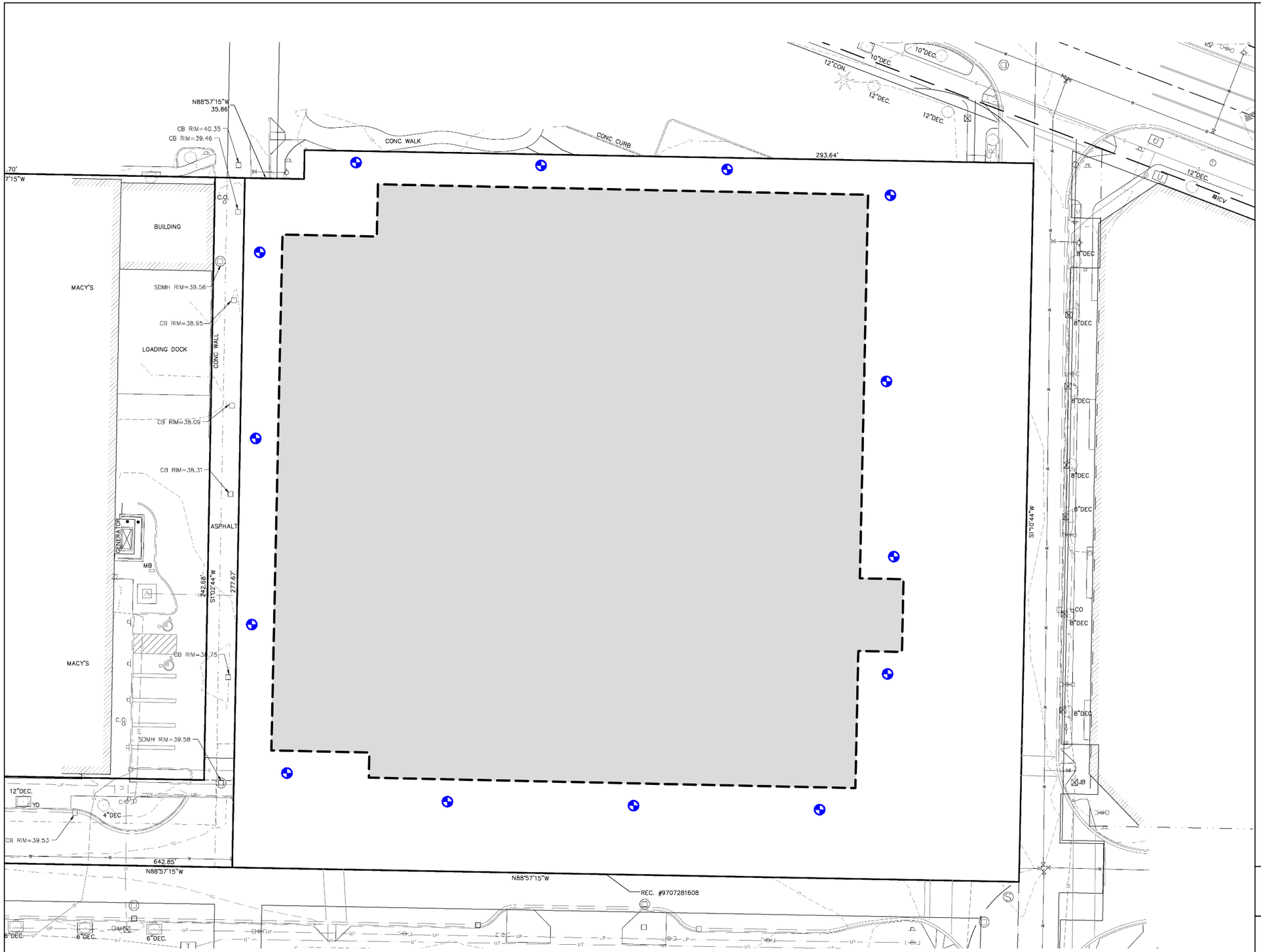
19162-01 2/16

HARTCROWSER

Figure

**1**

Document Path: L:\Notebooks\1916201_Redmond 5B Geotech Feasibility Study\GIS\Map Documents\1916201-AC (VMap).mxd Date: 2/16/2016 User Name: ericlindquist




**Legend**

Proposed dewatering well

Excavation outline

0 40 80

Scale in Feet

N

Redmond 5B Construction Dewatering Assessment
Redmond, Washington

**Site and Dewatering Plan**

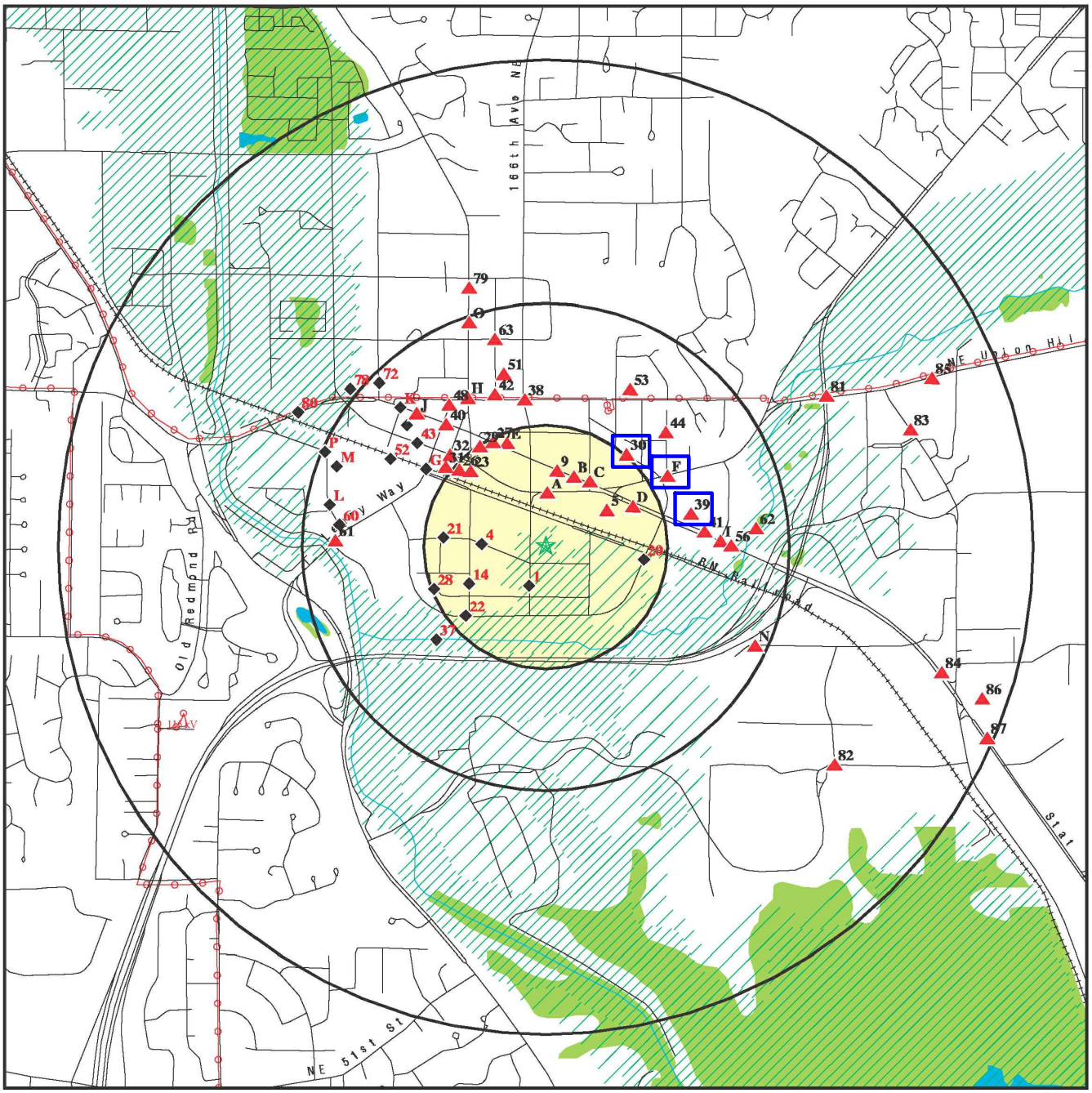
19162-01 2/16

HARTCROWSER

Figure

**2**

EAL 02/16/16 1916201-003 (SPlan).dwg




- ★ Target property
- ▲ Sites at elevations higher than or equal to the target property
- ◆ Sites at elevations lower than the target property
- Manufactured gas plants
- National priority list sites
- Department of Defense sites
- Potential environmental impact sites
- Indian reservation BIA
- Power transmission lines
- 100-year flood zone
- 500-year flood zone
- National Wetland inventory

**Source:** Basemap prepared from figure "Overview Map - 4374016.2S," created by EDR, dated 8/4/15.

Redmond 5B Construction Dewatering Assessment
Redmond, Washington

**Location of Environmental Sites**

19162-01 2/16

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Figure **3**

EAL 02/16/16 1916201-004 (Env).dwg

1601 Fifth Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 kpff.com

February 10, 2016

Mr. Roy Jensen, LHG
Hart Crowser, Inc.
3131 Elliott Ave, Suite 600
Seattle, WA 98121

Subject: Redmond Town Center, Parcel 5B
Downstream Conveyance for Temporary Construction Dewatering Assessment

Dear Roy:

We understand that the City of Redmond (City) has required the project to provide a Temporary Construction Dewatering Assessment for this site. As required by the city in support of that assessment, KPFF has analyzed the existing downstream stormwater conveyance system. In fact, downstream stormwater conveyance for the Redmond Town Center campus has been analyzed by KPFF in past projects. "Redmond Town Center, Phase 1, Drainage Infrastructure Calculations" dated June 23rd, 1995 by KPFF provides conveyance and backwater calculations for the entire campus, including parcel 5B. For simplicity, relevant portions of the report have been excerpted and attached to this letter. The report in its entirety is available upon request and is also public record.

A map of the existing downstream conveyance system can be found attached. The project site and discharge bath to the Sammamish River is highlighted for clarity.

Per the geotechnical engineer, the proposed project dewatering discharge rate is expected to range from 1,000 to 2,500 gpm. At their recommendation, we have assumed 3,000 gpm (6.7 cfs) to be conservative. Conveyance calculations showing capacity in the downstream system for a 25-year storm event storm flow (and therefore the 10-year storm event storm flow combined with temporary discharge) can be found attached.

A backwater analysis which demonstrates that the project dewatering discharge (6.7 cfs) combined with the 10-year storm event storm flow does not cause a hydraulic grade to rise within six-inches of the grate of any downstream catch basin can be found attached. Specifically, calculations show that a 100-year event (which exceeds the 10-year storm event storm flow combined with temporary discharge) with 10-year tailwater will not cause the HGL to rise within 6 inches of the grate of any downstream catch basin.

If you have any questions, please feel free to call me at (206) 622-5822.

