

Drainage plan must be uploaded as separate full size PDF.

Advisory Note: PDR approval is required prior to Civil Plan Approval

1st Review - please contact Rifka Wine with any questions. rwine@bhinc.com

Galloway Response: Understood, a separate full size plan will be provided.

Galloway Response: Understood, thank you.

Please provide responses to the provided comments to expedite the next review.

PRELIMINARY DRAINAGE REPORT

Galloway Response: Understood, a comment has been added to each comment on this document.

Provide Formal Subdivision name on report cover, including Flg. 01, also include #, Lot #

ENT CREDIT UNION

E. Hampden Avenue & S. Tower Road
Aurora, CO 80013

Galloway Response: Subdivision name, lot #, and block # have been added to the report.

Per Section 2.31 of SSDTC Manual include engineer's phone number & owner contact name and phone number

Galloway Response: The engineer's contact and owner's contact information has been added.

PREPARED FOR:
Ent Credit Union

PREPARED BY:
Galloway & Company, Inc.
6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111

DATE:
February 23, 2021

APPROVED FOR ONE YEAR FROM THIS DATE	

CITY ENGINEER	DATE
_____	_____
WATER DEPARTMENT	DATE
_____	_____

Approval block needs to be larger. Refer to Section 2.35, p. 2-17 of SSDTC Manual for required size of approval block.

Galloway Response: The approval block size has been increased per Section 2.35.



PRELIMINARY DRAINAGE REPORT

Galloway Response:
"6th" has been
added.

ENT Credit Union

6th

Legal Description

Lot 1, Block 1, Firestone Subdivision Filing No. 1, located in the southwest 1/4 of Section 34, Township 4 South, Range 66 West of the Principal Meridian, City of Aurora, County of Arapahoe, State of Colorado, containing 36,984 square feet or 0.849 acres of land more or less.

Preparation Date

02/23/2021

Revised: XXXXX

Revised: XXXXX

Prepared for

Ent Credit Union
7520 Campus Dr
Colorado Springs, CO, 80920
Attn: Jeff Wilkins
Email: jwilkins@ent.com

Per Section 2.31 of SSDTC Manual include engineer's phone number

Galloway Response:
Engineer's contact
information has been
added to the cover
sheet.

Prepared by:

Duncan Rady

Reviewed by:

Jenny Romano

ENGINEER'S STATEMENT

I affirm that this report and plan for the Preliminary drainage design for Ent Credit Union was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Aurora Storm Drainage design & Criteria manual for the owners thereof. I understand that the City of Aurora does not and will not assume liability for drainage facilities designed by others.

Jenny Romano, PE #44401
For and on behalf of Galloway & Company, Inc.

Date

DEVELOPER'S CERTIFICATION

"Ent Credit Union hereby certifies that the drainage facilities for Ent Credit Union shall be constructed according to the design presented in this report. I understand that the City of Aurora does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that the City of Aurora reviews drainage plans pursuant to the Municipal Code; but cannot, on behalf of Ent Credit Union, guarantee that final drainage design review will absolve Ent Credit Union and/or their successors and/or assigns of future liability for improper design."

Authorized Signature
Jeff Wilkins

Date

Revise Table of Contents and section/subsection headings as needed to match PDR outline in SDDTC Section 2.32. Follow A.1.a format & include all sections.

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Galloway Response:
Table of Contents
has been revised to
match the PDR out-
line in SDDTC Sec-
tion 2.32.

Appendices:

- A. Exhibits and Figures
- B. Hydrologic Computations
- C. Hydraulic Computations
- D. Drainage Map

I. Introduction

Location

The proposed Ent Credit Union is located in Arapahoe complex, at the corner of South Tower Road and the southwest space of Firestone Complete Auto Care facility. The site is located on Section 34, Township 4 South, Range 66 West of the 6th P

Proposed Development

The project site consists of previously developed structure of approximately 6,600 square feet. The proposed development will include the demolition of the existing pavement, utilities, and pavement, and the development of a new structure including drive-up banking, pavement, new utilities, and water quality control. The site generally slopes from the (along the sidewalk north of E. Hampden) proposed site plans to maintain the existing patterns.

The NRCS Web Soil Survey of Arapahoe Renohill-Little-Thedalund complex soils, has percent. Group D soils are typically charac

The FEMA Flood Map shows the site is in Zone X, which was performed in the appendices.

II. Historic Drainage

Overall Basin Description

The lot is approximately 0.849 acres of land containing a mixture of impervious pavements, landscaping, and buildings contributing to the site runoff. In addition to the existing lot runoff, this site receives runoff from the adjacent property immediately to the east through means of two 3-foot wide concrete channels. According to drainage study 880085FD, prepared by Robinson Engineering, Inc. on April 1, 2011, the total off-site contributing basin totals to approximately 1.34 acres. The site is in drainage area of approved Seven Hills Plaza Final Drainage Report prepared by Holland Corporation and approved by Aurora approval number C5-2-613FD. The intent of the original drainage study for the complex was to receive direct runoff from the project site, and its adjacent sites, and to and discharge runoff from the site to historical flow rates. The existing detention facility was designed to accommodate this site and is located within the northeast parking lot of the Seven Hills Plaza shopping complex.

III. Design

Design Criteria References

The City of Aurora Storm Drainage Design and Technical Criteria manual was reference to perform the hydrologic analysis and hydraulic design for the project location. The Rational Method was used to calculate the flows generated within each basin for the 2-year, 100-year return period storms. Due to the minimal size of the project site, the intensities used

Galloway Response:
The original percent impervious for the design of the detention pond and the proposed percent impervious has been added.

Per SDDTC Section 2.32, List the composite percent of impervious area. Related to detention- also list the original percent impervious used for the detention calculations.

