Redmond Town Center
Parcel 5B Redevelopment

Redmond, Washington

Preliminary Stormwater Report

February 2016 | Site Plan Entitlement – 60% PREP

kpff Consulting Engineers

Preliminary Stormwater Report

February 2016

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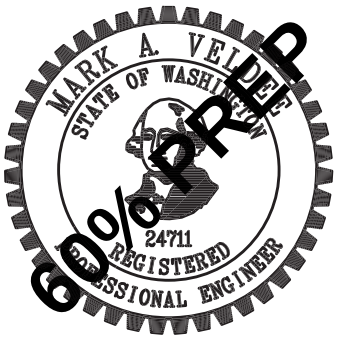

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1. Project Overview

Lowe Enterprises North West proposes to redevelop an existing asphalt parking lot on the Redmond Town Center campus into a mixed use multi-story residential apartment building with ground floor retail and parking garage. The total area of the parcel is approximately 2.1 acres, however the total area of disturbance is approximately 1.8 acres.

The parcel is bound by an existing alley to the west, existing commercial parking area to the north (with Northeast 76th Street beyond), 168th Avenue Northeast to the east, and by Northeast 74th Street to the south.

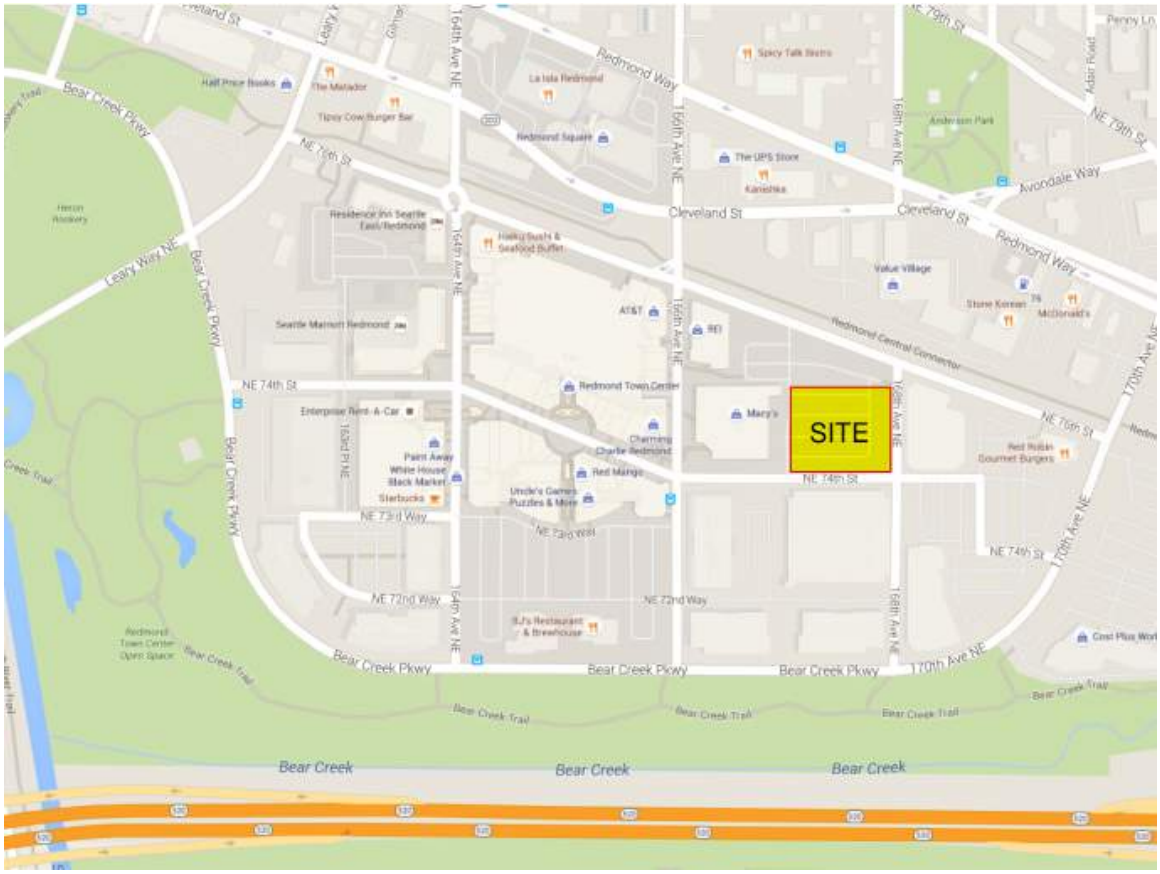


Figure 1-1: Vicinity Map

EXISTING SITE HYDROLOGY

The parcel was previously developed as part of the Redmond Town Center campus and consists of an existing asphalt parking lot, with some trees and landscaping. The site slopes from east to west and stormwater is collected by a series of catch basins in the existing alley at the west boundary of the site and conveyed to the City storm drain in Northeast 74th Street.

Site soils generally consist of glacial recessional outwash: loose to medium dense sand and gravel that becomes progressively denser with depth. Per the Preliminary Geotechnical Engineering Study prepared by Hart Crowser (Appendix B), groundwater should be expected between 6 and 10 feet below ground surface. Elevation relief across the site is approximately 8 feet sloping downward from the east to west.

2. Minimum Requirements Summary

This project is classified as redevelopment project because the existing site has greater than 35% impervious area. Additionally, the project will add greater than 5,000 square feet of impervious area therefore, per Redmond Stormwater Manual Figure 3.3, Minimum Requirements #1-5 apply to the new and replaced impervious surfaces and the land disturbed, and Minimum Requirements #1-9 apply to the new plus replaced impervious surfaces.

Minimum Requirement No. 1 – Preparation of Stormwater Site Plans

This stormwater report accompanies the site plans that describe the temporary and permanent drainage controls associated with this project. See the Proposed Conditions Map in Appendix A.

Minimum Requirement No. 2 – Construction Stormwater Pollution Prevention Plan (SWPPP)

A SWPPP will be prepared for this project and approved by the City of Redmond prior to commencement of any land clearing activities. Additionally, because the total disturbed area is greater than 1 acre and Notice of Intent will be filed with the Washington State Department of Ecology.

Minimum Requirement No. 3 – Source Control of Pollution

The urban and residential nature of this development does not require additional structural source control BMP's. Relevant operational Source Control BMP's include Landscaping/Vegetation Management.

Minimum Requirement No.4 – Preservation of Natural Drainage Systems and Outfalls

The site was previously developed to collect and discharge stormwater to the City owned storm sewer system. The new development will collect and discharge stormwater to the same system in a similar location.

Minimum Requirement No. 5 – On-site Stormwater Management

Onsite stormwater will be collected and discharged to the City owned storm sewer. A green roof and landscaping on the building podium will be constructed to provide mitigation of peak stormwater

The Critical Areas Report states that the entire roof area will be infiltrated onsite. Please update to reflect the latest plans.

discharge for a portion of the parcel. Additional low impact development BMP's, such as bioretention and infiltration, are not feasible because the project is nearly zero-lot line which does not allow sufficient available space.

Minimum Requirement No.6 – Runoff Treatment

Water quality facilities are not required because the project does not meet the applicable thresholds. See Section 6.

Minimum Requirement No.7 – Flow Control

Flow control facilities will not be required because this project drains directly to the Samammish River. See Section 5.

Minimum Requirement No. 8 – Wetlands Protection

This project will not provide wetland protection because the parcel does not discharge stormwater to a wetland.

Minimum Requirement No. 9 – Operation and Maintenance Manual

An Operation and Maintenance Manual for the stormwater infrastructure associated with this project is located in Appendix D.

3. Off-Site Analysis

Because the total proposed impervious area closely matches the existing impervious area on the site, the downstream storm drainage infrastructure is considered adequate to safely convey stormwater discharge that results from this development. A complete off-site analysis will be prepared for this site and will be included in the Final TIR to be submitted as part of the COR Coordinated Civil Review.

4. Conveyance Design

All stormwater infrastructure that serves the existing Redmond Town Center campus and specifically this parcel will remain in place. Stormwater runoff will be collected in the building and conveyed to the existing 18-inch diameter public storm drain in the alley at the west side of the site, matching existing stormwater runoff discharge from the site. Runoff from the sidewalk areas along Northeast 74th Street and 168th Avenue Northeast will sheet flow away from the site and be collected in existing public storm infrastructure in the roadways, matching existing drainage patterns. Conveyance design is not provided for this project because no additional conveyance infrastructure will be constructed.

5. Flow Control Design

Flow control is not required for this project because it will be located on an existing developed site for which a stormwater management system has already been permitted and constructed. A complete summary of this stormwater management system can be found in the "Redmond Town Center Infrastructure Drainage Calculations" dated June, 1995. A copy of this report can be found in Appendix C.

EXISTING HYDROLOGY

The existing surface hydrology is consistent with a typical site consisting of asphalt parking area and associated landscaping. Subsurface conditions are typically a small layer of fill soil (1-4') above glacial till (see the Preliminary Geotechnical Engineering Study in Appendix B). The existing site's pervious and impervious surface areas are shown in Table 5-1:

Table 5-1: Existing Site Area Takeoff

Land Cover	Total Area
Pervious	0.5 acres
Impervious	1.3 acres
Total	**1.8 acres**

DEVELOPED HYDROLOGY

The developed site has the same total area and a similar surface and subsurface hydrologic condition as the existing site, with building roof area replacing existing asphalt parking area. The developed site's impervious surface areas are shown in Table 5-2:

Table 5-2: Developed Site Area Takeoff

Land Cover	Total Area
Pervious	0.2 acres
Impervious	1.6 acres
Total	**1.8 acres**

6. Water Quality Design

Per Minimum Requirement #6 and the conditions of the Development Agreement this project must provide Enhanced Water Quality treatment if the total new plus replaced Pollution Generating Impervious Surface (PGIS) is greater than 5,000 square feet. This project does not propose any quantifiable PGIS, therefore no water quality treatment will be required.

7. Low Impact Development (LID) Site Assessment

A Low Impact Development (LID) Site Assessment is required for this project because it is classified as a Large Project. The following documents, required for the LID Site Assessment, are included in this report:

- Survey (included as a base on the Proposed Conditions Map in Appendix A).
- Location of lot lines and easements (included on the Proposed Conditions Map in Appendix A).
- Geotechnical report (Preliminary Geotechnical Study in Appendix B)

The following documents are not included in this report:

- Forest Survey and Report: removal of existing trees and vegetation on this site is covered by the Developer Agreement.
- Critical Areas Report: no critical areas exist on this site.

The Project Site is located in the Critical Aquifer Recharge Area for the City's supply wells.

- Flood Hazard Report: a flood plain analysis will be conducted prior to submittal for Coordinated Civil Review and a Flood Hazard Report will be provided at that time if the project is determined to be located within a flood plain.

SUMMARY OF LID IMPLEMENTATION

An on building landscaped courtyard amenity space is proposed for this project and feasibility of green roof or other on building LID Best Management Practices (BMPs) at this area is being coordinated at time of this report. Additional LID Best Management Practices (BMP's) are not applicable to this site because the project is similar to a zero-lot line project and does not have adequate available space; BMP's require a minimum square footage to be practical which is not available on this site. A complete summary of proposed BMPs for LID will be prepared for this site and will be included in the Final TIR to be submitted as part of the COR Coordinated Civil Review.

Please update to include infiltration of clean roof runoff as indicated in the Critical Areas Report. Site soils are highly transmissive and infiltration systems can be incorporated into relatively small areas adjacent to the building.

8. Construction Stormwater Pollution Prevention Plan

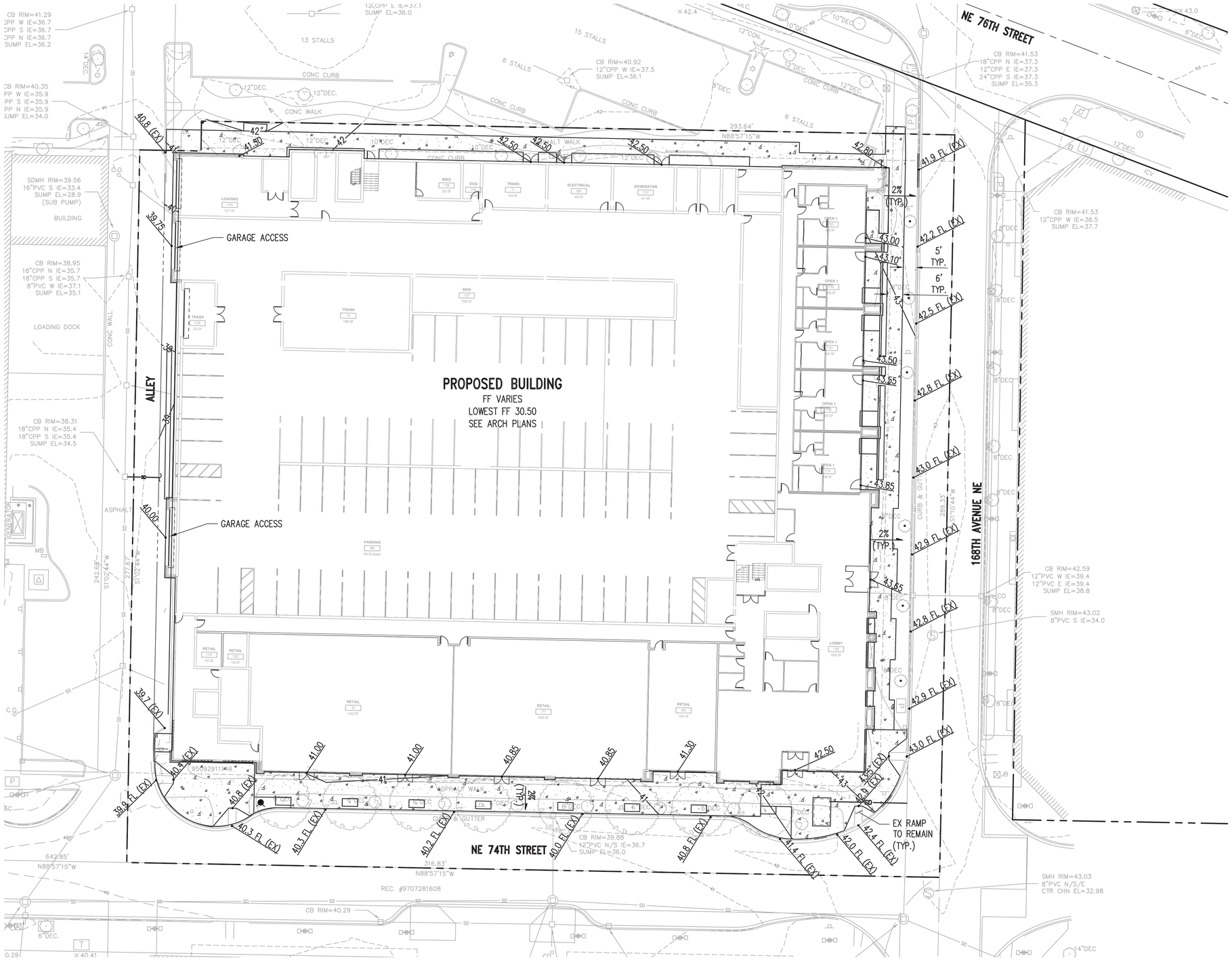
This project will require coverage under the Washington State Department of Ecology's (DOE) Construction Stormwater General Permit because the total disturbed area is greater than 1 acre. The Notice of Intent (NOI) will be submitted to the DOE and SWPPP approval will be received from the City of Redmond prior to any land disturbing activities.

9. Draft Operations and Maintenance Manual

An Operations and Maintenance Manual will be prepared for this site and will be included in the Final TIR to be submitted as part of the COR Coordinated Civil Review.

Appendix A

Proposed Conditions Map



LEGEND:

- PROPERTY LINE
- RIGHT OF WAY LINE
- SD — STORM DRAIN
- 41 — MINOR CONTOUR (PROPOSED)
- 40 — MAJOR CONTOUR (PROPOSED)
- 40 — EXISTING CONTOUR

N

0 10 20 40

1 inch = 20 feet

ORIGINAL SHEET SIZE 36" x 48"

REDMOND TOWN CENTER APARTMENTS

Redmond, WA

74TH STREET PROPERTY LLC

REVISION NO.

LAND-2015-02302

BLDG DEPT/PROJECT NO.

CHECK

PROJECT TEAM MEMBERS

60% PREP - LAND USE 02/25/16
ENTITLEMENT

PROPOSED CONDITIONS MAP

DPD APPROVAL STAMP

Appendix B

Preliminary Geotechnical Engineering Study

Geotechnical Feasibility Study

Redmond Town Center Parcel 5B Development

Redmond, Washington

Prepared for

Lowe Enterprises Real Estate Group

October 28, 2015
19162-01

HARTCROWSER

Geotechnical Feasibility Study

Redmond Town Center Parcel 5-B Development

Redmond, Washington

Prepared for

Lowe Enterprises Real Estate Group

October 28, 2015
17162-01

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INTRODUCTION

This report provides our geotechnical feasibility recommendations for the proposed Parcel 5-B Development at Redmond Town Center in Redmond, Washington (Figure 1). The project site is at Redmond Town Center on Parcel 5-B, which is east of the existing Macy's store just south of NE 76th Street and just west of 168th Avenue NE.

The purpose of our study was to review subsurface conditions at the proposed site and provide preliminary conclusions and recommendations on the geotechnical feasibility of the project. Our scope of work included:

- Review relevant and readily available geotechnical reports and construction documents to improve our understanding of the local soil and groundwater conditions;
- Drill one exploratory soil boring, collect soil samples, and complete laboratory analysis;
- Assess the feasibility of using shallow foundations for the project;
- Identify groundwater issues associated with development, including the need for construction dewatering to facilitate excavations below the groundwater table;
- Identify issues associated with long-term drainage of the subgrade portions of the building (i.e., permanent drainage versus a "water-tight boat" approach);
- Assess the potential for seismic liquefaction and the influence of potential seismic subsidence on the project's foundations, i.e., the need for ground improvement or use of pile foundations; and
- Present our results in this geotechnical feasibility study.

Figures illustrating site information follow the report text. Appendices A, B, and C contain the results of field explorations, laboratory testing programs, and historical explorations, respectively.

Our work was performed in general accordance with our original contract dated August 3, 2015, and subsequent contract change for geotechnical feasibility services dated September 23, 2015. This report is for the exclusive use of Lowe Enterprises Real Estate Group and its design consultants for specific application to the subject project and site. We completed this work in accordance with generally accepted professional practices for work of similar nature done under similar conditions in the same or similar localities as those encountered at the time our work was performed. We make no other warranty, express or implied.

SITE AND PROJECT DESCRIPTIONS

We understand the project will consist of constructing an eight-story mid-rise residential/commercial structure on Parcel 5-B, 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 at elevation 200 feet, with the lowest finished floor level at elevation 187 feet. Allowing for the thickness of the foundations, we anticipate an excavation depth of about 17 to 18 feet below existing grade. The site is currently a paved parking lot. Our understanding of the project is based on correspondence, meetings, and discussions with you and our previous experience at Redmond Town Center.

SUBSURFACE CONDITIONS

Our understanding of the subsurface conditions at the site is based on one boring advanced for this study and relevant historical explorations at the site as shown on Figure 2. Our exploration program for this study included drilling one boring (designated HC-1) to a depth of 51.5 feet. This boring was completed as a monitoring well to allow for long-term groundwater-level monitoring at the site. A detailed log of HC-1 is in Appendix A. The results of geotechnical laboratory tests performed on selected samples from HC-1 are in Appendix B.

Hart Crowser has conducted a number of geotechnical studies in this area associated with the original construction of Redmond Town Center. Numerous other geotechnical studies have been done for the design of the structures in the vicinity of the site. Appendix C includes a portion of the logs from previous studies (borings B-15, B-9, B-5, and TP-7).

The subsurface information used for this study represents conditions at discrete locations across the project site, and actual conditions in other areas could vary. Furthermore, the nature and extent of any variations may not become evident until additional explorations are performed or until construction begins. If significant variations are observed at that time, we may need to modify our conclusions and recommendations accordingly to reflect actual site conditions.

Soil

In general, this area of Redmond is underlain by glacial recessional outwash soils that consist of loose to medium dense sand and gravel that becomes progressively denser with depth. Isolated compressible silt layers have been encountered in isolated areas.

In HC-1, medium dense to very dense gravelly sand to sandy gravel was encountered from the ground surface to a depth of 37 feet. This soil unit contains varying amounts of cobbles and boulders. Dense to very dense slightly silty sand was encountered from 37 feet to the bottom of the boring.

In general, the subsurface conditions are suitable for shallow foundations and slabs-on-grade. However, in some areas, the sands and gravels just below the high groundwater table may be susceptible to seismically induced liquefaction, which may require some form of ground improvement to allow for use of shallow foundations, or short pile foundations may be required instead.

Groundwater

Groundwater at the time of drilling was encountered at a depth of 14.5 feet in HC-1. In general, historical borings indicate that groundwater in the site area should be expected between 6 and 10 feet below ground surface (bgs). Groundwater levels noted in existing and current borings are representative of the time of observations. Variation in groundwater level should be expected depending on location, season, and precipitation. In the Redmond Town Center area, groundwater level will also be controlled to a large extent by the flow (flood level) in the nearby Bear Creek.

Given the depth of planned excavation, groundwater will be encountered within the depth of the building. Previous studies have encountered groundwater at about 10 feet bgs, with locally higher water levels during periods of peak flow of Bear Creek. The proposed construction will require dewatering during construction and will require either a long-term dewatering of the proposed development or a "water-tight" subgrade space, which would need to be designed to resist hydrostatic lateral and uplift forces.

SEISMIC CONSIDERATIONS

Seismic Setting

The seismicity of Western Washington is dominated by the Cascadia Subduction Zone, in which the offshore Juan de Fuca Plate is subducting beneath the continental North American Plate. Three main types of earthquakes are typically associated with subduction zones: crustal, intraslab subduction, and interface subduction earthquakes.

Crustal Sources. Recent fault trenching and seismic records in the Puget Sound area clearly indicate a distinct shallow zone of crustal seismicity, the Seattle Fault, which may have surficial expressions and can extend 25 to 30 kilometers deep.

Subduction Zone Sources. The offshore Juan de Fuca Plate is subducting below the North American Plate. This causes two distinct types of events. Large-magnitude interface earthquakes occur at shallow depths near the Washington coast (e.g., the 1700 earthquake with magnitude of 8 to 9) at the interface between the two plates. A deeper zone of seismicity is associated with bending the Juan de Fuca Plate below the Puget Sound region that produces intraslab earthquakes at depths of 40 to 70 kilometers (e.g., the 1949, 1965, and 2001 earthquakes).

Seismic Parameters

The 2012 International Building Code seismic design parameters for the site latitude and longitude are provided in Table 1. These parameters should be used to develop the code-based design response spectrum. The parameters were obtained from the USGS US Seismic Design Maps web application (http://geohazards.usgs.gov/designmaps/us/application.php).

Site Class for Seismic Design. We determined the soil site class using information about the supporting foundation soils in accordance with ASCE 7-10. The soil site class is determined considering the soil

characteristics and a weighted average of the blow counts observed to a depth of 100 feet bgs. For HC-1, which was not 100 feet deep, when determining the site class we assumed the material density below the deepest sample remains constant to 100 feet and determined that the site should be designated as seismic Site Class D.

Table 1 – 2012 IBC Seismic Design Parameters

Parameter	Value
Latitude	47.6705
Longitude	–122.117
Site class	D
Mapped MCE_R spectral response acceleration at short periods, S_S	1.254 g
Mapped MCE_R spectral response acceleration at 1-second periods, S_1	0.480 g

Liquefaction Assessment

Loose, saturated granular soil is generally susceptible to liquefaction as a result of cyclic shaking during an earthquake. Cyclic shaking causes a rapid increase in pore water pressure that reduces the effective stress between soil particles, resulting in the sudden loss of shear strength in the soil. Granular soils that rely on inter-particle friction for strength are susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upward, carrying soil particles with the draining water. In general, loose, saturated sandy soils with low silt and clay contents are the most susceptible to liquefaction. Silty soils with low plasticity are also susceptible to liquefaction under relatively higher levels of ground shaking. For any soil type, the soil must be saturated for liquefaction to occur. Liquefaction can cause ground surface settlement and lateral spreading.

We used empirical methods to estimate liquefaction potential based on the standard penetration test (SPT) data obtained at the site. We used the SPT-based liquefaction triggering procedure after Idriss and Boulanger (2008). For our analysis of the maximum considered earthquake (MCE) hazard level, which corresponds to an average 2,475-year return period, we used an earthquake magnitude of 7.0 and a peak ground acceleration of 0.506 g that we obtained from USGS (2008) for the site coordinates and Site Class D.

Our analysis for one boring (HC-1), located toward the center of Parcel 5-B, generally shows that no soil below the groundwater table and above the bearing layer is susceptible to liquefaction. Overall assessment of liquefaction susceptibility for the site will be based on the additional analyses to cover all the five borings planned for the site, but for planning purposes it is reasonable to assume the site is not prone to liquefaction. Considering the generally dense soils noted in boring HC-1, we anticipate a low potential for liquefaction or other earthquake-induced geotechnical hazards affecting this site.

PRELIMINARY GEOTECHNICAL ENGINEERING DESIGN RECOMMENDATIONS

This section of the report presents our preliminary conclusions and recommendations for the geotechnical aspects of design and construction on the project site. We developed these recommendations based on our current understanding of the project and the subsurface conditions encountered in one boring. If the nature or location of the development is different than we have assumed, we should be notified so we can change or confirm our recommendations.

Excavation/Shoring Support Options

Based on the soil and groundwater conditions, it is our opinion that a dewatered excavation could be supported using conventional soldier piles with tieback anchors or cantilevered soldier piles. In our opinion, a soil nail shoring is not suitable, considering the soil conditions encountered in HC-1. We understand that the dewatering discharge during temporary excavation can be readily handled by the existing drainage system in the area.

Soldier Pile/Tieback Support of Excavation

Soldier pile/tieback shoring is feasible for this site. Soldier piles consist of wide-flange steel sections installed in predrilled holes that are filled with concrete or slurry. Tieback anchors are similar to soil nails but may have larger diameters or are pressure-grouted. Tiebacks are prestressed to reduce wall deflection, and each anchor is proof-tested after installation. The geotechnical criteria for the design of a conventional soldier pile/tieback shoring wall are lateral soil pressures, soil adhesion, and vertical bearing capacity of soldier piles.

Lateral Earth Pressures

Lateral earth pressures for the design of conventional shoring depend on the type of shoring, its ability to deform, and the presence or absence of structures within the deformation zone. This zone can be defined approximately by a line extending into the retained soil from the base of the wall at a slope of about 1H:1V. If the top of the shoring is allowed to deform at least 0.001 to 0.002 times the height, and if no settlement-sensitive structures or utilities are located in the deformation zone, shoring may be designed using active earth pressures.

If settlement-sensitive structures or utilities are within the potential deformation zone, or where the shoring system is too stiff to allow sufficient lateral movement to develop an active condition, at-rest earth pressures should be used to design the shoring. Theoretically, little movement should occur behind shoring properly designed and installed for at-rest conditions. We will provide lateral earth pressure recommendations for shoring design after completion of additional boring explorations, and in coordination with the shoring structural designer.

Soldier Pile Design

Soldier piles will be designed to carry bending stresses from earth pressures and surcharge loads, and the embedded portion of the piles will be deep enough to resist lateral kickout and vertical loads.

When tiebacks are used, the piles will be reinforced at the tieback locations to support the prestressing or testing load, and will be designed to support the vertical loads from the inclined tiebacks without significant settlement.

When drilling the soldier pile hole, the contractor will need to be sure the methods are appropriate to the conditions. Conditions such as caving soil or seeping groundwater can loosen soil at the bottom of the soldier pile borehole, reducing the pile's bearing capacity. Tieback de-stressing and shoring failure could occur if soldier pile bearing capacity is inadequate and the soldier piles settle under the vertical component of the inclined tieback load. The contractor should be prepared to case the soldier pile installations. The need for casing will be determined in the field at the time of installation.

Timber lagging is often used to prevent ground loss between the soldier piles. The lagging is inserted between the webs of the soldier piles and is designed for some fraction of the applied pressure on the wall.

Prompt and careful installation of lagging, particularly in areas of seepage and loose soil, will be important to maintain the integrity of the excavation. Proper installation should be the responsibility of the shoring contractor; it should prevent soil failure, sloughing, and ground loss and provide safe working conditions.

Timber lagging thickness (rough cut) is typically designed according to recommendations contained in FHWA GEC 4 and experience from similar excavations in the Seattle area.

Tieback Anchor Design and Testing

When used, tieback anchors for external lateral support of the soldier pile walls will be designed to carry the loads estimated from the apparent pressure envelope to be developed during design. The tiebacks may be installed using continuous flight augers or by using rotary methods with an air return system for the cuttings. In each case, the hole is fitted with a steel bar or stranded tendons and grouted (or pressure-grouted) in a continuous operation. Each anchor is proof-tested, typically to 130 percent of the design load, and a fraction of the anchors are performance-tested to 200 percent of the design load. This testing is designed to confirm both the design soil adhesion and the satisfactory construction of the anchor.

The anchorage is obtained behind a "no-load zone" defined based on experience, shoring design theory, and site conditions. At this site, and at most sites in the area of the overconsolidated soils, Hart Crowser recommends use of a no-load zone defined by a wedge with a setback of one-fourth of the excavation height, extending upward at an angle of 60 degrees to the horizontal.

For similar sites, tiebacks have been designed with a capacity of approximately 3 to 4 kips per linear foot of bond length in very dense, granular glacial soils.

Shoring Monitoring

The shoring monitoring program will include visual and optical surveys of the adjacent buildings (as noted earlier), together with routine optical survey monitoring of the shoring system. In addition, and

as conditions warrant, we will supplement the optical survey with geotechnical instrumentation such as inclinometers, crack gauges, settlement monitors, pressure gauges, and other devices. The goal is to provide an early warning if the shoring system is not performing as designed, and to protect both the owner of the new development and the owners of the adjacent structures.

Foundation Support

Considering the soil conditions and the planned floor elevations, shallow foundations will generally be suitable. Foundations will bear on very dense glacial soil that will provide good support, with settlements occurring as the loads are applied. We expect that spread foundations consisting of footings or mats can be used, with allowable bearing pressures of 6 to 10 kips per square foot (ksf). If the below-grade construction is to be designed as a “water-tight bathtub” without permanent dewatering, additional considerations to resist uplift pressure will be required.

Floor Slab

Floor slabs can be designed as slab-on-grade structures above a free-draining capillary break drainage layer. The thickness of this layer, and the need for underslab drains, will be assessed during design.

Lateral Pressures on Permanent Subgrade Walls

Permanent walls constructed immediately adjacent to temporary shoring can be designed for the same earth pressures used in the design of the shoring system. In addition, the lateral earth pressures for permanent walls will include a seismic earth pressure increment. This additional lateral earth pressure will be approximated as a rectangular uniform load (assuming a flat back slope at the top of wall). This increment will be calculated using the IBC hazard level for the site location.

Permanent walls must be designed for groundwater pressures unless a wall and underslab drainage system are included. This may depend on the expected groundwater flows and potential restrictions on disposal of groundwater into the combined sewer. This will be assessed during design.

Drainage Considerations

Groundwater will be encountered at elevations above the bottom of the proposed building. Deep wells may be required for dewatering, and should be planned and designed by a specialty contractor if found to be necessary. After construction dewatering, groundwater seepage will produce flow into the excavation. It will be necessary to install a permanent drainage system and pressure relief for the subgrade walls and the slab at the bottom of the excavation.

Permanent and specific underslab, behind the wall, and long-term groundwater management provisions will need to be determined during design. The City may restrict the volume of water that can be permanently discharged from the site. If waterproofing is required below grade, a specialty waterproofing subconsultant should be retained to design the waterproofing system. We have seen waterproofing systems, such as a heavy plastic membrane liners, bentonite clay panels (e.g., Volclay or equivalent), and other interior or exterior sealant used effectively on projects similar to this one.

For permanent drainage, the shoring walls will need to be covered using a waffle drain material such as MiraDrain. Floor slabs will be underlain by a capillary break and drainage layer, as mentioned above. A perimeter foundation drain may also be necessary. These issues will be considered and discussed with the design team. If a more water-resistant finish is required below grade, or if the groundwater flows are larger than expected, it may be necessary to use a waterproofing system such as a heavy plastic membrane liner, bentonite clay panels (e.g., Volclay or equivalent), or other interior or exterior sealants.

Temporary Open Cuts

The stability and safety of cut slopes depend on a number of factors, including:

- The type and density of the soil;
- The presence and amount of any seepage;
- The depth of cut;
- The proximity of the cut to any surcharge loads near the top of the cut, such as stockpiled material, traffic, or structures, and the magnitude of these surcharges;
- The duration of the open excavation; and
- The care and methods used by the contractor.