Sincerely

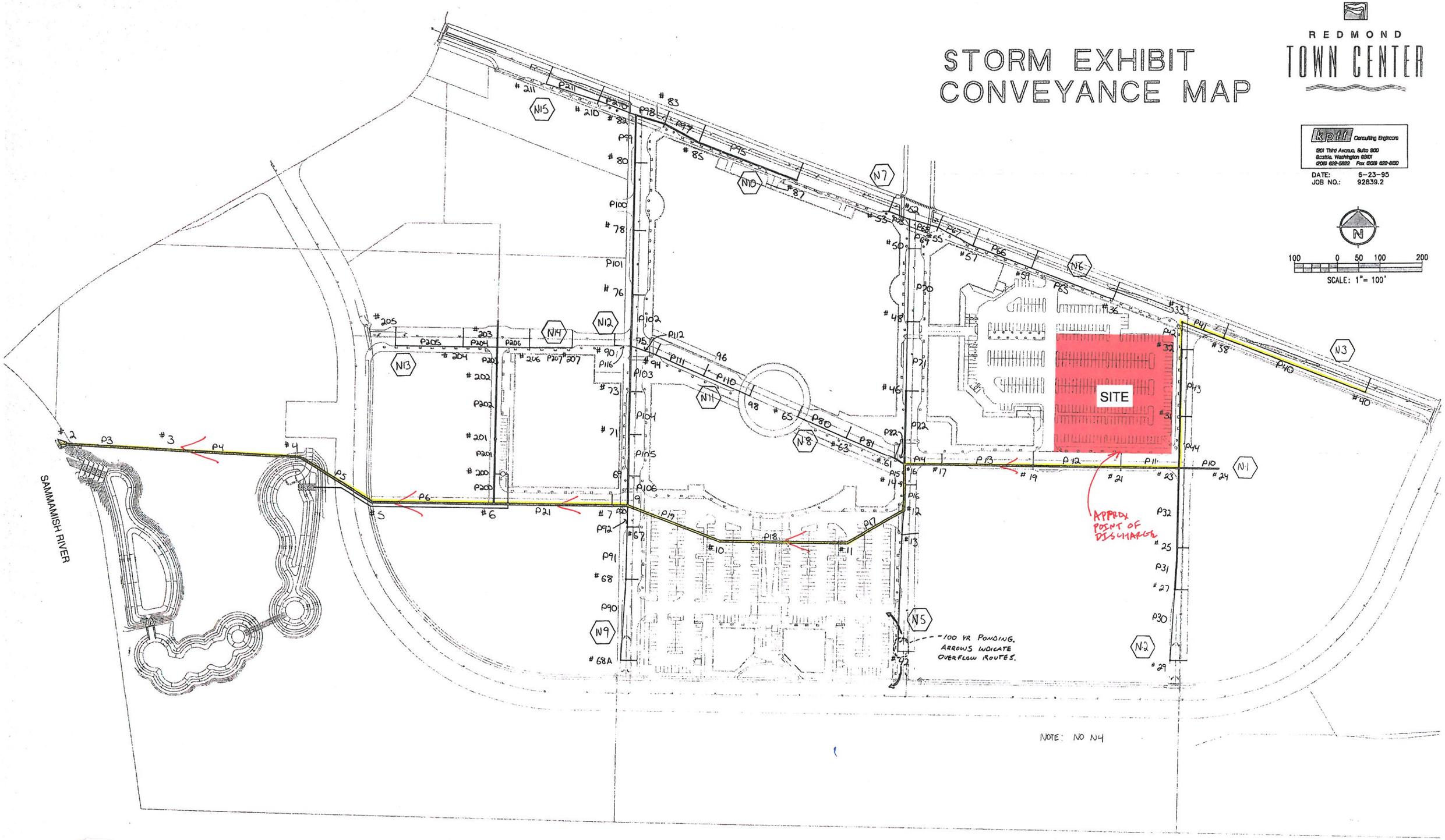
Sam DeBell, PE
Project Engineer

# STORM EXHIBIT
# CONVEYANCE MAP

REDMOND
TOWN CENTER

kpff Consulting Engineers
1201 Third Avenue, Suite 900
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

DATE: 6-23-95
JOB NO.: 92839.2



# REDMOND TOWN CENTER
# Phase 1

## Infrastructure
## Drainage Calculations

MARK A. VELDEE
STATE OF WASHINGTON
24711
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 9/14/96

*Prepared by:*

*Joe Eberhardt, P.E.*
*KPFF Consulting Engineers*
*1201 Third Avenue, Suite 900*
*Seattle, WA 98101*

*June 23, 1995*

EXCERPTED FOR PARCEL 5B
*TEMPORARY CONSTRUCTION*
*DEWATERING ASSESSMENT*
DOWNSTREAM CONVEYANCE
FEBRUARY 10, 2016

## *PROPOSED CONDITIONS*

At the City's request, separate drainage systems will be constructed for the public Bear Creek Parkway and the private on-site development. The majority of these systems will be built with Phase 1 construction, leaving the connection of future buildings and parking areas to the system to be accomplished in the future phases.

### *Bear Creek Parkway*

Stormwater from the northern one-half of the parkway is collected in structures at the curb line and piped to a conveyance swale located south of the parkway. Stormwater falling on the south one-half of the parkway flows overland to this same conveyance swale. For the east two-thirds of the parkway, these flows are conveyed by open channel to 200-foot long biofiltration swales. Once treated, these flows are infiltrated up to the 25-year storm in infiltration basins. To save trees adjacent to the west end of the parkway, the flows collected in the conveyance swale will be treated with a wetvault, then directly discharged to the Sammamish River.

### *On-Site System*

The on-site drainage system collects stormwater then transports it westerly towards the Sammamish River in a large diameter trunk line that bisects the site. Before crossing the Bear Creek Parkway, a stormwater pump station diverts the first flows from this trunk line (up to 6-month event) to the water quality wet ponds. Any flows in excess of the 6-month flows will continue down the trunk line to discharge at a flap gated headwall to the Sammamish River.

The trunk line has been sized to pass the 25-year flows in open channel condition. The surcharged (backwater) condition during flood events has been checked for the following scenarios:

1. 100-year flood elevation in the Sammamish River and 10-year flow in the trunk line.
2. 10-year flood elevation in the Sammamish River and 100-year flow in the trunk line.

The purposes of the flap gate on the trunk line at the Sammamish River outlet is to prevent silt-laden river water from entering the pond system and to allow the stormwater pumps to drain our site if the Sammamish River is flooded.

The proposed pump station utilizes two submersible 20 Hp pumps with approximately 14 cfs combined capacity. To pump the low flows and to provide water volume to pump against, the pumps are located where the storm trunk line steps up 24 inches in invert elevation. Storm water will back up in the trunk line until either the pump(s) turn on and evacuate the line or the backed-up water exceeds 24 inches. If it exceeds 24 inches, the run-off continues down the trunk line to the Sammamish River.

The wet pond is designed per DOE Criteria to store the 6-month storm event. A 3-cell pond is proposed with the following purposes:

- Cell 1: Sedimentation, Floatable Separation
- Cell 2: Biofiltration
- Cell 3: Finishing/Fish Refuge

## *DEVELOPED SITE CONDITION*

The developed site has been modeled using SCS methodology. The computed program used is *Waterworks* by Engenious Systems. The Santa Barbara Urban Hydrograph (SBUH) will be used to model the storm events.

For the "full build out" conditions, the developed site will be considered impervious and a curve number (CN) of 98 will be used. This is conservative, as landscaping is not considered.

## *CONVEYANCE CHECK*
## *and*
## *BACKWATER CALCULATIONS*

The site was modeled for conveyance and backwater conditions using a computer model. The program is *C.I.A.* by Engenious Systems.

The model used the Rational Method for storm event modeling.

Two situations were modeled for backwater:

1 ) 100 year onsite storm event with a 10 year water elevation in Sammamish for a tailwater condition.

2 ) 10 year onsite storm with a 100 year tailwater condition.

Calculations indicate that minimal ponding will occur in situation 1 and that no ponding will occur in situation 2. The ponding that does occur will have alternative drain routes to other catch basins. The model indicates ponding for the 100 year storm at the south end of 166th Street. Overflow drainage routes are south to Bearcreek Parkway, and north and west into the south parking lot. Both of the routes provide flooding relief below the finished floor elevation of the nearest building.

kpff Consulting Engineers
1201 Third Avenue, Suite 900
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

| project | by | sheet no. |
|---|---|---|
| location | date | |
| client | | job no. |
| | | |

25 yr STORM - CONVEYANCE CHECK

JDE

## REACH SUMMARY

Routing based on Seattle family @ 25 yr freq

CAPACITY

ACTUAL

### Network N2:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P30 | B29 | 2.03 | 0.74 | 1.50 | 1.50 | 6.32 | 2.51 | 3.78 | 18 | 0.012 | 0.0038 | 7.57 | 4.29 | 4.05 | 165.51 | 0.68 |
| P31 | | | | | 1.50 | 7.01 | 2.42 | 3.63 | 24 | 0.012 | 0.0038 | 16.32 | 5.19 | 3.97 | 97.13 | 0.41 |
| P32 | B25 | 4.83 | 0.83 | 4.02 | 5.52 | 7.41 | 2.36 | 13.05 | 30 | 0.012 | 0.0038 | 29.48 | 6.01 | 5.51 | 185.01 | 0.56 |

### Network N3:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P40 | B40 | 1.07 | 0.90 | 0.96 | 0.96 | 6.32 | 2.51 | 2.42 | 18 | 0.012 | 0.0025 | 6.14 | 3.47 | 3.10 | 356.18 | 1.92 |
| P41 | B38 | 1.45 | 0.90 | 1.31 | 2.27 | 8.24 | 2.25 | 5.09 | 18 | 0.012 | 0.0078 | 10.84 | 6.14 | 5.72 | 103.82 | 0.30 |
| P42 | B33 | 0.46 | 0.90 | 0.41 | 2.68 | 8.54 | 2.20 | 5.91 | 18 | 0.012 | 0.0081 | 11.04 | 6.25 | 6.01 | 63.07 | 0.17 |
| P43 | B32 | 0.94 | 0.90 | 0.85 | 3.53 | 8.72 | 2.18 | 7.69 | 24 | 0.012 | 0.0068 | 21.76 | 6.93 | 6.00 | 155.00 | 0.43 |
| P44 | B31 | 0.07 | 0.90 | 0.06 | 3.59 | 9.15 | 2.12 | 7.61 | 24 | 0.012 | 0.0114 | 28.28 | 9.00 | 7.24 | 124.06 | 0.29 |

### Network N13:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P60 | B21 | 4.17 | 0.82 | 3.43 | 3.43 | 6.32 | 2.51 | 8.62 | 24 | 0.012 | 0.0037 | 16.11 | 5.13 | 4.93 | 35.01 | 0.12 |

### Network N7:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P75 | B53 | 0.52 | 0.90 | 0.47 | 0.47 | 6.32 | 2.51 | 1.18 | 12 | 0.012 | 0.0050 | 2.95 | 3.76 | 3.36 | 51.62 | 0.26 |

### Network N6:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P65 | B36 | 0.73 | 0.90 | 0.66 | 0.66 | 6.32 | 2.51 | 1.65 | 12 | 0.012 | 0.0025 | 2.08 | 2.65 | 2.77 | 207.63 | 1.25 |
| P66 | B59 | 0.39 | 0.90 | 0.35 | 1.01 | 7.57 | 2.34 | 2.36 | 15 | 0.012 | 0.0026 | 3.87 | 3.15 | 3.13 | 140.87 | 0.75 |
| P67 | B57 | 0.46 | 0.90 | 0.41 | 1.42 | 8.33 | 2.23 | 3.18 | 15 | 0.012 | 0.0024 | 3.72 | 3.03 | 3.20 | 98.68 | 0.51 |
| P68 | B55 | 0.23 | 0.90 | 0.21 | 1.63 | 8.84 | 2.16 | 3.52 | 18 | 0.012 | 0.0026 | 6.27 | 3.55 | 3.45 | 68.96 | 0.33 |
| P69 | | | | | 2.10 | 9.17 | 2.12 | 4.44 | 18 | 0.012 | 0.0075 | 10.65 | 6.03 | 5.45 | 74.33 | 0.23 |
| P70 | | | | | 2.10 | 9.40 | 2.08 | 4.37 | 18 | 0.012 | 0.0078 | 10.85 | 6.14 | 5.50 | 172.63 | 0.52 |
| P71 | B48 | 0.86 | 0.90 | 0.77 | 2.87 | 9.92 | 2.01 | 5.77 | 18 | 0.012 | 0.0081 | 11.02 | 6.24 | 5.97 | 160.03 | 0.45 |
| P72 | B46 | 1.19 | 0.90 | 1.07 | 3.94 | 10.37 | 1.97 | 7.77 | 24 | 0.012 | 0.0096 | 25.89 | 8.24 | 6.83 | 174.03 | 0.42 |

### Network N8:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P80 | B65 | 0.68 | 0.90 | 0.61 | 0.61 | 5.00 | 2.70 | 1.65 | 12 | 0.012 | 0.0051 | 2.96 | 3.77 | 3.66 | 124.48 | 0.57 |
| P81 | B63 | 0.51 | 0.90 | 0.46 | 1.07 | 5.57 | 2.62 | 2.81 | 15 | 0.012 | 0.0048 | 5.23 | 4.26 | 4.10 | 125.00 | 0.51 |
| P82 | B61 | 0.32 | 0.90 | 0.29 | 1.36 | 6.08 | 2.55 | 3.46 | 18 | 0.012 | 0.0295 | 21.10 | 11.94 | 8.37 | 26.40 | 0.05 |