Per SDDTC Section 2.32, reference vicinity map in appendix and discuss the surrounding development.

Galloway Response: Per email received on 4/20/2021, off-site flows have been re-directed to maintain original drainage intent, however to not enter the WQ Swale.

Galloway Response:
The vicinity map has been referenced and additional details have been provided on the surrounding development.

Galloway Response: Off-site basins have been added in Appendix D.

off site flow entering the site needs to be better explained & WQ must be provided for off-site flow through your site.

Per COA SDDTC Manual Section 2.22, off site basins must be shown

Galloway Response: Pond certificate and I&M plan are being gathered.

Need to provide a pond certificate and signed I&M plan for the Seven Hills Plaza detention facility. Also, need to work with the Seven Hills Plaza owner to provide a drainage easement for the underground detention facility.

include reference to the documents that you have attached to this report to better explain how these show that existing detention has capacity for this site.

Galloway Response: Additional reference have been added to reflect the original detention facilities design and how this site was incorporated.

Provide calculations for grass swale USDCM design form. Provide additional detail to show entire site (and off site flow) drains through swale and receives WQ treatment.

Galloway Response: UDSCM UD-BMP spreadsheet has been added to this report and off-site area has been added to Drainage Map.

Discuss that swale is private and who will maintain WQ swale, easement for swale, and access for maintenance.

Galloway Response: Additional information has been added regarding the water quality swale.

Galloway Response: Rainfall data sources have been added.

Following PDR outline in SDDTC Section 2.32 list rainfall source and values identified in report.

where/how will the underdrain outfall? include information on the filter media and required irrigation.

V. Drainage Plan

Galloway Response: Additional details have been added in regards to the filter media and the irrigation practices.

Per Volume 3 of the USDCM for grass swale - Check the conditions for the 100-year flow to ensure that drainage is being handled without flooding this building, adjacent structures or adjacent streets. Flow depth + 1' of freeboard is required.

Specific Details

Galloway Response: Additional details have been added in regards to the roof drains

For roof drains, please indicate locations and whether they will be sized for the 100yr event.

Galloway Response: 100-Year flow scenarios of the swale and concrete chase have been added to this report. 1-foot of freeboard is not achievable due to site constraints. However, the FFE is approximately 1.8' above the 100-yr WSEL and the attached reports for the 100-yr scenario exhibit that the 100-yr storm event is contained within the swale and concrete chase.

Galloway Response: Off-site basin description has been added.

Discuss off site basins in this section.

how will the
underdrain drain?

Galloway Response: Additional details have been added in regards to the underdrain and where it will discharge.

grass swale, or during larger storm events that overtop the originally intended flow path within existing gutters to the

To abide by the design criteria, set forth by USDCM, the grass swale will have a longitudinal slope of 0.50%, with an underdrain beneath the flowline discharging into the existing street. The grass swale is intended to have a 2-foot bottom width, and 4:1 side slopes with a total depth of 0.50-feet. The water surface elevation of the 2-year storm event is expected to reach 0.33-feet with a velocity of 1.26 feet per second. Due to existing grades, in order to adequately discharge from the grass swale a 2-foot wide 0.5-foot curbed flume will need to be installed beneath the existing sidewalk. The water surface elevation of the 2-year storm event is expected to reach a height of 0.25-feet with a velocity of 2.76 feet per second. To allow continued pedestrian access along the sidewalk a metal plate will be placed across the width of the flume. A copy of preliminary calculations for the grass swale has been provided within the appendices.

For underdrain - discuss the filter media & that irrigation will be required for the swale

V. Conclusions

This report has been prepared in accordance with the City of Aurora Storm Drainage and Technical Criteria Manual, Seven Hills Plaza Subdivision Final Drainage Report. With proposed design, runoff will be consistent between the existing and proposed conditions. The on-site to address water quality concerns and runoff will ultimately drain towards the existing underground detention facility.

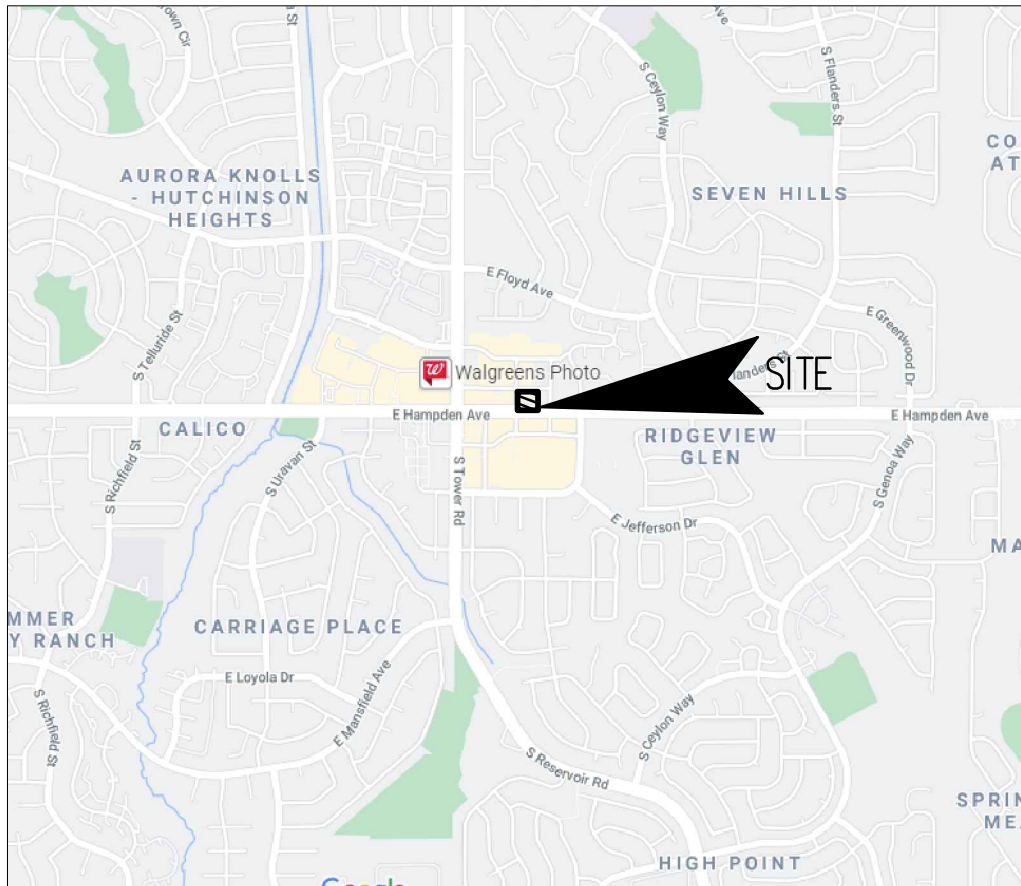
Galloway Response: Additional details have been added in regards to the filter media and the irrigation practices.