Temporary soil cuts for site excavations that are more than 4 feet deep should be adequately sloped back to prevent sloughing and collapse in accordance with Washington Department of Occupational Safety and Health (DOSH) guidelines (WAC Chapter 296-155 Part N). Based on these guidelines, the soil at the site would be classified as Type C. We recommend the following for open cuts:

- Use a maximum allowable slope for excavation less than 20 feet deep of 1.5H:1V for cuts in Soil Type C.
- Use a maximum allowable slope of 1.5H:1V or flatter it groundwater seepage is encountered within the excavation slopes.
- Do not excavate below the bearing elevation of the existing footings or structural elements. Consult with the geotechnical engineer during construction to limit the size of these excavations and the amount of time they remain open.
- Protect the slope from erosion by using plastic sheeting, especially during wet weather excavation.
- Limit the maximum duration of the open excavation to the shortest time possible.
- Place no surcharge loads (equipment, materials) within 10 feet of the top of the slope, in general. However, more or less stringent requirements may apply depending on field conditions and actual surcharge loads.
- Use special care when excavating through the soft peat layer.

Because of the variables involved, actual slope angles required for stability in temporary cut areas can only be estimated prior to construction. We recommend that stability of the temporary slopes used for construction be the sole responsibility of the contractor, since the contractor is in control of the construction operation and is continuously at the site to observe the nature and condition of the

subsurface. All excavations should be made in accordance with all local, state, and federal safety requirements.

RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

Design and Consulting Services

This report presents our preliminary geotechnical engineering design recommendations, which are appropriate for a feasibility-level study. These recommendations should not be used for the design phase. We recommend that we be retained for the design phase of the project to update these recommendations and provide additional design recommendations. For the design phase, we recommend that we:

- Continue to meet with the design team periodically as design concepts and design documents progress,
- Provide updated recommendations for the elements broadly introduced in this document,
- Provide additional geotechnical recommendations based on consultation and discussion with the design team and further evaluation of the subsurface conditions,
- Provide an update to this report as part of the final design process, and
- Review the final design plans to verify that the geotechnical engineering recommendations have been properly interpreted and implemented into the design.

We recommend completing four additional borings at the site to assess subsurface conditions. Borings will be located in the field and observed by an engineering geologist from our firm, who will collect samples and prepare continuous logs of the soil and groundwater conditions encountered. We will perform limited index testing of samples retrieved from the borings.

Construction Services

After design, and before construction begins, Hart Crowser will review final foundation plans, shoring design plans and specifications, and applicable civil elements to verify that the geotechnical engineering recommendations are properly interpreted and implemented into the design.

During the construction phase of the project, Hart Crowser will observe installation of shoring systems; review shoring system displacement and monitoring results; observe excavation, subgrade preparation, and placement of foundations and slabs-on-grade; observe placement and compaction of structural fill; observe installation of subslab and wall drainage, if necessary; and address other geotechnical considerations that may arise during the course of construction.

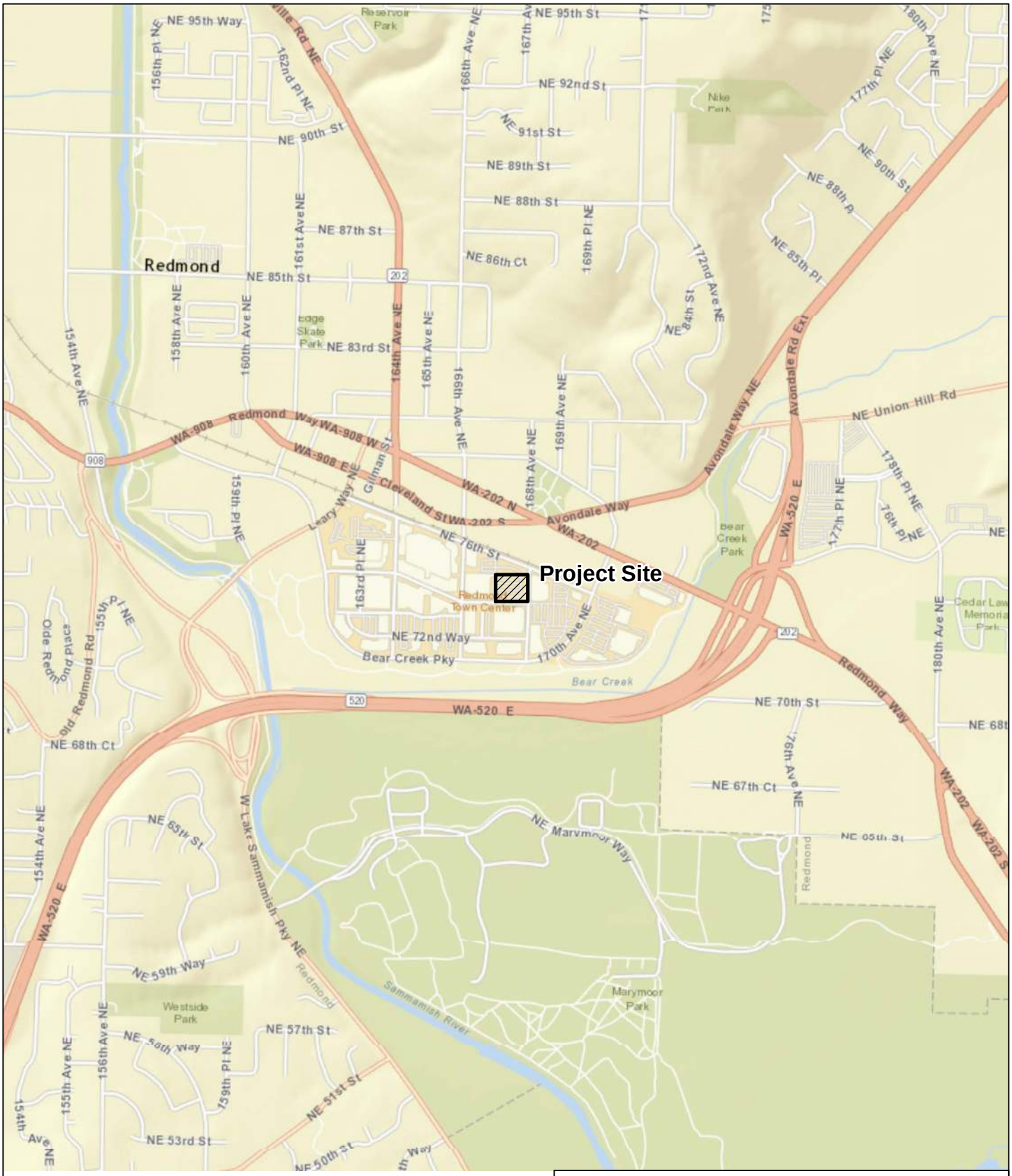
REFERENCES

ASCE 2010. Minimum Design Loads for Buildings and Other Structures, ASCE Standard ASCE/SEI 7-10.

FHWA 1999. Geotechnical Engineering Circular No. 4, Ground Anchors and Anchored Systems. FHWA-IF-99-015.

International Code Council 2012. 2012 International Building Code.

L:\Notebooks\1916201_Redmond 5B Geotech Feasibility Study\Deliverables\Reports\Preliminary Geotechnical Engineering Study\Preliminary Geotechnical Engineering Study.docx



Service Layer Credits: 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 Town Center Parcel 5-B
Redmond, Washington

Vicinity Map

19162-01 10/15

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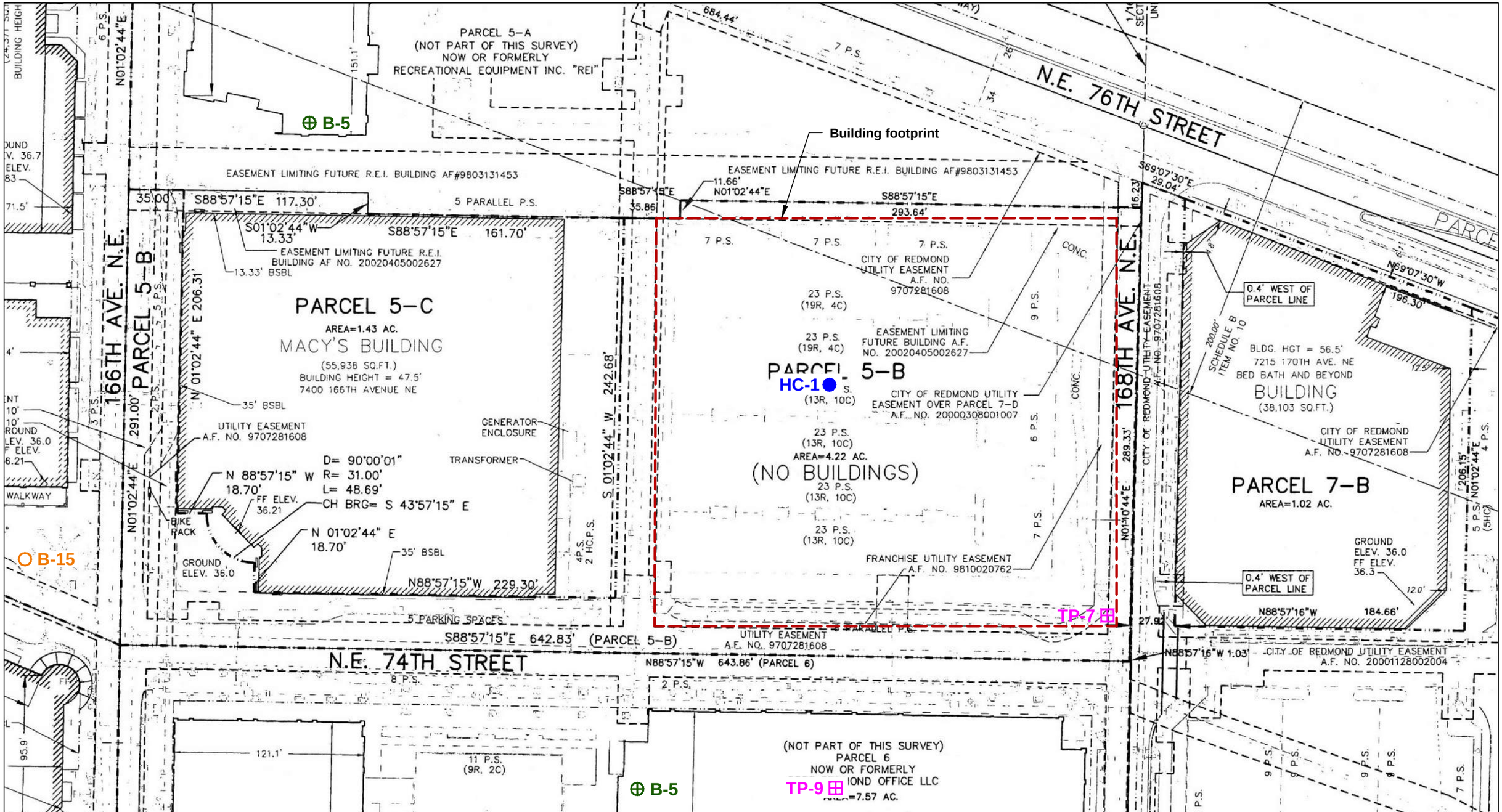
Figure

1

EAL 10/26/15 1916201-AA (VMap).mxd



Legend

HC-1 ●	Boring (Hart Crowser 2015)	B-5 ⊕	Boring (Hart Crowser 1979)
B-15 ○	Boring (Hart Crowser 1982)		
TP-7 ⊞	Test pit (Hart Crowser 1982)		

0 60 120
Approximate Scale in Feet

N

Source: Base map prepared from a scanned copy of a survey document created by White Shield, Inc., dated 7/19/13.

Redmond Town Center Parcel 5-B
Redmond, Washington

Site and Exploration Plan

19162-01 10/15

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Figure
2

EAL 10/28/15 1916201-001 (SPlan).dwg

APPENDIX A
Field Exploration Methods and Analysis

APPENDIX A

Field Explorations Methods and Analysis

This appendix documents the processes Hart Crowser used to determine the nature of the site soil and groundwater. This appendix includes information on the following subjects:

- Explorations and Their Location;
- Hollow-Stem Auger Borings;
- Standard Penetration Test Procedures; and
- Monitoring Well Installation.

Explorations and Their Location

Subsurface explorations for this project included one hollow-stem auger (HSA) boring. The exploration logs in this appendix show our interpretation of the drilling, sampling, and testing data. The logs indicates the depth where soils change. Note that the actual change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1 - Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Figure 2 illustrates the horizontal locations of explorations, which are based on field measurements from existing physical features. The elevations on the logs are taken from the elevation contours on the site plans provided to us. The vertical datum is NAVD88. All elevations presented in this report are based on NAVD88.

Hollow-Stem Auger Borings

One HSA boring, designated HC-1, was completed on September 25, 2015 to a depth of 51.5 feet using a 4-1/4-inch inside diameter hollow-stem auger. The boring was advanced with a truck-mounted drill rig subcontracted by Hart Crowser. The drilling was continuously observed by a geologist from Hart Crowser. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT), we obtained samples at 2-1/2- and 5-foot depth intervals.

Standard Penetration Test Procedures

The standard penetration test (SPT) method (as described in ASTM D 1586) was used to obtain disturbed samples. This test is an approximate measure of soil density and consistency. To be useful, the results must be used with engineering judgment in conjunction with other tests. The SPT test employs a standard 2-inch-outside-diameter split-spoon sampler. Using a 140-pound hammer, free-falling 30 inches, the sampler is driven into the soil for 18 inches. The number of blows required to drive the sampler <u>the last 12 inches only</u> is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. If a total of 50 blows are struck within any 6-inch interval, the driving is stopped and the blow count is

recorded as 50 blows for the actual penetration distance. The blow counts are plotted on the boring logs at their respective sample depths.

Monitoring Well Installation

Monitoring wells were installed in boring HC-1 to allow for long-term groundwater level monitoring at the site.

We used 2-inch-diameter Schedule 40 PVC riser pipe and 2-inch-diameter 0.020-inch machine-slotted screen for the well casings and screens. The well screen and casing riser were lowered down through the hollow-stem auger. As the auger was withdrawn, No. 10/20 silica sand was placed in the annular (ring-shaped) space from the base of the boring to approximately 2 to 3 feet above the top of the well screen.

Well seals were constructed by placing bentonite chips in the annular space on top of the filter sand to within 3 feet of the ground surface. The remaining annular space was backfilled with concrete to complete the surface seal. For security, the monitoring wells were completed with a flush-mounted steel monument set in concrete. The monitoring well construction details are illustrated on the boring logs.

The monitoring wells were installed in accordance with Washington State Department of Ecology regulations.

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 to 4	Very soft	0 to 2	<0.125
Loose	4 to 10	Soft	2 to 4	0.125 to 0.25
Medium dense	10 to 30	Medium stiff	4 to 8	0.25 to 0.5
Dense	30 to 50	Stiff	8 to 15	0.5 to 1.0
Very dense	>50	Very stiff	15 to 30	1.0 to 2.0
		Hard	>30	>2.0

Sampling Test Symbols

- 1.5" I.D. Split Spoon
- Grab (Jar)
- 3.0" I.D. Split Spoon
- Shelby Tube (Pushed)
- Bag
- Cuttings
- Core Run

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Laboratory Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits

Water Content in Percent
Liquid Limit
Natural
Plastic Limit

PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density in PCF
OT	Tests by Others

Groundwater Indicators

- Groundwater Level on Date or (ATD) At Time of Drilling
- Groundwater Seepage (Test Pits)

Sample Key

Sample Type
Sample Recovery
S-1
12
23
50/3"
Sample Number
Blows per 6 inches

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19162-01 *9/15*

Figure A-1

KEY SHEET 1916201-BL.GPJ HC_CORP.GDT 10/28/15

Boring Log HC-1

Location: Lat: 47.670450 Long: -122.117100
Approximate Ground Surface Elevation: 42 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Hollow Stem Auger
Hammer Type: SPT w/ 140 lb. Autohammer
Hole Diameter: 8 inches
Logged By: B. McDonald Reviewed By: J. Bruce

USCS Class	Soil Descriptions	Depth in Feet
GW-GM	6 inches of Asphalt over medium dense to dense, moist, brownish gray to gray, slightly silty, very sandy GRAVEL with occasional cobbles and boulders.	0
GW-GM	Dense to very dense, wet, gray, slightly silty, very sandy GRAVEL.	15
SW-SM	Dense to very dense, wet, brownish gray to gray, slightly silty SAND to SAND with trace gravel.	37

Well Construction: Flush mount monument; Concrete; Bentonite chips; 10-20 Silica sand; Screened 2" PVC; 9/28/15

Sample	Blows per Foot	LAB TESTS
S-1		
S-2	2 12 12	
S-3	13 27 22	
S-4	9 14 18	
S-5	5 8 10	
S-6	10 15 15	GS
S-7	3 10 13	
S-8	13 19 27	GS
S-9	9 15 17	GS
S-10	12 30 44	GS
S-11	19 38 50/5"	
S-12	6 11 30	GS

STANDARD PENETRATION RESISTANCE: ▲ Blows per Foot (0, 10, 20, 30, 40, 50+); ● Water Content in Percent (0, 20, 40, 60, 80, 100+)

NEW BORING LOG 1916201-BL.GPJ HC_CORP.GDT 10/28/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

Boring Log HC-1

Location: Lat: 47.670450 Long: -122.117100
Approximate Ground Surface Elevation: 42 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Hollow Stem Auger
Hammer Type: SPT w/ 140 lb. Autohammer
Hole Diameter: 8 inches
Logged By: B. McDonald Reviewed By: J. Bruce

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Well Construction	Sample	Blows per Foot (0 10 20 30 40 50+)	Water Content in Percent (0 20 40 60 80 100+)	LAB TESTS
SW-SM		Dense to very dense, wet, brownish gray to gray, slightly silty SAND to SAND with trace gravel. (cont'd)	45		S-13	16 25 22		
			50		S-14 A/B	12 22 37		
		Sandy GRAVEL.						
		Bottom of Boring at 51.5 Feet.						
		Started 09/25/15.						
		Completed 09/25/15.						
		Ecology Well Tag #BJB-600	55					
			60					
			65					
			70					
			75					
			80					
			85					
			90					

NEW BORING LOG 1916201-BL.GPJ HC_CORP.GDT 10/28/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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APPENDIX B
Laboratory Testing Program

APPENDIX B

Laboratory Testing Program

A laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. The tests performed and the procedures followed are outlined below.

Soil Classification

Soil samples from the explorations were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations include relative density/consistency, moisture condition, and grain size estimates.

The classifications of selected samples were checked by laboratory tests such as grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Water Content Determinations

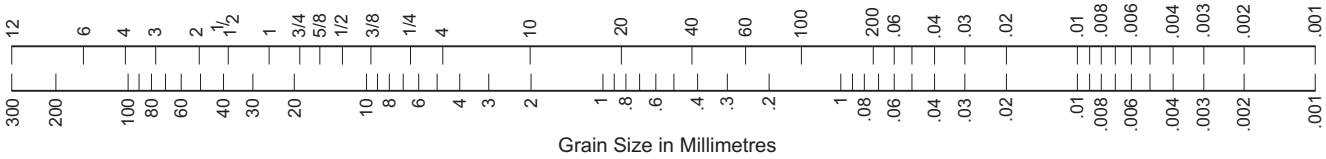
Water content was determined for most samples recovered in the explorations in general accordance with ASTM D 2216, as soon as possible following their arrival in our laboratory. Water contents were not determined for very small samples or samples where large gravel contents would result in unrepresentative values. The results of these tests are plotted or presented at the respective sample depth on the exploration logs. In addition, water contents are routinely determined for samples subjected to other testing. These are also presented on the exploration logs.

Grain Size Analysis

Grain size distribution was analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The results of the tests are presented as curves on Figures B-2 and B-3 plotting percent finer by weight versus grain size.

Unified Soil Classification (USC) System
Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

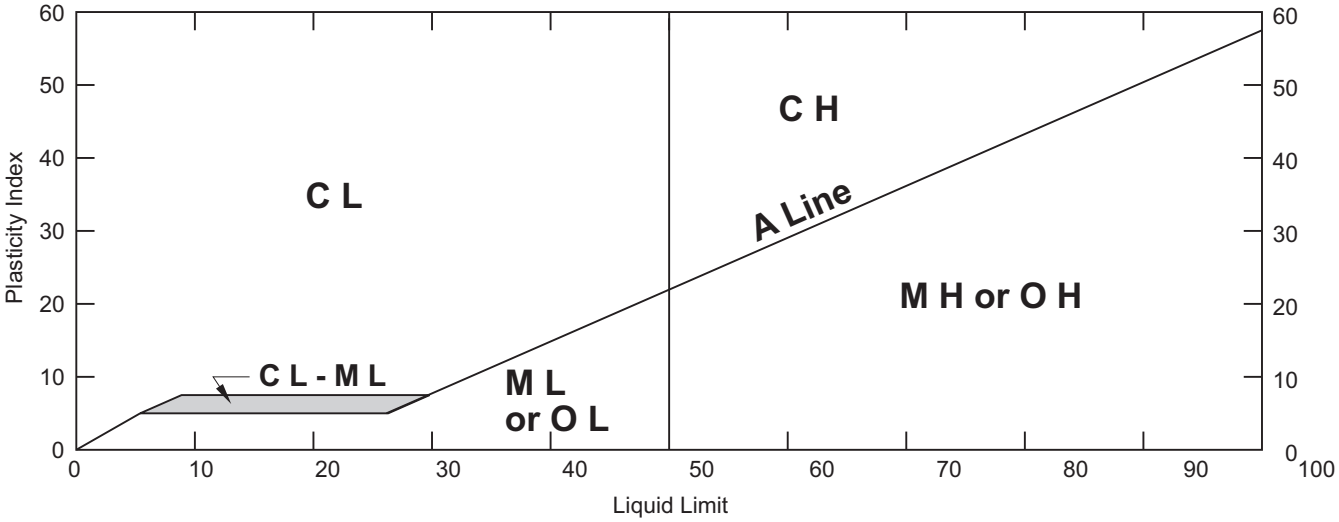
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



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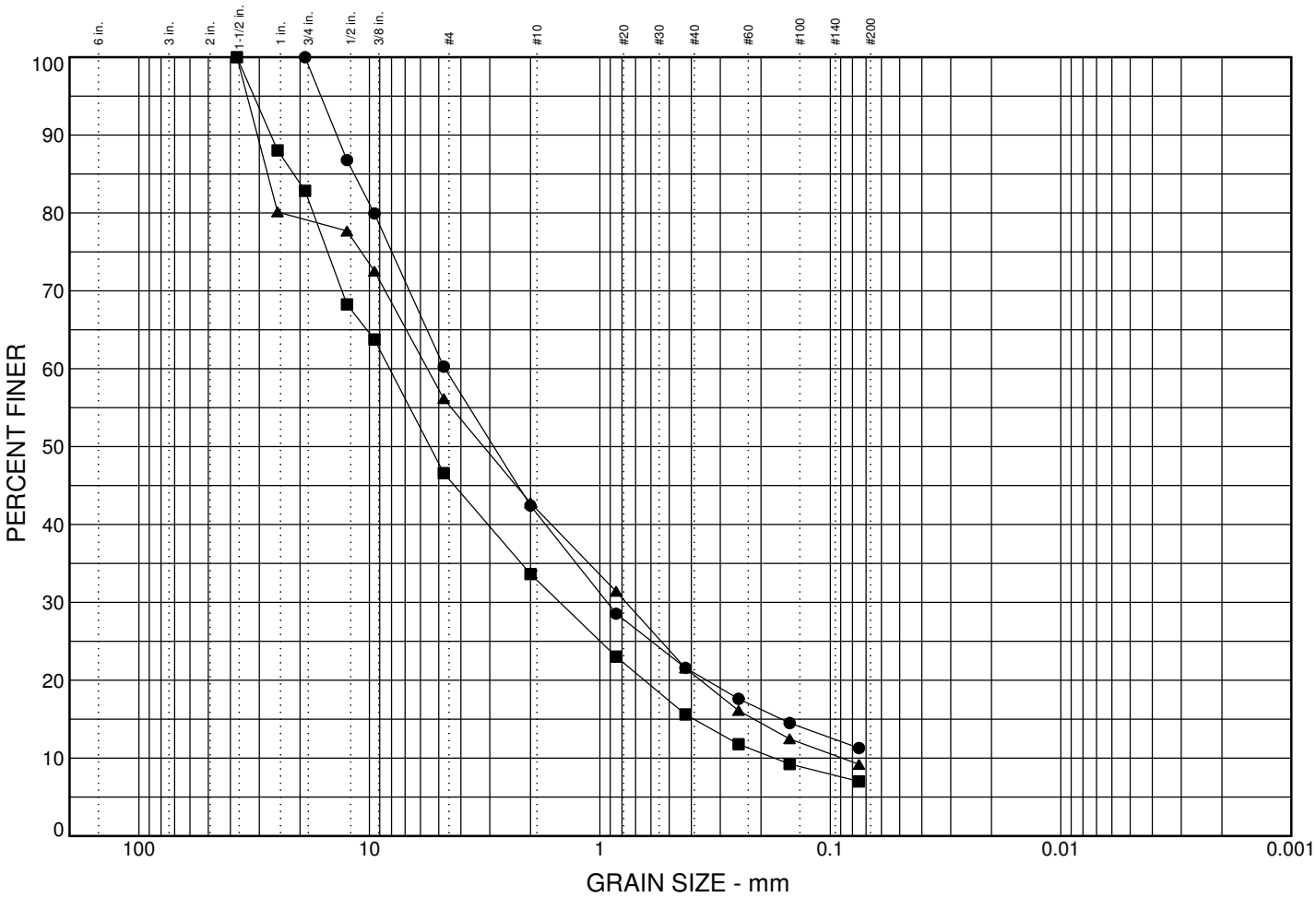
SRF Grain Size (B-1).cdr 3/06

19162-01 9/15

Figure B-1

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	39.7	49.0	11.3	
■	0.0	53.4	39.6	7.0	
▲	0.0	43.8	47.0	9.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			11.63	4.687	2.886	0.929	0.163		3.25	82.76
■			21.293	8.157	5.447	1.491	0.391	0.175	1.56	46.71
▲			27.614	5.59	3.191	0.769	0.214	0.089	1.19	62.89

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, very gravelly SAND	SP-SM	5.8%
■ slightly silty, very sandy GRAVEL	GW-GM	8.9%
▲ slightly silty very gravelly SAND	SW-SM	9.5%

Remarks:

●

■

▲

Project: Redmond Town Center Parcel 5-B

Client:

● Source: HC-1	Sample No.: S-6	Depth: 12.5 to 14.0
■ Source: HC-1	Sample No.: S-8	Depth: 20.0 to 21.5
▲ Source: HC-1	Sample No.: S-9	Depth: 25.0 to 26.5

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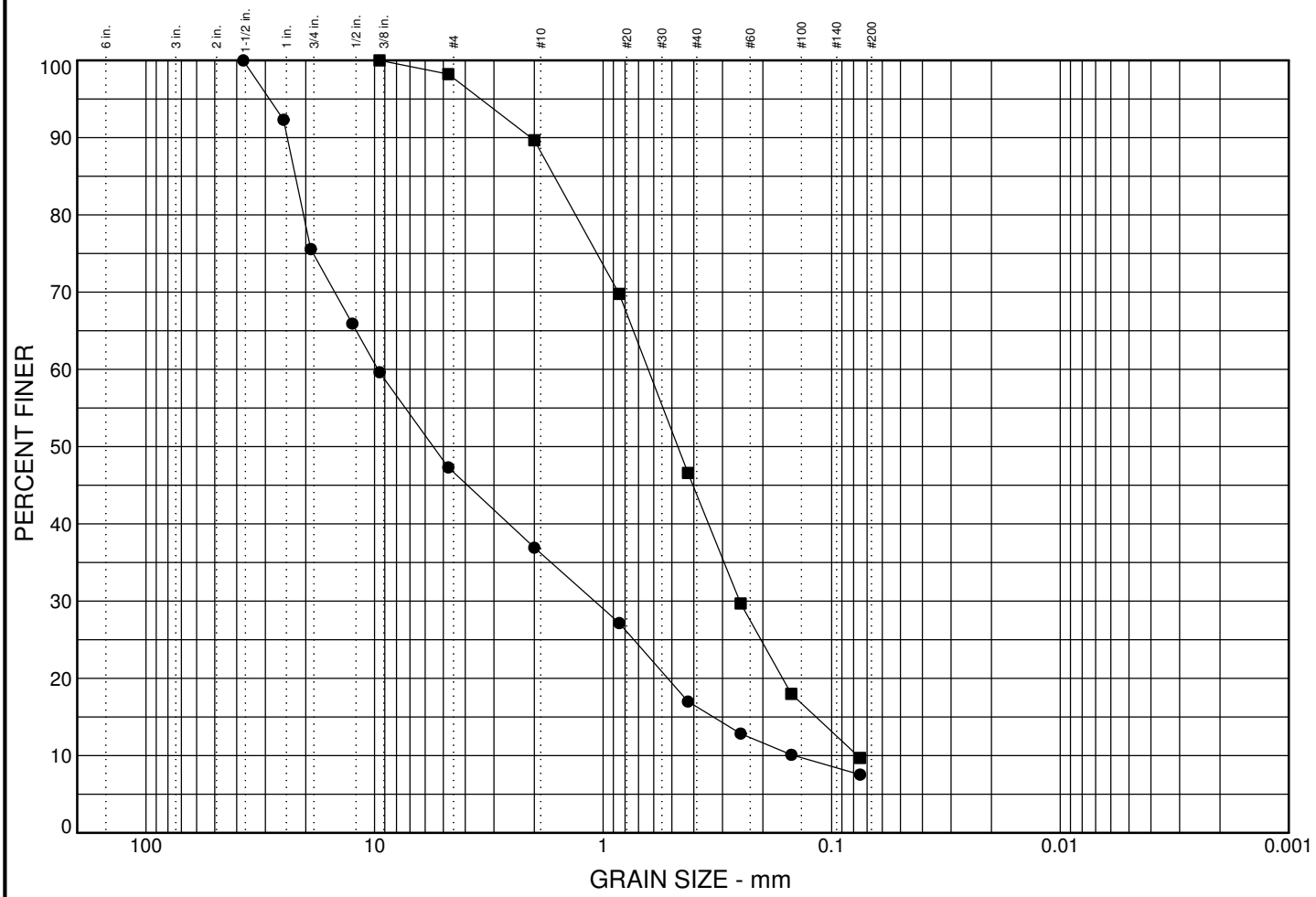
19162-01 *9/15*

Figure B-2

GRAIN SIZE 1916201-BL.GPJ HC_CORP.GDT 10/28/15

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	52.7	39.8	7.5	
■	0.0	1.8	88.5	9.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			22.172	9.65	5.525	1.09	0.329	0.146	0.85	66.30
■			1.636	0.635	0.471	0.252	0.117	0.077	1.30	8.24

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, very sandy GRAVEL	GP-GM	8.5%
■ slightly silty SAND, trace gravel	SW-SM	17.5%

Remarks:

●

■

Project: Redmond Town Center Parcel 5-B

Client:

● Source: HC-1 Sample No.: S-10 Depth: 30.0 to 31.5
■ Source: HC-1 Sample No.: S-12 Depth: 40.0 to 41.5

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19162-01 *9/15*

Figure B-3

GRAIN SIZE 1916201-BL.GPJ HC_CORP.GDT 10/28/15

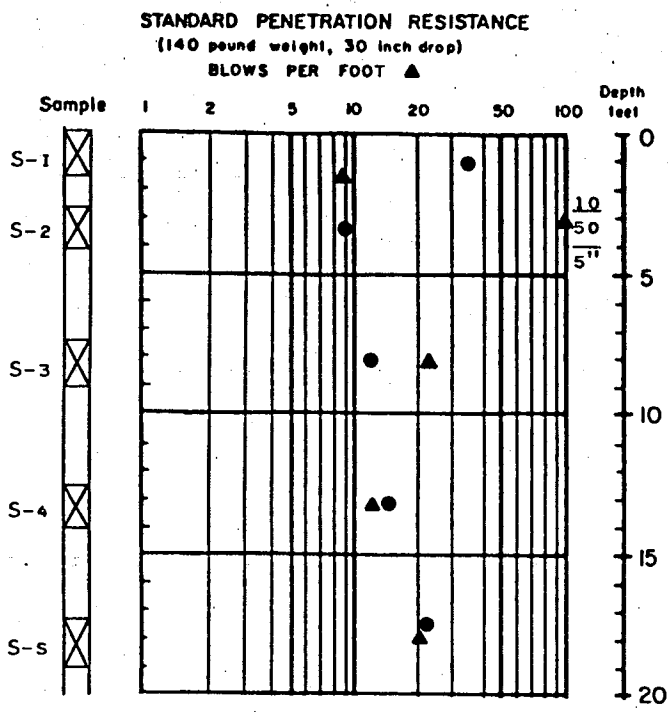
APPENDIX C
Historical Explorations

APPENDIX C

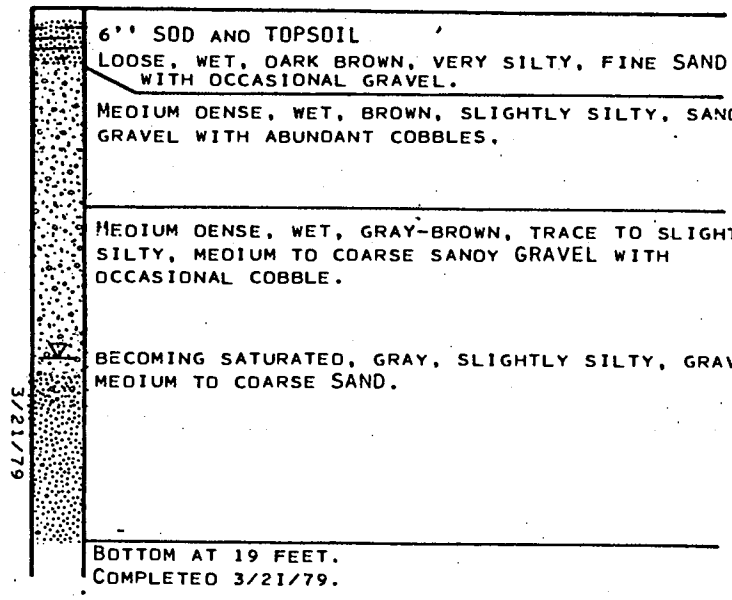
Historical Explorations

We reviewed existing historical explorations to gain an understanding of the subsurface conditions near the site. Historical borings located in the vicinity are presented as they appear in original reports. Approximate locations of these historical explorations are shown on Figure 2; actual locations may differ from those shown.