## REACH SUMMARY

### Network N5:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P55 | | B42 | 2.54 | 0.90 | 2.29 | 2.29 | 6.32 | 2.51 | 5.75 | 15 | 0.012 | 0.0100 | 7.55 | 6.15 | 6.38 | 269.22 | 0.70 |
| P55A | | | | | | 2.29 | 7.03 | 2.42 | 5.52 | 18 | 0.012 | 0.0129 | 13.92 | 7.88 | 7.03 | 55.23 | 0.13 |

### Network N9:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P90 | | B68A | 1.73 | 0.90 | 1.56 | 1.56 | 6.32 | 2.51 | 3.92 | 15 | 0.012 | 0.0119 | 8.25 | 6.72 | 6.28 | 188.38 | 0.50 |
| P91 | | B68 | 0.14 | 0.90 | 0.13 | 1.68 | 6.82 | 2.44 | 4.11 | 15 | 0.012 | 0.0122 | 8.33 | 6.79 | 6.41 | 118.11 | 0.31 |
| P92 | | B67 | 0.62 | 0.90 | 0.56 | 2.24 | 7.13 | 2.40 | 5.38 | 18 | 0.012 | 0.0122 | 13.58 | 7.69 | 6.86 | 49.01 | 0.12 |

### Network N16:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P211 | | B211 | 0.36 | 0.90 | 0.32 | 0.32 | 6.32 | 2.51 | 0.81 | 15 | 0.012 | 0.0133 | 8.71 | 7.10 | 4.23 | 129.24 | 0.51 |
| P210 | | B210 | 0.14 | 0.90 | 0.13 | 0.45 | 6.83 | 2.44 | 1.10 | 15 | 0.012 | 0.0100 | 7.53 | 6.14 | 4.16 | 94.37 | 0.38 |

### Network N11:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P110 | | B98 | 0.87 | 0.90 | 0.78 | 0.78 | 5.03 | 2.70 | 2.11 | 15 | 0.012 | 0.0080 | 6.75 | 5.50 | 4.61 | 118.85 | 0.43 |
| P111 | | B96 | 0.87 | 0.90 | 0.78 | 1.57 | 5.46 | 2.64 | 4.13 | 15 | 0.012 | 0.0079 | 6.70 | 5.46 | 5.42 | 124.48 | 0.38 |
| P112 | | B94 | 0.28 | 0.90 | 0.25 | 1.82 | 5.84 | 2.58 | 4.69 | 18 | 0.012 | 0.0082 | 11.14 | 6.31 | 5.72 | 59.46 | 0.17 |

### Network N12:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P116 | | B92 | 0.24 | 0.90 | 0.22 | 0.22 | 5.03 | 2.70 | 0.58 | 12 | 0.012 | 0.0642 | 10.55 | 13.43 | 6.85 | 40.01 | 0.10 |

### Network N10:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P95 | | B87 | 2.28 | 0.90 | 2.05 | 2.05 | 6.32 | 2.51 | 5.16 | 24 | 0.012 | 0.0025 | 13.34 | 4.25 | 3.77 | 247.19 | 1.09 |
| P97 | | B85 | 0.32 | 0.90 | 0.29 | 2.34 | 7.42 | 2.36 | 5.53 | 24 | 0.012 | 0.0025 | 13.23 | 4.21 | 3.81 | 91.79 | 0.40 |
| P98 | | B83 | 0.16 | 0.90 | 0.14 | 2.48 | 7.82 | 2.31 | 5.73 | 24 | 0.012 | 0.0026 | 13.47 | 4.29 | 3.90 | 69.35 | 0.30 |
| P99 | | | | | | 2.93 | 8.12 | 2.26 | 6.64 | 24 | 0.012 | 0.0056 | 19.84 | 6.32 | 5.39 | 110.02 | 0.34 |
| P100 | | B80 | 0.62 | 0.90 | 0.56 | 3.49 | 8.46 | 2.22 | 7.74 | 24 | 0.012 | 0.0056 | 19.76 | 6.29 | 5.60 | 161.08 | 0.48 |
| P101 | | B78 | 0.65 | 0.90 | 0.58 | 4.08 | 8.94 | 2.15 | 8.76 | 24 | 0.012 | 0.0056 | 19.85 | 6.32 | 5.80 | 149.01 | 0.43 |
| P102 | | B76 | 2.91 | 0.90 | 2.62 | 6.69 | 9.36 | 2.09 | 13.98 | 30 | 0.012 | 0.0056 | 35.81 | 7.30 | 6.49 | 120.00 | 0.31 |
| P103 | | | | | | 8.73 | 9.67 | 2.05 | 17.85 | 30 | 0.012 | 0.0058 | 36.40 | 7.42 | 6.99 | 104.02 | 0.25 |
| P104 | | B73 | 0.51 | 0.90 | 0.46 | 9.19 | 9.92 | 2.01 | 18.47 | 30 | 0.012 | 0.0056 | 35.86 | 7.31 | 6.97 | 100.02 | 0.24 |
| P105 | | B71 | 0.45 | 0.90 | 0.40 | 9.59 | 10.16 | 1.99 | 19.06 | 30 | 0.012 | 0.0056 | 35.87 | 7.31 | 7.02 | 100.00 | 0.24 |
| P106 | | B69 | 0.44 | 0.90 | 0.40 | 9.99 | 10.40 | 1.97 | 19.66 | 30 | 0.012 | 0.0062 | 37.89 | 7.72 | 7.37 | 72.01 | 0.16 |

JDE

## REACH SUMMARY

### Network N15:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P207 | B207 | 0.10 | 0.90 | 0.09 | 0.09 | 6.32 | 2.51 | 0.23 | 12 | 0.012 | 0.0200 | 5.89 | 7.50 | 3.43 | 100.00 | 0.49 |
| P206 | B206 | 0.12 | 0.90 | 0.11 | 0.20 | 6.81 | 2.45 | 0.48 | 12 | 0.012 | 0.0211 | 6.04 | 7.69 | 4.38 | 76.01 | 0.29 |

### Network N14:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P205 | B205 | 0.20 | 0.90 | 0.18 | 0.18 | 6.32 | 2.51 | 0.45 | 12 | 0.012 | 0.0101 | 4.19 | 5.33 | 3.31 | 157.08 | 0.79 |
| P204 | B204 | 0.15 | 0.90 | 0.13 | 0.32 | 7.12 | 2.40 | 0.76 | 12 | 0.012 | 0.0098 | 4.11 | 5.23 | 3.79 | 82.02 | 0.36 |
| P203 | WEO | 4.50 | 0.63 | 2.85 | 3.36 | 16.39 | 1.53 | 5.15 | 24 | 0.012 | 0.0112 | 27.94 | 8.89 | 6.44 | 68.01 | 0.18 |
| P202 | B202 | 0.10 | 0.90 | 0.09 | 3.45 | 16.56 | 1.52 | 5.25 | 24 | 0.012 | 0.0106 | 27.24 | 8.67 | 6.36 | 160.05 | 0.42 |
| P201 | B201 | 0.12 | 0.90 | 0.11 | 3.56 | 16.98 | 1.50 | 5.34 | 24 | 0.012 | 0.0049 | 18.55 | 5.91 | 4.84 | 69.03 | 0.24 |
| P200 | | | | | 3.56 | 17.22 | 1.49 | 5.30 | 24 | 0.012 | 0.0032 | 15.05 | 4.79 | 4.14 | 71.00 | 0.29 |

### Network N1:

10-yr+TEMP

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P10 | BBW | 6.95 | 0.90 | 6.25 | 6.25 | 25.42 | 1.14 | 7.12 | 30 | 0.012 | 0.0025 | 23.96 | 4.88 | 4.04 | 200.00 | 0.83 |
| P11 | | | | | 15.37 | 26.24 | 1.11 | 17.10 | 36 | 0.012 | 0.0026 | 39.68 | 5.61 | 5.12 | 135.03 | 0.44 |
| P12 | B22 | 4.17 | 0.90 | 3.75 | 22.55 | 26.68 | 1.10 | 24.80 | 36 | 0.012 | 0.0028 | 41.61 | 5.89 | 5.81 | 207.02 | 0.59 |
| P13 | B19 | 2.92 | 0.79 | 2.30 | 24.85 | 27.28 | 1.08 | 26.88 | 42 | 0.012 | 0.0052 | 84.66 | 8.80 | 7.41 | 214.06 | 0.48 |
| P14 | B17 | 0.77 | 0.90 | 0.69 | 25.55 | 27.76 | 1.07 | 27.27 | 42 | 0.012 | 0.0025 | 58.78 | 6.11 | 5.68 | 88.01 | 0.26 |
| P15 | | | | | 30.85 | 28.02 | 1.06 | 32.68 | 42 | 0.012 | 0.0040 | 73.96 | 7.69 | 7.06 | 48.01 | 0.11 |
| P16 | B14 | 0.46 | 0.90 | 0.41 | 31.26 | 28.13 | 1.06 | 33.02 | 48 | 0.012 | 0.0038 | 103.06 | 8.20 | 6.92 | 61.01 | 0.15 |
| P17 | B12 | 0.66 | 0.90 | 0.59 | 34.14 | 28.28 | 1.05 | 35.91 | 48 | 0.012 | 0.0047 | 114.93 | 9.15 | 7.66 | 153.56 | 0.33 |
| P18 | B11 | 2.33 | 0.82 | 1.90 | 36.04 | 28.61 | 1.04 | 37.55 | 48 | 0.012 | 0.0036 | 100.70 | 8.01 | 7.04 | 300.04 | 0.71 |
| P19 | B10 | 2.45 | 0.82 | 2.01 | 38.05 | 29.32 | 1.02 | 38.83 | 48 | 0.012 | 0.0035 | 98.69 | 7.85 | 7.00 | 231.40 | 0.55 |
| P20 | | | | | 50.28 | 29.87 | 1.00 | 50.47 | 48 | 0.012 | 0.0036 | 100.55 | 8.00 | 7.58 | 39.01 | 0.09 |
| P21 | B07 | 0.14 | 0.90 | 0.13 | 50.41 | 29.96 | 1.00 | 50.47 | 48 | 0.012 | 0.0039 | 104.50 | 8.32 | 7.80 | 276.05 | 0.59 |
| P22 | | | | | 53.97 | 30.55 | 0.98 | 52.96 | 54 | 0.012 | 0.0029 | 123.78 | 7.78 | 7.09 | 286.04 | 0.67 |
| P23 | | | | | 53.97 | 31.22 | 0.96 | 51.73 | 54 | 0.012 | 0.0029 | 123.69 | 7.78 | 7.04 | 203.63 | 0.48 |
| P24 | | | | | 53.97 | 31.70 | 0.94 | 50.84 | 54 | 0.012 | 0.0029 | 124.04 | 7.80 | 7.02 | 298.54 | 0.71 |
| P25 | | | | | 53.97 | 32.41 | 0.92 | 49.54 | 54 | 0.012 | 0.0029 | 123.25 | 7.75 | 6.94 | 236.36 | 0.57 |

27.3
29.1
29.5
34.1
34.3
36.8
38.2
39.4
49.4
49.4

AND 10-YR PLUS TEMP

ALL PIPES LISTED PASS THE 25yr STORM WITHOUT CAPACITY PROBLEMS.

kpff Consulting Engineers
1201 Third Avenue, Suite 900
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

| | | | |
|---|---|---|---|
| project RTC | by JDE | sheet no. |
| location | date 6-23-95 | |
| client CONVEYANCE MODEL | | job no. |

# BACKWATER CALCULATIONS - 10yr - 100yr River
- 100yr - 10yr River

## REACH REPORT

REACH SUMMARY DESCRIBES HYDRAULIC GRADELINE ELEVATIONS, RIM ELEVATIONS, LOSSES IN SYSTEM, AND CONVEYANCE CALCULATIONS. A LISTING OF EACH INDIVIDUAL REACH FOLLOWS THE SUMMARIES. THIS LISTING DESCRIBES PIPE REACH END-POINTS & ELEVATIONS, PIPE LENGTH, DIAMETER, SLOPE, CAPACITY, VELOCITY.