VI. References

1. Urban Storm Drainage Criteria Manual, Volumes 1 to 3, Urban Drainage and Flood Control District, March 2018.
2. Storm Drainage Design and Technical Criteria manual, City of Aurora, Colorado, 2010
3. Final Drainage Study for Seven Hills Plaza Subdivision Filing No. 1, Holland Corporation, July 25, 1984, City of Aurora Project No. C5-2-613FD
4. Final Drainage Report for Firestone Subdivision Filing No. 1, Robinson Engineering, Inc., August, 17, 1988, City of Aurora Project No. 80085FD
5. Flood Insurance Rate Map – Arapahoe County, Colorado and Incorporated Areas Community Panel No. 08005C0194L, Effective September 4, 2020.
6. Soil Map – Arapahoe County Area, Colorado as available through the Natural Resources Conservation Service National Cooperative Soil Survey web site via Web Soil Survey 2.0.

APPENDIX A

Exhibits and Figures



VICINITY MAP

SCALE: 1" = 2000'

National Flood Hazard Layer FIRMMette



104°46'30"W 39°39'24"N



USGS The National Map: Orthoimagery. Data refreshed October, 2020.

0 250 500 1,000 1,500 2,000 Feet 1:6,000

104°45'53"W 39°38'57"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
OTHER FEATURES		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **11/30/2020 at 2:57 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.





United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

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

Custom Soil Resource Report for **Arapahoe County, Colorado**



November 30, 2020

Preface

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

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

Custom Soil Resource Report

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

Soil Map

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

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 16, Jun 4, 2020

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
RtE	Renohill-Little-Thedalund complex, 9 to 30 percent slopes	0.8	100.0%
Totals for Area of Interest		0.8	100.0%

Map Unit Descriptions

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

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

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

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

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

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

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

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

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Arapahoe County, Colorado

RtE—Renohill-Litle-Thedalund complex, 9 to 30 percent slopes

Map Unit Setting

National map unit symbol: 34z4
Elevation: 3,600 to 6,200 feet
Mean annual precipitation: 11 to 16 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 100 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Renohill and similar soils: 40 percent
Litle and similar soils: 32 percent
Thedalund and similar soils: 20 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Renohill

Setting

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loam clayey

Typical profile

H1 - 0 to 3 inches: loam
H2 - 3 to 15 inches: clay loam, clay
H2 - 3 to 15 inches: loam, clay loam
H3 - 15 to 24 inches: unweathered bedrock
H3 - 15 to 24 inches:
H4 - 24 to 28 inches:

Properties and qualities

Slope: 9 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R049XY208CO - Clayey Foothill DRAFT (1-2018) MLRA 49
Hydric soil rating: No

Description of Little

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits

Typical profile

H1 - 0 to 3 inches: silty clay loam
H2 - 3 to 30 inches: silty clay, clay
H2 - 3 to 30 inches: weathered bedrock
H3 - 30 to 34 inches:

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R049XY208CO - Clayey Foothill DRAFT (1-2018) MLRA 49
Hydric soil rating: No

Description of Thedalund

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Interbedded residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 5 inches: clay loam
H2 - 5 to 23 inches: loam, clay loam
H2 - 5 to 23 inches: weathered bedrock
H3 - 23 to 27 inches:

Properties and qualities

Slope: 9 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches

Custom Soil Resource Report

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water capacity: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: C

Ecological site: R049XY208CO - Clayey Foothill DRAFT (1-2018) MLRA 49

Hydric soil rating: No

Minor Components

Buick

Percent of map unit: 5 percent

Hydric soil rating: No

Tassel

Percent of map unit: 3 percent

Hydric soil rating: No

References

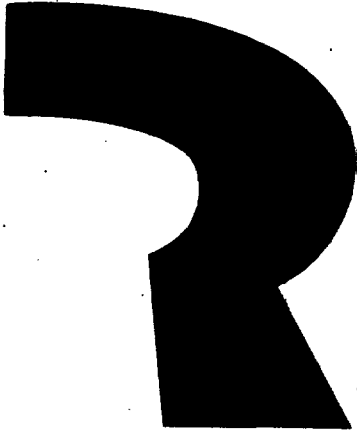
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Custom Soil Resource Report

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ROBINSON ENGINEERING INC.