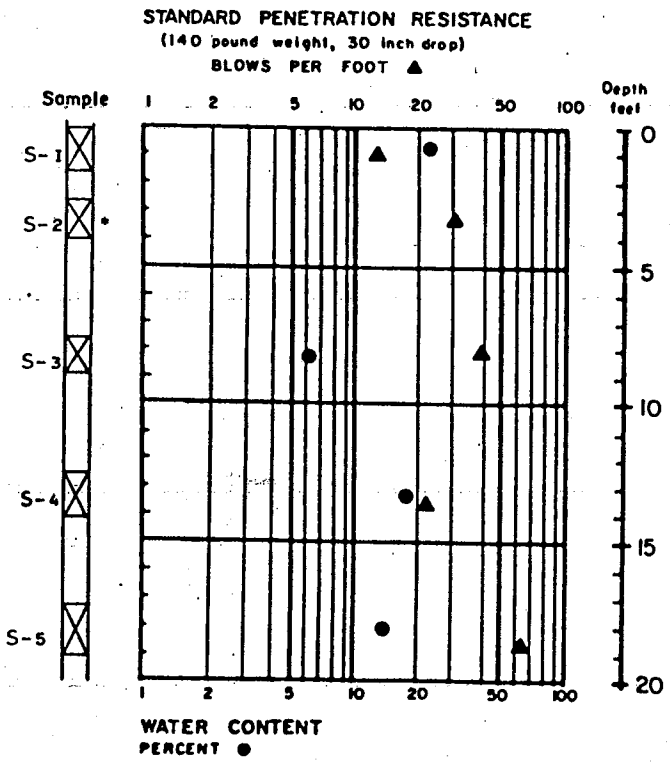
BORING LOG B-4



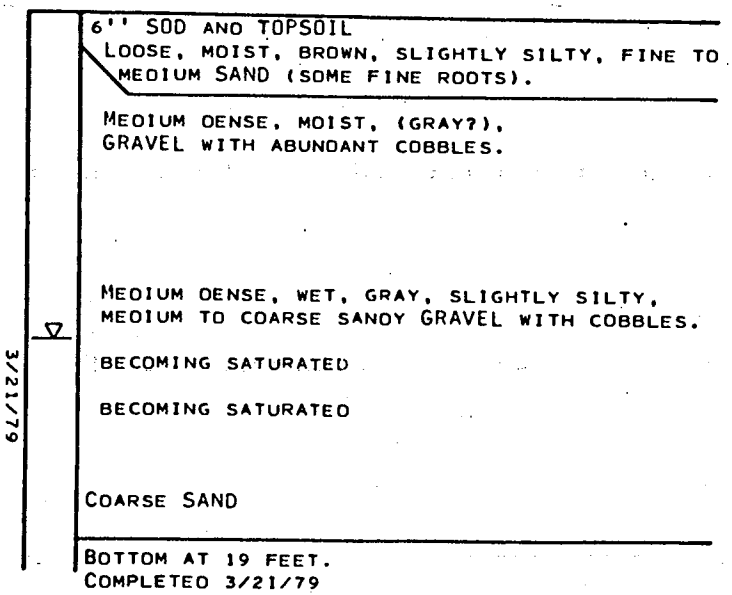
SOIL INTERPRETATION



BORING LOG B-5



SOIL INTERPRETATION



LEGEND

- ⊠ 2" O.D. Split Spoon Sample
- ⊠ 3" O.D. Shelby Sample
- ★ No Sample Recovery
- ▽ Water Level
- ▯ Observation Well

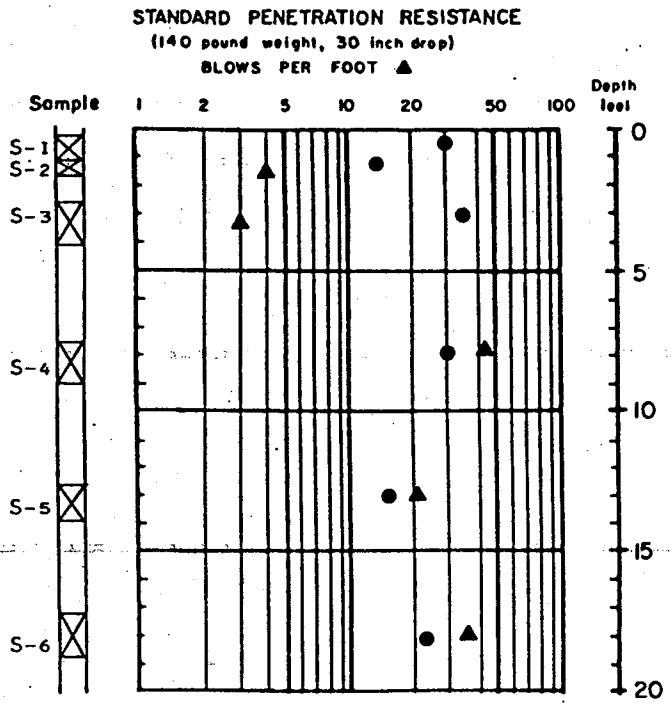
NOTE: Soil descriptions are interpretive and actual changes may be gradual.

J-791 March 1979

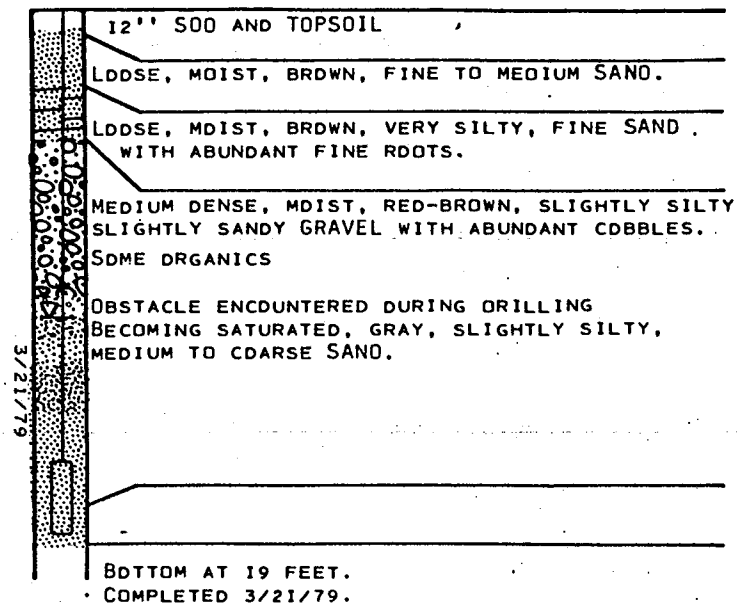
HART-CROWSER & associates inc.

Figure A-3

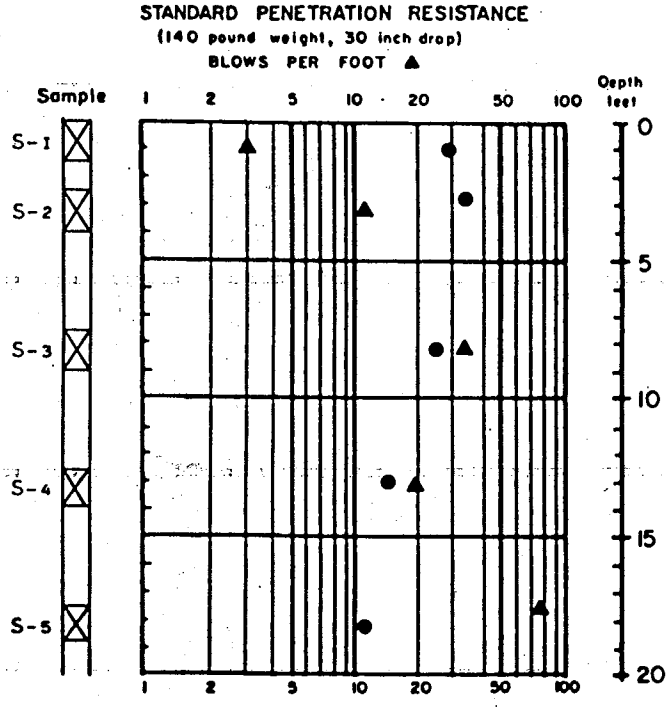
BORING LOG B-9



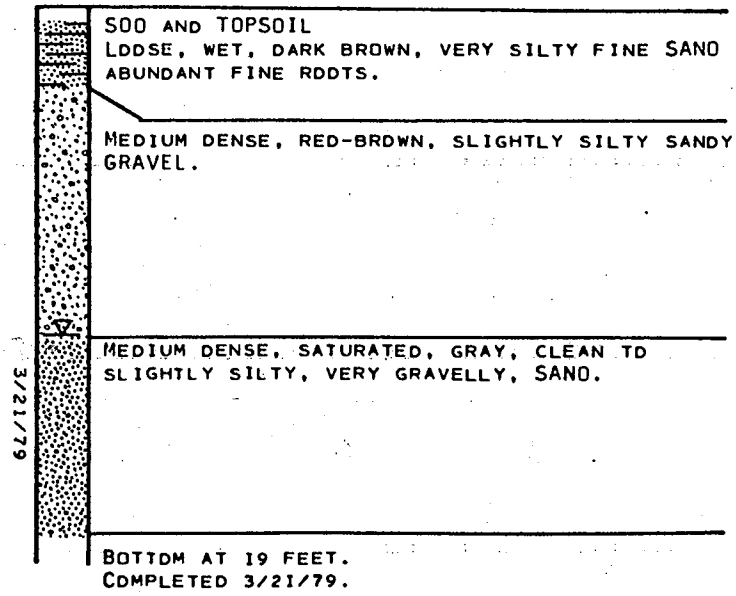
SOIL INTERPRETATION



BORING LOG B-10



SOIL INTERPRETATION



LEGEND

- ⊠ 2" O.D. Split Spoon Sample
- ⊠ 3" O.D. Shelby Sample
- ★ No Sample Recovery
- ▽ Water Level
- ▯ Observation Well

NOTE: Soil descriptions are interpretive and actual changes may be gradual.

J-791 March 1979

HART-CROWSER & associates inc.

Figure A-6

Boring Log B-15

SOIL INTERPRETATION

STANDARD PENETRATION RESISTANCE (140 pound weight, 30 inch drop)

LABORATORY TESTS

Approximate Ground Surface Elevation in Feet

MEDIUM DENSE, WET, DARK BROWN, GRAVELLY, SILTY SAND TO SANDY SILT.

SLIGHTLY ORGANIC.

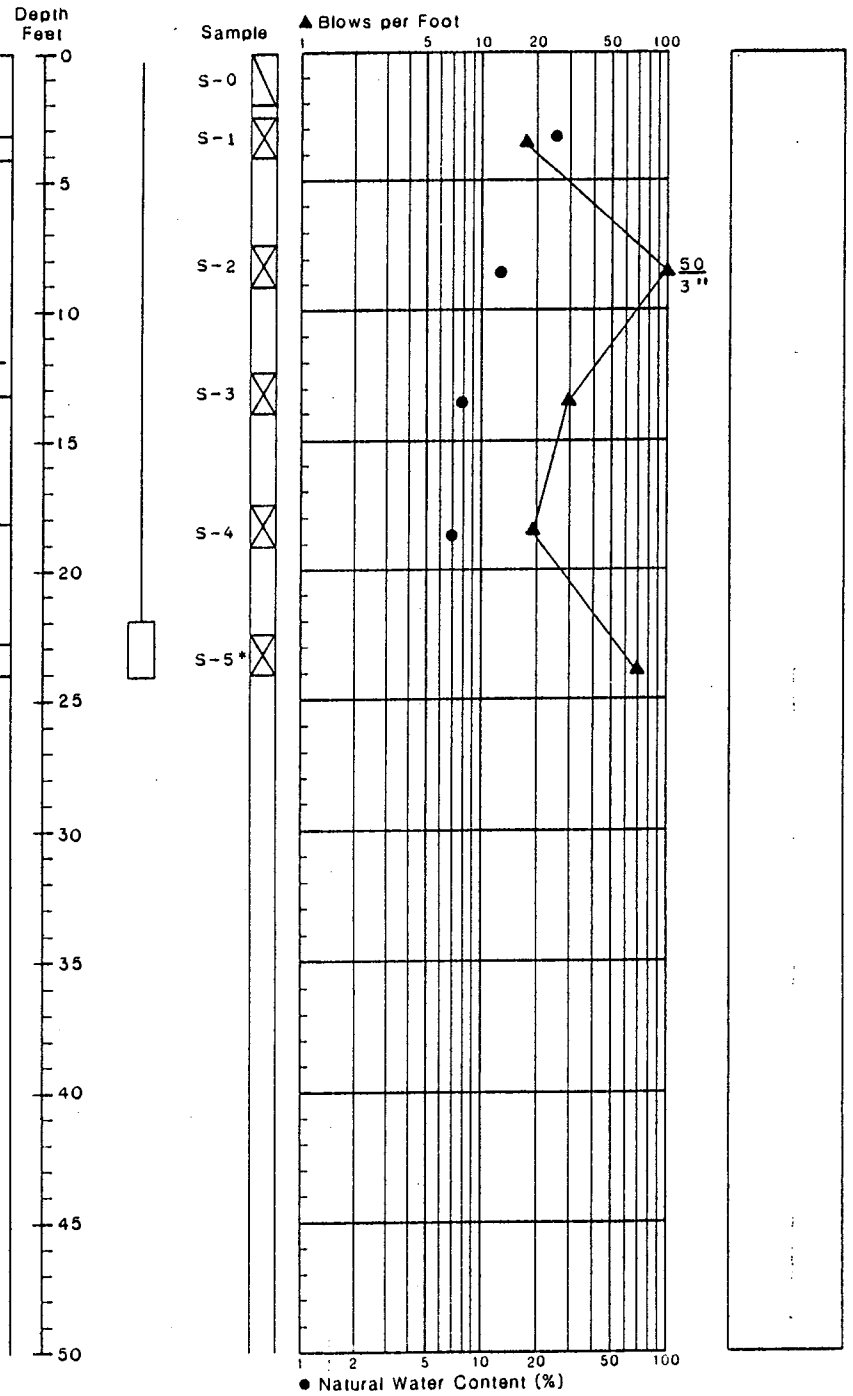
VERY DENSE, SATURATED, BROWN, GRAVELLY, SILTY SAND.

DENSE, GRAY AND TRACE SILT BELOW 12 FEET

MEDIUM DENSE.

VERY DENSE.

BOTTOM OF BORING 24.0 FEET
COMPLETED 12/15/81



Groundwater Level

Bentonite Seal

2/4/81 ATD — Water Level (Date) At Time of Drilling

Observation Well Tip or Slotted Section

Sampling

- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- Cutting Sample
- * No Sample Recovery

Laboratory Tests

GS	Grain Size Analysis
CN	Consolidation Test
K	Permeability Test
DS	Direct Shear
QU	Unconfined Compression, tsf
TV	Torvane, tsf
PP	Pocket Penetrometer, tsf
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained

Water Content (%)

Plastic Limit — Natural Water Content — Liquid Limit

Notes

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year

J-791-01 December 1981

HART-CROWSER & associates inc.

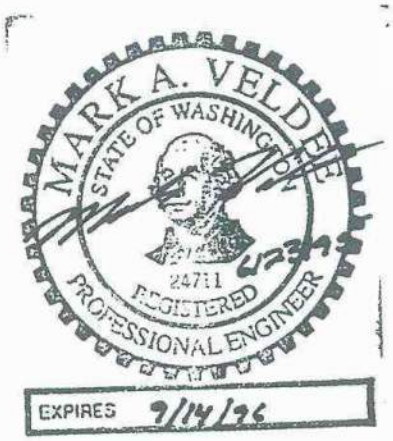
Figure A-5

Appendix C

Redmond Town Center - Infrastructure Drainage Calculations

REDMOND TOWN CENTER
Phase 1

Infrastructure
Drainage Calculations



Prepared by:

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

June 23, 1995

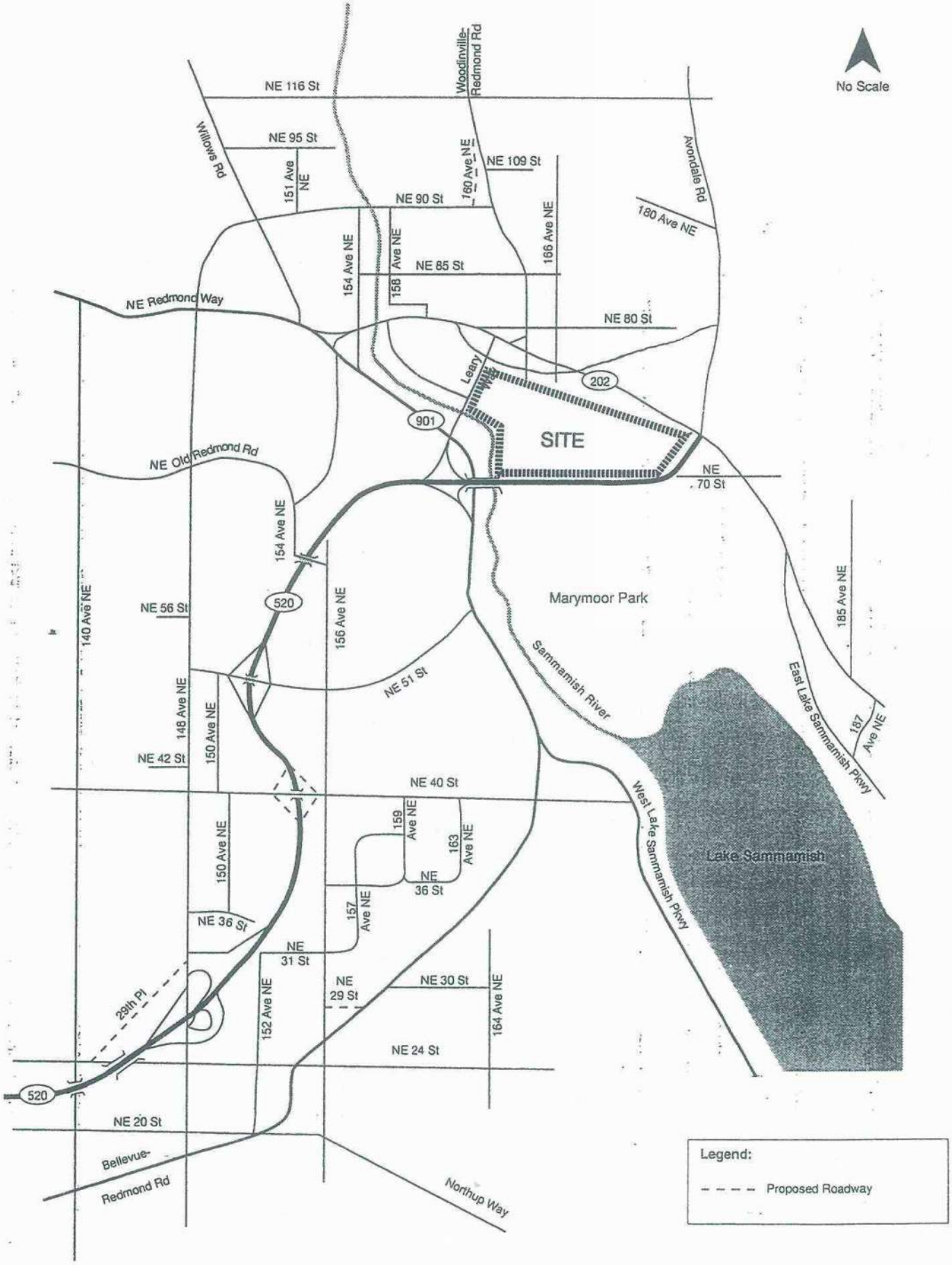
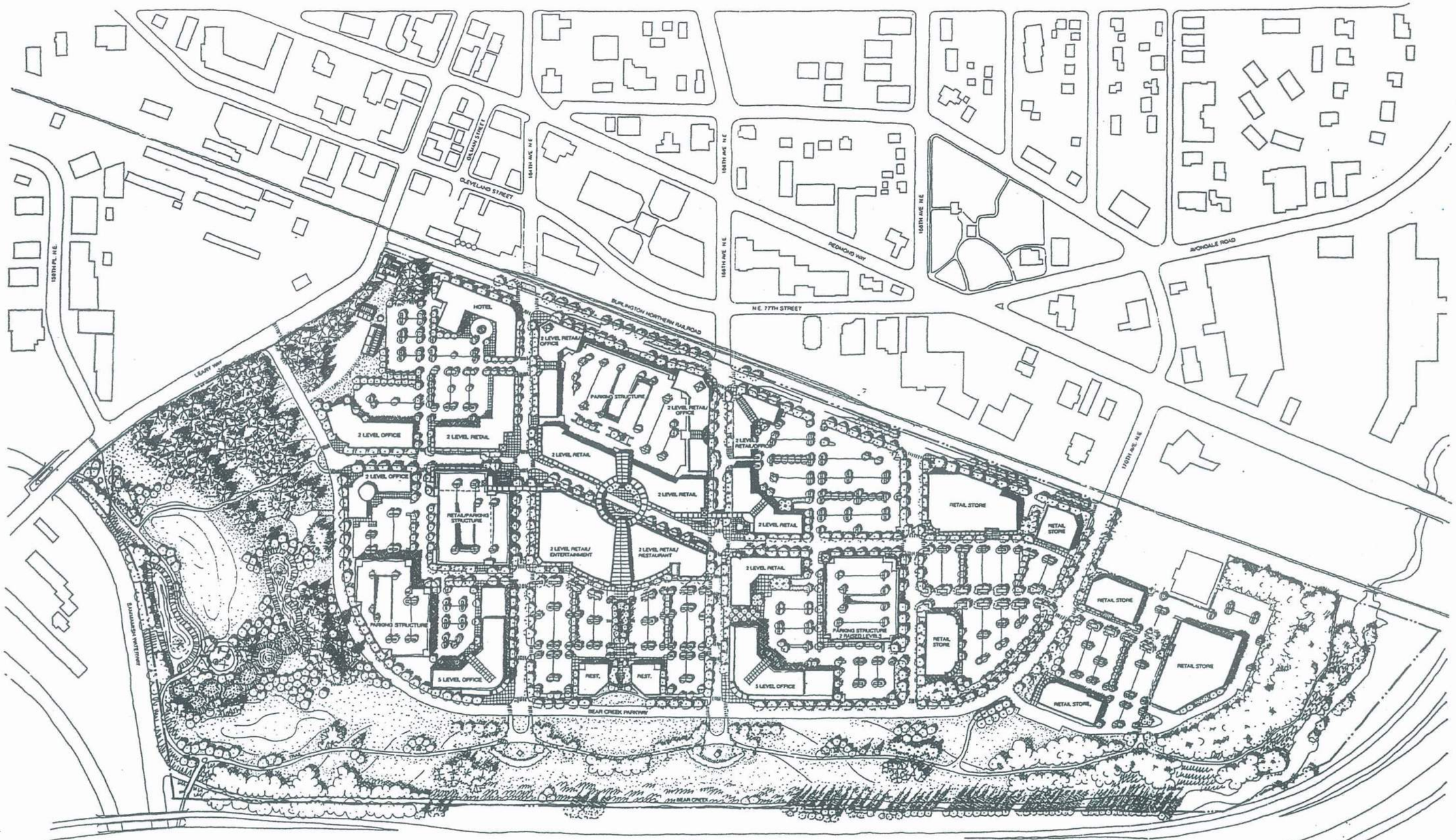

No Scale
NE 116 St
Woodinville-Redmond Rd
Willows Rd
NE 95 St
151 Ave NE
160 Ave NE
NE 109 St
Avondale Rd
NE 90 St
180 Ave NE
154 Ave NE
158 Ave NE
166 Ave NE
NE 85 St
NE Redmond Way
NE 80 St
Leary Way
202
901
SITE
NE Old Redmond Rd
NE 70 St
154 Ave NE
140 Ave NE
NE 56 St
520
156 Ave NE
Marymoor Park
185 Ave NE
Sammamish River
NE 51 St
148 Ave NE
150 Ave NE
East Lake Sammamish Pkwy
187 Ave NE
NE 42 St
NE 40 St
159 Ave NE
163 Ave NE
West Lake Sammamish Pkwy
Lake Sammamish
150 Ave NE
NE 36 St
157 Ave NE
NE 36 St
NE 31 St
29th Pl
NE 29 St
NE 30 St
152 Ave NE
164 Ave NE
NE 24 St
520
NE 20 St
Bellevue-Redmond Rd
Northup Way
Legend:
Proposed Roadway

Figure
Base



SR-520

FULL BUILD-OUT

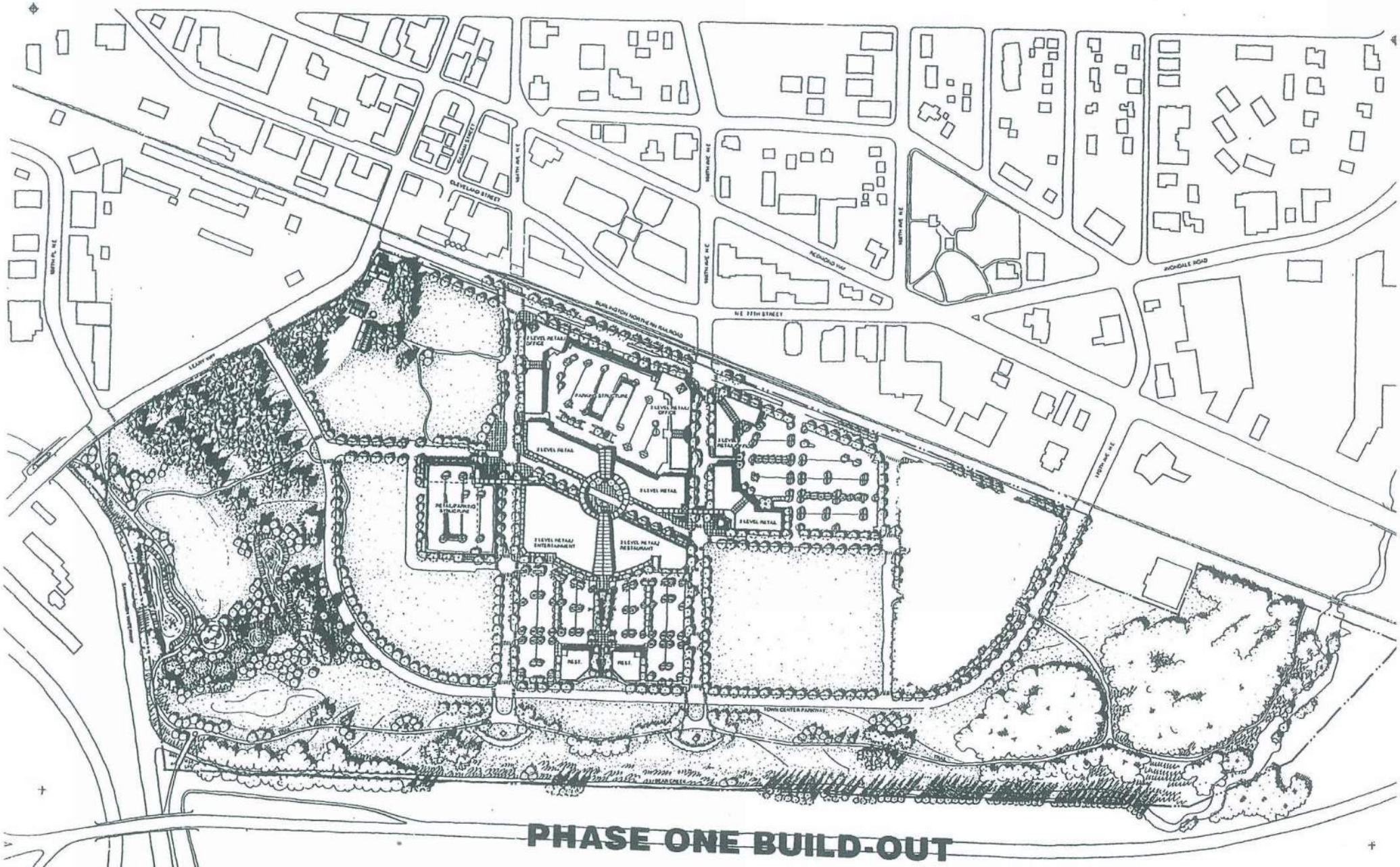
LMN
LOSCHKY MARQUAROT & NESHOLM

0 25 50 100 200

REDMOND
TOWN CENTER

NORTH

WINMAR
COMPANY INC



PHASE ONE BUILD-OUT

LMN
LOSCHEY MARQUARDT & NESHOLM

0 25 50 100 200

REDMOND
TOWN CENTER

NORTH

WINMAR COMPANY, INC

EXISTING CONDITIONS

Description

A rough grading permit has been applied for on 6-2-95. This permit will allow clearing and grubbing, and the placement of fill on site. The following existing conditions description applies to the site prior to rough grading.

The project site encompasses 120 acres located at the confluence of Bear Creek and the Sammamish River. The majority of the project site was filled in the early part of the 1900's as part of ongoing and developing agricultural land uses. The site can be characterized into distinct areas based on past land uses and existing vegetation communities. A description of these areas follows:

- The Abandoned Redmond Golf Course Site

  This area was developed as a golf course several years ago and, although no longer used as a golf course, continues to retain such landscape characteristics. The plant community is dominated by seeded turf grasses, bluegrasses and mature coniferous trees. The mature trees outlined the old golf course fairways. Invasive species such as Himalayan blackberry, scotch broom and Canadian thistle are becoming established within the plant community as a result of the lack of continuous mowing and removal. These invasive species are most evident around the exterior of the golf course.

- Butler Walls Parcel

  This area is located north of the Bear Creek floodplain wetland area and east of the old golf course. This area appears to have been used for agricultural purposes until approximately 1980, at which time it was filled in anticipation of commercial development. The plant community is dominated by invasive/volunteer species which include sapling red alder, sapling black cottonwood, Himalayan blackberry, scotch broom and a few douglas fir saplings. This area contains the overflow flood channel that conveys Bear Creek flood flows that exceed the capacity of the Burlington Northern trestle crossing.