JDE

## REACH SUMMARY

Routing based on Seattle family @ 10 yr freq - ONSITE STORM EVENT W/100-YR TAILWATER

Hydraulic Gradeline for Reach HG1

| <-FROM-> | <--TO--> | <FLOW> cfs | floss -loss- | Ent_HGL -Elev-- | EntLoss --loss- | ExtLoss --loss- | OutLet --Elev- | Inlet --Elev- | AppHead --loss- | BndHead --loss- | JunHead --loss- | HeadWtr --Elev- | -cb/mh- --Rim-- | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CB02 | | | | | | | | | | | | 31.50 | | SAMM. R. 100 |
| CB03 | CB02 | 42.92 | 0.10 | 31.60 | 0.02 | 0.11 | 31.73 | 25.64 | 0.12 | 0.00 | -0.00 | 31.61 | 36.00 | W.S ELE. |
| CB04 | CB03 | 43.72 | 0.13 | 31.74 | 0.02 | 0.12 | 31.88 | 26.52 | 0.12 | 0.02 | -0.00 | 31.78 | 34.00 | ✓ |
| CB05 | CB04 | 44.26 | 0.09 | 31.87 | 0.02 | 0.12 | 32.01 | 27.11 | 0.12 | 0.03 | -0.00 | 31.91 | 36.00 | ✓ |
| CB06 | CB05 | 45.02 | 0.13 | 32.04 | 0.02 | 0.12 | 32.19 | 27.95 | 0.18 | 0.00 | 0.01 | 32.02 | 35.53 | |
| CB07 | CB06 | 42.67 | 0.21 | 32.22 | 0.04 | 0.18 | 32.44 | 27.01 | 0.18 | 0.00 | 0.00 | 32.26 | 34.56 | |
| CB09 | CB07 | 42.65 | 0.03 | 32.29 | 0.04 | 0.18 | 32.50 | 27.15 | 0.16 | 0.21 | 0.12 | 32.68 | 35.30 | |
| CB10 | CB09 | 32.72 | 0.10 | 32.78 | 0.02 | 0.11 | 32.90 | 27.84 | 0.10 | 0.01 | 0.00 | 32.82 | 35.00 | |
| CB11 | CB10 | 31.53 | 0.12 | 32.94 | 0.02 | 0.10 | 33.06 | 28.91 | 0.09 | 0.12 | 0.00 | 33.09 | 35.00 | |
| CB12 | CB11 | 30.10 | 0.06 | 33.15 | 0.02 | 0.09 | 33.26 | 29.61 | 0.10 | 0.13 | 0.12 | 33.41 | 35.39 | |
| CB14 | CB12 | 27.66 | 0.02 | 33.43 | 0.02 | 0.08 | 33.52 | 29.81 | 0.13 | 0.00 | 0.00 | 33.39 | 35.13 | |
| CB16 | CB14 | 27.37 | 0.03 | 33.42 | 0.03 | 0.13 | 33.58 | 30.00 | 0.09 | 0.12 | 0.01 | 33.62 | 34.78 | |
| CB17 | CB16 | 22.80 | 0.04 | 33.66 | 0.02 | 0.09 | 33.76 | 30.16 | 0.08 | 0.00 | 0.00 | 33.68 | 34.78 | |
| CB19 | CB17 | 22.43 | 0.09 | 33.77 | 0.02 | 0.08 | 33.87 | 31.27 | 0.13 | 0.00 | 0.01 | 33.75 | 36.50 | |
| CB21 | CB19 | 20.64 | 0.17 | 33.92 | 0.03 | 0.13 | 34.07 | 31.84 | 0.08 | 0.10 | 0.06 | 34.16 | 36.51 | |
| CB23 | CB21 | 14.21 | 0.05 | 34.21 | 0.01 | 0.06 | 34.29 | 32.09 | 0.07 | 0.09 | 0.02 | 34.33 | 38.75 | |
| CB24 | CB23 | 5.89 | 0.03 | 34.36 | 0.00 | 0.02 | 34.39 | 32.41 | 0.00 | 0.00 | 0.00 | 34.39 | 39.00 | ✓ NO POND |
| CB09 | | | | | | | | | | | | 32.68 | | |
| CB67 | CB09 | 4.35 | 0.07 | 32.75 | 0.02 | 0.09 | 32.86 | 27.17 | 0.11 | 0.00 | 0.03 | 32.77 | 34.87 | |
| CB68 | CB67 | 3.33 | 0.27 | 33.04 | 0.02 | 0.11 | 33.17 | 28.59 | 0.10 | 0.00 | 0.00 | 33.08 | 35.15 | |
| CB68A | CB68 | 3.18 | 0.39 | 33.46 | 0.02 | 0.10 | 33.59 | 30.83 | 0.00 | 0.00 | 0.00 | 33.59 | 33.69 | ✓ |
| CB09 | | | | | | | | | | | | 32.68 | | |
| CB69 | CB09 | 15.60 | 0.09 | 32.76 | 0.03 | 0.16 | 32.95 | 27.29 | 0.15 | 0.00 | 0.00 | 32.81 | 35.12 | |
| CB71 | CB69 | 15.12 | 0.12 | 32.92 | 0.03 | 0.15 | 33.10 | 27.84 | 0.14 | 0.00 | 0.00 | 32.97 | 35.15 | |
| CB73 | CB71 | 14.62 | 0.11 | 33.08 | 0.03 | 0.14 | 33.24 | 28.39 | 0.13 | 0.00 | 0.00 | 33.12 | 35.15 | |
| CB75 | CB73 | 14.10 | 0.10 | 33.22 | 0.03 | 0.13 | 33.38 | 28.97 | 0.08 | 0.00 | 0.02 | 33.31 | 35.78 | |
| CB76 | CB75 | 11.08 | 0.07 | 33.39 | 0.02 | 0.08 | 33.48 | 29.58 | 0.08 | 0.00 | 0.03 | 33.43 | 34.94 | |
| CB78 | CB76 | 6.97 | 0.12 | 33.55 | 0.02 | 0.08 | 33.65 | 30.32 | 0.06 | 0.00 | 0.01 | 33.59 | 36.29 | |
| CB80 | CB78 | 6.18 | 0.10 | 33.69 | 0.01 | 0.06 | 33.77 | 31.20 | 0.04 | 0.00 | 0.01 | 33.73 | 37.89 | |
| CB82 | CB80 | 5.32 | 0.05 | 33.78 | 0.01 | 0.04 | 33.83 | 31.79 | 0.03 | 0.04 | 0.00 | 33.85 | 39.20 | |
| CB83 | CB82 | 4.60 | 0.02 | 33.87 | 0.01 | 0.03 | 33.91 | 31.95 | 0.03 | 0.00 | 0.00 | 33.88 | 38.51 | |
| CB85 | CB83 | 4.45 | 0.03 | 33.91 | 0.01 | 0.03 | 33.95 | 32.18 | 0.03 | 0.00 | 0.00 | 33.92 | 38.21 | ✓ |
| CB87 | CB85 | 4.19 | 0.07 | 34.00 | 0.01 | 0.03 | 34.03 | 32.80 | 0.00 | 0.00 | 0.00 | 34.03 | 36.17 | |
| CB75 | | | | | | | | | | | | 33.31 | | |
| CB94 | CB75 | 3.81 | 0.07 | 33.38 | 0.01 | 0.07 | 33.47 | 29.21 | 0.12 | 0.00 | 0.01 | 33.36 | 35.14 | |
| CB96 | CB94 | 3.35 | 0.28 | 33.65 | 0.02 | 0.12 | 33.79 | 30.20 | 0.03 | 0.00 | 0.02 | 33.77 | 35.12 | |
| CB98 | CB96 | 1.72 | 0.07 | 33.84 | 0.01 | 0.03 | 33.88 | 31.03 | 0.00 | 0.00 | 0.00 | 33.88 | 35.14 | ✓ |
| CB75 | | | | | | | | | | | | 33.31 | | |
| CB90 | CB75 | 0.47 | 0.01 | 33.32 | 0.00 | 0.01 | 33.33 | 31.05 | 0.00 | 0.00 | 0.00 | 33.33 | 35.16 | ✓ |
| CB12 | | | | | | | | | | | | 33.41 | | |
| CB13 | CB12 | 4.46 | 0.08 | 33.49 | 0.02 | 0.10 | 33.61 | 29.89 | 0.22 | 0.00 | -0.01 | 33.38 | 34.98 | ✓ ok |

NO PONDING

JDE

## REACH SUMMARY

Hydraulic Gradeline for Reach Continued

| <-FROM-> | <--TO--> | <FLOW> cfs | floss -loss- | Ent_HGL -Elev-- | EntLoss --loss- | ExtLoss --loss- | OutLet --Elev- | Inlet --Elev- | AppHead --loss- | BndHead --loss- | JunHead --loss- | HeadWtr --Elev- | -cb/mh- --Rim-- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CB42 | CB13 | 4.67 | 1.19 | 34.57 | 0.04 | 0.22 | 34.84 | 32.69 | 0.00 | 0.00 | 0.00 | 34.84 | 35.24 ✓ |
| CB16 | | | | | | | | | | | | 33.62 | |
| CB61 | CB16 | 2.81 | 0.02 | 33.63 | 0.01 | 0.04 | 33.68 | 30.28 | 0.05 | 0.00 | 0.01 | 33.64 | 35.06 |
| CB63 | CB61 | 2.28 | 0.13 | 33.77 | 0.01 | 0.05 | 33.84 | 30.88 | 0.05 | 0.00 | 0.02 | 33.81 | 35.12 |
| CB65 | CB63 | 1.35 | 0.15 | 33.96 | 0.01 | 0.05 | 34.02 | 31.45 | 0.00 | 0.00 | 0.00 | 34.02 | 35.13 ✓ |
| CB16 | | | | | | | | | | | | 33.62 | |
| CB46 | CB16 | 6.17 | 0.11 | 33.73 | 0.01 | 0.06 | 33.80 | 31.30 | 0.10 | 0.00 | 0.03 | 33.72 | 35.13 |
| CB48 | CB46 | 4.58 | 0.26 | 33.98 | 0.02 | 0.10 | 34.10 | 32.57 | 0.06 | 0.00 | 0.01 | 34.06 | 36.59 |
| CB50 | CB48 | 3.47 | 0.16 | 34.22 | 0.01 | 0.06 | 34.29 | 33.86 | 0.06 | 0.01 | -0.00 | 34.24 | 38.29 |
| CB52 | CB50 | 3.53 | 0.31 | 34.55 | 0.01 | 0.06 | 34.62 | 34.42 | 0.04 | 0.05 | 0.01 | 34.65 | 39.12 |
| CB55 | CB52 | 2.81 | 0.43 | 34.98 | 0.01 | 0.04 | 35.02 | 34.57 | 0.07 | 0.00 | 0.01 | 34.96 | 38.41 |
| CB57 | CB55 | 2.55 | 0.32 | 35.28 | 0.01 | 0.07 | 35.36 | 34.80 | 0.04 | 0.00 | 0.01 | 35.33 | 38.22 |
| CB59 | CB57 | 1.90 | 0.16 | 35.51 | 0.01 | 0.04 | 35.56 | 35.13 | 0.05 | 0.00 | 0.01 | 35.53 | 37.90 |
| CB36 | CB59 | 1.34 | 0.39 | 35.97 | 0.01 | 0.05 | 36.03 | 35.61 | 0.00 | 0.00 | 0.00 | 36.03 | 38.12 ✓ |
| CB52 | | | | | | | | | | | | 34.66 | |
| CB53 | CB52 | 0.96 | 0.07 | 34.74 | 0.00 | 0.02 | 34.76 | 34.54 | 0.00 | 0.00 | 0.00 | 34.76 | 38.43 ✓ |
| CB23 | | | | | | | | | | | | 34.33 | |
| CB25 | CB23 | 10.51 | 0.10 | 34.43 | 0.01 | 0.07 | 34.52 | 32.72 | 0.01 | 0.00 | 0.01 | 34.52 | 36.85 |
| CB27 | CB25 | 2.94 | 0.01 | 34.53 | 0.00 | 0.01 | 34.55 | 32.87 | 0.05 | 0.00 | -0.00 | 34.50 | 36.78 |
| CB29 | CB27 | 3.07 | 0.12 | 34.62 | 0.01 | 0.05 | 34.67 | 33.50 | 0.00 | 0.00 | 0.00 | 34.67 | 36.42 ✓ |
| CB23 | | | | | | | | | | | | 34.33 | |
| CB31 | CB23 | 6.04 | 0.07 | 34.40 | 0.01 | 0.06 | 34.47 | 33.32 | 0.06 | 0.00 | -0.00 | 34.41 | 39.16 |
| CB32 | CB31 | 6.13 | 0.11 | 34.64 | 0.01 | 0.06 | 34.71 | 34.38 | 0.11 | 0.00 | 0.02 | 34.63 | 38.60 |
| CB33 | CB32 | 4.72 | 0.58 | tw & dn <dc: Inlet Ctrl Assumed | | | | 34.87 | 0.08 | 0.11 | 0.01 | 34.90 | 39.53 |
| CB38 | CB33 | 4.08 | 3.34 | 35.80 | 0.02 | 0.08 | 35.90 | 35.64 | 0.02 | 0.00 | 0.01 | 35.89 | 39.03 |
| CB40 | CB38 | 1.97 | 0.78 | 36.72 | 0.00 | 0.02 | 36.75 | 36.43 | 0.00 | 0.00 | 0.00 | 36.75 | 39.15 ✓ ok |