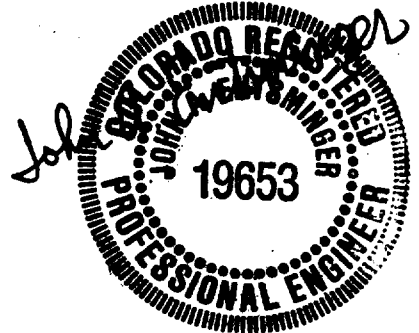
3001 South Jamaica Court
Aurora, Colorado 80014
(303) 752-4823

16N
880085

FINAL DRAINAGE REPORT
for
FIRESTONE SUBDIVISION FILING No. 1

Prepared for:
First Interstate Mortgage of Colorado
1999 Broadway, Suite 2700
Denver, Colorado 80202
Contact: Mr. Orrin Snyder
Representative for the Applicant
433-7909

Prepared by:
Robinson Engineering, Inc.
3001 South Jamaica Court
Aurora, Colorado 80014
Contact: John A. Entsminger, P.E.
752-4823



APPROVED FOR ONE YEAR FROM THIS DATE

8-17-88

KW
8-4-88

Director of Public Works

US
8-8-88

Director of Utilities

Kevin W. Jensen for

8-5-88

Date

T. J. Donald

8/8/88

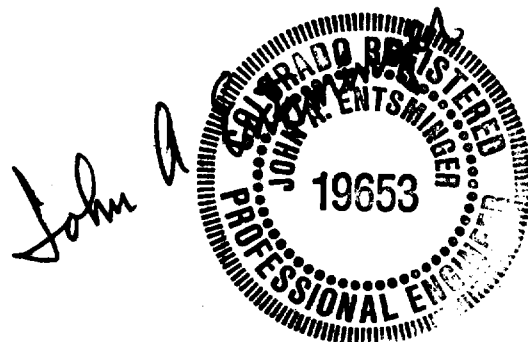
Date

3rd

FINAL DRAINAGE REPORT
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752-4823



Final Drainage Report

For

Firestone Subdivision Filing No. 1

The subject property is the West 200 feet of Lot 5, Block 1 of SEVEN HILLS SUBDIVISION FILING NO. 1. The Firestone Tire and Rubber Company proposes to construct a Firestone Store on the property. This proposal will require a Resubdivision of said Lot 5 and an administrative amendment to the PBG Plat entitled SEVEN HILLS SUBDIVISION PLAZA SHOPPING CENTER.

This final drainage report is a minor modification to the Final Drainage Plan for SEVEN HILLS PLAZA SHOPPING CENTER. The Final Drainage Plan was prepared by the Holland Corporation and was approved July, 1984 (see C5-2-613). As shown in the approved report, the subject property is part of Area C which drains to a large combination surface/underground detention pond adjacent to Tower Road.

The final grading and drainage plan for the subject property slightly modifies the grades shown on the approved plan to fit the proposed building and parking improvements. However, the concept of the approved report remains unchanged. The site drains to the Northwest corner of Lot 5 toward the Area C Detention Pond. Also, storm runoff from the East portion of Lot 5 is routed through the property to the said Northwest corner.

The summary of storm runoff flows for the Subject Site and for the off-site tributary flows is as follows:

Subject Site Only:

Q2 = 2.21 cfs

Q100 = 6.87 cfs

Off-site Tributary Basin 0-1

Q2 = 1.41 cfs

Q100 = 4.14 cfs

Off-site Tributary Basin 0-2

Q2 = 2.41 cfs

Q100 = 7.37 cfs

The storm flows from Basins 0-1 and 0-2 are routed through the 10 foot wide landscape area via two 3 foot wide concrete channels. These channels have adequate capacity to convey the minor storm events. During a major storm event, there may be minor over-topping of the landscape curb head. The 10 foot wide landscape area will be grass sodded and will have a cross slope of 10% (1 foot fall in 10 feet), so erosion is not considered to be a problem should infrequent over-topping of the curb occur.

A 5 foot wide X 6 inch deep concrete channel is proposed to be constructed on the South side of the Firestone Building. This channel is adequate to convey the 100 year storm runoff from Basin 0-2 and the Southeast parking area. Should this channel be blocked, storm runoff will overflow around the South side of the building without causing flooding. The proposed finished floor elevation is 5459.50.

The storm runoff to the Area C Detention Pond is not increased. The Firestone Store requires fewer parking spaces; therefore, there is more landscaping along the West and East sides of the building than was accounted for in the approved drainage report.

Development of the Firestone property as shown on the accompanying Final Grading and Drainage Plan will not adversely impact the approved Drainage Report and Drainage Plan for the SEVEN HILLS PLAZA SUBDIVISION FILING NO. 1.

I. Offsite Tributary Flow

A. Basin 0-1

1. Area = 0.44 acres

2. Runoff Coefficient

Landscape Area = 1500 SF

Asphalt Area = 17,666 SF

$$C_2 = \frac{(1500)(0.00) + (17666)(0.87)}{19,166} = 0.80$$

$$C_{100} = \frac{(1500)(0.20) + (17666)(0.93)}{19,166} = 0.87$$

3. Time of Concentration

Slope = $\frac{82.5 - 61.3}{440} = 4.8\%$

Length of Travel = 440'

Overland Flow in Asphalt Area
Fig 3-2, Find Velocity = 4.5 ft/s

$$T_c = 440' \cdot \frac{\text{Sec}}{4.5'} \cdot \frac{\text{min}}{60 \text{ sec}} = 1.6 \text{ min} \quad \text{Use } T_c = 5 \text{ min}$$