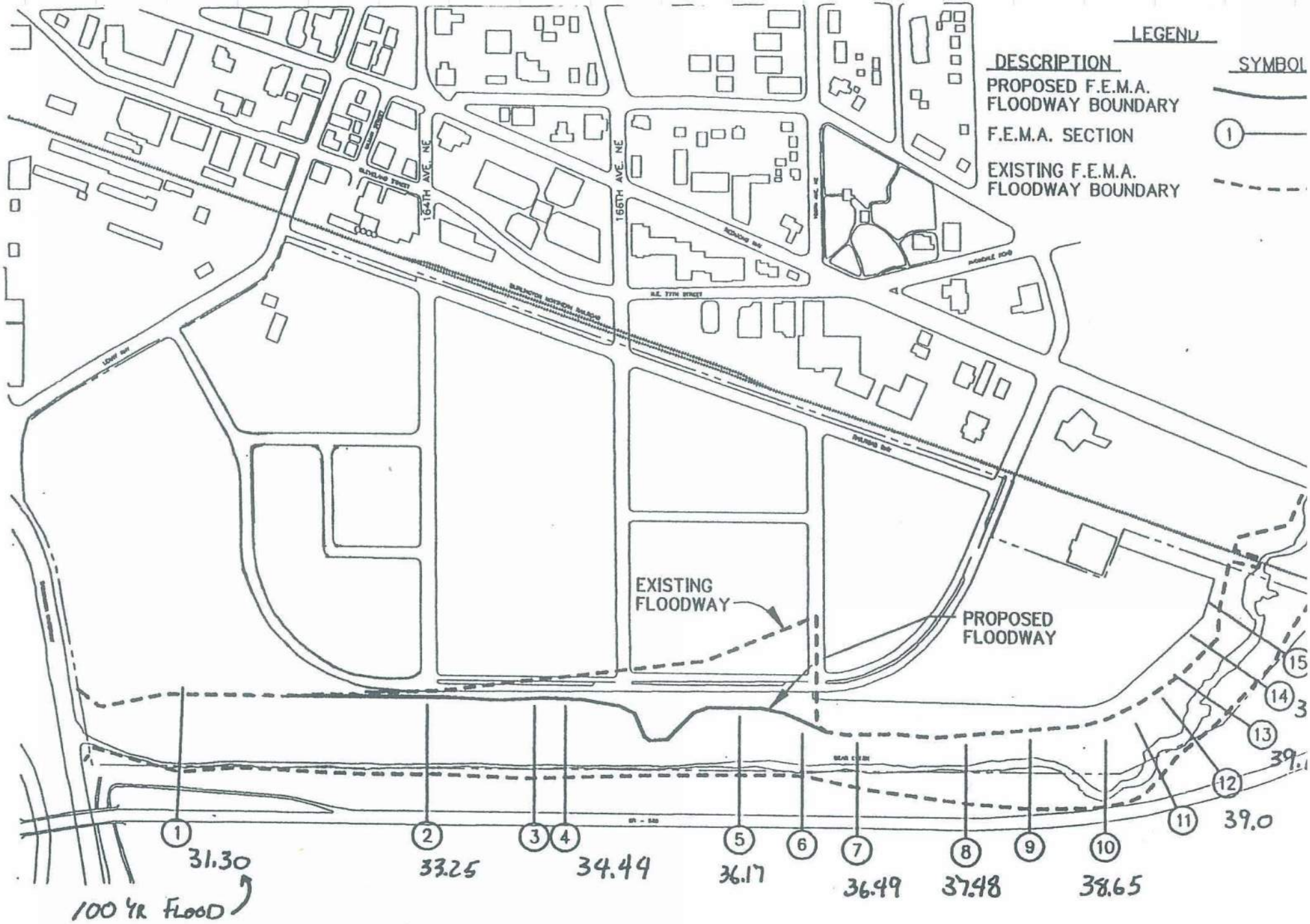
The site topography is very flat with an average slope of 0.5% falling generally from the Burlington Northern Railroad tracks to Bear Creek and the Sammamish River.

Tributary Off-Site Flows

Off-site flows tributary to the project are limited by the topography and the adjacent railroad tracks. The Leary Way biofiltration swale receives stormwater from the widened street section then discharges to the Sammamish River. This swale is located at the western corner of the site. The floodway that bisects the Butler Walls site receives periodic flood overflows from Bear Creek and stormwater from the American Family Health Club and a limited area north of the Railroad tracks, including the Seafirst Bank. Neither the Leary Way nor the flood overflow channel will be affected by Phase 1 construction.

Flood Considerations

Both Bear Creek and the Sammamish River flood during extreme rainfall events. On-site road and building elevations are driven by the Bear Creek 100-year flood elevations established by the Montgomery Water Group FEMA Letter of Map Revision, dated November 28, 1994. One hundred-year flood elevations along the Sammamish River have been determined from the enclosed FEMA Flood Profile 73 P.



PROPOSED REVISION TO F.E.M.A. FLOODWAY

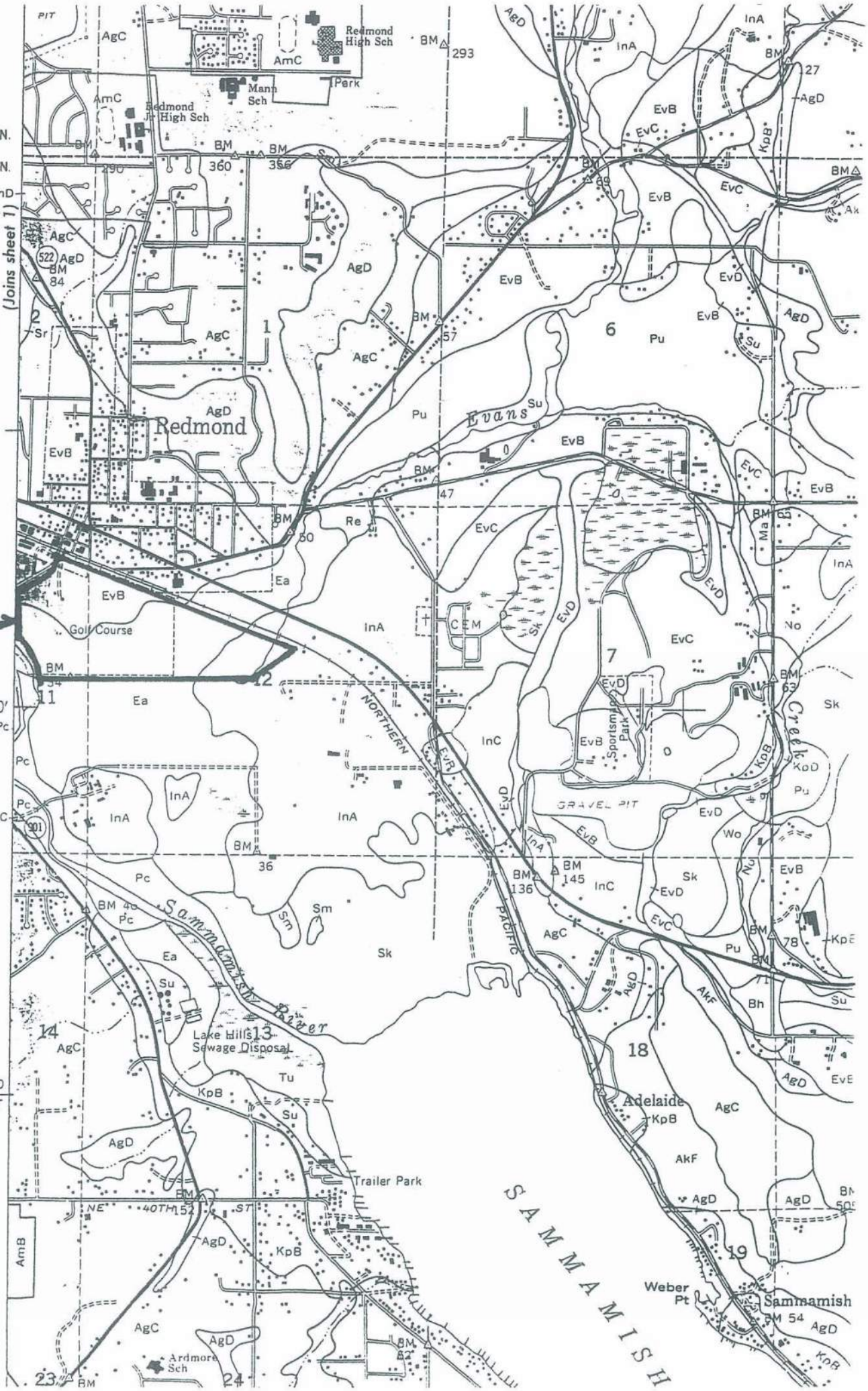
REDMOND TOWN CENTER

Existing Soils

The SCS soils survey describes the site as approximately one-third Everett series soil (Type A) and two-thirds Earlmont series (Type D). The computer model for the existing conditions follows these parameters.

SCS SOILS MAP

PROPOSED SITE



N

depth is restricted. The available water capacity is high. Runoff is slow, and the erosion hazard is slight.

This soil is used for seeded pasture and hay. Capability unit IIIw-2; woodland group 4w1.

Coastal Beaches

Coastal beaches (Cb) are long, narrow areas of sand and gravel along Puget Sound. Small areas of tidal marsh are included. These beach areas are above mean tide but are swept by storm waves. Capability unit VIIIw-1; no woodland classification.

Earlmont Series

The Earlmont series is made up of somewhat poorly drained soils that formed in diatomaceous material. These nearly level soils are on flood plains. Slopes are less than 1 percent. The annual precipitation is 45 to 50 inches, and the mean annual air temperature is about 50° F. The frost-free season is about 200 days. Elevation is about 40 feet.

In a representative profile, the surface layer is dark grayish-brown silt loam about 9 inches thick. The subsoil is grayish-brown, light brownish-gray, and brown silt loam and silty clay loam about 35 inches thick. The substratum is stratified very fine sandy loam, muck, and diatomite. It extends to a depth of 60 inches or more.

Earlmont soils are used for row crops and grass pasture.

Earlmont silt loam (Ea).--This nearly level soil occurs as long, narrow areas that range from 30 to 40 acres in size.

Representative profile of Earlmont silt loam, cultivated, 930 feet west and 250 feet north of the east quarter corner of sec. 27, T. 26 N., R. 5 E.:

Ap--0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam, white (10YR 8/1) dry; moderate, coarse and very coarse, granular structure; slightly hard, friable, nonsticky, nonplastic; many roots; strongly acid; abrupt, smooth boundary. 7 to 11 inches thick.

B21--9 to 25 inches, grayish-brown (10YR 5/2) silt loam, white (10YR 8/1) dry; common, fine, prominent dark-brown (7.5YR 4/4) mottles, and many, large, distinct, yellowish-brown (10YR 5/6) mottles on ped faces; common, fine, prominent mottles of brownish yellow (10YR 6/6) and yellow (10YR 7/6) dry; medium, very coarse, prismatic structure; hard, firm, slightly sticky, slightly plastic; common roots; very strongly acid; gradual, smooth boundary. 13 to 16 inches thick.

B22--25 to 41 inches, light brownish-gray (2.5Y 6/2) silty clay loam, white (N 8/0) dry; common, fine, prominent, yellowish-red (5YR 4/8) mottles in root casts, yellow (10YR 7/6 and 8/6) dry; moderate, very coarse, prismatic structure; hard, firm, sticky, plastic; common roots; very strongly acid; clear, smooth boundary. 16 to 20 inches thick.

B23--41 to 44 inches, brown (10YR 5/3) and light brownish-gray (10YR 6/2) silt loam, white (N 8/0) dry; common, fine, prominent, yellowish-brown (10YR 5/6) mottles, light yellowish brown (10YR 6/4) and brownish yellow (10YR 6/6) dry; moderate, very coarse, prismatic structure; hard, firm, slightly sticky, slightly plastic; common roots; very strongly acid; abrupt, smooth boundary. 2 to 4 inches thick.

IIC--44 to 46 inches, very pale brown (10YR 7/3) very fine sandy loam and silt loam, white (10YR 8/1) dry; common, fine, prominent, strong-brown (7.5YR 5/8) mottles, faint and pale brown (10YR 6/3) dry; massive; hard, firm, nonsticky, nonplastic; common roots; very strongly acid; abrupt, smooth boundary. 0 to 3 inches thick.

IIIOa--46 to 48 inches, black (10YR 2/1) and very dark brown (10YR 2/2) muck, dark grayish brown (10YR 4/2) streaked with light gray (10YR 7/1) dry; massive; hard, firm, slightly sticky, slightly plastic; few roots; very strongly acid; abrupt, smooth boundary. 0 to 3 inches thick.

IVC--48 to 60 inches, very dark brown (10YR 2/2) and light-gray (10YR 7/2) laminations of diatomite and muck, white (N 8/0) and grayish brown (10YR 5/2) dry; common, medium, prominent, yellowish-brown (10YR 5/6 and 5/8) mottles in the diatomite, very pale brown (10YR 8/4) dry; weak laminar structure; hard, firm, slightly sticky; slightly plastic; few roots; very strongly acid. Laminated material similar to this horizon extends downward many feet.

The A horizon ranges from gray to dark gray or dark grayish brown. The B horizon ranges from gray and light gray to brown. Below this is stratified diatomite, peat, muck, and volcanic ash. Peat and muck are below a depth of 40 inches; gravel is below a depth of 48 inches in some places.

Some areas are as much as 10 percent the somewhat poorly drained Snohomish, light colored variant, soils; and some areas are 1 percent the poorly drained Seattle and Tukwila soils in depressions.

Permeability is moderate. There is a seasonal water table at a depth of 2 to 3 feet. In drained areas, roots penetrate easily to a depth of 60 inches and more. In undrained areas, root penetration is limited. Available water capacity is high. Runoff is slow, and the erosion hazard is slight. This soil is subject to flooding.

This soil is used for grass pasture and row crops. Capability unit IIw-2; woodland group 3w2.

Edgewick Series

The Edgewick series is made up of well-drained soils. These soils formed in alluvium, under conifers

and grass on valley floors in the vicinity of North Bend. Slopes are 0 to 3 percent. The annual precipitation is 70 to 80 inches, and the mean annual temperature is about 50° F. The frost-free season is about 150 days. Elevation ranges from 400 to 500 feet.

In a representative profile, the surface layer is very dark grayish-brown to dark grayish-brown fine sandy loam that extends to a depth of about 34 inches. The underlying layers are black gravelly sand and gravelly sandy loam that extend to a depth of 60 inches or more.

Edgewick soils are used for pasture.

Edgewick fine sandy loam (Ed).--This soil is slightly convex or level. Areas are irregular in shape and range from 5 acres to more than 300 acres in size. Slope is less than 3 percent.

Representative profile of Edgewick fine sandy loam, in pasture, 1,430 feet east and 1,000 feet south of the west quarter corner of sec. 15, T. 23 N., R. 8 E.:

Ap--0 to 9 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak, fine, granular structure; slightly hard, very friable, nonsticky, nonplastic; many roots; strongly acid; abrupt, smooth boundary. 8 to 11 inches thick.

C1--9 to 34 inches, dark grayish-brown (2.5Y 4/2) and olive-brown (2.5Y 4/4) fine sandy loam, grayish brown (2.5Y 5/2) dry; massive; soft, very friable, nonsticky, nonplastic; common roots; medium acid; abrupt, smooth boundary. 24 to 30 inches thick.

IIC2--34 to 60 inches, black (5Y 2/2), stratified gravelly sand and gravelly sandy loam, grayish brown (2.5Y 5/2) dry; massive; soft, very friable, nonsticky, nonplastic; neutral.

The C horizon ranges from dark grayish brown to olive brown. The content of gravel is as much as 10 percent in places in the A horizon and the C1 horizon. The IIC horizon, at a depth below 32 to 40 inches, ranges from dark grayish brown to black and from stratified sand to fine sandy loam that has gravel in some places.

Soils included with this soil in mapping make up no more than 15 percent of the total acreage. Some areas are up to 10 percent Nooksack and Si soils; some are up to 5 percent Pilchuck soils, which occupy the natural levees along streams and the higher swells and undulations; some areas are up to 2 percent the poorly drained Puget soils; and some are 1 percent the poorly drained Seattle soils.

Permeability is moderately rapid. The effective rooting depth is restricted by the gravelly sand substratum. There is a seasonal high water table at a depth of 3 to 4 feet. Available water capacity is moderately high. Runoff is slow, and the erosion hazard is slight. The hazard of stream overflow is moderate to severe.

This soil is used for pasture. Capability unit IIIw-1; woodland group 2o1.

Everett Series

The Everett series is made up of somewhat excessively drained soils that are underlain by very gravelly sand at a depth of 18 to 36 inches. These soils formed in very gravelly glacial outwash deposits, under conifers. They are on terraces and terrace fronts and are gently undulating and moderately steep. Slopes are 0 to 30 percent. The annual precipitation is 35 to 60 inches, and the mean annual air temperature is about 50° F. The frost-free season ranges from 150 to 200 days. Elevation ranges from about sea level to 500 feet.

In a representative profile, the surface layer and subsoil are black to brown, gravelly to very gravelly sandy loam about 32 inches thick. The substratum extends to a depth of 60 inches or more. It is multicolored black to gray very gravelly sand (pl. I, left).

Everett soils are used for timber and pasture and for urban development.

Everett gravelly sandy loam, 0 to 5 percent slopes (EvB).--This nearly level to very gently undulating soil is on terraces. Areas are irregular in shape and range from 5 acres to more than 200 acres in size.

Representative profile of Everett gravelly sandy loam, 0 to 5 percent slopes, in forest, 450 feet west and 250 feet north of the southeast corner of sec. 30, T. 22 N., R. 7 E.:

O1--1 to 3/4 inch, undecomposed roots, twigs, and moss; abundant roots. 1 to 2 inches thick.

O2--3/4 inch to 0, black (10YR 2/1), decomposed organic matter; abundant roots. 3/4 of an inch to 1 1/2 inches thick.

A1--0 to 1 1/2 inches, black (10YR 2/1) sandy loam, gray (10YR 5/1) dry; massive; soft, very friable, nonsticky, nonplastic; many roots; slightly acid; abrupt, distinct boundary. 0 to 1 1/2 inches thick.

B2ir--1 1/2 to 17 inches, dark-brown (7.5YR 3/4) gravelly sandy loam, yellowish brown (10YR 5/4) dry; massive; soft, very friable, nonsticky, nonplastic; many roots; slightly acid; clear, smooth boundary. 10 to 18 inches thick.

B3--17 to 32 inches, brown (10YR 4/3) very gravelly sandy loam, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky, nonplastic; many roots; medium acid; clear, wavy boundary. 8 to 18 inches thick.

IIC--32 to 60 inches, black and dark grayish-brown (10YR 2/1 and 4/2) very gravelly coarse sand, gray, grayish brown, and brown (10YR 5/1 and 5/3) dry; single grain; loose, nonsticky, nonplastic; few roots; medium acid.

The A horizon ranges from black to dark gray. The Bir horizon ranges from dark brown and brown to dark yellowish brown and the B3 horizon from brown to dark brown. The IIC horizon ranges from black and very dark brown to olive brown, and from very

(2) CN values can be area weighted when they apply to pervious areas of similar CN's (within 20 CN points). However, high CN areas should not be combined with low CN areas (unless the low CN areas are less than 15% of the subbasin). In this case, separate hydrographs should be generated and summed to form one hydrograph.

FIGURE 3.5.2A HYDROLOGIC SOIL GROUP OF THE SOILS IN KING COUNTY

SOIL GROUP	HYDROLOGIC GROUP*	SOIL GROUP	HYDROLOGIC GROUP*
Alderwood	C	Orcas Peat	D
Arents, Alderwood Material	C	Oridia	D
Arents, Everett Material	B	Ovall	C
Beausite	C	Pilchuck	C
Bellingham	D	Puget	D
Briscot	D	Puyallup	B
Buckley	D	Ragnar	B
Coastal Beaches	Variable	Renton	D
Earlmont Silt Loam	D	Riverwash	Variable
Edgewick	C	Salal	C
Everett	A/B	Sammamish	D
Indianola	A	Seattle	D
Kitsap	C	Shacar	D
Klaus	C	Si Silt	C
Mixed Alluvial Land	Variable	Snohomish	D
Neilton	A	Sultan	C
Newberg	B	Tukwila	D
Nooksack	C	Urban	Variable
Normal Sandy Loam	D	Woodinville	D

HYDROLOGIC SOIL GROUP CLASSIFICATIONS

A. (Low runoff potential). Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well-to-excessively drained sands or gravels. These soils have a high rate of water transmission.

B. (Moderately low runoff potential). Soils having moderate infiltration rates when thoroughly wetted, and consisting chiefly of moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

C. (Moderately high runoff potential). Soils having slow infiltration rates when thoroughly wetted, and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures. These soils have a slow rate of water transmission.

D. (High runoff potential). Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

* From SCS, TR-55, Second Edition, June 1986, Exhibit A-1. Revisions made from SCS, Soil Interpretation Record, Form #5, September 1988.

TABLE 3.5.2B SCS WESTERN WASHINGTON RUNOFF CURVE NUMBERS

SCS WESTERN WASHINGTON RUNOFF CURVE NUMBERS (Published by SCS in 1982)

Runoff curve numbers for selected agricultural, suburban and urban land use for Type 1A rainfall distribution, 24-hour storm duration.

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP A	B	C	D
Cultivated land(1):	winter condition	86	91	94	95
Mountain open areas:	low growing brush and grasslands	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	undisturbed or older second growth	42	64	76	81
Wood or forest land:	young second growth or brush	55	72	81	86
Orchard:	with cover crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping.					
good condition:	grass cover on 75% or more of the area	68	80	86	90
fair condition:	grass cover on 50% to 75% of the area	77	85	90	92
Gravel roads and parking lots		76	85	89	91
Dirt roads and parking lots		72	82	87	89
Impervious surfaces, pavement, roofs, etc.		98	98	98	98
Open water bodies:	lakes, wetlands, ponds, etc.	100	100	100	100
Single Family Residential (2)					
Dwelling Unit/Gross Acre	% Impervious (3)	Separate curve number shall be selected for pervious and impervious portion of the site or basin			
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
Planned unit developments, condominiums, apartments, commercial business and industrial areas.	% impervious must be computed				

1/3

2/3 FOR EXIS CONDITIO.

(1) For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, August 1972.
(2) Assumes roof and driveway runoff is directed into street/storm system.
(3) The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

Existing Conditions

The existing site has been modeled using SCS methodology. Storm events utilize a Santa Barbara Urban Hydrograph (SBUH). Isopluvial maps from the 1990 KCSWDM indicate the following precipitation:

2 Year Precipitation = 1.9 inches
10 Year Precipitation = 2.8 inches
25 Year Precipitation = 3.2 inches
100 Year Precipitation = 3.7 inches

The Time of Concentration (Tc) route is described on the existing basin map. Also shown on this map are the drainage basin limits.

STORM WATER BASINS
6-1-95

==========

BASIN SUMMARY

BASIN ID: EX10 NAME: EXISTING 10YR
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 2.80 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 110.86 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 22.80 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 46.00 Acres
CN....: 89.00

TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 1.90 s:0.0050
TcReach - Shallow L:1550.00 ks:11.00 s:0.0050
PEAK RATE: 7.66 cfs VOL: 7.39 Ac-ft TIME: 520 min

BASIN ID: EX100 NAME: EXISTING 100YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 3.70 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 110.86 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 22.80 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 46.00 Acres
CN....: 89.00

TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 1.90 s:0.0050
TcReach - Shallow L:1550.00 ks:11.00 s:0.0050
PEAK RATE: 12.41 cfs VOL: 11.38 Ac-ft TIME: 520 min

BASIN ID: EX2 NAME: EXISTING 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 1.90 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 110.86 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 22.80 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 46.00 Acres
CN....: 89.00

TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 1.90 s:0.0050
TcReach - Shallow L:1550.00 ks:11.00 s:0.0050
PEAK RATE: 3.72 cfs VOL: 3.83 Ac-ft TIME: 520 min

STORM WATER BASINS
6-1-95

==========

BASIN SUMMARY

BASIN ID: EX25 NAME: EXISTING 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 3.20 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 110.86 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 22.80 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 46.00 Acres
CN....: 89.00

TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 1.90 s:0.0050
TcReach - Shallow L:1550.00 ks:11.00 s:0.0050
PEAK RATE: 9.70 cfs VOL: 9.12 Ac-ft TIME: 520 min

BASIN ID: EXWQ NAME: EXISTING WATER QUAL - 6MO
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 1.29 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 110.86 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 22.80 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 46.00 Acres
CN....: 89.00

TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 1.90 s:0.0050
TcReach - Shallow L:1550.00 ks:11.00 s:0.0050
PEAK RATE: 1.56 cfs VOL: 1.84 Ac-ft TIME: 530 min

SUMMARY	
EVENT	FLOW (CFS)
Water Quality	1.56
2 yr	3.72
10 yr	7.66
25 yr	9.70
100 yr	12.41

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

Based on discussions with the Muckleshoot Indian Tribe and the Department of Fisheries, Cell 3 has been designed to allow salmon access during high flows in the Sammamish River. Access is provided by a stepped pool fish ladder created with concrete weirs. Due to the permeability of site soils, all ponds will be lined with a PVC liner. To maintain water flows during summer months, makeup water will be introduced from the on-site well to Cells 1 and/or 3.

The on-site system has been designed for the entire developed site (including Railroad Street and Parcel 8), excluding the Bear Creek Parkway.

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.

STORM WATER BASINS
5-30-95

==========

BASIN SUMMARY

BASIN ID: DEV10 NAME: DEV 10YR
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 2.80 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 34.91 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 0.00 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 68.80 Acres
CN....: 98.00

TcReach - Sheet L: 300.00 ns:0.0110 p2yr: 1.90 s:0.0150
TcReach - Shallow L: 100.00 ks:27.00 s:0.0150
TcReach - Channel L:3800.00 kc:42.00 s:0.0025
PEAK RATE: 31.47 cfs VOL: 14.73 Ac-ft TIME: 480 min

BASIN ID: DEV2 NAME: DEV 2YEAR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 1.90 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 34.91 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 0.00 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 68.80 Acres
CN....: 98.00

TcReach - Sheet L: 300.00 ns:0.0110 p2yr: 1.90 s:0.0150
TcReach - Shallow L: 100.00 ks:27.00 s:0.0150
TcReach - Channel L:3800.00 kc:42.00 s:0.0025
PEAK RATE: 20.72 cfs VOL: 9.60 Ac-ft TIME: 480 min

BASIN ID: DEV25 NAME: DEV 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 3.20 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 34.91 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 0.00 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 68.80 Acres
CN....: 98.00

TcReach - Sheet L: 300.00 ns:0.0110 p2yr: 1.90 s:0.0150
TcReach - Shallow L: 100.00 ks:27.00 s:0.0150
TcReach - Channel L:3800.00 kc:42.00 s:0.0025
PEAK RATE: 36.20 cfs VOL: 17.01 Ac-ft TIME: 480 min

STORM WATER BASINS
5-30-95

==========

BASIN SUMMARY

BASIN ID: DEVWQ NAME: DEV WATER QUALITY STORM 6MO
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 1.29 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 34.91 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 0.00 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 68.80 Acres
CN....: 98.00

TcReach - Sheet L: 300.00 ns:0.0110 p2yr: 1.90 s:0.0150
TcReach - Shallow L: 100.00 ks:27.00 s:0.0150
TcReach - Channel L:3800.00 kc:42.00 s:0.0025
PEAK RATE: 13.33 cfs VOL: 6.16 Ac-ft TIME: 480 min

BASIN ID: DV100 NAME: DEV 100 YR STROM
SBUH METHODOLOGY
TOTAL AREA.....: 68.80 Acres
RAINFALL TYPE....: USER1
PRECIPITATION....: 3.70 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 34.91 min
ABSTRACTION COEFF: 0.20

BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 0.00 Acres
CN....: 65.00
IMPERVIOUS AREA
AREA..: 68.80 Acres
CN....: 98.00

TcReach - Sheet L: 300.00 ns:0.0110 p2yr: 1.90 s:0.0150
TcReach - Shallow L: 100.00 ks:27.00 s:0.0150
TcReach - Channel L:3800.00 kc:42.00 s:0.0025
PEAK RATE: 42.11 cfs VOL: 19.87 Ac-ft TIME: 480 min

SUMMARY	
EVENT	FLOW (CFS)
WATER QUALITY	13.33
2 yr	20.72
10 yr	31.47
25 yr	36.20
100 yr	42.11

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.

WET POND STORAGE VOLUME:

BY PLANIMETER, AREA DRAINING TO PONDS = 68.8 AC

THIS AREA EXCLUDES BEAR CREEK PARKWAY AND AREAS OUTSIDE (SOUTH AND WEST) OF THE PARKWAY.

THE DEPT. OF ECOLOGY "STORMWATER MANAGEMENT MANUAL" REQUIRES PERMANENT POOL VOLUME = VOLUME OF THE 6 MONTH, 24 HR STORM.

⇒ A = 68.8
CN = 98 (ASSUME NO PERVIOUS - CONSERVATIVE)
P_{REQ} = 1.29 INCHES (BASED FROM 64% 2yr STORM VOLUME)

T_c ⇒ 300 LF SHEET FLOW 1.5%
100 LF SHALLOW FLOW 1.5%
3800 LF CHANNEL FLOW 0.25% CONC.

⇒ ≈ 35 min
(SEE BASIN PRINT-OUTS)

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project	by	sheet no.
location	date	
client		job no.

WET POND SYSTEM LAYOUT:

TOTAL REQUIRED VOLUME = 268,165 CF

3 CELLED POND:

1ST and 3rd CELL EACH HAVE 2/5 OF TOTAL VOLUME

2nd CELL HAS 1/5 OF TOTAL VOLUME

RECOMMENDED

CELL 1 and 2 = 107,266 ft^3

CELL 2 = 53,633 ft^3

ACTUAL

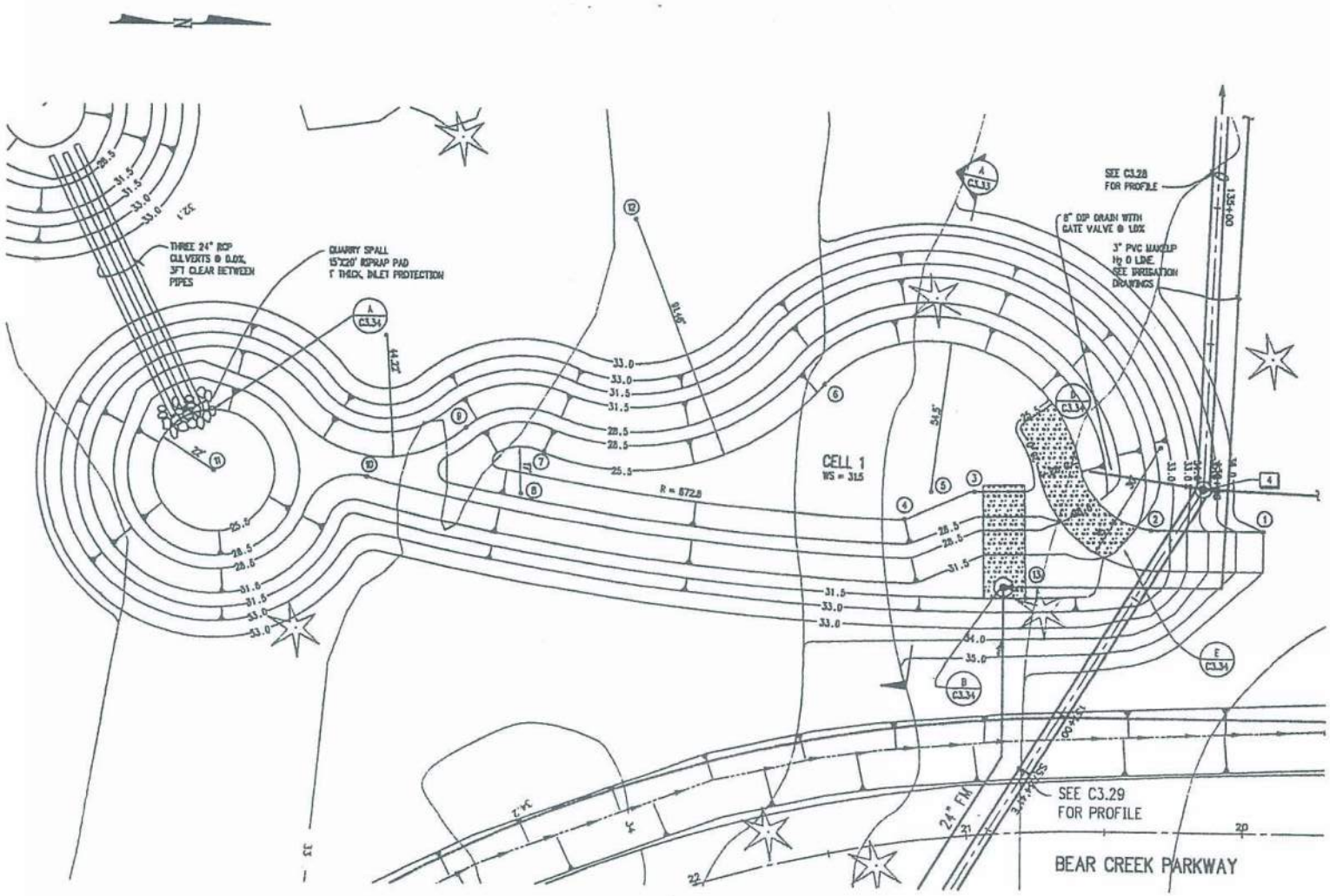
CELL 1 = 101,100 ft^3

CELL 2 = 57,400 ft^3

CELL 3 = 121,800 ft^3

TOTAL = 280,300 ft^3 > 268165 ft^3 ∴ O.K.