No Ponding

### Network N2:

| Pipe | Reach Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P30 | B29 | 2.03 | 0.74 | 1.50 | 1.50 | 6.32 | 2.04 | 3.07 | 18 | 0.012 | 0.0038 | 7.57 | 4.29 | 3.85 | 165.51 | 0.72 |
| P31 | | | | | 1.50 | 7.04 | 1.95 | 2.94 | 24 | 0.012 | 0.0038 | 16.32 | 5.19 | 3.73 | 97.13 | 0.43 |
| P32 | B25 | 4.83 | 0.83 | 4.02 | 5.52 | 7.48 | 1.90 | 10.51 | 30 | 0.012 | 0.0038 | 29.48 | 6.01 | 5.21 | 185.01 | 0.59 |

### Network N3:

| Pipe | Reach Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P40 | B40 | 1.07 | 0.90 | 0.96 | 0.96 | 6.32 | 2.04 | 1.97 | 18 | 0.012 | 0.0025 | 6.14 | 3.47 | 2.93 | 356.18 | 2.03 |
| P41 | B38 | 1.45 | 0.90 | 1.31 | 2.27 | 8.35 | 1.80 | 4.08 | 18 | 0.012 | 0.0078 | 10.84 | 6.14 | 5.40 | 103.82 | 0.32 |
| P42 | B33 | 0.46 | 0.90 | 0.41 | 2.68 | 8.67 | 1.76 | 4.72 | 18 | 0.012 | 0.0081 | 11.04 | 6.25 | 5.68 | 63.07 | 0.18 |
| P43 | B32 | 0.94 | 0.90 | 0.85 | 3.53 | 8.86 | 1.74 | 6.13 | 24 | 0.012 | 0.0068 | 21.76 | 6.93 | 5.64 | 155.00 | 0.46 |

REACH SUMMARY

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P44 | B31 | 0.07 | 0.90 | 0.06 | 3.59 | 9.31 | 1.68 | 6.04 | 24 | 0.012 | 0.0114 | 28.28 | 9.00 | 6.79 | 124.06 | 0.30 |

Network N13:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P60 | B21 | 4.17 | 0.82 | 3.43 | 3.43 | 6.32 | 2.04 | 7.00 | 24 | 0.012 | 0.0037 | 16.11 | 5.13 | 4.69 | 35.01 | 0.12 |

Network N7:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P75 | B53 | 0.52 | 0.90 | 0.47 | 0.47 | 6.32 | 2.04 | 0.96 | 12 | 0.012 | 0.0050 | 2.95 | 3.76 | 3.18 | 51.62 | 0.27 |

Network N6:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P65 | B36 | 0.73 | 0.90 | 0.66 | 0.66 | 6.32 | 2.04 | 1.34 | 12 | 0.012 | 0.0025 | 2.08 | 2.65 | 2.66 | 207.63 | 1.30 |
| P66 | B59 | 0.39 | 0.90 | 0.35 | 1.01 | 7.62 | 1.89 | 1.90 | 15 | 0.012 | 0.0026 | 3.87 | 3.15 | 2.97 | 140.87 | 0.79 |
| P67 | B57 | 0.46 | 0.90 | 0.41 | 1.42 | 8.41 | 1.79 | 2.55 | 15 | 0.012 | 0.0024 | 3.72 | 3.03 | 3.08 | 98.68 | 0.53 |
| P68 | B55 | 0.23 | 0.90 | 0.21 | 1.63 | 8.95 | 1.73 | 2.81 | 18 | 0.012 | 0.0026 | 6.27 | 3.55 | 3.27 | 68.96 | 0.35 |
| P69 | | | | | 2.10 | 9.30 | 1.68 | 3.53 | 18 | 0.012 | 0.0075 | 10.65 | 6.03 | 5.13 | 74.33 | 0.24 |
| P70 | | | | | 2.10 | 9.54 | 1.66 | 3.47 | 18 | 0.012 | 0.0078 | 10.85 | 6.14 | 5.18 | 172.63 | 0.56 |
| P71 | B48 | 0.86 | 0.90 | 0.77 | 2.87 | 10.10 | 1.59 | 4.58 | 18 | 0.012 | 0.0081 | 11.02 | 6.24 | 5.63 | 160.03 | 0.47 |
| P72 | B46 | 1.19 | 0.90 | 1.07 | 3.94 | 10.57 | 1.57 | 6.17 | 24 | 0.012 | 0.0096 | 25.89 | 8.24 | 6.41 | 174.03 | 0.45 |

Network N8:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P80 | B65 | 0.68 | 0.90 | 0.61 | 0.61 | 5.00 | 2.20 | 1.35 | 12 | 0.012 | 0.0051 | 2.96 | 3.77 | 3.49 | 124.48 | 0.60 |
| P81 | B63 | 0.51 | 0.90 | 0.46 | 1.07 | 5.60 | 2.13 | 2.28 | 15 | 0.012 | 0.0048 | 5.23 | 4.26 | 3.90 | 125.00 | 0.53 |
| P82 | B61 | 0.32 | 0.90 | 0.29 | 1.36 | 6.13 | 2.06 | 2.81 | 18 | 0.012 | 0.0295 | 21.10 | 11.94 | 7.87 | 26.40 | 0.06 |

Network N5:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P55 | B42 | 2.54 | 0.90 | 2.29 | 2.29 | 6.32 | 2.04 | 4.67 | 15 | 0.012 | 0.0100 | 7.55 | 6.15 | 6.12 | 269.22 | 0.73 |
| P55A | | | | | 2.29 | 7.06 | 1.95 | 4.46 | 18 | 0.012 | 0.0129 | 13.92 | 7.88 | 6.65 | 55.23 | 0.14 |

Network N9:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P90 | B68A | 1.73 | 0.90 | 1.56 | 1.56 | 6.32 | 2.04 | 3.18 | 15 | 0.012 | 0.0119 | 8.25 | 6.72 | 5.96 | 188.38 | 0.53 |
| P91 | B68 | 0.14 | 0.90 | 0.13 | 1.68 | 6.85 | 1.98 | 3.33 | 15 | 0.012 | 0.0122 | 8.33 | 6.79 | 6.07 | 118.11 | 0.32 |
| P92 | B67 | 0.62 | 0.90 | 0.56 | 2.24 | 7.18 | 1.94 | 4.35 | 18 | 0.012 | 0.0122 | 13.58 | 7.69 | 6.48 | 49.01 | 0.13 |

JDE

## REACH SUMMARY

### Network N16:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P211 | | B211 | 0.36 | 0.90 | 0.32 | 0.32 | 6.32 | 2.04 | 0.66 | 15 | 0.012 | 0.0133 | 8.71 | 7.10 | 3.98 | 129.24 | 0.54 |
| P210 | | B210 | 0.14 | 0.90 | 0.13 | 0.45 | 6.87 | 1.98 | 0.89 | 15 | 0.012 | 0.0100 | 7.53 | 6.14 | 3.91 | 94.37 | 0.40 |

### Network N11:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P110 | | B98 | 0.87 | 0.90 | 0.78 | 0.78 | 5.03 | 2.20 | 1.72 | 15 | 0.012 | 0.0080 | 6.75 | 5.50 | 4.36 | 118.85 | 0.45 |
| P111 | | B96 | 0.87 | 0.90 | 0.78 | 1.57 | 5.49 | 2.14 | 3.35 | 15 | 0.012 | 0.0079 | 6.70 | 5.46 | 5.17 | 124.48 | 0.40 |
| P112 | | B94 | 0.28 | 0.90 | 0.25 | 1.82 | 5.89 | 2.09 | 3.81 | 18 | 0.012 | 0.0082 | 11.14 | 6.31 | 5.41 | 59.46 | 0.18 |

### Network N12:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P116 | | B92 | 0.24 | 0.90 | 0.22 | 0.22 | 5.03 | 2.20 | 0.47 | 12 | 0.012 | 0.0642 | 10.55 | 13.43 | 6.44 | 40.01 | 0.10 |

### Network N10:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P95 | | B87 | 2.28 | 0.90 | 2.05 | 2.05 | 6.32 | 2.04 | 4.19 | 24 | 0.012 | 0.0025 | 13.34 | 4.25 | 3.56 | 247.19 | 1.16 |
| P97 | | B85 | 0.32 | 0.90 | 0.29 | 2.34 | 7.48 | 1.90 | 4.45 | 24 | 0.012 | 0.0025 | 13.23 | 4.21 | 3.60 | 91.79 | 0.42 |
| P98 | | B83 | 0.16 | 0.90 | 0.14 | 2.48 | 7.91 | 1.85 | 4.60 | 24 | 0.012 | 0.0026 | 13.47 | 4.29 | 3.68 | 69.35 | 0.31 |
| P99 | | | | | | 2.93 | 8.22 | 1.81 | 5.32 | 24 | 0.012 | 0.0056 | 19.84 | 6.32 | 5.08 | 110.02 | 0.36 |
| P100 | | B80 | 0.62 | 0.90 | 0.56 | 3.49 | 8.58 | 1.77 | 6.18 | 24 | 0.012 | 0.0056 | 19.76 | 6.29 | 5.27 | 161.08 | 0.51 |
| P101 | | B78 | 0.65 | 0.90 | 0.58 | 4.08 | 9.09 | 1.71 | 6.97 | 24 | 0.012 | 0.0056 | 19.85 | 6.32 | 5.46 | 149.01 | 0.45 |
| P102 | | B76 | 2.91 | 0.90 | 2.62 | 6.69 | 9.54 | 1.65 | 11.08 | 30 | 0.012 | 0.0056 | 35.81 | 7.30 | 6.10 | 120.00 | 0.33 |
| P103 | | | | | | 8.73 | 9.87 | 1.62 | 14.10 | 30 | 0.012 | 0.0058 | 36.40 | 7.42 | 6.58 | 104.02 | 0.26 |
| P104 | | B73 | 0.51 | 0.90 | 0.46 | 9.19 | 10.14 | 1.59 | 14.62 | 30 | 0.012 | 0.0056 | 35.86 | 7.31 | 6.57 | 100.02 | 0.25 |
| P105 | | B71 | 0.45 | 0.90 | 0.40 | 9.59 | 10.39 | 1.58 | 15.12 | 30 | 0.012 | 0.0056 | 35.87 | 7.31 | 6.63 | 100.00 | 0.25 |
| P106 | | B69 | 0.44 | 0.90 | 0.40 | 9.99 | 10.64 | 1.56 | 15.60 | 30 | 0.012 | 0.0062 | 37.89 | 7.72 | 6.96 | 72.01 | 0.17 |

### Network N15:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P207 | | B207 | 0.10 | 0.90 | 0.09 | 0.09 | 6.32 | 2.04 | 0.18 | 12 | 0.012 | 0.0200 | 5.89 | 7.50 | 3.22 | 100.00 | 0.52 |
| P206 | | B206 | 0.12 | 0.90 | 0.11 | 0.20 | 6.84 | 1.98 | 0.39 | 12 | 0.012 | 0.0211 | 6.04 | 7.69 | 4.11 | 76.01 | 0.31 |