4. Rainfall Intensity - See COA Rainfall Chart So of Alameda

$I_2 = 4.00 \text{ in/hr}$

$I_{100} = 10.77 \text{ in/hr}$

5. Storm Runoff $Q = C_f C I A$

$$Q_2 = (0.80)(4.00)(0.44) = 1.41 \text{ cfs}$$

$$Q_{100} = (0.87)(10.77)(0.44) = 4.14 \text{ cfs}$$

B. Basin 0-2

1. Area = 0.90 acres

2. Runoff Coefficient

LS Area = 9220 SF

Asphalt & Conc. Area = 29,984 SF

$$\therefore C_2 = \frac{(9220)(0.00) + (29984)(0.87)}{39,204} = 0.67$$

$$C_{100} = \frac{(9220)(0.20) + (29984)(0.93)}{39,204} = 0.76$$

3. $T_c = 5 \text{ min}$

4. $I_2 = 4.00 \text{ in/hr}$

$I_{100} = 10.77 \text{ in/hr}$

$$5. Q_2 = (0.67)(4.00)(0.90) = 2.41 \text{ cfs}$$

$$Q_{100} = (0.76)(10.77)(0.90) = 7.37 \text{ cfs}$$

2. Storm Runoff (Subject Site Only)

A. Area = $(200' \times 185') = 37000 \text{ SF} = 0.85 \text{ acres}$

B. Runoff Coefficient (Composite)

1. Rooftop Area = 6600 SF

2. Landscape Area = 8835 SF

3. Asphalt Area = 21,565 SF

$$C_2 = \frac{(6600 \times 0.80) + (8835 \times 0.20) + (21565 \times 0.87)}{37,000} = 0.65$$

$$C_{100} = \frac{(6600 \times 0.90) + (8835 \times 0.20) + (21565 \times 0.93)}{37,000} = 0.75$$

C. Time of Concentration = 5 min

D. Rainfall Intensity

1. $I_2 = 4.00 \text{ in/hr}$

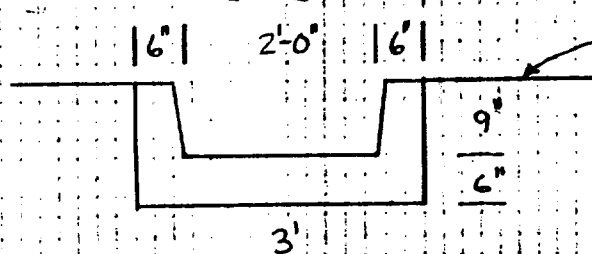
2. $I_{100} = 10.77 \text{ in/hr}$

E. Storm Runoff to the Northwest Corner of the Subject Site

1. $Q_2 = (0.65 \times 4.00 \times 0.85) = 2.21 \text{ cfs}$

2. $Q_{100} = (0.75 \times 10.77 \times 0.85) = 6.87 \text{ cfs}$

3. Size Concrete Channels at East Property Line Conveying the Off-Site Tributary Flows



Top of Curb at East Prop. Line

$$Q = 3.33 (L - 0.2H) H^{1.5} \quad \text{where } L = 2.0', H = 0.75'$$

Age 69; CAMERON HYDRAULIC DATA

$$\therefore Q = 4.00 \text{ cfs}$$

From above, For Off-Site Tributary Basin 0-1, $Q_2 = 11.41 \text{ cfs}$
 $Q_{100} = 41.14 \text{ cfs}$

For Off-Site Tributary Basin 0-2, $Q_2 = 2.41 \text{ cfs}$
 $Q_{100} = 7.37 \text{ cfs}$

\therefore For Basin 0-1, The concrete channel is adequate with only minor over-topping of the parking curb during the 100 yr. storm event.

For Basin 0-2, The concrete channel is adequate for the minor storm events. Over-topping of the curb will occur during major storm events and the storm runoff will be routed around the South side of the building. The 10 foot wide Landscape strip will be grass-sodded with a cross slope of 10% \pm . Thus, the curb over-topping is not considered an erosion problem.

4. Concrete Drainage Channel on the South Side of the Proposed Firestone Building. 3

The channel is proposed to be 5' wide x 9" high.

$$n = 0.013$$

$$S = 0.73\%$$

$$\therefore V = 1.486 \left(\frac{2.5}{6.0} \right)^{2/3} (0.0073)^{1/2} / 0.013 = 5.45 \text{ cfs}$$

$$\therefore Q = VA = (5.45)(2.5) = \underline{13.6 \text{ cfs}}$$

Q. Design

$$\text{Area} = 0-2 + 60' \times 60' \text{ area at SE corner Subj Prop} = 0.98 \text{ ac.}$$

$$T_c = 5 \text{ min.}$$

$$I_{100} = 10.77 \text{ in/hr.}$$

$$C_{100} = 0.75$$

$$\therefore Q_{\text{Des}} = (0.75)(10.77)(0.98) = 7.92 \text{ cfs}$$

Therefore, Channel Capacity is adequate

Note: The invert Elevation of this channel at the East end is 58.5'. The Top of channel elevation is 59.25'. IF the channel is plugged, the storm runoff will back-up in the east parking lot on the East side of the building to the 59.25 foot elevation. Water will then over flow to the West on the South side of the building, and will also overflow to the North and thence West around the North Side of the building. The Finished Floor Elevation will be 59.50 feet. Flooding of the building will not be a problem if properly Constructed.