SEE FOLLOWING PLAN VIEWS FOR ACTUAL POND LAYOUT.



POND CELL 1 HORIZONTAL CONTROL			
POINT NO.	DESCRIPTION	BASELINE STATION	BASELINE OFFSET
1	ROAD	19+83.32	111.00 RT
2	ROAD PT	20+31.09	111.00 RT
3	AP	20+91.16	125.48 RT
4	AP	21+08.84	118.13 RT
5	CENTER	21+01.85	126.86 RT
6	PCC	21+27.90	159.85 RT
7	PCC	22+08.82	156.85 RT
8	PCC	22+16.38	155.47 RT
9	CENTER	22+24.62	154.44 RT
10	PCC	22+53.89	150.47 RT
11	CENTER	22+90.01	205.54 RT
12	CENTER	21+68.68	240.94 RT
13	RIPRAP	20+75.69	85.94 RT

BASELINE IS CENTERLINE OF BEAR CREEK PARKWAY

NTS

HOR.: 1"= 20' 20 0 10 20 40

VERT: 1"= 5' 5 0 2.5 5 10

APPROVED FOR CONSTRUCTION

Carol Osborne
Director Of Public Works
City Of Redmond

Date:

Plan Chk Engr.
For Sheet(s)
Site Dev Engr
Util Engr
Fire
Tr
Bldg Dept.

This approval is for the design only. These plans appear to be in conformance with the City Of Redmond design standards for construction. This approval shall not be construed to authorize construction not in conformance with applicable City standards. The City reserves the right to require revisions to the approved plans if they are nonconforming with City Of Redmond design standards for construction and if at any time that it is discovered that the proposed construction does not otherwise meet the applicable construction standards. The owner is required to provide designs and plans in accordance with applicable City standards and ensure that construction is accomplished in accordance with these standards. The owner and/or design engineer and/or developer of the site may be required to make necessary approved field revisions to correct any errors or omissions found on the approved plan.

NOT FOR CONSTRUCTION

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

FILE NAME	JOB #	JOB NAME	DRAWN BY	DATE	PLOT SCALE	PLOT SET UP	P SPACE	ORIGINAL TO	DISCARD OLD	# PRINTS	PRINTS TO	PROT'S, RTCXSP-3.JR RTCXSP.JRT RTCXS3.JRT RTCXSB.JRT RTCXTR.JRT RTCXR.VEL.DXT
RTCXSP-1	92839.2	RED TOWN CEN	LN	06/22/95	1=1	OVL	YES	LN	0	0	0	HOTS, RTCXSP-3 ROTARE @ 271.0492, VIEW PLOT1

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY MHV DATE 6/23/95
DESIGNED BY JOE
CHECKED BY JRS
APPROVED BY MAV

SCALE:
HORIZ. 1" = 20'
VERT. 1" = 5'
JOB NO.: 92839.2

kpff Consulting Engineers
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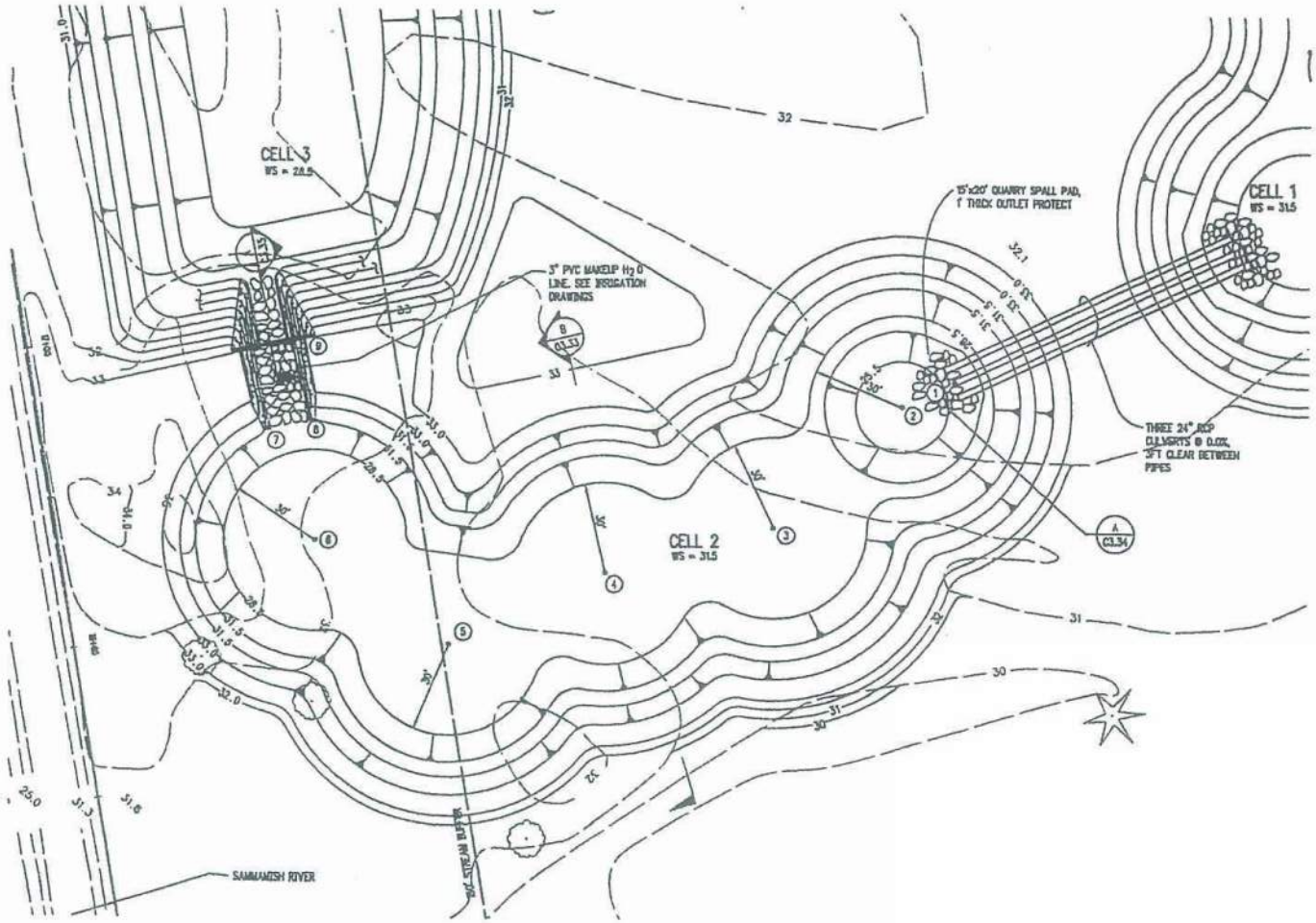
(206) 622-5822 Fax (206) 622-8130

REDMOND TOWN CENTER

DRAINAGE DETAILS
POND CELL 1

SHEET
C3.30



POND CELL 2 HORIZONTAL CONTROL			
POINT NO.	DESCRIPTION	BASELINE STATION	BASELINE OFFSET
1	PIPE END	17+57.71	297.75 LT
2	CENTER	17+62.82	279.57 LT
3	CENTER	17+86.09	232.54 LT
4	CENTER	18+02.35	175.54 LT
5	CENTER	18+17.57	121.10 LT
6	CENTER	17+76.83	83.03 LT
7	BASE	17+30.89	74.20 LT
8	BASE	17+40.20	67.82 LT
9	WIER	17+11.30	72.90 LT

BASELINE IS WEST PROPERTY LINE.

NTS

HOR.: 1"= 20' 20 0 10 20 40

VERT: 1"= 5' 5 0 2.5 5 10

APPROVED FOR CONSTRUCTION

Carol Osborne
Director Of Public Works
City Of Redmond

Date:

Plan Chk Engr.
For Sheet(s)
Dim Ctrl Engr
Util Engr
Fire Dept.
Traffic Engr.
Planning Dept.

This approval is for the design only. These plans appear to be in conformance with the City Of Redmond design standards for construction. This approval shall not be construed to authorize construction not in conformance with applicable City standards. The City reserves the right to require revisions to the approved plans if they are nonconformance with City Of Redmond design standards for construction. In the event that it is discovered that the proposed construction does not conform and the applicable construction standards. The owner is responsible to provide designs and plans in conformance with applicable City standards and ensure that construction is accomplished in conformance with these standards. The owner and/or design engineer and/or developer may be required to make necessary approved field revisions to correct any errors or omissions found on the approved plan.

NOT FOR CONSTRUCTION

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

FILE NAME	JOB #	JOB NAME	DRAWN BY	DATE	PLOT SCALE	PLOT SET UP	P SPACE	ORIGINAL TO DISCARD OLD	PRINTS	PRINTS TO	TRIS'S: RTCCSP-1,RTCCSP-2,RTCCSR,RTCCS,RTCCSW,RTCSWD,RTCS,RTCSWD,RTCS,RTCSWD
RTCDPC1	92839.2	RED TOWN CEN	LN	08/22/95	1=1	CIVIL	YES	LN	0	0	NOTES: RTCCSP-3 ROTATE @ 27.0492, VIEW PLOT1

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY NHV DATE 6/23/95
DESIGNED BY
CHECKED BY JRB
APPROVED BY MAV

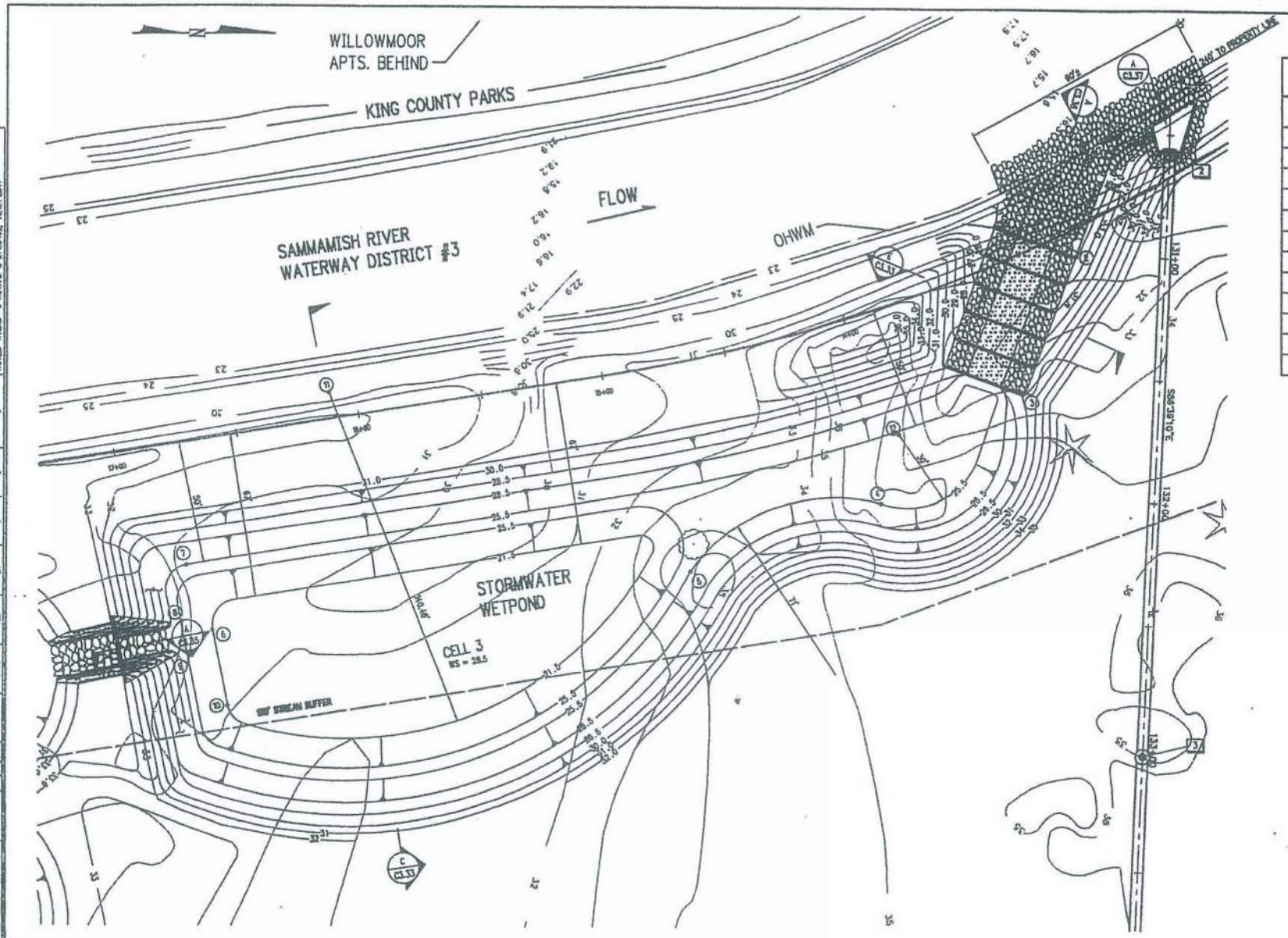
SCALE:
HORIZ. 1" = 20'
VERT. 1" = 5'
JOB NO.: 92839.2

kpff Consulting Engineers
1201 Third Avenue, Suite 900
Seattle, Washington 98101
(206) 622-5522 Fax (206) 622-8130

REDMOND TOWN CENTER

DRAINAGE DETAILS
POND CELL 2

SHEET
C3.31



POND CELL 3 HORIZONTAL CONTROL			
POINT NO.	DESCRIPTION	BASELINE STATION	BASELINE OFFSET
1			
2	WEIR	13+03.68	10.55 LT
3	WEIR	13+43.85	53.80 LT
4	PT	14+07.30	76.25 LT
5	PC	14+79.82	84.97 LT
6	PC	15+71.89	77.39 LT
7	PT	15+78.23	60.00 LT
8	RIPRAP	15+92.31	73.78 LT
9	RIPRAP	15+92.32	83.90 LT
10	PT	15+70.85	106.71 LT
11	CENTER	15+03.89	9.14 RT
12	CENTER	13+90.33	52.58 LT

BASELINE IS WEST PROPERTY LINE.

FILL QUANTITY – APPROXIMATELY 85 cy OF RIP RAP PLACED BELOW OHWM.

NTS

HOR.: 1" = 20'

VERT: 1" = 5'

FILE NAME	JOB #	JOB NAME	DRAWN BY	DATE	PLOT SCALE	PLOT SET UP	P SPACE	ORIGINAL TO	DISCARD OLD	# PRINTS	PRINTS TO	XREF'S RTCSP-1,RTCSP-2,RTCSP-3,RTCSP-4,RTCSP-5,RTCSP-6,RTCSP-7,RTCSP-8,RTCSP-9,RTCSP-10,RTCSP-11,RTCSP-12,RTCSP-13,WLVLEC
RTCSP-13	92839.2	RED TOWN CEN	LN	08/22/95	1=1	CVL	YES	LN	0	0	0	NOTES: RTCSP-3 ROTATE @ 277.0492, VIEW PLOT

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY: HHV
DATE: 6/23/95
DESIGNED BY: JDE
CHECKED BY: JRB
APPROVED BY: MAV
SCALE:
HORIZ. 1" = 20'
VERT.
JOB NO.: 92839.2

kpff Consulting Engineers
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Seattle, Washington 98101
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REDMOND TOWN CENTER

DRAINAGE DETAILS
POND CELL 3

SHEET
C3.32

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.

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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

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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

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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:

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

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

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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.

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REACH SUMMARY

Routing based on Seattle family @ 10 yr freq - ONSITE STORM EVENT

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 PONDI
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

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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

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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}

JDE

REACH SUMMARY

Routing based on Seattle family @ 100 yr freq → ONSITE STORM EVENT

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--	
												28.25		SAMM. R. 10y
CB02														
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	W.S. ELEV
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	✓ No Pond
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	✓

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

REACH SUMMARY

PIPE REACH ID No. P101
From: CB78 To: CB76
Pipe Diameter: 2.00 ft n: 0.0120
Pipe Length : 149.01 ft s: 0.0056
Up invert : 29.86 ft down invert: 29.02
Collection Area: 4.53 Ac.
Design Flow : 11.40 cfs Dsgn Depth: 1.14 ft
Pipe Capacity : 19.85 cfs
Design Vel : 6.18 fps Travel Time: 0.40 min
Pipe Full Vel : 6.48 fps

PIPE REACH ID No. P102
From: CB76 To: CB75
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 120.00 ft s: 0.0056
Up invert : 29.02 ft down invert: 28.35
Collection Area: 7.44 Ac.
Design Flow : 18.28 cfs Dsgn Depth: 1.32 ft
Pipe Capacity : 35.81 cfs
Design Vel : 6.94 fps Travel Time: 0.29 min
Pipe Full Vel : 7.49 fps

PIPE REACH ID No. P103
From: CB75 To: CB73
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 104.02 ft s: 0.0058
Up invert : 28.35 ft down invert: 27.75
Collection Area: 9.70 Ac.
Design Flow : 23.43 cfs Dsgn Depth: 1.53 ft
Pipe Capacity : 36.40 cfs
Design Vel : 7.44 fps Travel Time: 0.23 min
Pipe Full Vel : 7.61 fps

PIPE REACH ID No. P104
From: CB73 To: CB71
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 100.02 ft s: 0.0056
Up invert : 27.75 ft down invert: 27.19
Collection Area: 10.21 Ac.
Design Flow : 24.32 cfs Dsgn Depth: 1.58 ft
Pipe Capacity : 35.86 cfs
Design Vel : 7.41 fps Travel Time: 0.22 min
Pipe Full Vel : 7.50 fps

REACH SUMMARY

PIPE REACH ID No. P105
From: CB71 To: CB69
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 100.00 ft s: 0.0056
Up invert : 27.19 ft down invert: 26.63
Collection Area: 10.66 Ac.
Design Flow : 25.05 cfs Dsgn Depth: 1.62 ft
Pipe Capacity : 35.87 cfs
Design Vel : 7.46 fps Travel Time: 0.22 min
Pipe Full Vel : 7.50 fps

PIPE REACH ID No. P106
From: CB69 To: CB09
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 72.01 ft s: 0.0062
Up invert : 26.63 ft down invert: 26.18
Collection Area: 11.10 Ac.
Design Flow : 25.80 cfs Dsgn Depth: 1.59 ft
Pipe Capacity : 37.89 cfs
Design Vel : 7.84 fps Travel Time: 0.15 min
Pipe Full Vel : 7.92 fps

PIPE REACH ID No. P11
From: CB23 To: CB21
Pipe Diameter: 3.00 ft n: 0.0120
Pipe Length : 135.03 ft s: 0.0026
Up invert : 31.47 ft down invert: 31.12
Collection Area: 17.80 Ac.
Design Flow : 22.33 cfs Dsgn Depth: 1.68 ft
Pipe Capacity : 39.68 cfs
Design Vel : 5.47 fps Travel Time: 0.41 min
Pipe Full Vel : 5.76 fps

PIPE REACH ID No. P110
From: CB98 To: CB96
Pipe Diameter: 1.25 ft n: 0.0120
Pipe Length : 118.85 ft s: 0.0080
Up invert : 30.77 ft down invert: 29.82
Collection Area: 0.87 Ac.
Design Flow : 2.66 cfs Dsgn Depth: 0.68 ft
Pipe Capacity : 6.75 cfs
Design Vel : 4.90 fps Travel Time: 0.40 min
Pipe Full Vel : 5.64 fps

REACH SUMMARY

```
PIPE REACH            ID No. P111
From: CB96   To: CB94
Pipe Diameter:     1.25 ft       n: 0.0120
Pipe Length  :   124.48 ft       s: 0.0079
Up invert    :    29.82 ft       down invert:    28.84
Collection Area:     1.74 Ac.
Design Flow    :     5.22 cfs       Dsgn Depth:     0.88 ft
Pipe Capacity  :     6.70 cfs
Design Vel     :     5.68 fps      Travel Time:     0.37 min
Pipe Full Vel  :     5.60 fps


PIPE REACH            ID No. P112
From: CB94   To: CB75
Pipe Diameter:     1.50 ft       n: 0.0120
Pipe Length  :    59.46 ft       s: 0.0082
Up invert    :    28.84 ft       down invert:    28.35
Collection Area:     2.02 Ac.
Design Flow    :     5.95 cfs       Dsgn Depth:     0.82 ft
Pipe Capacity  :    11.14 cfs
Design Vel     :     6.06 fps      Travel Time:     0.16 min
Pipe Full Vel  :     6.47 fps


PIPE REACH            ID No. P115
From: CB92A  To: CB92
Pipe Diameter:     1.00 ft       n: 0.0120
Pipe Length  :   100.02 ft       s: 0.0075
Up invert    :    29.69 ft       down invert:    28.94
Collection Area:     0.61 Ac.
Design Flow    :     1.21 cfs       Dsgn Depth:     0.59 ft
Pipe Capacity  :     3.60 cfs
Design Vel     :     3.92 fps      Travel Time:     0.43 min
Pipe Full Vel  :     4.71 fps


PIPE REACH            ID No. P116
From: CB90   To: CB75
Pipe Diameter:     1.00 ft       n: 0.0120
Pipe Length  :    40.01 ft       s: 0.0642
Up invert    :    30.92 ft       down invert:    28.35
Collection Area:     0.24 Ac.
Design Flow    :     0.73 cfs       Dsgn Depth:     0.19 ft
Pipe Capacity  :    10.55 cfs
Design Vel     :     7.33 fps      Travel Time:     0.09 min
Pipe Full Vel  :    13.79 fps
```

REACH SUMMARY

PIPE REACH ID No. P12
From: CB21 To: CB19
Pipe Diameter: 3.00 ft n: 0.0120
Pipe Length : 207.02 ft s: 0.0028
Up invert : 31.12 ft down invert: 30.53
Collection Area: 26.14 Ac.
Design Flow : 32.38 cfs Dsgn Depth: 2.10 ft
Pipe Capacity : 41.61 cfs
Design Vel : 6.13 fps Travel Time: 0.56 min
Pipe Full Vel : 6.04 fps

PIPE REACH ID No. P13
From: CB19 To: CB17
Pipe Diameter: 3.50 ft n: 0.0120
Pipe Length : 214.06 ft s: 0.0052
Up invert : 30.53 ft down invert: 29.42
Collection Area: 29.06 Ac.
Design Flow : 35.13 cfs Dsgn Depth: 1.86 ft
Pipe Capacity : 84.66 cfs
Design Vel : 7.95 fps Travel Time: 0.45 min
Pipe Full Vel : 9.03 fps

PIPE REACH ID No. P14
From: CB17 To: CB16
Pipe Diameter: 3.50 ft n: 0.0120
Pipe Length : 88.01 ft s: 0.0025
Up invert : 29.42 ft down invert: 29.20
Collection Area: 29.83 Ac.
Design Flow : 35.65 cfs Dsgn Depth: 2.06 ft
Pipe Capacity : 58.78 cfs
Design Vel : 6.05 fps Travel Time: 0.24 min
Pipe Full Vel : 6.27 fps

PIPE REACH ID No. P15
From: CB16 To: CB14
Pipe Diameter: 3.50 ft n: 0.0120
Pipe Length : 48.01 ft s: 0.0040
Up invert : 29.20 ft down invert: 29.01
Collection Area: 35.72 Ac.
Design Flow : 42.75 cfs Dsgn Depth: 2.00 ft
Pipe Capacity : 73.96 cfs
Design Vel : 7.53 fps Travel Time: 0.11 min
Pipe Full Vel : 7.89 fps

REACH SUMMARY

PIPE REACH ID No. P16
From: CB14 To: CB12
Pipe Diameter: 4.00 ft n: 0.0120
Pipe Length : 61.01 ft s: 0.0038
Up invert : 29.01 ft down invert: 28.78
Collection Area: 36.18 Ac.
Design Flow : 43.19 cfs Dsgn Depth: 2.12 ft
Pipe Capacity : 103.06 cfs
Design Vel : 7.43 fps Travel Time: 0.14 min
Pipe Full Vel : 8.42 fps

PIPE REACH ID No. P17
From: CB12 To: CB11
Pipe Diameter: 4.00 ft n: 0.0120
Pipe Length : 153.56 ft s: 0.0047
Up invert : 28.78 ft down invert: 28.06
Collection Area: 39.38 Ac.
Design Flow : 46.99 cfs Dsgn Depth: 2.14 ft
Pipe Capacity : 114.93 cfs
Design Vel : 8.23 fps Travel Time: 0.31 min
Pipe Full Vel : 9.39 fps

PIPE REACH ID No. P18
From: CB11 To: CB10
Pipe Diameter: 4.00 ft n: 0.0120
Pipe Length : 300.04 ft s: 0.0036
Up invert : 28.06 ft down invert: 26.98
Collection Area: 41.71 Ac.
Design Flow : 49.15 cfs Dsgn Depth: 2.06 ft
Pipe Capacity : 100.70 cfs
Design Vel : 7.54 fps Travel Time: 0.66 min
Pipe Full Vel : 8.22 fps

PIPE REACH ID No. P19
From: CB10 To: CB09
Pipe Diameter: 4.00 ft n: 0.0120
Pipe Length : 231.40 ft s: 0.0035
Up invert : 26.98 ft down invert: 26.18
Collection Area: 44.16 Ac.
Design Flow : 50.89 cfs Dsgn Depth: 2.13 ft
Pipe Capacity : 98.69 cfs
Design Vel : 7.49 fps Travel Time: 0.51 min
Pipe Full Vel : 8.06 fps

REACH SUMMARY

PIPE REACH ID No. P20
From: CB09 To: CB07
Pipe Diameter: 4.00 ft n: 0.0120
Pipe Length : 39.01 ft s: 0.0036
Up invert : 26.18 ft down invert: 26.04
Collection Area: 57.75 Ac.
Design Flow : 66.20 cfs Dsgn Depth: 2.49 ft
Pipe Capacity : 100.55 cfs
Design Vel : 8.07 fps Travel Time: 0.08 min
Pipe Full Vel : 8.21 fps

PIPE REACH ID No. P200
From: CB200 To: CB06
Pipe Diameter: 2.00 ft n: 0.0120
Pipe Length : 71.00 ft s: 0.0032
Up invert : 25.20 ft down invert: 24.97
Collection Area: 5.29 Ac.
Design Flow : 6.76 cfs Dsgn Depth: 1.02 ft
Pipe Capacity : 15.05 cfs
Design Vel : 4.41 fps Travel Time: 0.27 min
Pipe Full Vel : 4.91 fps

PIPE REACH ID No. P201
From: CB201 To: CB200
Pipe Diameter: 2.00 ft n: 0.0120
Pipe Length : 69.03 ft s: 0.0049
Up invert : 25.54 ft down invert: 25.20
Collection Area: 5.29 Ac.
Design Flow : 6.82 cfs Dsgn Depth: 1.13 ft
Pipe Capacity : 18.55 cfs
Design Vel : 5.17 fps Travel Time: 0.22 min
Pipe Full Vel : 6.06 fps

PIPE REACH ID No. P202
From: CB202 To: CB201
Pipe Diameter: 2.00 ft n: 0.0120
Pipe Length : 160.05 ft s: 0.0106
Up invert : 27.24 ft down invert: 25.54
Collection Area: 5.17 Ac.
Design Flow : 6.70 cfs Dsgn Depth: 1.30 ft
Pipe Capacity : 27.24 cfs
Design Vel : 6.81 fps Travel Time: 0.39 min
Pipe Full Vel : 8.90 fps

REACH SUMMARY

PIPE REACH ID No. P203
From: CB203 To: CB202
Pipe Diameter: 2.00 ft n: 0.0120
Pipe Length : 68.01 ft s: 0.0112
Up invert : 28.00 ft down invert: 27.24
Collection Area: 5.07 Ac.
Design Flow : 6.57 cfs Dsgn Depth: 1.31 ft
Pipe Capacity : 27.94 cfs
Design Vel : 6.89 fps Travel Time: 0.16 min
Pipe Full Vel : 9.13 fps

PIPE REACH ID No. P204
From: CB204 To: CB203
Pipe Diameter: 1.00 ft n: 0.0120
Pipe Length : 82.02 ft s: 0.0098
Up invert : 28.80 ft down invert: 28.00
Collection Area: 0.35 Ac.
Design Flow : 0.97 cfs Dsgn Depth: 0.66 ft
Pipe Capacity : 4.11 cfs
Design Vel : 4.06 fps Travel Time: 0.34 min
Pipe Full Vel : 5.37 fps

PIPE REACH ID No. P205
From: CB205 To: CB204
Pipe Diameter: 1.00 ft n: 0.0120
Pipe Length : 157.08 ft s: 0.0101
Up invert : 30.39 ft down invert: 28.80
Collection Area: 0.20 Ac.
Design Flow : 0.57 cfs Dsgn Depth: 0.74 ft
Pipe Capacity : 4.19 cfs
Design Vel : 3.55 fps Travel Time: 0.74 min
Pipe Full Vel : 5.47 fps

PIPE REACH ID No. P206
From: CB206 To: CB203
Pipe Diameter: 1.00 ft n: 0.0120
Pipe Length : 76.01 ft s: 0.0211
Up invert : 29.60 ft down invert: 28.00
Collection Area: 0.22 Ac.
Design Flow : 0.62 cfs Dsgn Depth: 0.22 ft
Pipe Capacity : 6.04 cfs
Design Vel : 4.70 fps Travel Time: 0.27 min
Pipe Full Vel : 7.89 fps

REACH SUMMARY

```
PIPE REACH            ID No. P207
From: CB207   To: CB206
Pipe Diameter:      1.00 ft        n: 0.0120
Pipe Length  :    100.00 ft        s: 0.0200
Up invert    :     31.60 ft        down invert:    29.60
Collection Area:     0.10 Ac.
Design Flow    :     0.29 cfs        Dsgn Depth:     0.16 ft
Pipe Capacity  :     5.89 cfs
Design Vel     :     3.68 fps       Travel Time:     0.45 min
Pipe Full Vel  :     7.69 fps


PIPE REACH            ID No. P21
From: CB07   To: CB06
Pipe Diameter:      4.00 ft        n: 0.0120
Pipe Length  :    276.05 ft        s: 0.0039
Up invert    :     26.04 ft        down invert:    24.97
Collection Area:    57.89 Ac.
Design Flow    :    66.21 cfs        Dsgn Depth:     2.42 ft
Pipe Capacity  :   104.50 cfs
Design Vel     :     8.32 fps       Travel Time:     0.55 min
Pipe Full Vel  :     8.53 fps


PIPE REACH            ID No. P210
From: CB210   To: CB82
Pipe Diameter:      1.25 ft        n: 0.0120
Pipe Length  :     94.37 ft        s: 0.0100
Up invert    :     32.32 ft        down invert:    31.38
Collection Area:     0.50 Ac.
Design Flow    :     1.40 cfs        Dsgn Depth:     0.87 ft
Pipe Capacity  :     7.53 cfs
Design Vel     :     4.46 fps       Travel Time:     0.35 min
Pipe Full Vel  :     6.30 fps


PIPE REACH            ID No. P211
From: CB211   To: CB210
Pipe Diameter:      1.25 ft        n: 0.0120
Pipe Length  :    129.24 ft        s: 0.0133
Up invert    :     34.04 ft        down invert:    32.32
Collection Area:     0.36 Ac.
Design Flow    :     1.03 cfs        Dsgn Depth:     0.95 ft
Pipe Capacity  :     8.71 cfs
Design Vel     :     4.53 fps       Travel Time:     0.48 min
Pipe Full Vel  :     7.28 fps
```

REACH SUMMARY

PIPE REACH ID No. P22
From: CB06 To: CB05
Pipe Diameter: 4.50 ft n: 0.0120
Pipe Length : 286.04 ft s: 0.0029
Up invert : 26.97 ft down invert: 26.14
Collection Area: 63.18 Ac.
Design Flow : 69.69 cfs Dsgn Depth: 2.53 ft
Pipe Capacity : 123.78 cfs
Design Vel : 7.58 fps Travel Time: 0.63 min
Pipe Full Vel : 7.99 fps