### Network N14:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P205 | | B205 | 0.20 | 0.90 | 0.18 | 0.18 | 6.32 | 2.04 | 0.37 | 12 | 0.012 | 0.0101 | 4.19 | 5.33 | 3.12 | 157.08 | 0.84 |
| P204 | | B204 | 0.15 | 0.90 | 0.13 | 0.32 | 7.16 | 1.94 | 0.61 | 12 | 0.012 | 0.0098 | 4.11 | 5.23 | 3.57 | 82.02 | 0.38 |
| P203 | | WEO | 4.50 | 0.63 | 2.85 | 3.36 | 16.39 | 1.24 | 4.19 | 24 | 0.012 | 0.0112 | 27.94 | 8.89 | 6.07 | 68.01 | 0.19 |
| P202 | | B202 | 0.10 | 0.90 | 0.09 | 3.45 | 16.57 | 1.24 | 4.27 | 24 | 0.012 | 0.0106 | 27.24 | 8.67 | 6.00 | 160.05 | 0.44 |

JDE

## REACH SUMMARY

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P201 | B201 | 0.12 | 0.90 | 0.11 | 3.56 | 17.02 | 1.22 | 4.34 | 24 | 0.012 | 0.0049 | 18.55 | 5.91 | 4.57 | 69.03 | 0.25 |
| P200 | | | | | 3.56 | 17.27 | 1.21 | 4.31 | 24 | 0.012 | 0.0032 | 15.05 | 4.79 | 3.92 | 71.00 | 0.30 |

**Network N1:**

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P10 | BBW | 6.95 | 0.90 | 6.25 | 6.25 | 25.42 | 0.94 | 5.89 | 30 | 0.012 | 0.0025 | 23.96 | 4.88 | 3.83 | 200.00 | 0.87 |
| P11 | | | | | 15.37 | 26.29 | 0.92 | 14.21 | 36 | 0.012 | 0.0026 | 39.68 | 5.61 | 4.88 | 135.03 | 0.46 |
| P12 | B22 | 4.17 | 0.90 | 3.75 | 22.55 | 26.75 | 0.92 | 20.64 | 36 | 0.012 | 0.0028 | 41.61 | 5.89 | 5.56 | 207.02 | 0.62 |
| P13 | B19 | 2.92 | 0.79 | 2.30 | 24.85 | 27.37 | 0.90 | 22.43 | 42 | 0.012 | 0.0052 | 84.66 | 8.80 | 7.05 | 214.06 | 0.51 |
| P14 | B17 | 0.77 | 0.90 | 0.69 | 25.55 | 27.87 | 0.89 | 22.80 | 42 | 0.012 | 0.0025 | 58.78 | 6.11 | 5.42 | 88.01 | 0.27 |
| P15 | | | | | 30.85 | 28.14 | 0.89 | 27.37 | 42 | 0.012 | 0.0040 | 73.96 | 7.69 | 6.74 | 48.01 | 0.12 |
| P16 | B14 | 0.46 | 0.90 | 0.41 | 31.26 | 28.26 | 0.88 | 27.66 | 48 | 0.012 | 0.0038 | 103.06 | 8.20 | 6.59 | 61.01 | 0.15 |
| P17 | B12 | 0.66 | 0.90 | 0.59 | 34.14 | 28.42 | 0.88 | 30.10 | 48 | 0.012 | 0.0047 | 114.93 | 9.15 | 7.31 | 153.56 | 0.35 |
| P18 | B11 | 2.33 | 0.82 | 1.90 | 36.04 | 28.77 | 0.87 | 31.53 | 48 | 0.012 | 0.0036 | 100.70 | 8.01 | 6.72 | 300.04 | 0.74 |
| P19 | B10 | 2.45 | 0.82 | 2.01 | 38.05 | 29.51 | 0.86 | 32.72 | 48 | 0.012 | 0.0035 | 98.69 | 7.85 | 6.69 | 231.40 | 0.58 |
| P20 | | | | | 50.28 | 30.09 | 0.85 | 42.65 | 48 | 0.012 | 0.0036 | 100.55 | 8.00 | 7.27 | 39.01 | 0.09 |
| P21 | B07 | 0.14 | 0.90 | 0.13 | 50.41 | 30.18 | 0.85 | 42.67 | 48 | 0.012 | 0.0039 | 104.50 | 8.32 | 7.48 | 276.05 | 0.62 |
| P22 | | | | | 53.97 | 30.79 | 0.83 | 45.02 | 54 | 0.012 | 0.0029 | 123.78 | 7.78 | 6.79 | 286.04 | 0.70 |
| P23 | | | | | 53.97 | 31.50 | 0.82 | 44.26 | 54 | 0.012 | 0.0029 | 123.69 | 7.78 | 6.76 | 203.63 | 0.50 |
| P24 | | | | | 53.97 | 32.00 | 0.81 | 43.72 | 54 | 0.012 | 0.0029 | 124.04 | 7.80 | 6.75 | 298.54 | 0.74 |
| P25 | | | | | 53.97 | 32.73 | 0.80 | 42.92 | 54 | 0.012 | 0.0029 | 123.25 | 7.75 | 6.69 | 236.36 | 0.59 |

$Q_{10}$ (CIA)

$V_{10}$

RTC5

JDE

==========

REACH SUMMARY

Routing based on Seattle family @ 100 yr freq → ONSITE STORM EVENT W/10-yr TAILWATER

Hydraulic Gradeline for Reach HG1

OUTFALL

POINT OF DISCHARGE

| <-FROM-> | <--TO--> | <FLOW> cfs | floss -loss- | Ent_HGL -Elev-- | EntLoss --loss- | ExtLoss --loss- | OutLet --Elev- | Inlet --Elev- | AppHead --loss- | BndHead --loss- | JunHead --loss- | HeadWtr --Elev- | -cb/mh- --Rim-- | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CB02 | | | | | | | | | | | | 28.25 | | SAMM. R. 10yr W.S. ELEV |
| CB03 | CB02 | 65.93 | 0.19 | 28.39 | 0.05 | 0.27 | 28.71 | 25.86 | 0.28 | 0.00 | -0.01 | 28.43 | 36.00 | |
| CB04 | CB03 | 67.36 | 0.29 | 28.63 | 0.06 | 0.28 | 28.96 | 26.74 | 0.29 | 0.05 | -0.00 | 28.72 | 34.00 | ✓ |
| CB05 | CB04 | 68.33 | 0.29 | 28.88 | 0.06 | 0.29 | 29.23 | 27.34 | 0.30 | 0.06 | -0.00 | 28.99 | 36.00 | ✓ |
| CB06 | CB05 | 69.69 | 0.58 | 29.47 | 0.06 | 0.30 | 29.82 | 28.19 | 0.43 | 0.00 | 0.02 | 29.41 | 35.53 | ✓ |
| CB07 | CB06 | 66.21 | 0.50 | 29.91 | 0.09 | 0.43 | 30.43 | 27.33 | 0.43 | 0.00 | 0.00 | 30.00 | 34.56 | ✓ |
| CB09 | CB07 | 66.20 | 0.06 | 30.05 | 0.09 | 0.43 | 30.57 | 27.47 | 0.43 | 0.57 | 0.31 | 31.02 | 35.30 | ✓ |
| CB10 | CB09 | 50.89 | 0.25 | 31.27 | 0.05 | 0.25 | 31.58 | 28.05 | 0.24 | 0.03 | 0.01 | 31.37 | 35.00 | ✓ |
| CB11 | CB10 | 49.15 | 0.30 | 31.67 | 0.05 | 0.24 | 31.95 | 29.11 | 0.22 | 0.29 | 0.01 | 32.03 | 35.00 | ✓ |
| CB12 | CB11 | 46.99 | 0.13 | 32.11 | 0.04 | 0.22 | 32.37 | 29.80 | 0.25 | 0.33 | 0.29 | 32.74 | 35.39 | ✓ |
| CB14 | CB12 | 43.19 | 0.04 | 32.78 | 0.04 | 0.18 | 33.00 | 29.98 | 0.31 | 0.00 | 0.00 | 32.69 | 35.13 | ✓ |
| CB16 | CB14 | 42.75 | 0.07 | 32.77 | 0.06 | 0.31 | 33.14 | 30.24 | 0.21 | 0.28 | 0.03 | 33.24 | 34.78 | ✓ |
| CB17 | CB16 | 35.65 | 0.09 | 33.33 | 0.04 | 0.21 | 33.59 | 30.34 | 0.21 | 0.00 | 0.00 | 33.39 | 34.78 | ✓ |
| CB19 | CB17 | 35.13 | 0.22 | 33.61 | 0.04 | 0.21 | 33.86 | 31.44 | 0.33 | 0.00 | 0.02 | 33.55 | 36.50 | ✓ |
| CB21 | CB19 | 32.38 | 0.41 | 33.97 | 0.07 | 0.33 | 34.36 | 32.09 | 0.19 | 0.25 | 0.15 | 34.57 | 36.51 | ✓ |
| CB23 | CB21 | 22.33 | 0.13 | 34.70 | 0.03 | 0.15 | 34.89 | 32.23 | 0.18 | 0.24 | 0.04 | 34.99 | 38.75 | ✓ |
| CB24 | CB23 | 9.28 | 0.09 | 35.07 | 0.01 | 0.06 | 35.14 | 32.49 | 0.00 | 0.00 | 0.00 | 35.14 | 39.00 | ✓ |
| | | | | | | | | | | | | | | |
| CB09 | | | | | | | | | | | | 31.02 | | |
| CB67 | CB09 | 6.87 | 0.18 | 31.20 | 0.05 | 0.23 | 31.48 | 27.35 | 0.28 | 0.00 | 0.06 | 31.27 | 34.87 | |
| CB68 | CB67 | 5.24 | 0.66 | 31.92 | 0.06 | 0.28 | 32.26 | 29.38 | 0.25 | 0.00 | 0.01 | 32.02 | 35.15 | |
| CB68A | CB68 | 4.96 | 0.94 | 32.97 | 0.05 | 0.25 | 33.27 | 31.23 | 0.00 | 0.00 | 0.00 | 33.27 | 33.69 | ✓ |
| | | | | | | | | | | | | | | |
| CB09 | | | | | | | | | | | | 31.02 | | |
| CB69 | CB09 | 25.80 | 0.24 | 31.27 | 0.09 | 0.43 | 31.78 | 27.63 | 0.40 | 0.00 | 0.01 | 31.39 | 35.12 | |
| CB71 | CB69 | 25.05 | 0.32 | 31.70 | 0.08 | 0.40 | 32.19 | 28.16 | 0.38 | 0.00 | 0.01 | 31.82 | 35.15 | |
| CB73 | CB71 | 24.32 | 0.30 | 32.12 | 0.08 | 0.38 | 32.58 | 28.69 | 0.35 | 0.00 | 0.01 | 32.23 | 35.15 | |
| CB75 | CB73 | 23.43 | 0.29 | 32.52 | 0.07 | 0.35 | 32.95 | 29.26 | 0.22 | 0.00 | 0.04 | 32.78 | 35.78 | |
| CB76 | CB75 | 18.28 | 0.20 | 32.98 | 0.04 | 0.22 | 33.24 | 29.76 | 0.20 | 0.00 | 0.08 | 33.11 | 34.94 | |
| CB78 | CB76 | 11.40 | 0.32 | 33.43 | 0.04 | 0.20 | 33.68 | 30.49 | 0.16 | 0.00 | 0.02 | 33.54 | 36.29 | |
| CB80 | CB78 | 10.01 | 0.27 | 33.81 | 0.03 | 0.16 | 34.00 | 31.33 | 0.12 | 0.00 | 0.02 | 33.90 | 37.89 | |
| CB82 | CB80 | 8.56 | 0.13 | 34.03 | 0.02 | 0.12 | 34.17 | 31.90 | 0.09 | 0.11 | 0.01 | 34.21 | 39.20 | |
| CB83 | CB82 | 7.36 | 0.06 | 34.27 | 0.02 | 0.09 | 34.37 | 32.04 | 0.08 | 0.00 | 0.00 | 34.30 | 38.51 | |
| CB85 | CB83 | 7.07 | 0.08 | 34.37 | 0.02 | 0.08 | 34.47 | 32.26 | 0.07 | 0.00 | 0.00 | 34.40 | 38.21 | |
| CB87 | CB85 | 6.54 | 0.18 | 34.58 | 0.01 | 0.07 | 34.66 | 32.87 | 0.00 | 0.00 | 0.00 | 34.66 | 36.17 | ✓ |
| | | | | | | | | | | | | | | |
| CB75 | | | | | | | | | | | | 32.78 | | |
| CB94 | CB75 | 5.95 | 0.16 | 32.94 | 0.04 | 0.18 | 33.15 | 29.34 | 0.28 | 0.00 | 0.03 | 32.90 | 35.14 | |
| CB96 | CB94 | 5.22 | 0.69 | 33.59 | 0.06 | 0.28 | 33.93 | 30.95 | 0.07 | 0.00 | 0.04 | 33.90 | 35.12 | |
| CB98 | CB96 | 2.66 | 0.17 | 34.07 | 0.01 | 0.07 | 34.15 | 31.09 | 0.00 | 0.00 | 0.00 | 34.15 | 35.14 | ✓ |
| | | | | | | | | | | | | | | |
| CB75 | | | | | | | | | | | | 32.78 | | |
| CB90 | CB75 | 0.73 | 0.01 | 32.79 | 0.00 | 0.01 | 32.81 | 31.08 | 0.00 | 0.00 | 0.00 | 32.81 | 35.16 | ✓ |
| | | | | | | | | | | | | | | |
| CB12 | | | | | | | | | | | | 32.74 | | |
| CB13 | CB12 | 7.04 | 0.21 | 32.95 | 0.05 | 0.25 | 33.25 | 30.07 | 0.55 | 0.01 | -0.02 | 32.69 | 34.98 | ✓ |