ROUTING SLIP/CHECK LIST
READ CAREFULLY

16N

TITLE FIRESTONE #1
CONSULTANT ROBINSON CUS PH# 752-4823
Contact DEVELOPER JOHN A. ENTSMINGER PH# 7) 1'

TYPE:	T	PLAN	RO	PD	BR	FLT	USE
	C	DESC	WA	<u>FD</u>	OT	FUD	ADM
	M		SA	GT		PBG	LAN

DATE RECEIVED 5-23-88 DATE CONSULTANT CONTACTED FOR PICK-UP 6-7-88
6-14-88 6-27-88
7-14-88 7-26-88
7-27-88 8-9-88

SUBMIT# 80273

ENGINEERING	Checked	<u>TE</u>	Date	<u>6-2-88</u>
		<u>2</u>		<u>7-22</u>
		<u>2</u>		<u>7-26</u>
		<u>2</u>		<u>8-4</u>
TRAFFIC	Checked			
FIRE	Checked		Date	
UTILITIES	Checked	<u>LB</u>	Date	<u>6-6-88</u>
		<u>LB</u>		<u>7-26-88</u>
		<u>LB</u>		<u>8-8-88</u>

RESUBMITTAL STATUS:

Submit check prints of corrected plans for additional review ✓
Submit mylar sepia of corrected plans for approval ✓
Submit mylar sepia of plans for approval ✓

7-26-88
10

All submittals shall be routed through the Engineering Services Section.

The normal time for review shall be 20 working days per submittal. The normal time for final approval signatures shall be 10 working days. The consultant will be notified by phone when the plans are ready for pick-up.

After all approval signatures are obtained, the mylar(s) shall become property of the City.

Plans returned to the Engineering Services Section for further review and/or approval without the routing slip/check list and check prints will be returned to the consultant without further review until they are included.

Plans are reviewed on a first come - first serve basis only.

Plans returned to the consultant for lack of adequate information or conflicts with City of Aurora design criteria will be subject to further review once resubmitted to the Engineering Services Section.
ECS.0011

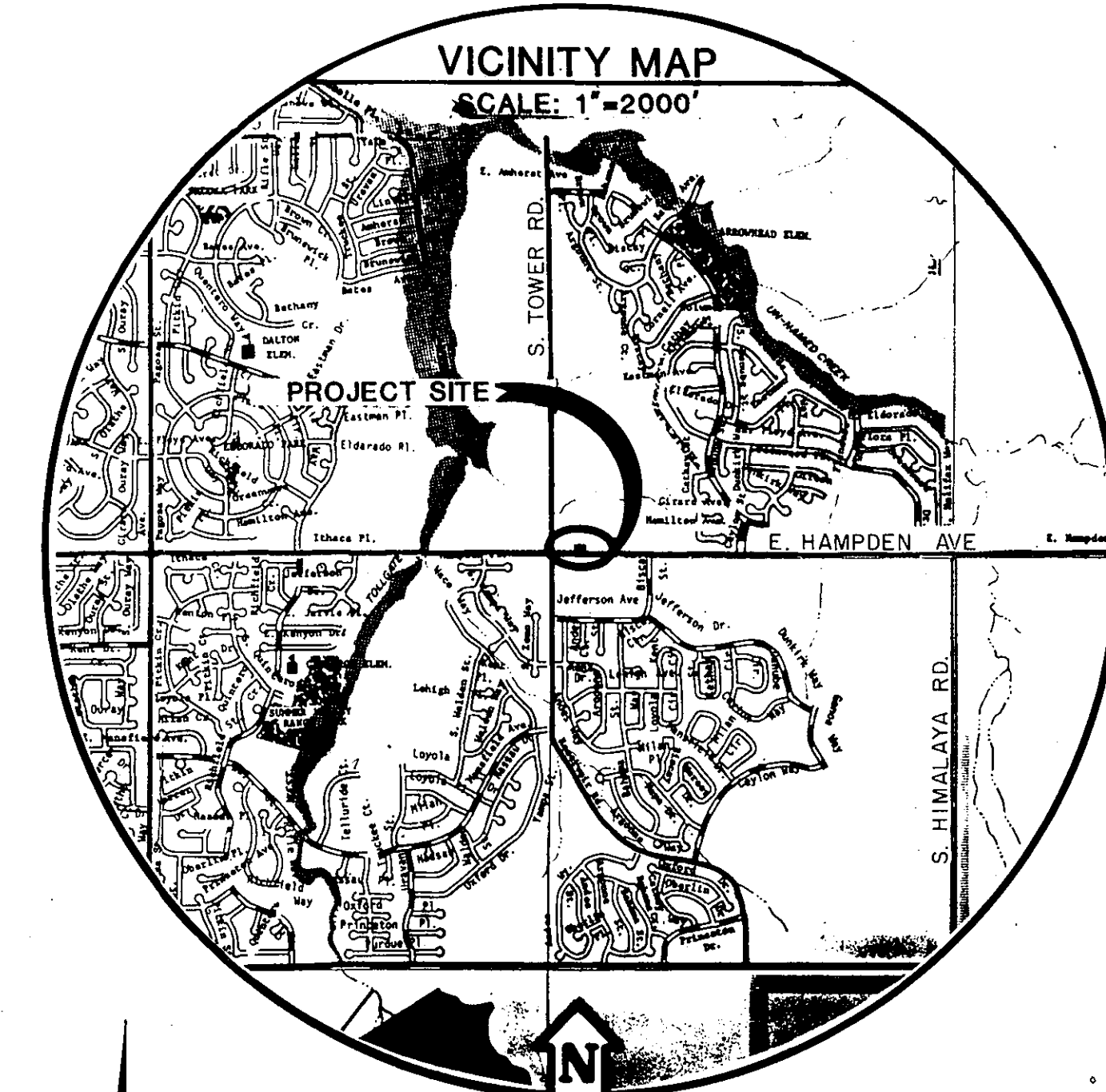
880085 1/2

"PRIVATE" N.T.S.