PIPE REACH ID No. P23
From: CB05 To: CB04
Pipe Diameter: 4.50 ft n: 0.0120
Pipe Length : 203.63 ft s: 0.0029
Up invert : 26.14 ft down invert: 25.55
Collection Area: 63.18 Ac.
Design Flow : 68.33 cfs Dsgn Depth: 2.50 ft
Pipe Capacity : 123.69 cfs
Design Vel : 7.54 fps Travel Time: 0.45 min
Pipe Full Vel : 7.98 fps

PIPE REACH ID No. P24
From: CB04 To: CB03
Pipe Diameter: 4.50 ft n: 0.0120
Pipe Length : 298.54 ft s: 0.0029
Up invert : 25.55 ft down invert: 24.68
Collection Area: 63.18 Ac.
Design Flow : 67.36 cfs Dsgn Depth: 2.47 ft
Pipe Capacity : 124.04 cfs
Design Vel : 7.53 fps Travel Time: 0.66 min
Pipe Full Vel : 8.00 fps

PIPE REACH ID No. P25
From: CB03 To: CB02
Pipe Diameter: 4.50 ft n: 0.0120
Pipe Length : 236.36 ft s: 0.0029
Up invert : 24.68 ft down invert: 24.00
Collection Area: 63.18 Ac.
Design Flow : 65.93 cfs Dsgn Depth: 2.45 ft
Pipe Capacity : 123.25 cfs
Design Vel : 7.46 fps Travel Time: 0.53 min
Pipe Full Vel : 7.95 fps

REACH SUMMARY

```
PIPE REACH            ID No. P26
From: CB02   To: CB01
Pipe Diameter:     4.50 ft        n: 0.0120
Pipe Length  :   144.17 ft        s: -0.0028
Up invert    :    24.00 ft        down invert:    24.41
Collection Area:          Ac.
Design Flow    :          cfs       Dsgn Depth:          ft
Pipe Capacity  :          cfs
Design Vel     :          fps      Travel Time:          min
Pipe Full Vel  :          fps


PIPE REACH            ID No. P27
From: CB01   To: OUTFALL
Pipe Diameter:     4.50 ft        n: 0.0120
Pipe Length  :   138.71 ft        s: 0.0030
Up invert    :    24.41 ft        down invert:    24.00
Collection Area:          Ac.
Design Flow    :          cfs       Dsgn Depth:          ft
Pipe Capacity  :          cfs
Design Vel     :          fps      Travel Time:          min
Pipe Full Vel  :          fps


PIPE REACH            ID No. P30
From: CB29   To: CB27
Pipe Diameter:     1.50 ft        n: 0.0120
Pipe Length  :   165.51 ft        s: 0.0038
Up invert    :    33.17 ft        down invert:    32.54
Collection Area:     2.03 Ac.
Design Flow    :     4.79 cfs       Dsgn Depth:     0.91 ft
Pipe Capacity  :     7.57 cfs
Design Vel     :     4.28 fps      Travel Time:     0.64 min
Pipe Full Vel  :     4.40 fps


PIPE REACH            ID No. P31
From: CB27   To: CB25
Pipe Diameter:     2.00 ft        n: 0.0120
Pipe Length  :    97.13 ft        s: 0.0038
Up invert    :    32.54 ft        down invert:    32.17
Collection Area:     2.03 Ac.
Design Flow    :     4.63 cfs       Dsgn Depth:     1.24 ft
Pipe Capacity  :    16.32 cfs
Design Vel     :     4.24 fps      Travel Time:     0.38 min
Pipe Full Vel  :     5.33 fps
```

REACH SUMMARY

PIPE REACH ID No. P32
From: CB25 To: CB23
Pipe Diameter: 2.50 ft n: 0.0120
Pipe Length : 185.01 ft s: 0.0038
Up invert : 32.17 ft down invert: 31.47
Collection Area: 6.86 Ac.
Design Flow : 16.70 cfs Dsgn Depth: 1.41 ft
Pipe Capacity : 29.48 cfs
Design Vel : 5.86 fps Travel Time: 0.53 min
Pipe Full Vel : 6.16 fps

PIPE REACH ID No. P40
From: CB40 To: CB38
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 356.18 ft s: 0.0025
Up invert : 36.15 ft down invert: 35.26
Collection Area: 1.07 Ac.
Design Flow : 3.07 cfs Dsgn Depth: 0.78 ft
Pipe Capacity : 6.14 cfs
Design Vel : 3.29 fps Travel Time: 1.81 min
Pipe Full Vel : 3.56 fps

PIPE REACH ID No. P41
From: CB38 To: CB33
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 103.82 ft s: 0.0078
Up invert : 35.26 ft down invert: 34.45
Collection Area: 2.52 Ac.
Design Flow : 6.58 cfs Dsgn Depth: 0.88 ft
Pipe Capacity : 10.84 cfs
Design Vel : 6.08 fps Travel Time: 0.28 min
Pipe Full Vel : 6.30 fps

PIPE REACH ID No. P42
From: CB33 To: CB32
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 63.07 ft s: 0.0081
Up invert : 34.45 ft down invert: 33.94
Collection Area: 2.98 Ac.
Design Flow : 7.65 cfs Dsgn Depth: 0.97 ft
Pipe Capacity : 11.04 cfs
Design Vel : 6.37 fps Travel Time: 0.17 min
Pipe Full Vel : 6.41 fps

REACH SUMMARY

```
PIPE REACH            ID No. P43
From: CB32   To: CB31
Pipe Diameter:     2.00 ft        n: 0.0120
Pipe Length  :   155.00 ft        s: 0.0068
Up invert    :    33.94 ft        down invert:    32.89
Collection Area:     3.92 Ac.
Design Flow    :     9.97 cfs       Dsgn Depth:     1.01 ft
Pipe Capacity  :    21.76 cfs
Design Vel     :     6.42 fps      Travel Time:     0.40 min
Pipe Full Vel  :     7.11 fps


PIPE REACH            ID No. P44
From: CB31   To: CB23
Pipe Diameter:     2.00 ft        n: 0.0120
Pipe Length  :   124.06 ft        s: 0.0114
Up invert    :    32.89 ft        down invert:    31.47
Collection Area:     3.99 Ac.
Design Flow    :     9.92 cfs       Dsgn Depth:     1.15 ft
Pipe Capacity  :    28.28 cfs
Design Vel     :     7.78 fps      Travel Time:     0.27 min
Pipe Full Vel  :     9.24 fps


PIPE REACH            ID No. P55
From: CB42   To: CB13
Pipe Diameter:     1.25 ft        n: 0.0120
Pipe Length  :   269.22 ft        s: 0.0100
Up invert    :    32.18 ft        down invert:    29.49
Collection Area:     2.54 Ac.
Design Flow    :     7.29 cfs       Dsgn Depth:     1.07 ft
Pipe Capacity  :     7.55 cfs
Design Vel     :     6.49 fps      Travel Time:     0.69 min
Pipe Full Vel  :     6.31 fps


PIPE REACH            ID No. P55A
From: CB13   To: CB12
Pipe Diameter:     1.50 ft        n: 0.0120
Pipe Length  :    55.23 ft        s: 0.0129
Up invert    :    29.49 ft        down invert:    28.78
Collection Area:     2.54 Ac.
Design Flow    :     7.04 cfs       Dsgn Depth:     0.79 ft
Pipe Capacity  :    13.92 cfs
Design Vel     :     7.47 fps      Travel Time:     0.12 min
Pipe Full Vel  :     8.08 fps
```

REACH SUMMARY

```
PIPE REACH            ID No. P60
From: CB22   To: CB21
Pipe Diameter:     2.00 ft       n: 0.0120
Pipe Length  :    35.01 ft       s: 0.0037
Up invert    :    31.25 ft       down invert:    31.12
Collection Area:     4.17 Ac.
Design Flow    :    10.93 cfs       Dsgn Depth:     1.27 ft
Pipe Capacity  :    16.11 cfs
Design Vel     :     5.20 fps      Travel Time:     0.11 min
Pipe Full Vel  :     5.26 fps


PIPE REACH            ID No. P65
From: CB36   To: CB59
Pipe Diameter:     1.00 ft       n: 0.0120
Pipe Length  :   207.63 ft       s: 0.0025
Up invert    :    35.37 ft       down invert:    34.85
Collection Area:     0.73 Ac.
Design Flow    :     2.09 cfs       Dsgn Depth:          ft
Pipe Capacity  :     2.08 cfs
Design Vel     :     2.67 fps      Travel Time:     1.30 min
Pipe Full Vel  :     2.72 fps
  (surcharged tt)

PIPE REACH            ID No. P66
From: CB59   To: CB57
Pipe Diameter:     1.25 ft       n: 0.0120
Pipe Length  :   140.87 ft       s: 0.0026
Up invert    :    34.85 ft       down invert:    34.48
Collection Area:     1.12 Ac.
Design Flow    :     3.00 cfs       Dsgn Depth:     0.87 ft
Pipe Capacity  :     3.87 cfs
Design Vel     :     3.28 fps      Travel Time:     0.72 min
Pipe Full Vel  :     3.24 fps


PIPE REACH            ID No. P67
From: CB57   To: CB55
Pipe Diameter:     1.25 ft       n: 0.0120
Pipe Length  :    98.68 ft       s: 0.0024
Up invert    :    34.48 ft       down invert:    34.24
Collection Area:     1.58 Ac.
Design Flow    :     4.08 cfs       Dsgn Depth:          ft
Pipe Capacity  :     3.72 cfs
Design Vel     :     3.32 fps      Travel Time:     0.50 min
Pipe Full Vel  :     3.11 fps
  (surcharged tt)
```

REACH SUMMARY

PIPE REACH ID No. P68
From: CB55 To: CB52
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 68.96 ft s: 0.0026
Up invert : 34.25 ft down invert: 34.07
Collection Area: 1.81 Ac.
Design Flow : 4.54 cfs Dsgn Depth: 1.00 ft
Pipe Capacity : 6.27 cfs
Design Vel : 3.65 fps Travel Time: 0.32 min
Pipe Full Vel : 3.64 fps

PIPE REACH ID No. P69
From: CB52 To: CB50
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 74.33 ft s: 0.0075
Up invert : 34.07 ft down invert: 33.51
Collection Area: 2.33 Ac.
Design Flow : 5.74 cfs Dsgn Depth: 0.82 ft
Pipe Capacity : 10.65 cfs
Design Vel : 5.81 fps Travel Time: 0.21 min
Pipe Full Vel : 6.19 fps

PIPE REACH ID No. P70
From: CB50 To: CB48
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 172.63 ft s: 0.0078
Up invert : 33.51 ft down invert: 32.16
Collection Area: 2.33 Ac.
Design Flow : 5.67 cfs Dsgn Depth: 0.80 ft
Pipe Capacity : 10.85 cfs
Design Vel : 5.88 fps Travel Time: 0.49 min
Pipe Full Vel : 6.30 fps

PIPE REACH ID No. P71
From: CB48 To: CB46
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 160.03 ft s: 0.0081
Up invert : 32.16 ft down invert: 30.87
Collection Area: 3.19 Ac.
Design Flow : 7.53 cfs Dsgn Depth: 0.96 ft
Pipe Capacity : 11.02 cfs
Design Vel : 6.34 fps Travel Time: 0.42 min
Pipe Full Vel : 6.40 fps