10-YR + TEMP. DISCHARGE = 20.4 + 6.7 = 27.3 CFS

100-YR = 32.38 > 27.3 ✓

NO Ponding

JDE

## REACH SUMMARY

Hydraulic Gradeline for Reach Continued

| <-FROM-> | <--TO--> | <FLOW> cfs | floss -loss- | Ent_HGL -Elev-- | EntLoss --loss- | ExtLoss --loss- | OutLet --Elev- | Inlet --Elev- | AppHead --loss- | BndHead --loss- | JunHead --loss- | HeadWtr --Elev- | -cb/mh- --Rim-- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CB42 | CB13 | 7.29 | 2.90 | 35.60 | 0.11 | 0.55 | 36.25 | 34.13 | 0.00 | 0.00 | 0.00 | 35.34* | 35.24 |
| CB16 | | | | | | | | | | | | 33.24 | |
| CB61 | CB16 | 4.40 | 0.04 | 33.28 | 0.02 | 0.10 | 33.39 | 30.36 | 0.13 | 0.01 | 0.02 | 33.30 | 35.06 |
| CB63 | CB61 | 3.55 | 0.32 | 33.62 | 0.03 | 0.13 | 33.77 | 30.98 | 0.11 | 0.00 | 0.05 | 33.71 | 35.12 |
| CB65 | CB63 | 2.08 | 0.36 | 34.07 | 0.02 | 0.11 | 34.20 | 31.53 | 0.00 | 0.00 | 0.00 | 34.20 | 35.13 |
| CB16 | | | | | | | | | | | | 33.24 | |
| CB46 | CB16 | 10.13 | 0.30 | 33.54 | 0.03 | 0.16 | 33.73 | 31.44 | 0.28 | 0.00 | 0.07 | 33.52 | 35.13 |
| CB48 | CB46 | 7.53 | 0.70 | 34.21 | 0.06 | 0.28 | 34.55 | 32.79 | 0.16 | 0.01 | 0.04 | 34.44 | 36.59 |
| CB50 | CB48 | 5.67 | 0.43 | 34.86 | 0.03 | 0.16 | 35.06 | 33.99 | 0.16 | 0.03 | -0.00 | 34.92 | 38.29 |
| CB52 | CB50 | 5.74 | 0.16 | 34.96 | 0.03 | 0.16 | 35.16 | 34.55 | 0.10 | 0.14 | 0.02 | 35.21 | 39.12 |
| CB55 | CB52 | 4.54 | 0.13 | 35.33 | 0.02 | 0.10 | 35.45 | 34.66 | 0.17 | 0.00 | 0.02 | 35.30 | 38.41 |
| CB57 | CB55 | 4.08 | 0.33 | 35.82 | 0.03 | 0.17 | 36.03 | 34.93 | 0.09 | 0.00 | 0.02 | 35.96 | 38.22 |
| CB59 | CB57 | 3.00 | 0.26 | 36.22 | 0.02 | 0.09 | 36.33 | 35.20 | 0.11 | 0.00 | 0.03 | 36.26 | 37.90 |
| CB36 | CB59 | 2.09 | 0.61 | 36.86 | 0.02 | 0.11 | 37.00 | 35.70 | 0.00 | 0.00 | 0.00 | 37.00 | 38.12 |
| CB52 | | | | | | | | | | | | 35.21 | |
| CB53 | CB52 | 1.49 | 0.08 | 35.29 | 0.01 | 0.06 | 35.36 | 34.59 | 0.00 | 0.00 | 0.00 | 35.36 | 38.43 |
| CB23 | | | | | | | | | | | | 34.99 | |
| CB25 | CB23 | 16.70 | 0.26 | 35.25 | 0.04 | 0.18 | 35.46 | 32.86 | 0.03 | 0.00 | 0.03 | 35.46 | 36.85 |
| CB27 | CB25 | 4.63 | 0.03 | 35.49 | 0.01 | 0.03 | 35.54 | 32.93 | 0.11 | 0.00 | -0.00 | 35.42 | 36.78 |
| CB29 | CB27 | 4.79 | 0.29 | 35.71 | 0.02 | 0.11 | 35.85 | 33.59 | 0.00 | 0.00 | 0.00 | 35.85 | 36.42 |
| CB23 | | | | | | | | | | | | 34.99 | |
| CB31 | CB23 | 9.92 | 0.20 | 35.19 | 0.03 | 0.15 | 35.37 | 33.45 | 0.16 | 0.00 | -0.00 | 35.22 | 39.16 |
| CB32 | CB31 | 9.97 | 0.26 | 35.47 | 0.03 | 0.16 | 35.66 | 34.51 | 0.29 | 0.00 | 0.06 | 35.44 | 38.60 |
| CB33 | CB32 | 7.65 | 0.28 | 35.60 | 0.06 | 0.29 | 35.95 | 35.17 | 0.21 | 0.29 | 0.03 | 36.05 | 39.53 |
| CB38 | CB33 | 6.58 | 0.34 | 36.39 | 0.04 | 0.21 | 36.65 | 35.81 | 0.05 | 0.00 | 0.03 | 36.63 | 39.03 |
| CB40 | CB38 | 3.07 | 0.22 | 37.00 | 0.01 | 0.05 | 37.06 | 36.48 | 0.00 | 0.00 | 0.00 | 37.06 | 39.15 |

PONDING

SEE EXHIBIT FOR OVERLAND FLOW ROUTES

NO FLOODING

### Network N2:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P30 | | B29 | 2.03 | 0.74 | 1.50 | 1.50 | 6.32 | 3.19 | 4.79 | 18 | 0.012 | 0.0038 | 7.57 | 4.29 | 4.28 | 165.51 | 0.64 |
| P31 | | | | | | 1.50 | 6.97 | 3.09 | 4.63 | 24 | 0.012 | 0.0038 | 16.32 | 5.19 | 4.24 | 97.13 | 0.38 |
| P32 | | B25 | 4.83 | 0.83 | 4.02 | 5.52 | 7.35 | 3.02 | 16.70 | 30 | 0.012 | 0.0038 | 29.48 | 6.01 | 5.86 | 185.01 | 0.53 |

### Network N3:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P40 | | B40 | 1.07 | 0.90 | 0.96 | 0.96 | 6.32 | 3.19 | 3.07 | 18 | 0.012 | 0.0025 | 6.14 | 3.47 | 3.29 | 356.18 | 1.81 |
| P41 | | B38 | 1.45 | 0.90 | 1.31 | 2.27 | 8.13 | 2.90 | 6.58 | 18 | 0.012 | 0.0078 | 10.84 | 6.14 | 6.08 | 103.82 | 0.28 |
| P42 | | B33 | 0.46 | 0.90 | 0.41 | 2.68 | 8.42 | 2.85 | 7.65 | 18 | 0.012 | 0.0081 | 11.04 | 6.25 | 6.37 | 63.07 | 0.17 |
| P43 | | B32 | 0.94 | 0.90 | 0.85 | 3.53 | 8.58 | 2.83 | 9.97 | 24 | 0.012 | 0.0068 | 21.76 | 6.93 | 6.42 | 155.00 | 0.40 |

## REACH SUMMARY

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P44 | B31 | 0.07 | 0.90 | 0.06 | 3.59 | 8.98 | 2.76 | 9.92 | 24 | 0.012 | 0.0114 | 28.28 | 9.00 | 7.78 | 124.06 | 0.27 |

### Network N13:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P60 | B21 | 4.17 | 0.82 | 3.43 | 3.43 | 6.32 | 3.19 | 10.93 | 24 | 0.012 | 0.0037 | 16.11 | 5.13 | 5.20 | 35.01 | 0.11 |

### Network N7:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P75 | B53 | 0.52 | 0.90 | 0.47 | 0.47 | 6.32 | 3.19 | 1.49 | 12 | 0.012 | 0.0050 | 2.95 | 3.76 | 3.57 | 51.62 | 0.24 |

### Network N6:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P65 | B36 | 0.73 | 0.90 | 0.66 | 0.66 | 6.32 | 3.19 | 2.09 | 12 | 0.012 | 0.0025 | 2.08 | 2.65 | 2.67 | 207.63 | 1.30 |
| P66 | B59 | 0.39 | 0.90 | 0.35 | 1.01 | 7.62 | 2.98 | 3.00 | 15 | 0.012 | 0.0026 | 3.87 | 3.15 | 3.28 | 140.87 | 0.72 |
| P67 | B57 | 0.46 | 0.90 | 0.41 | 1.42 | 8.34 | 2.87 | 4.08 | 15 | 0.012 | 0.0024 | 3.72 | 3.03 | 3.32 | 98.68 | 0.50 |
| P68 | B55 | 0.23 | 0.90 | 0.21 | 1.63 | 8.83 | 2.79 | 4.54 | 18 | 0.012 | 0.0026 | 6.27 | 3.55 | 3.65 | 68.96 | 0.32 |
| P69 | | | | | 2.10 | 9.15 | 2.74 | 5.74 | 18 | 0.012 | 0.0075 | 10.65 | 6.03 | 5.81 | 74.33 | 0.21 |
| P70 | | | | | 2.10 | 9.36 | 2.70 | 5.67 | 18 | 0.012 | 0.0078 | 10.85 | 6.14 | 5.88 | 172.63 | 0.49 |
| P71 | B48 | 0.86 | 0.90 | 0.77 | 2.87 | 9.85 | 2.62 | 7.53 | 18 | 0.012 | 0.0081 | 11.02 | 6.24 | 6.34 | 160.03 | 0.42 |
| P72 | B46 | 1.19 | 0.90 | 1.07 | 3.94 | 10.27 | 2.57 | 10.13 | 24 | 0.012 | 0.0096 | 25.89 | 8.24 | 7.33 | 174.03 | 0.40 |

### Network N8:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P80 | B65 | 0.68 | 0.90 | 0.61 | 0.61 | 5.00 | 3.40 | 2.08 | 12 | 0.012 | 0.0051 | 2.96 | 3.77 | 3.85 | 124.48 | 0.54 |
| P81 | B63 | 0.51 | 0.90 | 0.46 | 1.07 | 5.54 | 3.31 | 3.55 | 15 | 0.012 | 0.0048 | 5.23 | 4.26 | 4.32 | 125.00 | 0.48 |
| P82 | B61 | 0.32 | 0.90 | 0.29 | 1.36 | 6.02 | 3.24 | 4.40 | 18 | 0.012 | 0.0295 | 21.10 | 11.94 | 8.95 | 26.40 | 0.05 |