[illegible]

HAMPDEN AVENUE

FIGURE A



BENCHMARK: "□" Chiseled Square at back of walk, South curb return,
Southeast corner of the intersection of Hampden Avenue and South
Yampa Way. C.O.A. S-58
ELEVATION = 5632.30

CONTACT: MR. ORRIN SNYDER- REPRESENTATIVE
FOR THE APPLICANT- (433-1909)

John A. Entaminger

JOB NO. 100-511-12 DATE 1 94

SITE BENCHMARK
ELEV = 5154.00

UTILITIES NOTE: ALL UTILITIES SHOWN, EXCEPT AS SHOWN OTHERWISE, WERE TAKEN OFF PLANS PREPARED BY: HOLLAND CORP. "OVERALL WATER AND SEWER PLAN FOR SEVEN HILLS PLAZA" PROJ. NO. 0011 DATE: 6/18/84 SHEET 2 OF 2

WATER & SANITARY SEWER UTILITIES
CITY OF AURORA ~ 303-695-1390

E. All elevations are (SEE LEGEND) (indicate top of curb or flowline) unless otherwise noted.

TOWER ROAD

The contractor shall be responsible for the field location and verification of all utilities both horizontally and vertically prior to the construction of any portion of this project.

880085- 2/2

-
- 50'-0" BUILDING**
- 59'-0"**
- 26'-0" FIRE & UTILITY EASEMENT
- 4" UNDERGROUND P.V.C. CONDUIT FOR SECONDARY SERVICE BY ELEC. CONTRACTOR
- EXISTING S/C SEWER SERVICE CONNECTION PER C.O.A. STD. 300
- ELEC. METER & CT. CABINET S 89° 33' 35" E 200.0'
- EXISTING SAN. M.H. INV. = 50.56.15 INV. OUT = 47.17
- 2" UNDERGROUND PVC CONDUIT WITH FISHWIRE TO EXISTING UNDERGROUND TELE. SERVICE PEDISTAL BY ELEC. CONTRACTOR. CONTACT MIKE HARVEY (203) 792-6300
- PROPOSED LOCATION FOR CONCRETE PAD MOUNTED S&P TRANSF. BANK BY PUBLIC SERVICE CO. OF COLORADO. CONTACT BILL WOBIDO (303) 671-3831
- UNDERGROUND PRIMARY ELEC. SERVICE BY PUBLIC SERVICE CO. OF COLORADO
- EXISTING LANDSCAPED TRAFFIC ISLE WITH S/C SIGN.
- S/C EXIT DRIVE (EXISTING)
- S/C ENTRANCE DRIVE (EXISTING)
- 50' FIRE & UTILITY EASEMENT
- 42'-0"
- 120 L.F. ± OF 4" Ø SDR-35 P.V.C. SAN. SEWER SERVICE LINE
- NEW ASPHALT PAVING
- CONCRETE APRON
- MIN. SLOPE = 2%
- FF. EL. = 56.59.50
- 320 GAL. SAND & OIL MIXTURE C.O.A. STD. 305 OF EQUAL.
- CUSTOMER WAITING AREA
- GREEN AREA
- MONUMENT SIGN SEE DETAIL SH. A.17
- N 89° 33' 35" W 200.0'
- 16' X 16' UTILITY EASEMENT
- 8'-0" EXISTING SIDEWALK
- 12" GAS LINE
- 4" GAS LINE
- APPROXIMATE LOCATION OF EXISTING UNDERGROUND PRIMARY ELECTRIC SERVICE VERIFY LOCATION WITH PUBLIC SERVICE CO. OF COLORADO. CONTACT BILL WOBIDO
- CONNECT TO EXISTING 4" MAIN PER PUBLIC SERVICE CO. OF COLORADO SPECIFIC LOCUS. CONTACT BILL WOBIDO (303) 671-3831
- 16" WATER LINE
- LOT 1**
- LOT 2**
- 132'-0" BUILDING**
- REDUCED PRESSURE BACKFLOW PREVENTER
- 10' OF 1" TYPE K CU WATER SERVICE LINE
- 125' OF 1" TYPE K CU WATER SERVICE LINE
- 130' ± OF 1" TYPE K CU WATER SERVICE LINE
- 20' FIRE LANE & UTILITY EASEMENT
- EXISTING 8" Ø WATER MAIN
- 16' X 16' UTILITY EASEMENT
- 1" WATER METER C.O.A. STD. 200
- PRIVATE UTILITY EASEMENT
- 55'-0"
- 4 Hampden Ave

[illegible]

UNIT TYPE	FIXTURE	NUMBER OF FIXTURES (A)	FIXTURE VALUE (B)	FIXTURE VALUE (A x B)
COMMERCIAL	WATER CLOSET (FLUSH TANK) PRIVATE	1	3	3
	PUBLIC	1	5	5
	URINAL	1	5	5
	LAVATORY PRIVATE	1	1	1
	PUBLIC	1	2	2
	SERVICE SINK	1	3	3
	ELECTRIC WATER COOLER	2	± 2	± 4
	1/2" HOSE BIB	3	± 2	± 6
	—	—	—	—
	—	—	—	—
			TOTAL	30.29

NOTE: APPROVAL FOR WATER AND SANITARY ONLY.

SCALE: 1" = 20'-0"

A horizontal graphic scale bar with tick marks at 0, 10, 20, 30, 40, and 50 feet. The bar is divided into segments by vertical lines, with the numbers 0, 10, 20, 30, 40, and 50 placed above the corresponding tick marks.