REACH SUMMARY

```
PIPE REACH            ID No. P72
From: CB46   To: CB16
Pipe Diameter:      2.00 ft        n: 0.0120
Pipe Length  :    174.03 ft        s: 0.0096
Up invert    :     30.87 ft        down invert:    29.20
Collection Area:     4.38 Ac.
Design Flow    :    10.13 cfs        Dsgn Depth:     1.09 ft
Pipe Capacity  :    25.89 cfs
Design Vel     :     7.33 fps       Travel Time:     0.40 min
Pipe Full Vel  :     8.46 fps


PIPE REACH            ID No. P75
From: CB53   To: CB52
Pipe Diameter:      1.00 ft        n: 0.0120
Pipe Length  :     51.62 ft        s: 0.0050
Up invert    :     34.33 ft        down invert:    34.07
Collection Area:     0.52 Ac.
Design Flow    :     1.49 cfs        Dsgn Depth:     0.53 ft
Pipe Capacity  :     2.95 cfs
Design Vel     :     3.57 fps       Travel Time:     0.24 min
Pipe Full Vel  :     3.86 fps


PIPE REACH            ID No. P80
From: CB65   To: CB63
Pipe Diameter:      1.00 ft        n: 0.0120
Pipe Length  :    124.48 ft        s: 0.0051
Up invert    :     31.21 ft        down invert:    30.58
Collection Area:     0.68 Ac.
Design Flow    :     2.08 cfs        Dsgn Depth:     0.65 ft
Pipe Capacity  :     2.96 cfs
Design Vel     :     3.85 fps       Travel Time:     0.54 min
Pipe Full Vel  :     3.87 fps


PIPE REACH            ID No. P81
From: CB63   To: CB61
Pipe Diameter:      1.25 ft        n: 0.0120
Pipe Length  :    125.00 ft        s: 0.0048
Up invert    :     30.58 ft        down invert:    29.98
Collection Area:     1.19 Ac.
Design Flow    :     3.55 cfs        Dsgn Depth:     0.79 ft
Pipe Capacity  :     5.23 cfs
Design Vel     :     4.32 fps       Travel Time:     0.48 min
Pipe Full Vel  :     4.37 fps
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REACH SUMMARY

PIPE REACH ID No. P82
From: CB61 To: CB16
Pipe Diameter: 1.50 ft n: 0.0120
Pipe Length : 26.40 ft s: 0.0295
Up invert : 29.98 ft down invert: 29.20
Collection Area: 1.51 Ac.
Design Flow : 4.40 cfs Dsgn Depth: 0.48 ft
Pipe Capacity : 21.10 cfs
Design Vel : 8.95 fps Travel Time: 0.05 min
Pipe Full Vel : 12.25 fps

PIPE REACH ID No. P90
From: CB68A To: CB68
Pipe Diameter: 1.25 ft n: 0.0120
Pipe Length : 188.38 ft s: 0.0119
Up invert : 30.47 ft down invert: 28.22
Collection Area: 1.73 Ac.
Design Flow : 4.96 cfs Dsgn Depth: 0.73 ft
Pipe Capacity : 8.25 cfs
Design Vel : 6.65 fps Travel Time: 0.47 min
Pipe Full Vel : 6.90 fps

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

STRUCTURE REPORT

SUMMARY OF STRUCTURES IN MODEL.
DESCRIBES RIMS, IE'S, PIPES IN + OUT,
AND COORDINATE LOCATION.

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RATIONAL DRAINAGE AREA SUMMARY

PROPOSED STRUCTURE REACH ID No. CB02

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area:
Bend.....: Curved or Deflected
Ent type.: Area/sump:
Ent Loss: 0.139 Exit: 0.278 App Vel: 0.284 Junct: -0.002 Bend: 0.291

North : 7084.0000
East : 1726.0000
Rim Elev : 36.0000
Bottom El: 22.0000
Hgrade El: 28.2500 ft

Reach	<Invert>	<Diam>	< n >	<End>
P25	24.000	54.00	0.012	Lower

PROPOSED STRUCTURE REACH ID No. CB03

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.053 Exit: 0.267 App Vel: 0.279 Junct: -0.005 Bend: 0.001

North : 7071.0000
East : 1962.0000
Rim Elev : 36.0000
Bottom El: 22.6800
Hgrade El: 28.4268 ft

Reach	<Invert>	<Diam>	< n >	<End>
P24	24.680	54.00	0.012	Lower
P25	24.680	54.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB04

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.056 Exit: 0.279 App Vel: 0.287 Junct: -0.003 Bend: 0.054

North : 7053.0000
East : 2260.0000
Rim Elev : 34.0000
Bottom El: 23.5500
Hgrade El: 28.7243 ft

Reach	<Invert>	<Diam>	< n >	<End>
P23	25.550	54.00	0.012	Lower
P24	25.550	54.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB05

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 6944.0000
East : 2432.0000
Rim Elev : 36.0000
Bottom El: 24.1400
Hgrade El: 28.9868 ft

Ent Loss: 0.057 Exit: 0.287 App Vel: 0.298 Junct: -0.005 Bend: 0.064

Reach	<Invert>	<Diam>	< n >	<End>
P22	26.140	54.00	0.012	Lower
P23	26.140	54.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB06

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 6939.0000
East : 2718.0000
Rim Elev : 35.5300
Bottom El: 22.9700
Hgrade El: 29.4130 ft

Ent Loss: 0.060 Exit: 0.298 App Vel: 0.431 Junct: 0.019 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P21	24.970	48.00	0.012	Lower
P22	26.970	54.00	0.012	Upper
P200	24.970	24.00	0.012	Lower

PROPOSED STRUCTURE REACH ID No. CB07

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B07
Bend.....: No special shape
Ent type.: Area/sump:

North : 6934.0000
East : 2994.0000
Rim Elev : 34.5600
Bottom El: 24.0400
Hgrade El: 29.9982 ft

Ent Loss: 0.086 Exit: 0.431 App Vel: 0.431 Junct: 0.000 Bend: 0.002

Reach	<Invert>	<Diam>	< n >	<End>
P20	26.040	48.00	0.012	Lower
P21	26.040	48.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB09

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 6933.0000
East : 3033.0000
Rim Elev : 35.3000
Bottom El: 24.1800
Hgrade El: 31.0242 ft

Ent Loss: 0.086 Exit: 0.431 App Vel: 0.429 Junct: 0.310 Bend: 0.571

Reach	<Invert>	<Diam>	< n >	<End>
P19	26.180	48.00	0.012	Lower
P20	26.180	48.00	0.012	Upper
P92	26.180	18.00	0.012	Lower
P106	26.180	30.00	0.012	Lower

PROPOSED STRUCTURE REACH ID No. CB10

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B10
Bend.....: No special shape
Ent type.: Area/sump:

North : 6850.0000
East : 3249.0000
Rim Elev : 35.0000
Bottom El: 24.9800
Hgrade El: 31.3713 ft

Ent Loss: 0.051 Exit: 0.255 App Vel: 0.238 Junct: 0.007 Bend: 0.026

Reach	<Invert>	<Diam>	< n >	<End>
P18	26.980	48.00	0.012	Lower
P19	26.980	48.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB11

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B11
Bend.....: No special shape
Ent type.: Area/sump:

North : 6845.0000
East : 3549.0000
Rim Elev : 35.0000
Bottom El: 26.0600
Hgrade El: 32.0343 ft

Ent Loss: 0.048 Exit: 0.238 App Vel: 0.217 Junct: 0.008 Bend: 0.289

Reach	<Invert>	<Diam>	< n >	<End>
P17	28.060	48.00	0.012	Lower
P18	28.060	48.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB12

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B12
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.043 Exit: 0.217 App Vel: 0.246 Junct: 0.294 Bend: 0.328

North : 6920.0000
East : 3683.0000
Rim Elev : 35.3900
Bottom El: 26.7800
Hgrade El: 32.7438 ft

Reach	<Invert>	<Diam>	< n >	<End>
P16	28.780	48.00	0.012	Lower
P55A	28.780	18.00	0.012	Lower
P17	28.780	48.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB13

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.049 Exit: 0.246 App Vel: 0.548 Junct: -0.016 Bend: 0.007

North : 6865.0000
East : 3678.0000
Rim Elev : 34.9800
Bottom El: 27.4900
Hgrade El: 32.6919 ft

Reach	<Invert>	<Diam>	< n >	<End>
P55	29.490	15.00	0.012	Lower
P55A	29.490	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB14

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B14
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.037 Exit: 0.183 App Vel: 0.307 Junct: 0.003 Bend: 0.003

North : 6981.0000
East : 3684.0000
Rim Elev : 35.1300
Bottom El: 27.0100
Hgrade El: 32.6949 ft

Reach	<Invert>	<Diam>	< n >	<End>
P15	29.010	42.00	0.012	Lower
P16	29.010	48.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB16

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.061 Exit: 0.307 App Vel: 0.213 Junct: 0.033 Bend: 0.284

North : 7029.0000
East : 3683.0000
Rim Elev : 34.7800
Bottom El: 27.2000
Hgrade El: 33.2394 ft

Reach	<Invert>	<Diam>	< n >	<End>
P14	29.200	42.00	0.012	Lower
P72	29.200	24.00	0.012	Lower
P82	29.200	18.00	0.012	Lower
P15	29.200	42.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB17

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B17
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.043 Exit: 0.213 App Vel: 0.207 Junct: 0.003 Bend: 0.001

North : 7028.0000
East : 3771.0000
Rim Elev : 34.7800
Bottom El: 27.4200
Hgrade El: 33.3856 ft

Reach	<Invert>	<Diam>	< n >	<End>
P13	29.420	42.00	0.012	Lower
P14	29.420	42.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB19

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B19
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.041 Exit: 0.207 App Vel: 0.326 Junct: 0.022 Bend: 0.002

North : 7023.0000
East : 3985.0000
Rim Elev : 36.5000
Bottom El: 28.5300
Hgrade El: 33.5533 ft

Reach	<Invert>	<Diam>	< n >	<End>
P12	30.530	36.00	0.012	Lower
P13	30.530	42.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB200

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

North : 7010.0000
East : 2718.0000
Rim Elev : 35.1000
Bottom El: 22.7900
Hgrade El: 0.0000 ft

Reach	<Invert>	<Diam>	< n >	<End>
P201	25.200	24.00	0.012	Lower
P200	25.200	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB201

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B201
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

North : 7079.0000
East : 2720.0000
Rim Elev : 34.5300
Bottom El: 23.5400
Hgrade El: 0.0000 ft

Reach	<Invert>	<Diam>	< n >	<End>
P202	25.540	24.00	0.012	Lower
P201	25.540	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB202

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B202
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

North : 7239.0000
East : 2724.0000
Rim Elev : 34.6000
Bottom El: 25.2400
Hgrade El: 0.0000 ft

Reach	<Invert>	<Diam>	< n >	<End>
P203	27.240	24.00	0.012	Lower
P202	27.240	24.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB203

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: WEO
Bend.....: No special shape
Ent type.: Area/sump:

North : 7307.0000
East : 2725.0000
Rim Elev : 35.4000
Bottom El: 26.0000
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P204	28.000	12.00	0.012	Lower
P206	28.000	12.00	0.012	Lower
P203	28.000	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB204

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B204
Bend.....: No special shape
Ent type.: Area/sump:

North : 7309.0000
East : 2643.0000
Rim Elev : 34.7200
Bottom El: 26.8000
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P205	28.800	12.00	0.012	Lower
P204	28.800	12.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB205

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B205
Bend.....: No special shape
Ent type.: Area/sump:

North : 7314.0000
East : 2486.0000
Rim Elev : 34.2800
Bottom El: 28.3900
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P205	30.390	12.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB206

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B206
Bend.....: No special shape
Ent type.: Area/sump:

North : 7306.0000
East : 2801.0000
Rim Elev : 35.0000
Bottom El: 27.6000
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P207	29.600	12.00	0.012	Lower
P206	29.600	12.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB207

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B207
Bend.....: No special shape
Ent type.: Area/sump:

North : 7306.0000
East : 2901.0000
Rim Elev : 35.0100
Bottom El: 29.6000
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P207	31.600	12.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB21

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B22
Bend.....: No special shape
Ent type.: Area/sump:

North : 7020.0000
East : 4192.0000
Rim Elev : 36.5100
Bottom El: 29.1200
Hgrade El: 34.5729 ft

Ent Loss: 0.065 Exit: 0.326 App Vel: 0.188 Junct: 0.153 Bend: 0.250

Reach	<Invert>	<Diam>	< n >	<End>
P11	31.120	36.00	0.012	Lower
P12	31.120	36.00	0.012	Upper
P60	31.120	24.00	0.012	Lower

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB210

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B210
Bend.....: No special shape
Ent type.: Area/sump:

North : 7874.0000
East : 2958.0000
Rim Elev : 38.3000
Bottom El: 30.3200
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P210	32.320	15.00	0.012	Upper
P211	32.320	15.00	0.012	Lower

PROPOSED STRUCTURE REACH ID No. CB211

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B211
Bend.....: No special shape
Ent type.: Area/sump:

North : 7922.0000
East : 2838.0000
Rim Elev : 38.3200
Bottom El: 32.0400
Hgrade El: 0.0000 ft

Ent Loss: 0.006 Exit: 0.032 App Vel: 0.033 Junct: -0.001 Bend: 0.044

Reach	<Invert>	<Diam>	< n >	<End>
P211	34.040	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB22

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B21
Bend.....: No special shape
Ent type.: Area/sump:

North : 7055.0000
East : 4193.0000
Rim Elev : 36.3700
Bottom El: 29.2500
Hgrade El: 0.0000 ft

Ent Loss: 0.000 Exit: 0.000 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P60	31.250	24.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB23

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.031 Exit: 0.155 App Vel: 0.180 Junct: 0.043 Bend: 0.236

North : 7017.0000
East : 4327.0000
Rim Elev : 38.7500
Bottom El: 29.4700
Hgrade El: 34.9867 ft

Reach	<Invert>	<Diam>	< n >	<End>
P44	31.470	24.00	0.012	Lower
P32	31.470	30.00	0.012	Lower
P10	31.470	30.00	0.012	Lower
P11	31.470	36.00	0.012	Upper

EXISTING STRUCTURE REACH ID No. CB24

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: BBW
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.011 Exit: 0.055 App Vel: 0.000 Junct: 0.000 Bend: 0.000

North : 7016.0000
East : 4527.0000
Rim Elev : 39.0000
Bottom El: 29.9700
Hgrade El: 35.1400 ft

Reach	<Invert>	<Diam>	< n >	<End>
P10	31.970	30.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB25

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B25
Bend.....: No special shape
Ent type.: Area/sump:
Ent Loss: 0.036 Exit: 0.180 App Vel: 0.034 Junct: 0.031 Bend: 0.000

North : 6832.0000
East : 4325.0000
Rim Elev : 36.8500
Bottom El: 30.1700
Hgrade El: 35.4603 ft

Reach	<Invert>	<Diam>	< n >	<End>
P31	32.170	24.00	0.012	Lower
P32	32.170	30.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB27

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 6735.0000
East : 4320.0000
Rim Elev : 36.7800
Bottom El: 30.5400
Hgrade El: 35.4191 ft

Ent Loss: 0.007 Exit: 0.034 App Vel: 0.114 Junct: -0.003 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P30	32.540	18.00	0.012	Lower
P31	32.540	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB29

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B29
Bend.....: No special shape
Ent type.: Area/sump:

North : 6570.0000
East : 4307.0000
Rim Elev : 36.4200
Bottom El: 31.1700
Hgrade El: 35.8474 ft

Ent Loss: 0.023 Exit: 0.114 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P30	33.170	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB31

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B31
Bend.....: No special shape
Ent type.: Area/sump:

North : 7141.0000
East : 4331.0000
Rim Elev : 39.1600
Bottom El: 30.8900
Hgrade El: 35.2187 ft

Ent Loss: 0.031 Exit: 0.155 App Vel: 0.157 Junct: -0.001 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P43	32.890	24.00	0.012	Lower
P44	32.890	24.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB32

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B32
Bend.....: No special shape
Ent type.: Area/sump:

North : 7296.0000
East : 4332.0000
Rim Elev : 38.6000
Bottom El: 31.9400
Hgrade El: 35.4382 ft

Ent Loss: 0.031 Exit: 0.157 App Vel: 0.291 Junct: 0.064 Bend: 0.003

Reach	<Invert>	<Diam>	< n >	<End>
P42	33.940	18.00	0.012	Lower
P43	33.940	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB33

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area: B33
Bend.....: No special shape
Ent type.: Area/sump:

North : 7359.0000
East : 4335.0000
Rim Elev : 39.5300
Bottom El: 32.4500
Hgrade El: 36.0465 ft

Ent Loss: 0.058 Exit: 0.291 App Vel: 0.215 Junct: 0.027 Bend: 0.286

Reach	<Invert>	<Diam>	< n >	<End>
P41	34.450	18.00	0.012	Lower
P42	34.450	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB36

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B36
Bend.....: No special shape
Ent type.: Area/sump:

North : 7413.0000
East : 4173.0000
Rim Elev : 38.1200
Bottom El: 33.3700
Hgrade El: 36.9975 ft

Ent Loss: 0.022 Exit: 0.110 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P65	35.370	12.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB38

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B38
Bend.....: No special shape
Ent type.: Area/sump:

North : 7322.0000
East : 4432.0000
Rim Elev : 39.0300
Bottom El: 33.2600
Hgrade El: 36.6308 ft

Ent Loss: 0.043 Exit: 0.215 App Vel: 0.047 Junct: 0.028 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P40	35.260	18.00	0.012	Lower
P41	35.260	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB40

Location :
Str Type : ---
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B40
Bend.....: No special shape
Ent type.: Area/sump:

North : 7193.0000
East : 4764.0000
Rim Elev : 39.1500
Bottom El: 34.1500
Hgrade El: 37.0559 ft

Ent Loss: 0.009 Exit: 0.047 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P40	36.150	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB42

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B42
Bend.....: No special shape
Ent type.: Area/sump:

North : 6596.0000
East : 3667.0000
Rim Elev : 35.2400
Bottom El: 30.1800
Hgrade El: 0.0000 ft

Ent Loss: 0.110 Exit: 0.548 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P55	32.180	15.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB46

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B46
Bend.....: No special shape
Ent type.: Area/sump:

North : 7203.0000
East : 3686.0000
Rim Elev : 35.1300
Bottom El: 28.8700
Hgrade El: 33.5175 ft

Ent Loss: 0.032 Exit: 0.161 App Vel: 0.282 Junct: 0.070 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P71	30.870	18.00	0.012	Lower
P72	30.870	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB48

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B48
Bend.....: No special shape
Ent type.: Area/sump:

North : 7363.0000
East : 3689.0000
Rim Elev : 36.5900
Bottom El: 30.1600
Hgrade El: 34.4379 ft

Ent Loss: 0.056 Exit: 0.282 App Vel: 0.160 Junct: 0.038 Bend: 0.006

Reach	<Invert>	<Diam>	< n >	<End>
P70	32.160	18.00	0.012	Lower
P71	32.160	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB50

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 7533.0000
East : 3719.0000
Rim Elev : 38.2900
Bottom El: 31.5100
Hgrade El: 34.9219 ft

Ent Loss: 0.032 Exit: 0.160 App Vel: 0.164 Junct: -0.002 Bend: 0.032

Reach	<Invert>	<Diam>	< n >	<End>
P69	33.510	18.00	0.012	Lower
P70	33.510	18.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB52

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 7603.0000
East : 3694.0000
Rim Elev : 39.1200
Bottom El: 32.0700
Hgrade El: 35.2111 ft

Ent Loss: 0.033 Exit: 0.164 App Vel: 0.102 Junct: 0.020 Bend: 0.136

Reach	<Invert>	<Diam>	< n >	<End>
P68	34.070	18.00	0.012	Lower
P75	34.070	12.00	0.012	Lower
P69	34.070	18.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB53

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B53
Bend.....: No special shape
Ent type.: Area/sump:

North : 7622.0000
East : 3646.0000
Rim Elev : 38.4300
Bottom El: 32.3300
Hgrade El: 35.3551 ft

Ent Loss: 0.011 Exit: 0.056 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P75	34.330	12.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB55

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B55
Bend.....: No special shape
Ent type.: Area/sump:

North : 7583.0000
East : 3760.0000
Rim Elev : 38.4100
Bottom El: 32.2400
Hgrade El: 35.2975 ft

Ent Loss: 0.020 Exit: 0.102 App Vel: 0.171 Junct: 0.016 Bend: 0.002

Reach	<Invert>	<Diam>	< n >	<End>
P67	34.240	15.00	0.012	Lower
P68	34.250	18.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB57

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B57
Bend.....: No special shape
Ent type.: Area/sump:

North : 7550.0000
East : 3853.0000
Rim Elev : 38.2200
Bottom El: 32.4800
Hgrade El: 35.9617 ft

Ent Loss: 0.034 Exit: 0.171 App Vel: 0.093 Junct: 0.024 Bend: 0.003

Reach	<Invert>	<Diam>	< n >	<End>
P66	34.480	15.00	0.012	Lower
P67	34.480	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB59

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B59
Bend.....: No special shape
Ent type.: Area/sump:

North : 7487.0000
East : 3979.0000
Rim Elev : 37.9000
Bottom El: 32.8500
Hgrade El: 36.2567 ft

Ent Loss: 0.019 Exit: 0.093 App Vel: 0.110 Junct: 0.033 Bend: 0.003

Reach	<Invert>	<Diam>	< n >	<End>
P65	34.850	12.00	0.012	Lower
P66	34.850	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB61

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B61
Bend.....: No special shape
Ent type.: Area/sump:

North : 7045.0000
East : 3662.0000
Rim Elev : 35.0600
Bottom El: 27.9800
Hgrade El: 33.2965 ft

Ent Loss: 0.019 Exit: 0.096 App Vel: 0.130 Junct: 0.023 Bend: 0.009

Reach	<Invert>	<Diam>	< n >	<End>
P81	29.980	15.00	0.012	Lower
P82	29.980	18.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB63

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B63
Bend.....: No special shape
Ent type.: Area/sump:

North : 7094.0000
East : 3547.0000
Rim Elev : 35.1200
Bottom El: 28.5800
Hgrade El: 33.7110 ft

Ent Loss: 0.026 Exit: 0.130 App Vel: 0.109 Junct: 0.047 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P80	30.580	12.00	0.012	Lower
P81	30.580	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB65

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B65
Bend.....: No special shape
Ent type.: Area/sump:

North : 7144.0000
East : 3433.0000
Rim Elev : 35.1300
Bottom El: 29.2100
Hgrade El: 34.2016 ft

Ent Loss: 0.022 Exit: 0.109 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P80	31.210	12.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB67

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B67
Bend.....: No special shape
Ent type.: Area/sump:

North : 6884.0000
East : 3032.0000
Rim Elev : 34.8700
Bottom El: 24.7800
Hgrade El: 31.2668 ft

Ent Loss: 0.047 Exit: 0.235 App Vel: 0.283 Junct: 0.064 Bend: 0.002

Reach	<Invert>	<Diam>	< n >	<End>
P91	26.780	15.00	0.012	Lower
P92	26.780	18.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB68

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B68
Bend.....: No special shape
Ent type.: Area/sump:

North : 6766.0000
East : 3027.0000
Rim Elev : 35.1500
Bottom El: 26.2200
Hgrade El: 32.0238 ft

Ent Loss: 0.057 Exit: 0.283 App Vel: 0.254 Junct: 0.012 Bend: 0.002

Reach	<Invert>	<Diam>	< n >	<End>
P90	28.220	15.00	0.012	Lower
P91	28.220	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB68A

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B68A
Bend.....: No special shape
Ent type.: Area/sump:

North : 6578.0000
East : 3015.0000
Rim Elev : 33.6900
Bottom El: 28.4700
Hgrade El: 33.2714 ft

Ent Loss: 0.051 Exit: 0.254 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P90	30.470	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB69