### Network N5:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P55 | B42 | 2.54 | 0.90 | 2.29 | 2.29 | 6.32 | 3.19 | 7.29 | 15 | 0.012 | 0.0100 | 7.55 | 6.15 | 6.49 | 269.22 | 0.69 |
| P55A | | | | | 2.29 | 7.02 | 3.08 | 7.04 | 18 | 0.012 | 0.0129 | 13.92 | 7.88 | 7.47 | 55.23 | 0.12 |

### Network N9:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P90 | B68A | 1.73 | 0.90 | 1.56 | 1.56 | 6.32 | 3.19 | 4.96 | 15 | 0.012 | 0.0119 | 8.25 | 6.72 | 6.65 | 188.38 | 0.47 |
| P91 | B68 | 0.14 | 0.90 | 0.13 | 1.68 | 6.80 | 3.11 | 5.24 | 15 | 0.012 | 0.0122 | 8.33 | 6.79 | 6.78 | 118.11 | 0.29 |
| P92 | B67 | 0.62 | 0.90 | 0.56 | 2.24 | 7.09 | 3.07 | 6.87 | 18 | 0.012 | 0.0122 | 13.58 | 7.69 | 7.30 | 49.01 | 0.11 |

JDE

## REACH SUMMARY

### Network N16:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P211 | | B211 | 0.36 | 0.90 | 0.32 | 0.32 | 6.32 | 3.19 | 1.03 | 15 | 0.012 | 0.0133 | 8.71 | 7.10 | 4.53 | 129.24 | 0.48 |
| P210 | | B210 | 0.14 | 0.90 | 0.13 | 0.45 | 6.80 | 3.11 | 1.40 | 15 | 0.012 | 0.0100 | 7.53 | 6.14 | 4.46 | 94.37 | 0.35 |

### Network N11:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P110 | | B98 | 0.87 | 0.90 | 0.78 | 0.78 | 5.03 | 3.40 | 2.66 | 15 | 0.012 | 0.0080 | 6.75 | 5.50 | 4.90 | 118.85 | 0.40 |
| P111 | | B96 | 0.87 | 0.90 | 0.78 | 1.57 | 5.44 | 3.33 | 5.22 | 15 | 0.012 | 0.0079 | 6.70 | 5.46 | 5.68 | 124.48 | 0.37 |
| P112 | | B94 | 0.28 | 0.90 | 0.25 | 1.82 | 5.80 | 3.27 | 5.95 | 18 | 0.012 | 0.0082 | 11.14 | 6.31 | 6.06 | 59.46 | 0.16 |

### Network N12:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P116 | | B92 | 0.24 | 0.90 | 0.22 | 0.22 | 5.03 | 3.40 | 0.73 | 12 | 0.012 | 0.0642 | 10.55 | 13.43 | 7.33 | 40.01 | 0.09 |

### Network N10:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P95 | | B87 | 2.28 | 0.90 | 2.05 | 2.05 | 6.32 | 3.19 | 6.54 | 24 | 0.012 | 0.0025 | 13.34 | 4.25 | 4.00 | 247.19 | 1.03 |
| P97 | | B85 | 0.32 | 0.90 | 0.29 | 2.34 | 7.35 | 3.02 | 7.07 | 24 | 0.012 | 0.0025 | 13.23 | 4.21 | 4.05 | 91.79 | 0.38 |
| P98 | | B83 | 0.16 | 0.90 | 0.14 | 2.48 | 7.73 | 2.96 | 7.36 | 24 | 0.012 | 0.0026 | 13.47 | 4.29 | 4.15 | 69.35 | 0.28 |
| P99 | | | | | | 2.93 | 8.01 | 2.92 | 8.56 | 24 | 0.012 | 0.0056 | 19.84 | 6.32 | 5.76 | 110.02 | 0.32 |
| P100 | | B80 | 0.62 | 0.90 | 0.56 | 3.49 | 8.33 | 2.87 | 10.01 | 24 | 0.012 | 0.0056 | 19.76 | 6.29 | 5.97 | 161.08 | 0.45 |
| P101 | | B78 | 0.65 | 0.90 | 0.58 | 4.08 | 8.78 | 2.80 | 11.40 | 24 | 0.012 | 0.0056 | 19.85 | 6.32 | 6.18 | 149.01 | 0.40 |
| P102 | | B76 | 2.91 | 0.90 | 2.62 | 6.69 | 9.18 | 2.73 | 18.28 | 30 | 0.012 | 0.0056 | 35.81 | 7.30 | 6.94 | 120.00 | 0.29 |
| P103 | | | | | | 8.73 | 9.47 | 2.69 | 23.43 | 30 | 0.012 | 0.0058 | 36.40 | 7.42 | 7.44 | 104.02 | 0.23 |
| P104 | | B73 | 0.51 | 0.90 | 0.46 | 9.19 | 9.70 | 2.65 | 24.32 | 30 | 0.012 | 0.0056 | 35.86 | 7.31 | 7.41 | 100.02 | 0.22 |
| P105 | | B71 | 0.45 | 0.90 | 0.40 | 9.59 | 9.93 | 2.61 | 25.05 | 30 | 0.012 | 0.0056 | 35.87 | 7.31 | 7.46 | 100.00 | 0.22 |
| P106 | | B69 | 0.44 | 0.90 | 0.40 | 9.99 | 10.15 | 2.58 | 25.80 | 30 | 0.012 | 0.0062 | 37.89 | 7.72 | 7.84 | 72.01 | 0.15 |

### Network N15:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P207 | | B207 | 0.10 | 0.90 | 0.09 | 0.09 | 6.32 | 3.19 | 0.29 | 12 | 0.012 | 0.0200 | 5.89 | 7.50 | 3.68 | 100.00 | 0.45 |
| P206 | | B206 | 0.12 | 0.90 | 0.11 | 0.20 | 6.78 | 3.12 | 0.62 | 12 | 0.012 | 0.0211 | 6.04 | 7.69 | 4.70 | 76.01 | 0.27 |

### Network N14:

| Pipe | Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P205 | | B205 | 0.20 | 0.90 | 0.18 | 0.18 | 6.32 | 3.19 | 0.57 | 12 | 0.012 | 0.0101 | 4.19 | 5.33 | 3.55 | 157.08 | 0.74 |
| P204 | | B204 | 0.15 | 0.90 | 0.13 | 0.32 | 7.06 | 3.07 | 0.97 | 12 | 0.012 | 0.0098 | 4.11 | 5.23 | 4.06 | 82.02 | 0.34 |
| P203 | | WEO | 4.50 | 0.63 | 2.85 | 3.36 | 16.39 | 1.95 | 6.57 | 24 | 0.012 | 0.0112 | 27.94 | 8.89 | 6.89 | 68.01 | 0.16 |
| P202 | | B202 | 0.10 | 0.90 | 0.09 | 3.45 | 16.55 | 1.94 | 6.70 | 24 | 0.012 | 0.0106 | 27.24 | 8.67 | 6.81 | 160.05 | 0.39 |

JDE

## REACH SUMMARY

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P201 | B201 | 0.12 | 0.90 | 0.11 | 3.56 | 16.94 | 1.91 | 6.82 | 24 | 0.012 | 0.0049 | 18.55 | 5.91 | 5.17 | 69.03 | 0.22 |
| P200 | | | | | 3.56 | 17.17 | 1.90 | 6.76 | 24 | 0.012 | 0.0032 | 15.05 | 4.79 | 4.41 | 71.00 | 0.27 |

Network N1:

| Pipe Reach | Basin Id | Area ac | --c- | --c*A- | --Sum- --c*A- | ---Tc- - min | --i-- in/hr | --QAct cfs | Dia in | -Mann --n-- | -Slope ft/ft | -QFull cfs | Vfull fps | -Vact fps | -Length ft | --tt-- min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P10 | BBW | 6.95 | 0.90 | 6.25 | 6.25 | 25.42 | 1.48 | 9.28 | 30 | 0.012 | 0.0025 | 23.96 | 4.88 | 4.33 | 200.00 | 0.77 |
| P11 | | | | | 15.37 | 26.19 | 1.45 | 22.33 | 36 | 0.012 | 0.0026 | 39.68 | 5.61 | 5.47 | 135.03 | 0.41 |
| P12 | B22 | 4.17 | 0.90 | 3.75 | 22.55 | 26.60 | 1.44 | 32.38 | 36 | 0.012 | 0.0028 | 41.61 | 5.89 | 6.13 | 207.02 | 0.56 |
| P13 | B19 | 2.92 | 0.79 | 2.30 | 24.85 | 27.16 | 1.41 | 35.13 | 42 | 0.012 | 0.0052 | 84.66 | 8.80 | 7.95 | 214.06 | 0.45 |
| P14 | B17 | 0.77 | 0.90 | 0.69 | 25.55 | 27.61 | 1.40 | 35.65 | 42 | 0.012 | 0.0025 | 58.78 | 6.11 | 6.05 | 88.01 | 0.24 |
| P15 | | | | | 30.85 | 27.85 | 1.39 | 42.75 | 42 | 0.012 | 0.0040 | 73.96 | 7.69 | 7.53 | 48.01 | 0.11 |
| P16 | B14 | 0.46 | 0.90 | 0.41 | 31.26 | 27.96 | 1.38 | 43.19 | 48 | 0.012 | 0.0038 | 103.06 | 8.20 | 7.43 | 61.01 | 0.14 |
| P17 | B12 | 0.66 | 0.90 | 0.59 | 34.14 | 28.10 | 1.38 | 46.99 | 48 | 0.012 | 0.0047 | 114.93 | 9.15 | 8.23 | 153.56 | 0.31 |
| P18 | B11 | 2.33 | 0.82 | 1.90 | 36.04 | 28.41 | 1.36 | 49.15 | 48 | 0.012 | 0.0036 | 100.70 | 8.01 | 7.54 | 300.04 | 0.66 |
| P19 | B10 | 2.45 | 0.82 | 2.01 | 38.05 | 29.07 | 1.34 | 50.89 | 48 | 0.012 | 0.0035 | 98.69 | 7.85 | 7.49 | 231.40 | 0.51 |
| P20 | | | | | 50.28 | 29.58 | 1.32 | 66.20 | 48 | 0.012 | 0.0036 | 100.55 | 8.00 | 8.07 | 39.01 | 0.08 |
| P21 | B07 | 0.14 | 0.90 | 0.13 | 50.41 | 29.67 | 1.31 | 66.21 | 48 | 0.012 | 0.0039 | 104.50 | 8.32 | 8.32 | 276.05 | 0.55 |
| P22 | | | | | 53.97 | 30.22 | 1.29 | 69.69 | 54 | 0.012 | 0.0029 | 123.78 | 7.78 | 7.58 | 286.04 | 0.63 |
| P23 | | | | | 53.97 | 30.85 | 1.27 | 68.33 | 54 | 0.012 | 0.0029 | 123.69 | 7.78 | 7.54 | 203.63 | 0.45 |
| P24 | | | | | 53.97 | 31.30 | 1.25 | 67.36 | 54 | 0.012 | 0.0029 | 124.04 | 7.80 | 7.53 | 298.54 | 0.66 |
| P25 | | | | | 53.97 | 31.96 | 1.22 | 65.93 | 54 | 0.012 | 0.0029 | 123.25 | 7.75 | 7.46 | 236.36 | 0.53 |

$Q_{100}$ (CIA)

PIPE REACH ID No. P10
From: CB24 To: CB23
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 200.00 ft s: 0.0025
Up invert : 31.97 ft down invert: 31.47
Collection Area: 6.95 Ac.
Design Flow : 9.28 cfs Dsgn Depth: 1.38 ft
Pipe Capacity : 23.96 cfs
Design Vel : 4.33 fps Travel Time: 0.77 min
Pipe Full Vel : 5.01 fps

PIPE REACH ID No. P100
From: CB80 To: CB78
Pipe Diameter: 2.00 ft n: 0.0120
Pipe Length : 161.08 ft s: 0.0056
Up invert : 30.76 ft down invert: 29.86
Collection Area: 3.88 Ac.
Design Flow : 10.01 cfs Dsgn Depth: 1.05 ft
Pipe Capacity : 19.76 cfs
Design Vel : 5.97 fps Travel Time: 0.45 min
Pipe Full Vel : 6.45 fps