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B69
Bend.....: No special shape
Ent type.: Area/sump:

North : 7005.0000
East : 3034.0000
Rim Elev : 35.1200
Bottom El: 24.6300
Hgrade El: 31.3879 ft

Ent Loss: 0.086 Exit: 0.429 App Vel: 0.404 Junct: 0.010 Bend: 0.002

Reach	<Invert>	<Diam>	< n >	<End>
P105	26.630	30.00	0.012	Lower
P106	26.630	30.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB71

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B71
Bend.....: No special shape
Ent type.: Area/sump:

North : 7105.0000
East : 3035.0000
Rim Elev : 35.1500
Bottom El: 25.1900
Hgrade El: 31.8194 ft

Ent Loss: 0.081 Exit: 0.404 App Vel: 0.381 Junct: 0.010 Bend: 0.002

Reach	<Invert>	<Diam>	< n >	<End>
P104	27.190	30.00	0.012	Lower
P105	27.190	30.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB73

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B73
Bend.....: No special shape
Ent type.: Area/sump:

North : 7205.0000
East : 3037.0000
Rim Elev : 35.1500
Bottom El: 25.7500
Hgrade El: 32.2336 ft

Ent Loss: 0.076 Exit: 0.381 App Vel: 0.354 Junct: 0.011 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P103	27.750	30.00	0.012	Lower
P104	27.750	30.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB75

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 48.00 sf/2.00 ft
Cont Area:
Bend.....: No special shape
Ent type.: Area/sump:

North : 7309.0000
East : 3039.0000
Rim Elev : 35.7800
Bottom El: 26.3500
Hgrade El: 32.7764 ft

Ent Loss: 0.071 Exit: 0.354 App Vel: 0.215 Junct: 0.045 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P102	28.350	30.00	0.012	Lower
P112	28.350	18.00	0.012	Lower
P116	28.350	12.00	0.012	Lower
P103	28.350	30.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB76

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B76
Bend.....: No special shape
Ent type.: Area/sump:

North : 7429.0000
East : 3040.0000
Rim Elev : 34.9400
Bottom El: 27.0200
Hgrade El: 33.1124 ft

Ent Loss: 0.043 Exit: 0.215 App Vel: 0.204 Junct: 0.079 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P101	29.020	24.00	0.012	Lower
P102	29.020	30.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB78

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B78
Bend.....: No special shape
Ent type.: Area/sump:

North : 7578.0000
East : 3042.0000
Rim Elev : 36.2900
Bottom El: 27.8600
Hgrade El: 33.5387 ft

Ent Loss: 0.041 Exit: 0.204 App Vel: 0.158 Junct: 0.017 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P100	29.860	24.00	0.012	Lower
P101	29.860	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB80

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B80
Bend.....: No special shape
Ent type.: Area/sump:

North : 7739.0000
East : 3047.0000
Rim Elev : 37.8900
Bottom El: 28.7600
Hgrade El: 33.8959 ft

Ent Loss: 0.032 Exit: 0.158 App Vel: 0.115 Junct: 0.015 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P99	30.760	24.00	0.012	Lower
P100	30.760	24.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB82

Location :
Str Type :
Str Cat : Stm Manhole
Str Diam : 48.00 in
Cont Area:
Bend.....: No special shape
Ent type.: Str Diam :

North : 7849.0000
East : 3049.0000
Rim Elev : 39.2000
Bottom El: 31.3800
Hgrade El: 34.2069 ft

Ent Loss: 0.023 Exit: 0.115 App Vel: 0.085 Junct: 0.011 Bend: 0.113

Reach	<Invert>	<Diam>	< n >	<End>
P98	31.380	24.00	0.012	Lower
P99	31.380	24.00	0.012	Upper
P210	31.380	15.00	0.012	Lower

PROPOSED STRUCTURE REACH ID No. CB83

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B83
Bend.....: No special shape
Ent type.: Area/sump:

North : 7820.0000
East : 3112.0000
Rim Elev : 38.5100
Bottom El: 29.5600
Hgrade El: 34.2958 ft

Ent Loss: 0.017 Exit: 0.085 App Vel: 0.079 Junct: 0.003 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P97	31.560	24.00	0.012	Lower
P98	31.560	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB85

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B85
Bend.....: No special shape
Ent type.: Area/sump:

North : 7783.0000
East : 3196.0000
Rim Elev : 38.2100
Bottom El: 29.7900
Hgrade El: 34.4043 ft

Ent Loss: 0.016 Exit: 0.079 App Vel: 0.067 Junct: 0.004 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P95	31.790	24.00	0.012	Lower
P97	31.790	24.00	0.012	Upper

==========

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB87

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B87
Bend.....: No special shape
Ent type.: Area/sump:

North : 7695.0000
East : 3427.0000
Rim Elev : 36.1700
Bottom El: 30.4200
Hgrade El: 34.6603 ft

Ent Loss: 0.013 Exit: 0.067 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P95	32.420	24.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB90

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B92
Bend.....: No special shape
Ent type.: Area/sump:

North : 7310.0000
East : 2999.0000
Rim Elev : 35.1600
Bottom El: 28.9200
Hgrade El: 32.8070 ft

Ent Loss: 0.003 Exit: 0.014 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P116	30.920	12.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB94

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B94
Bend.....: No special shape
Ent type.: Area/sump:

North : 7289.0000
East : 3095.0000
Rim Elev : 35.1400
Bottom El: 26.8400
Hgrade El: 32.9045 ft

Ent Loss: 0.035 Exit: 0.176 App Vel: 0.280 Junct: 0.031 Bend: 0.005

Reach	<Invert>	<Diam>	< n >	<End>
P111	28.840	15.00	0.012	Lower
P112	28.840	18.00	0.012	Upper

STRUCTURE REPORT

PROPOSED STRUCTURE REACH ID No. CB96

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B96
Bend.....: No special shape
Ent type.: Area/sump:

North : 7239.0000
East : 3209.0000
Rim Elev : 35.1200
Bottom El: 27.8200
Hgrade El: 33.8956 ft

Ent Loss: 0.056 Exit: 0.280 App Vel: 0.073 Junct: 0.039 Bend: 0.001

Reach	<Invert>	<Diam>	< n >	<End>
P110	29.820	15.00	0.012	Lower
P111	29.820	15.00	0.012	Upper

PROPOSED STRUCTURE REACH ID No. CB98

Location :
Str Type :
Str Cat : Catch Basin
Area/sump: 12.50 sf/2.00 ft
Cont Area: B98
Bend.....: No special shape
Ent type.: Area/sump:

North : 7194.0000
East : 3319.0000
Rim Elev : 35.1400
Bottom El: 28.7700
Hgrade El: 34.1536 ft

Ent Loss: 0.015 Exit: 0.073 App Vel: 0.000 Junct: 0.000 Bend: 0.000

Reach	<Invert>	<Diam>	< n >	<End>
P110	30.770	15.00	0.012	Upper

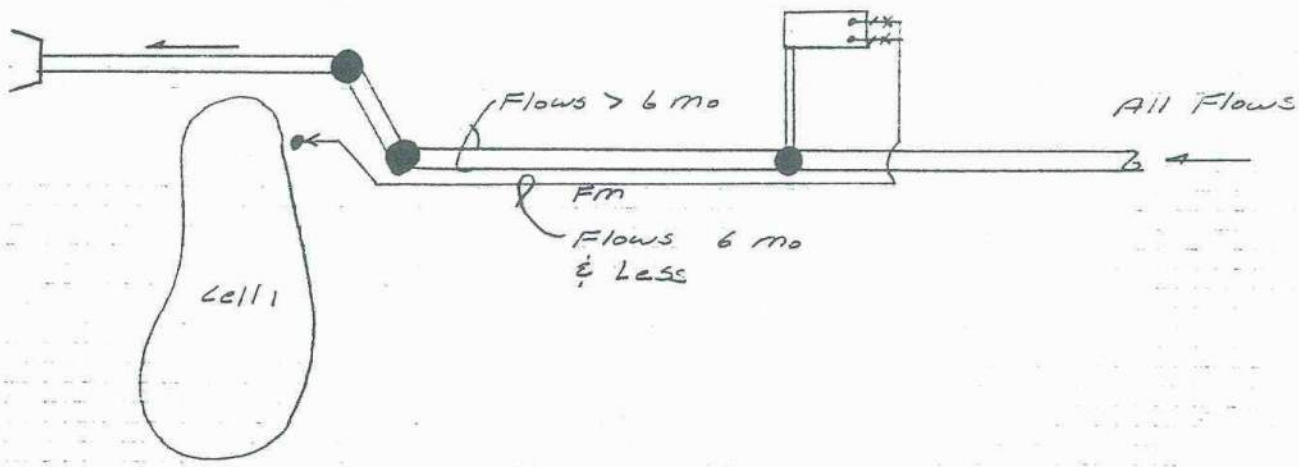
kpff consulting engineers seattle washington	project Redmond T.C.	by MAV	sheet no.
	location	date 5/13/95	1
	client	checked	job no.
		date	

Stormwater Pump Calc's

— System requirements —

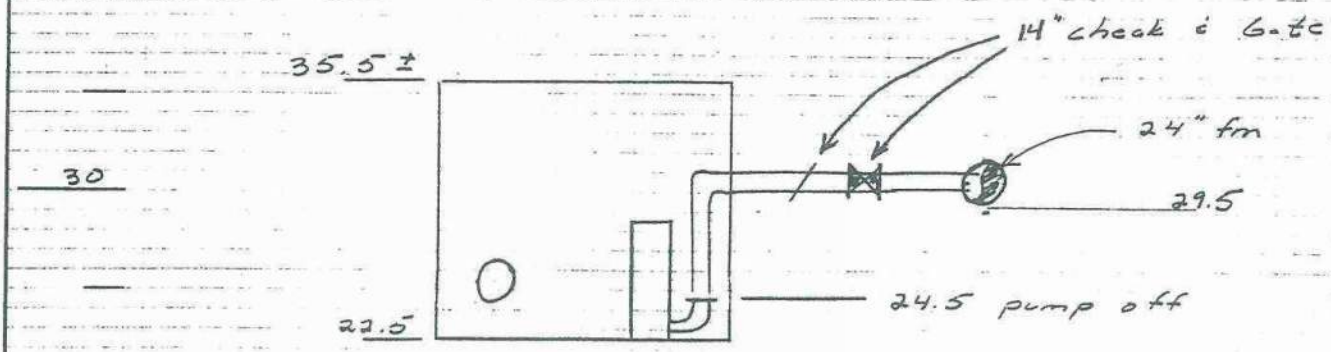
- pump first flows up to 6 mo storm
- Duplex system, both pumps operating pass 6 mo storm
- keep fm. Vel < 5fps to avoid waterhammer
- 6 mo storm ≈ 14 cfs

— System Configuration —

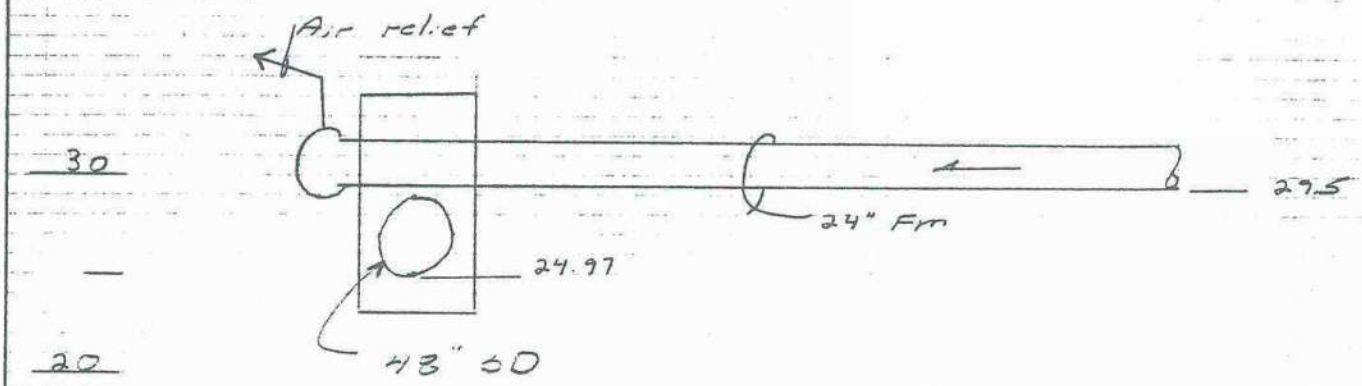


Schematic

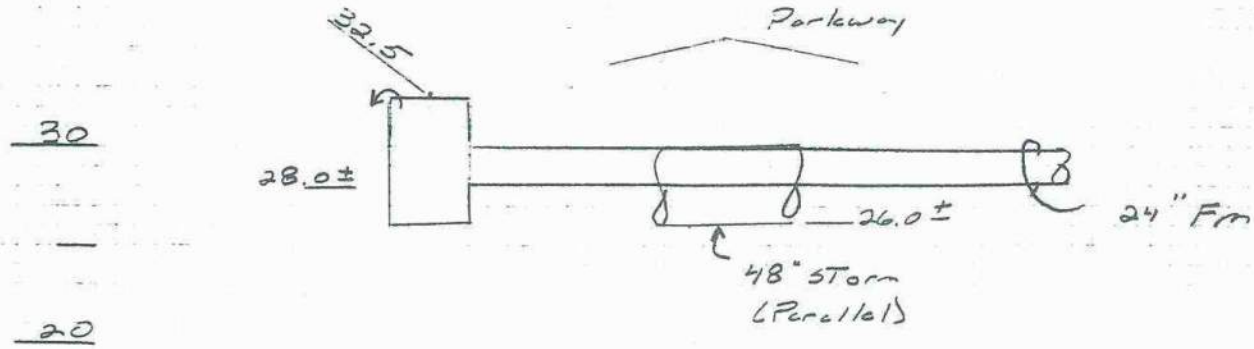
kpff consulting engineers seattle washington	project Redmond TC	by MAV	sheet no.
	location	date 5/13/95	2
	client	checked	job no.
		date	



Section @ Pump Stn



Forcemain Crossing 48" Storm



Forcemain @ Outfall

kpff consulting engineers seattle washington	project Redmond TL	by MAV	sheet no.
	location	date 5/13/95	3
	client	checked	job no.
		date	

— Determine System Head Curve Both pumps On —

TDH = Static + Minor + friction + Velocity

Static = 32.5 − 24.5 + Depth of Flow at outlet structure (15 cfs at 4'ø CB = 3.09 (2π2)(H)^1.5, H ≅ 0.5')

= 8.5' max

$$\text{Minor} = K \frac{V^2}{2g}$$

Fitting	K
Gate (14")	(1) × .2 = .2
check (14")	(1) × 2.5 = 2.5
90° (14")	2 × 1.0 = 2.0
Tee (14")	1 × 1.8 = 1.8
Σ	6.5 ← K (14")
90° (24")	(1) × 1.0 = 1.0
Expansion @ outlet	(1) × 1.0 = 1.0
45° (24")	2 × .5 = 1.0
	3.0 ← K (24")

kpff consulting engineers seattle washington	project RTC	by MAV	sheet no.
	location	date 5/13/95	4
	client	checked	job no.
		date	

Friction

$$h_f = f \frac{L}{D} \frac{V^2}{2g}$$

14" $\quad h_f = f \frac{25'}{1.17} \frac{V^2}{2g}$

$$= 21.4 f \frac{V^2}{2g}$$

24" $\quad h_f = f \frac{600'}{2} \frac{V^2}{2g}$

$$= 300 f \frac{V^2}{2g}$$

$$\therefore \; TDH = 8.5 + \frac{V_{14}^2}{2g}(6.5 + 21.4f + 1) + \frac{V_{24}^2}{2g}(3.0 + 300f + 1)$$

$$TDH = 8.5 + \frac{V_{14}^2}{2g}(7.5 + 21.4f) + \frac{V_{24}^2}{2g}(4 + 300f)$$

Assume Total $Q = \underline{5000 \text{ gpm}}$

$\therefore$ each pump $= 2500$ gpm

$V_{14} = 5.58 / \pi(.58)^2 = 5.2$ fps

$\frac{V_{14}^2}{2g} = 0.42$

$V_{24} = 3.6$ fps (5000 gpm)

$\frac{V_{24}^2}{2g} = 0.2$

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$R_{14} = VD/\nu = \frac{5.2(1.17)}{1.22\times10^{-5}} = 5.0\times10^5$

$\epsilon/D = .00085/1.17 = .0007$

from moody diagram $f = .019$

$R_{24} = \frac{3.6(2)}{1.22\times10^{-5}} = 5.9\times10^5$

$\epsilon/D = .00085/2 = .0004$

$f = .017$

$TDH = 8.5 + .42(7.5 + 21.4(.019) + .2(4 + 300(.017))$

$= 13.6'$

Assume Total $Q = \underline{6000 \text{ gpm}}$

$V_{14} = 6.3$ fps

$V_{14}^2/2g = 0.62$

$V_{24} = 4.3$ fps

$V_{24}^2/2g = 0.28$

$R_{14} = \frac{6.3(1.17)}{1.22\times10^{-5}} = 6\times10^5$ $f = .019$

$R_{24} = \frac{4.3(2)}{1.22\times10^{-5}} = 7.0\times10^5$ $f = .017$

$TDH = 8.5 + .62(7.5 + 21.4(.019)) + .28(4 + 300(.017))$

$= 16.0$

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Assume Total Q = 7000 gpm

$V_{14} = 7.4$ fps

$V_{14}^2/2g = .85$

$V_{24} = 4.97$ fps

$V_{24}^2/2g = 0.38$

$R_{14} = \frac{7.4(1.17)}{1.22\times10^{-5}} = 7.1\times10^5 \quad f = .019$

$R_{24} = \frac{4.97(2)}{1.22\times10^{-5}} = 8.1\times10^5 \quad f = .017$

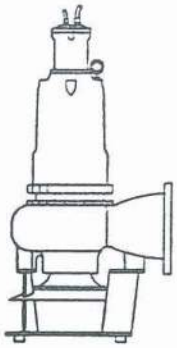
$TDH = 8.5 + .85(7.5 + 21.4(.019)) + .38(4 + 300(.017))$

$= 18.7$

∴ System head curve for each pump (when both on)

Q (gpm each)	TDH
2500	13.6
3000	16.0
3500	18.7

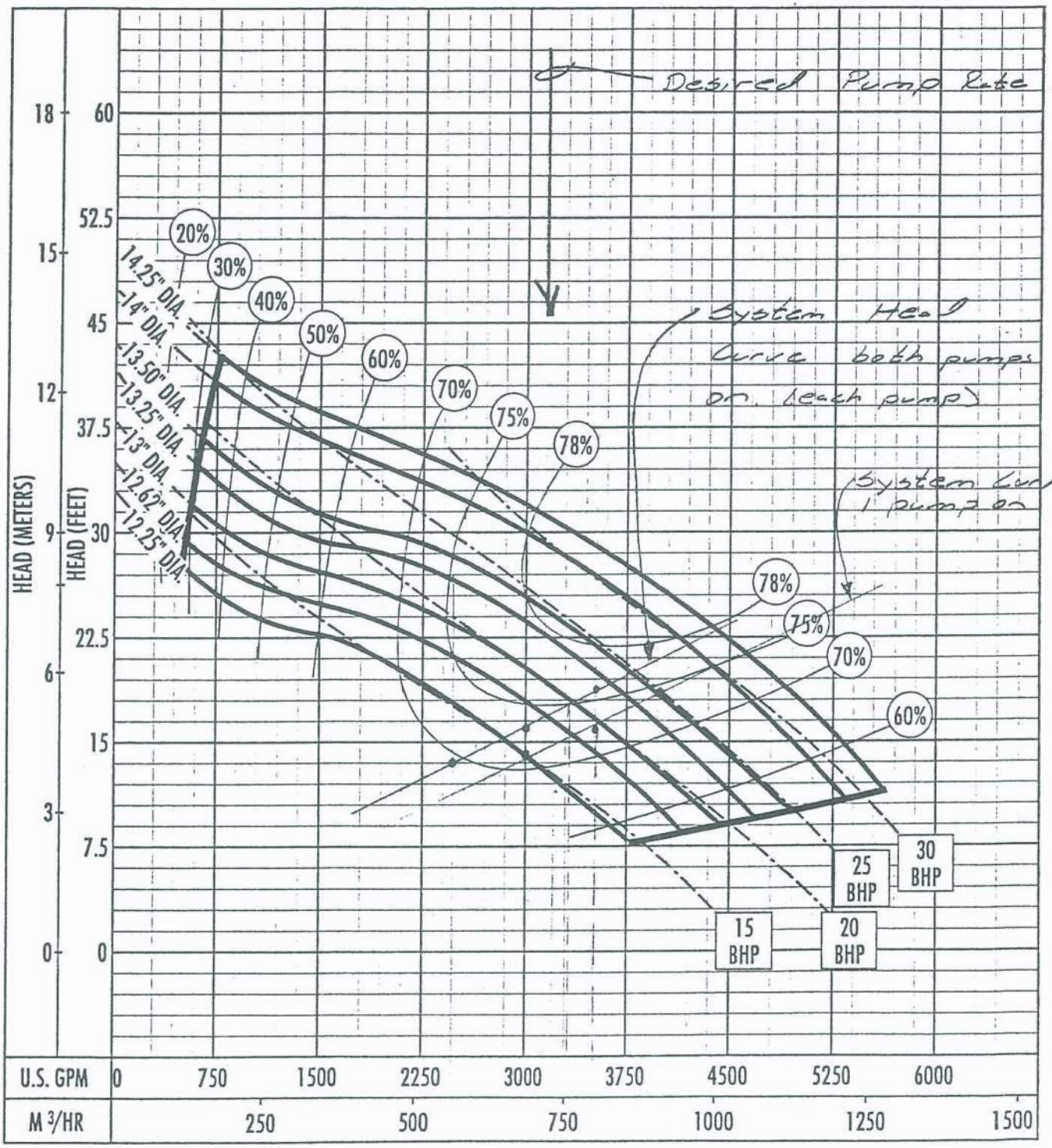
For Design Purposes Select Hydromatic 6 12L



Performance Curve

S12L/S12LX

RPM: **870** Discharge: **12"** Solids: **6"**



The curves reflect maximum performance characteristics without exceeding full load (Nameplate) horsepower. All pumps have a service factor of 1.2. Operation is recommended in the bounded area with operational point within the curve limit. Performance curves are based on actual tests with clear water at 70° F. and 1280 feet site elevation.

Conditions of Service:

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∴ select 13" impeller on 20 HP motor
75% efficiency.

$Q \approx 3300 \text{ gpm} \times 2 = 14.7 \text{ cfs}$

— Check Pump rate when 1 pump operating

$$TDH = 8.5 + \frac{V_{14}^2}{2g}(7.5 + 21.4f) + \frac{V_{24}^2}{2g}(4 + 300f)$$

Assume $Q = \underline{3000 \text{ gpm}}$

$V_{14} = 6.3 \text{ fps}$

$\frac{V_{14}^2}{2g} = 0.62$

$V_{24} = 2.13 \text{ fps}$

$\frac{V_{24}^2}{2g} = .07$

$$R = \frac{2.13(2)}{1.22 \times 10^{-5}} = 3.5 \times 10^5 \qquad f = .017$$

$$TDH = 8.5 + .62(7.5 + 21.4(.019)) + .07(4 + 300(.017))$$

$= 14.0$

Assume $Q = \underline{3500 \text{ gpm}}$

$V_{14} = 7.4 \text{ fps}$

$\frac{V_{14}^2}{2g} = .85$

$V_{24} = 2.48 \text{ fps}$

$\frac{V_{24}^2}{2g} = .096$

$$R = \frac{2.48(2)}{} = 4 \times 10^5 \qquad f = .017$$

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$TDH = 8.5 + .85(7.5 + 21.4(.019)) + .096(4 + 300(.017))$

$= 16.1$

Assume $\underline{Q = 4000 \text{ GPM}}$

$V_{14} = 8.4$ fps

$\frac{V_{14}^2}{2g} = 1.11$

$V_{24} = 2.8$ fps

$\frac{V_{24}^2}{2g} = 0.125$

$R_{14} = \frac{8.4(1.17)}{1.22 \times 10^{-5}} = 8 \times 10^5 \qquad f = .019$

$R_{24} = \frac{2.8(2)}{1.22 \times 10^{-5}} = 4.6 \times 10^5 \qquad f = .017$

$TDH = 8.5 + 1.11(7.5 + 21.4(.019)) + .125(4 + 300(.017))$

$= 18.4$

∴ System Curve w/ 1 pump on

Q (gpm)	TDH
3000	14.0
3500	16.1
4000	18.4

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	client	checked	job no.
		date	

∴ when 1 pump on Q ≈ 3500 = 7.8 cfs

— check velocities —

	14" ø (fps)	24" ø (fps)
1-pump on	7.4	2.5
(2) pumps on	7.0	4.7

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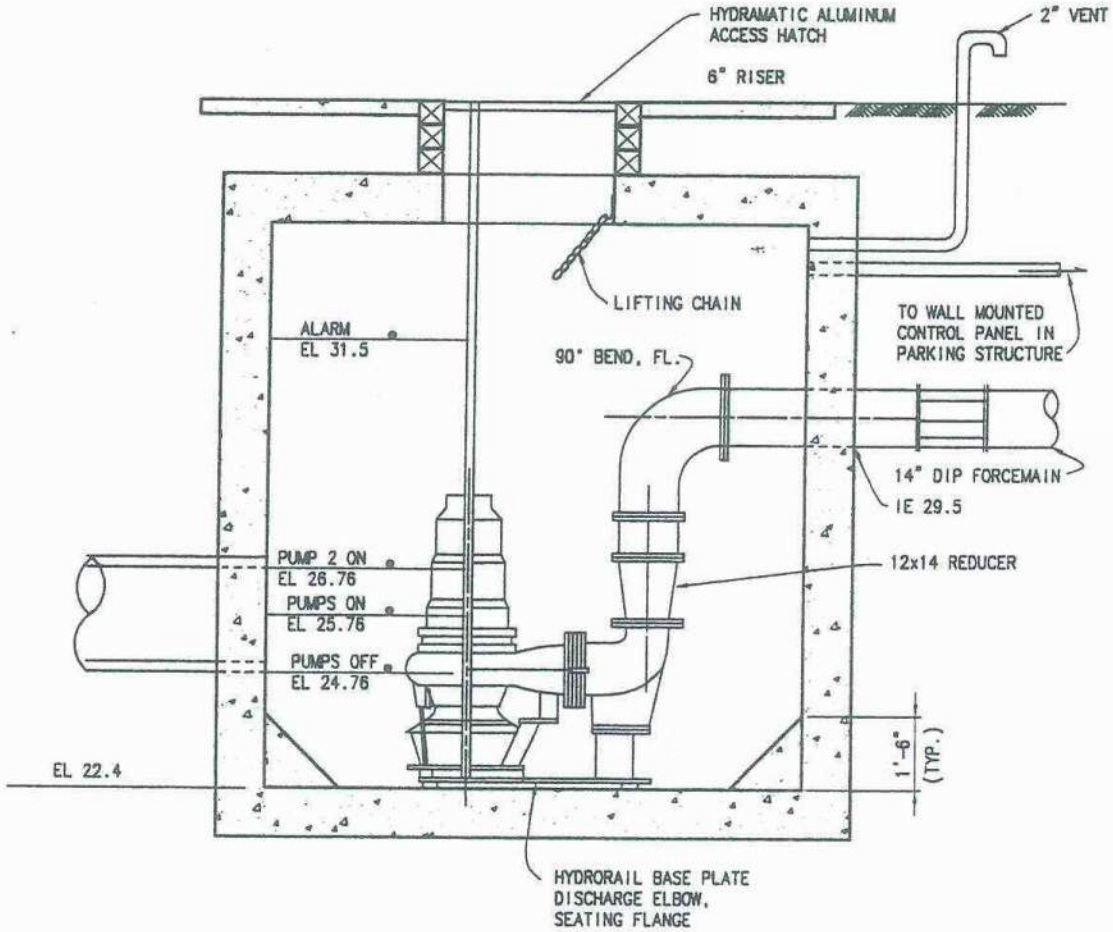
location	date 6-2-95		
client		job no.	
STORMWATER PUMP STATION			



STORMWATER PUMP STATION SECTION

1/2"=1'-0"

HALF SIZE

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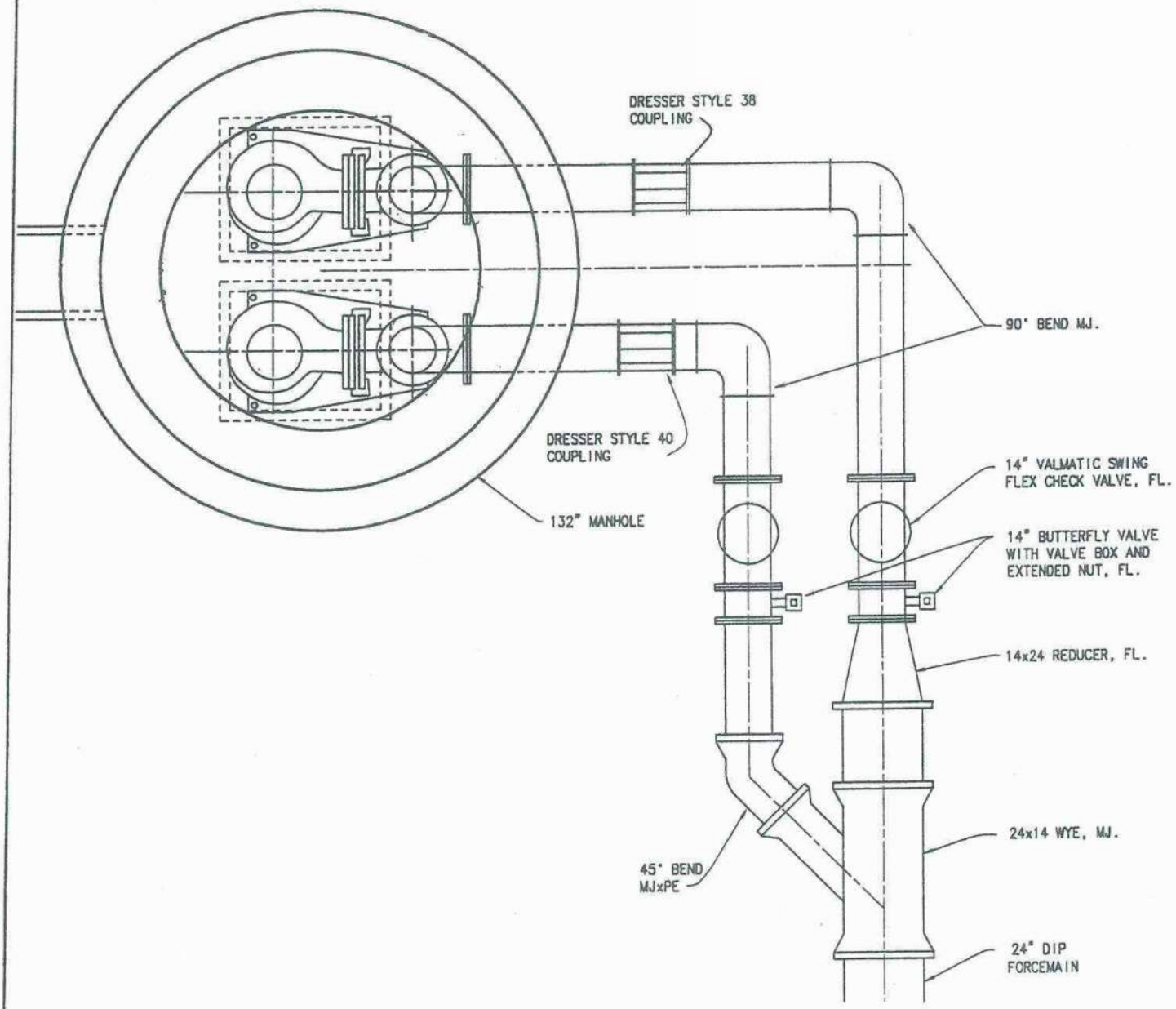
client		job no.
STORM WATER PUMP STA		



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Forcemain Outfall to Cell 1

- type 2 CB used for energy dissipation, check velocities.

  A) in structure $\approx \frac{15 \text{ cfs}}{\pi(4)} = 1.2$ fps

  B) thru grate, Assume 50% coverage = 2.5 fps

- check flow depth over CB Rim

  $\approx$ Broad Crested Weir

  $L = 2\pi(2) = 12.6$ ft

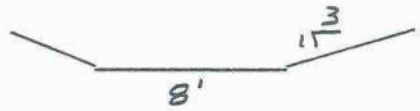
  $Q = CLH^{3/2}$

  $15 = 3.09(12.6)\,H^{3/2}$

  $H = 0.52' \approx 6''$

- check open channel Flow Vel

  Assume



$$15 = \frac{1.49}{.04} AR^{2/3} \sqrt{.1}$$

$$AR^{2/3} = 1.27$$

$$(8+3y)y \left[\frac{(8+3y)y}{8+2y\sqrt{10}}\right]^{2/3} = 1.27$$

by Trial & error $y \cong .33'$ or $4''$

$$\text{Vel} = \frac{15}{11(.33)} = 4.1 \text{ fps}$$

.3 1.1

per King County 4.3.6A 8" spall 1 ft thick adequate protection.

TABLE 4.3.6A ROCK PROTECTION AT OUTFALLS

Discharge Velocity At Design Flow (fps)		REQUIRED PROTECTION				
Greater than	Less than or equal to	Minimum Dimensions				
		Type	Thickness	Width	Length	Height
0	5	Rip Rap*	1 ft.	Diameter + 6 ft.	8 ft. or 4X Dia. whichever is greater	Crown + 1 ft.
5	10	Rip Rap**	1 ft.	Diameter + 6 ft. or 3X dia., whichever is greater	12 ft. or 4X dia. whichever is greater	Crown + 1 ft.
10	20	Gabion Outfall	1 ft.	(As required)	(As required)	Crown + 1 ft.
20	N/A	Engineered Energy Dissipator Required				

* Rip rap shall be in accordance with section 9-13.1 of the WSDOT/APWA Standard Specifications. Rip rap to be reasonably well graded with rock gradation as follows:

Passing 8 inch square sieve 100% or Maximum stone size 8"
Passing 6 inch square sieve 40-60% or Medium stone size 6"
Passing 2 inch square sieve 0-10% or Minimum stone size 2"

** Rip rap to be reasonably well graded with rock gradation as follows:

Maximum stone size 24" (nominal diameter)
Median stone size 16"
Minimum stone size 4"

Note: Rip rap sizing governed by side slopes on outlet channel, assumed to be ~3:1.

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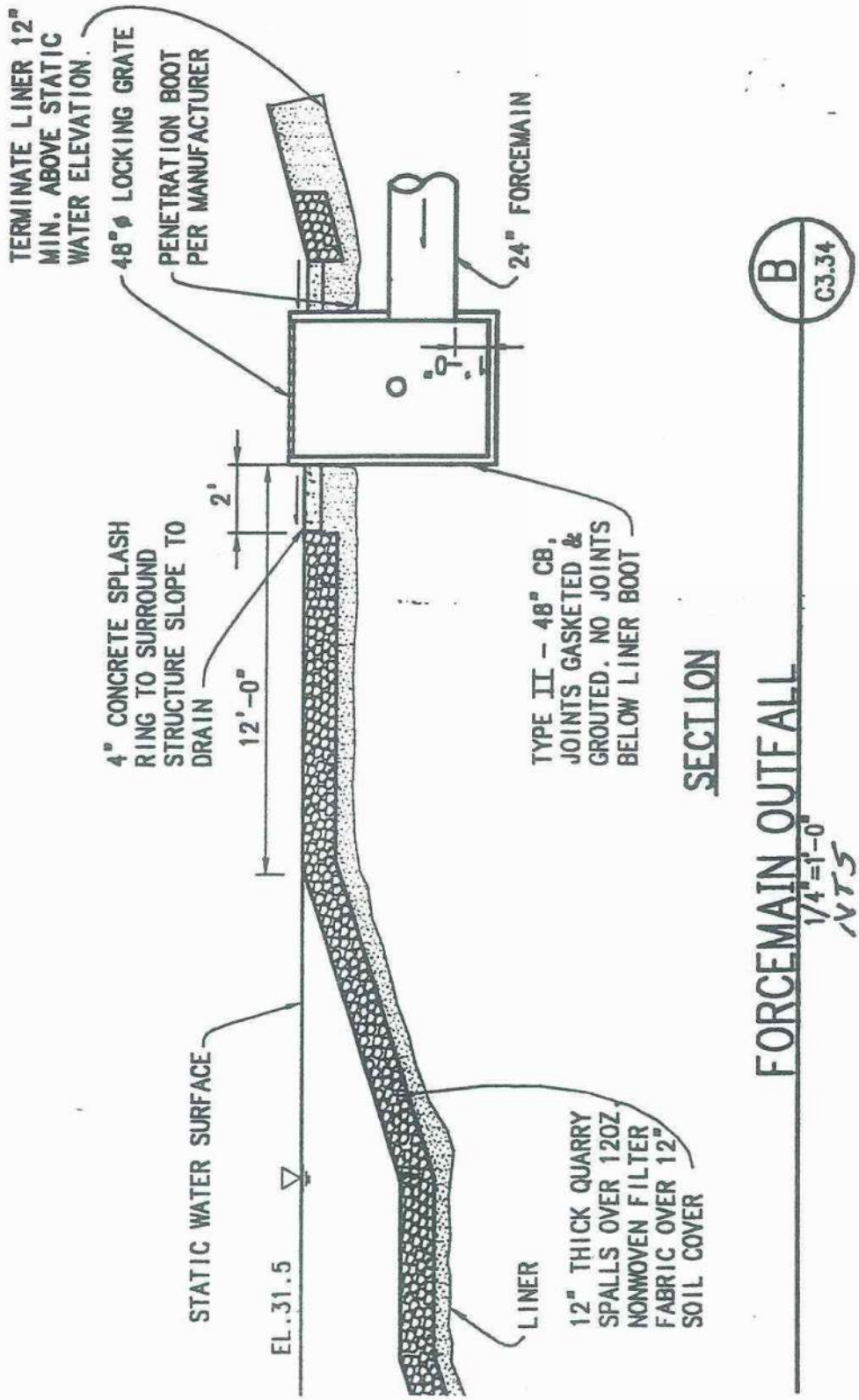

SECTION

FORCEMAIN OUTFALL

1/4"=1'-0"
NTS

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		date	

Well Supply to Ponds

Purpose — #1 prevent algal growth due to stagnation

#2 Side benefit is temperature regulation

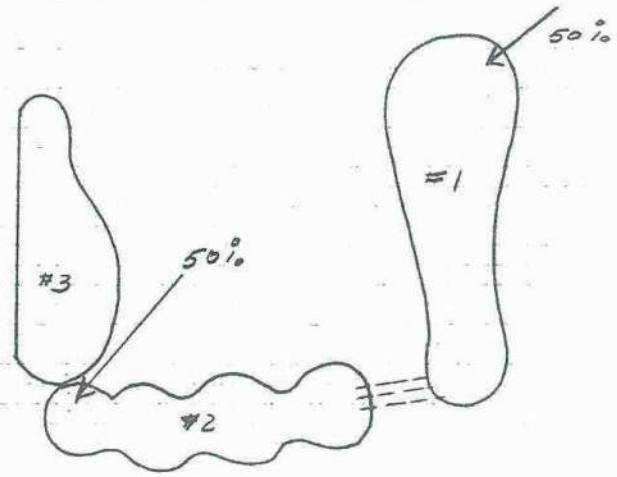
#3 Side benefit is Evap Makeup

per National Weather Service Evap rates (Avg)

March	1.74"
April	3.14
May	4.64
June	5.05
July	6.67
Aug	5.28
Sept	3.48
Oct	1.65"

} Assume supply over these 4 mo's.

Proposed Distribution to Ponds



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		date	

Assume 100 gpm Available as use irrig pump.

Assume operate when irrigation system off ≈ 8 Am → 8 pm

∴ total Demand on well

= 12 hours × 60 min/hr × 100 gpm

= 72,000 gallons/Day

= 9,625 ft^3/Day × 4 months × 30 Day

= 1,155,080 ft^3

= 27 Acre FT /yr

Anticipated irrig Demand = 1 Acft/Acre /yr × 5 Acre

= 5 Acre FT /yr

Σ = 32 Acre ft < 60 Acre ft Water right

∴ ok.

Check Pond Turnover

Cell 1 - 100,000 ft^3
Cell 2 - 50,000 ft^3
Cell 3 - 100,000 ft^3

Cell 1 - 50 gpm × 60 min/hr × 12 hr/Day =

= 36,000 gpd = 4,812 ft³/Day

100,000 ft³ / 4812 = 21 Day Turnover

Cell 2 - 10.5 Day Turnover

Cell 3 - 100 gpm × 60 × 12

= 72,000 gpd = 9,626 ft³/Day

= 10.4 Day Turnover

per L. Burnstad Above approach seems reasonable. Plumb so if we choose we can direct all Q to Cell 3 for fish.

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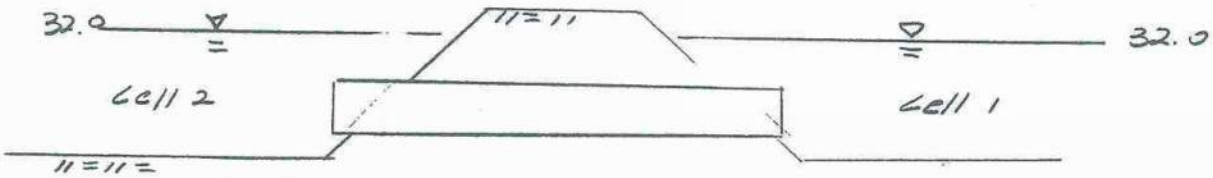
Culvert sizing Between upper & middle Ponds

Peak Q ≅ 15 cfs

Oversize pipes to keep headloss Down & Prevent Blockage.

Assume 2 Barrels ∴ Q = 7.5 cfs each



— Assume 18" ϕ (2)

From King Co nomograph 4.35E

$H_L \cong 1.2'$

$V = 7.5/\pi(.75)^2 = 4.2$ fps ∴ too fast

— Assume (3) 18"

Q ea = 5 cfs

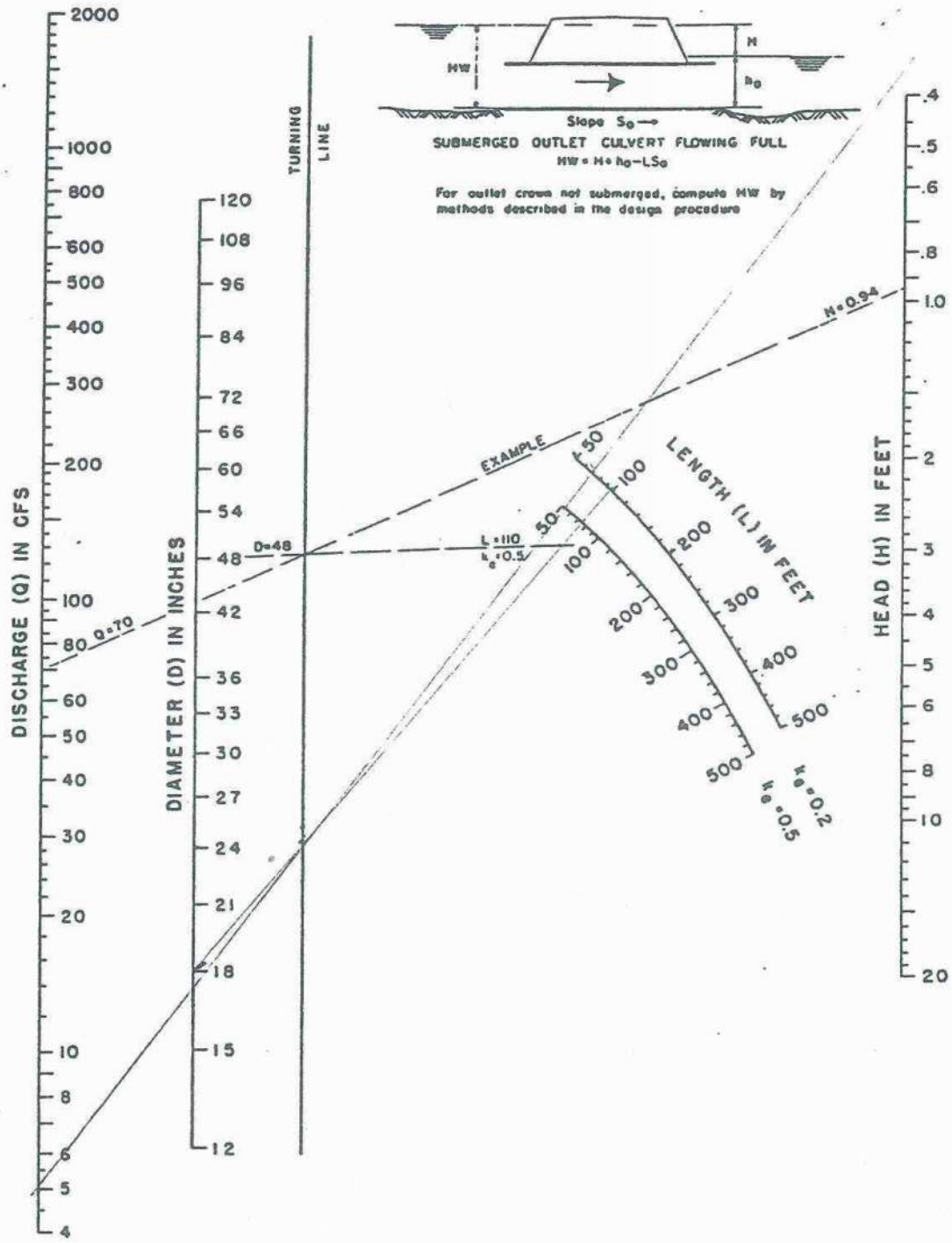
V ≅ 2.8 fps

From King Co nomograph Head reqd ≅ 0.4' ∴ ok

— Flotation

Only time subject to flotation is during 100 yr + storm yet ponds will then fill pipes with floodwater ∴ no concern.

FIGURE 4.3.5E HEAD FOR CULVERTS (PIPE W/ "n" = 0.012), FLOWING FULL WITH OUTLET CONTROL



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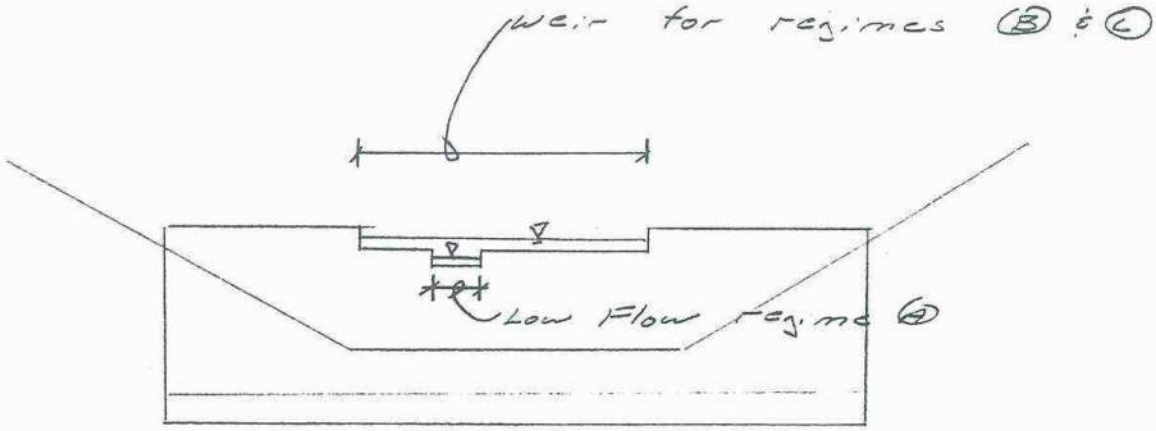
Fish Weir Design

- Desired velocity for fish passage = 1½ - 2 fps
- Desired Flow Depth = 3" → 6"
- Flow regimes
  - (A) During summer maintenance flow from well
    Assume 100 → 200 gpm
  - (B) One pump on ≈ 7 cfs
  - (C) two pumps on ≈ 15 cfs
- Concept



Weir Elevation

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	2	

· Maintenance Flow weir

$Q = CLH^{1.5}$

From Brater & King $C \approx 2.92$

$100 \text{ gpm} = .223 = 2.92\,(L)\,(.25)^{1.5}$

$L = .61' = 7.3''$ wide

$V = .223/.61\,(.25) = 1.46$ fps ∴ ok

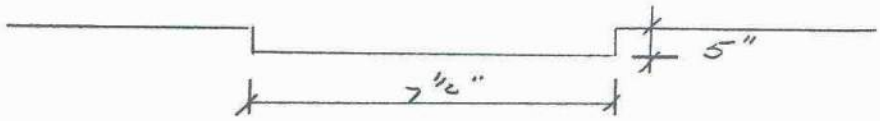
check Depth & Flow @ 200 gpm

$200 \text{ gpm} = .45 = 2.92\,(.61)\,(H)^{1.5}$

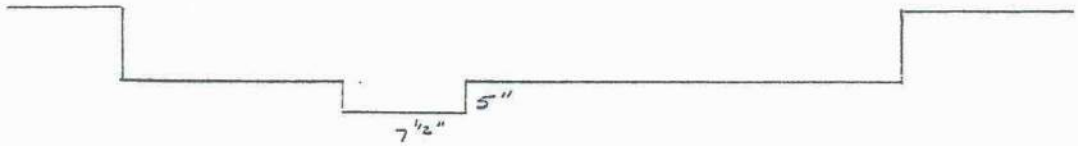
$H = 0.4' = 4.8''$

$V = .45/.4\,(.61) = 1.84$ fps ∴ ok

∴ set maint. weir



· One pump on, Regime (B)



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Flow thru maint weir

$Q \cong .45$ cfs

$\therefore$ 7 - .45 = 6.55 cfs over broad weir

Assume 15' wide weir

$6.55 = 2.7\,(15)\,H^{1.5}$

$H = .29' = 3.6''$

$V = 6.55 / 15\,(.29) = 1.5$ fps $\therefore$ ok

<u>Two pumps on Regime ⓪</u>

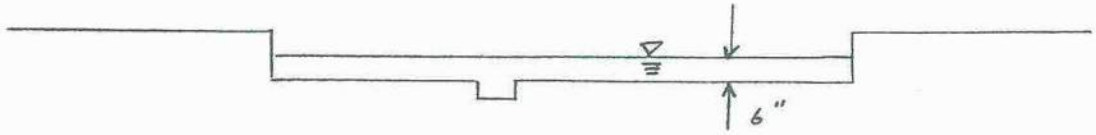
$Q \approx 15$ cfs

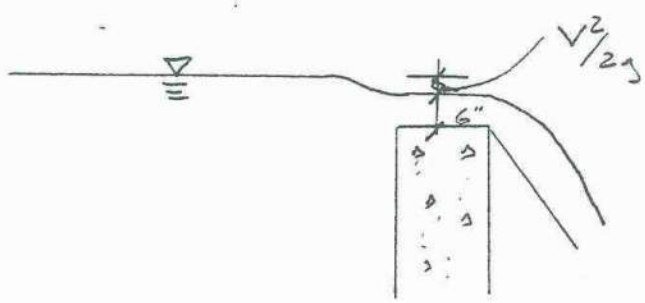
$15 - .45 = 14.55 = 2.7\,(15)\,H^{1.5}$

$H = 0.51' = 6''$

$V = 14.55 / 15\,(.51) = 1.9$ fps $\therefore$ ok

$\therefore$ During 6 MONTH or greater storm





$V^2/2g = 1.9^2/64.4 = .67''$

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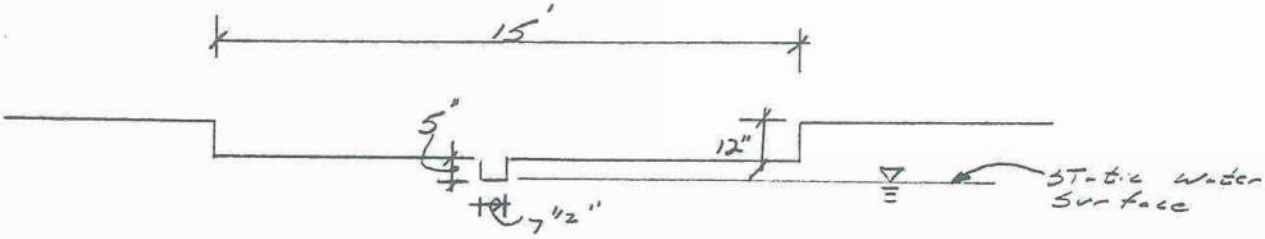
Set Weir Freeboard = 6"

Flow at Freeboard level:

$Q = 2.7\,(15)\,(1)^{1.5} = 40.5$ cfs

which is 2.7 times feasible flow from pumps ∴ 6" freeboard appears adequate.



Weir Elevation

BRATER + KING

Table 5-3. Values of C in the Formula $Q = CLH^{3/2}$ for Broad-crested Weirs

Measured head in feet, H	Breadth of crest of weir in feet										
	0.50	0.75	1.00	1.50	2.00	2.50	3.00	4.00	5.00	10.00	15.00
0.2	2.80	2.75	2.69	2.62	2.54	2.48	2.44	2.38	2.34	2.40	2.66
0.4	2.92	2.80	2.72	2.64	2.61	2.60	2.58	2.54	2.50	2.56	2.70
0.6	3.08	2.89	2.75	2.64	2.61	2.60	2.68	2.69	2.70	2.70	2.70
0.8	3.30	3.04	2.85	2.68	2.60	2.60	2.67	2.68	2.68	2.69	2.64
1.0	3.32	3.14	2.98	2.75	2.66	2.64	2.65	2.67	2.68	2.68	2.63
1.2	3.32	3.20	3.08	2.86	2.70	2.65	2.64	2.67	2.66	2.69	2.64
1.4	3.32	3.26	3.20	2.92	2.77	2.68	2.64	2.65	2.65	2.67	2.64
1.6	3.32	3.29	3.28	3.07	2.89	2.75	2.68	2.66	2.65	2.64	2.63
1.8	3.32	3.32	3.31	3.07	2.88	2.74	2.68	2.66	2.65	2.64	2.63
2.0	3.32	3.31	3.30	3.03	2.85	2.76	2.72	2.68	2.65	2.64	2.63
2.5	3.32	3.32	3.31	3.28	3.07	2.80	2.81	2.72	2.67	2.64	2.63
3.0	3.32	3.32	3.32	3.32	3.20	3.05	2.92	2.73	2.66	2.64	2.63
3.5	3.32	3.32	3.32	3.32	3.32	3.19	2.97	2.76	2.68	2.64	2.63
4.0	3.32	3.32	3.32	3.32	3.32	3.32	3.07	2.79	2.70	2.64	2.63
4.5	3.32	3.32	3.32	3.32	3.32	3.32	3.32	2.88	2.74	2.64	2.63
5.0	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.07	2.79	2.64	2.63
5.5	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	2.88	2.64	2.63

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ROCK ARMOR PROTECTION

VELOCITY OF SAMMAMISH RIVER FOR 100YR STORM IS LESS THAN 4 FPS.

THIS IS AVERAGE CHANNEL VELOCITY. IF A VELOCITY GRADIENT IS CONSIDERED, THE SHORELINE VELOCITY WILL BE LESS.

VELOCITY OF 54"ϕ STORM OUTFALL FOR 100yr ONSITE STORM = 7.5 FPS. TO USE THIS VELOCITY, TWO CONSERVATIVE ASSUMPTIONS MUST BE MADE:

1) THE RIVER ELEVATION WILL BE AT OR NEAR ORDINARY HIGH WATER. OTHERWISE, THE PIPE OUTFALL WILL BE SUBJECT TO DISIPATING FORCES OF PARTIALLY SUBMERGED CONDITION.

2) THE VELOCITY WILL NOT DECREASE AFTER FLOW LEAVES THE PIPE AND EXPANDS INTO THE CONCRETE HEADWALL SECTION.

TABLE 4.3.6A ROCK PROTECTION AT OUTFALLS

Discharge Velocity At Design Flow (fps)		REQUIRED PROTECTION				
		Minimum Dimensions				
Greater than	Less than or equal to	Type	Thickness	Width	Length	Height
0	5	Rip Rap*	1 ft.	Diameter + 6 ft.	8 ft. or 4X Dia. whichever is greater	Crown + 1 ft.
5	10	Rip Rap**	1 ft.	Diameter + 6 ft. or 3X dia., whichever is greater	12 ft. or 4X dia. whichever is greater	Crown + 1 ft.
10	20	Gabion Outfall	1 ft.	(As required)	(As required)	Crown + 1 ft.
20	N/A	Engineered Energy Dissipator Required				

USE

* Rip rap shall be in accordance with section 9-13.1 of the WSDOT/APWA Standard Specifications. Rip rap to be reasonably well graded with rock gradation as follows:

Passing 8 inch square sieve 100% or Maximum stone size 8"
Passing 6 inch square sieve 40-60% or Medium stone size 6"
Passing 2 inch square sieve 0-10% or Minimum stone size 2"

** Rip rap to be reasonably well graded with rock gradation as follows:

Maximum stone size 24" (nominal diameter)
Median stone size 16"
Minimum stone size 4"

Note: Rip rap sizing governed by side slopes on outlet channel, assumed to be ~3:1.

THIS SIZE REQUIRED (PER 1990 KCSWDM).

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client			job no.

ROCK ARMOR USED = LIGHT LOOSE RIPRAP

AS SPECIFIED BY STATE 9-13.1(2)

GRADATION IS AS FOLLOWS:

20% - 90%	2.0 ft^3 - .5 yd^3
15% - 80%	.33 ft^3 - .5 yd^3
10% - 20%	3 INCH

THIS ROCK GRADATION EXCEDES THE REQUIRED ROCK SIZES (PER K.C.) ∴ OK

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BACKWATER THROUGH POND CELLS

ASSUME MAX FLOW THROUGH PONDS AND SMALLEST POND CROSS SECTION.

USE 15 CFS AND CELL 2 SECTION.

FOR POND CROSS SECTION USE RECTANGULAR SECTION 40 FEET WIDE x 3 FEET DEEP.

$Q = 15$ CFS

$A = 40' \times 3' = 120$ FT^2

$R = WP/A = \frac{40' + 6'}{120} = \frac{46}{120} = .38$

$V = 0.13$ FPS

$n = 0.08$ (CHOW - OPEN CHANNEL HYDRAULICS)

MANNINGS EQUATION $\Rightarrow V = \frac{1.49}{n}\left(R^{2/3}\right)\left(S^{1/2}\right)$

SOLVE FOR $S \rightarrow 0.018\%$

THE POND NEEDS THIS SLOPE TO PASS THE GIVEN FLOW RATE

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Apply this slope over the length of cell 2.

300 LF @ 0.018% = .05 FT

so, the pond water surface will rise approximately .1 inche over the length of cell 2.

If this slope is applied over the combined length of cell 1 and 2, the total rise in the water surface will be less than 2 inches. This is a conservative assumption as cell 1 is a much larger cross section.

Pond W.S. at upper end

31.5 (weir el.) + .5' (Flow over Weir) + .17' Backwater + .4' culverts = 32.57

STORM EXHIBIT
CONVEYANCE MAP

REDMOND
TOWN CENTER

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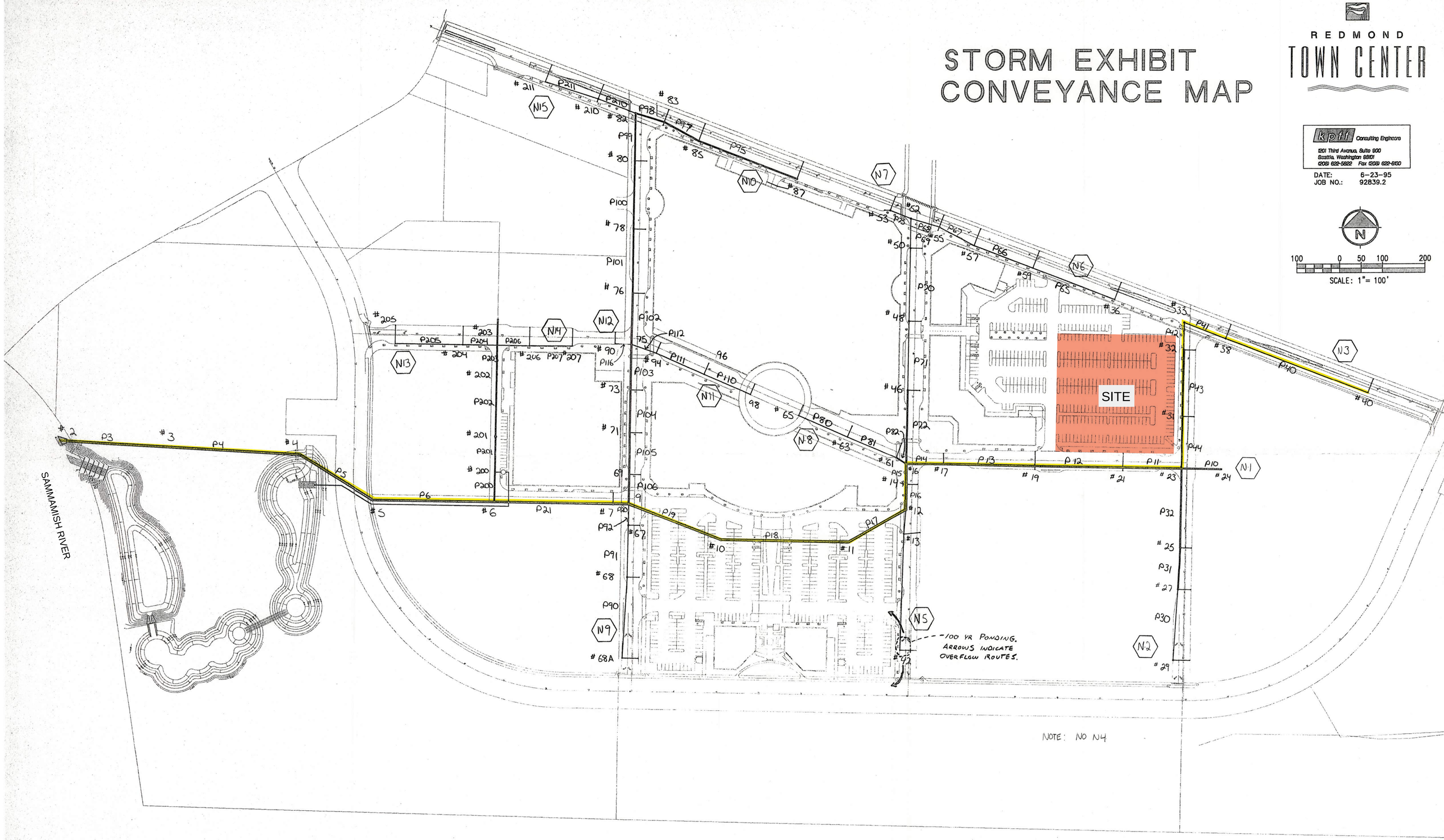
DATE: 6-23-95
JOB NO.: 92839.2