8-17-88

ROBINSON ENGINEERING, INC.
3001 S. JAMAICA CT.
AURORA, CO 80014
303-752-4823

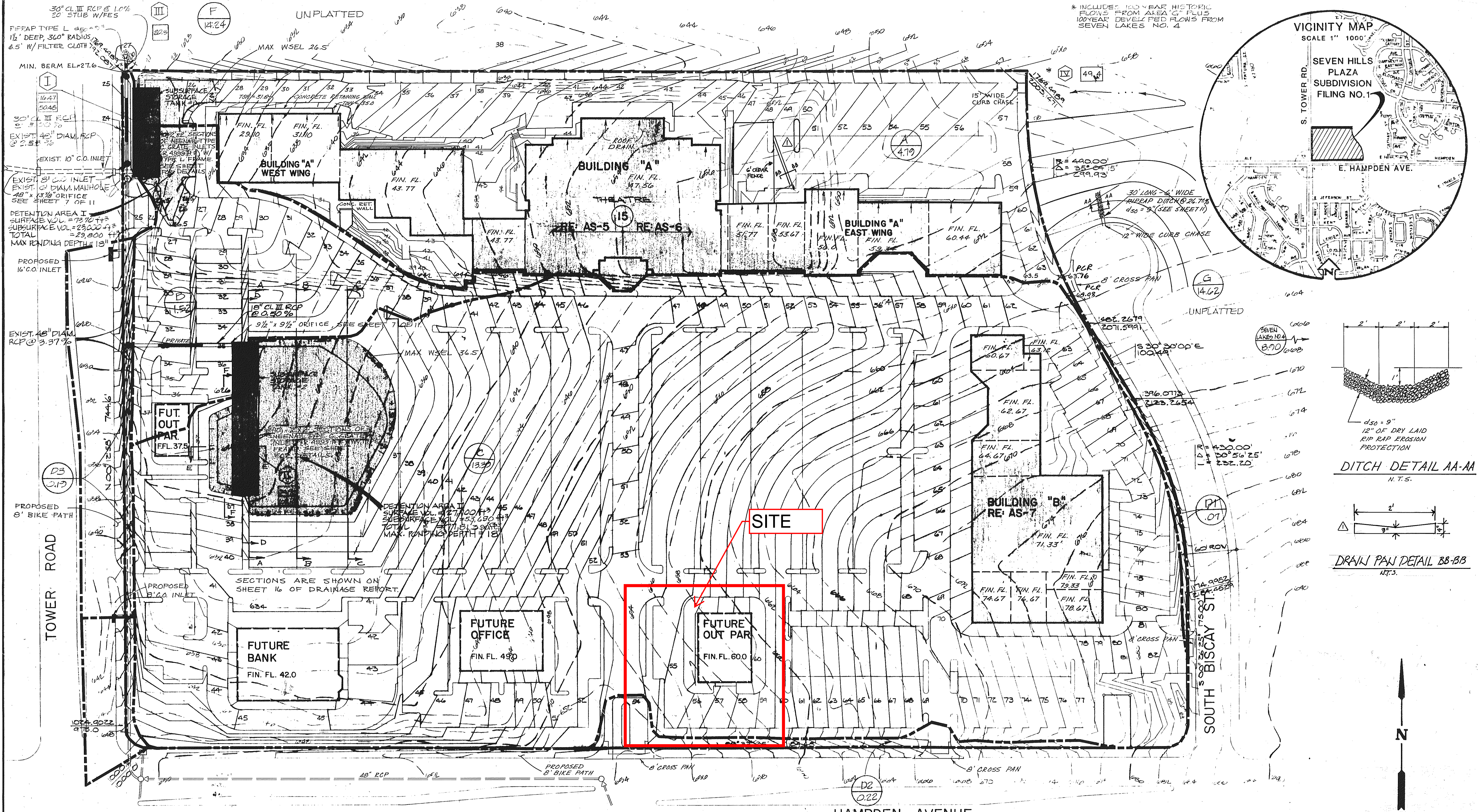
FIRESTONE SUB. FILE NO. 1 - FINAL

DESIGNED BY	JAE / ELD	DATE	3-21-88
DRAWN BY	JLD / FT&B-Co.	DATE	3-21-88
CHECKED BY	JAE	DATE	3-21-88
SCALE	1" = 20'	REVISED	7-11-88
JOB NO.	100-899-B	SHEET	2 OF 2

880085 2/2

G-2

05-2-613-8



GENERAL NOTES

1. ALL STORM SEWER CONSTRUCTION SHALL BE IN ACCORDANCE WITH CITY OF AURORA STANDARDS AND SPECIFICATIONS.
2. ALL INLETS ARE TO BE TYPE "R" C.O. INLETS.
3. ALL STORM SEWER PIPE SHALL BE CLASS III R.C.P. UNLESS NOTED OTHERWISE.
4. ALL BEDDING FOR STORM SEWER CONSTRUCTION SHALL BE CLASS "B".
5. ALL INTERIOR STORM SEWERS ARE PRIVATE.
6. GRASS SWALES ARE TO BE CONSTRUCTED TO SPECIFIED GRADES AND ARE TO BE MAINTAINED BY SEVEN HILLS PLAZA.
7. OUTFALL SECTIONS OF STORM SEWER PIPES ARE TO BE ADEQUATELY PROTECTED AGAINST EROSION DAMAGE AS REQUIRED.
8. ALL RIPRAP SHALL BE CLASS III AND CONSTRUCTION SHALL CONFORM TO THE LATEST CITY OF AURORA STANDARDS AND SPECIFICATIONS.

LEGEND

- BASIN BOUNDARY
- (D20) AREA DESIGNATION AREA (ACRES)
- (III) DESIGN POINT
- (641/204) 2 YEAR FLOW (cfs)
- (223) 100 YEAR HISTORIC FLOW (cfs)
- PROPOSED CONTOURS
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- BUILDING ENVELOPE

REFER TO OVERALL WATER & SEWER PLAN FOR EASEMENT LOCATIONS.

THE CONTOURS ON SHEET 9 OF 11 ARE HISTORIC. THE DASHED CONTOURS ON SHEET 8 OF 11 SHOW TOPOGRAPHY AFTER GRADING HAS OCCURED.

"City of Aurora plan review is only for general conformance with City of Aurora Design Criteria and the City Code. The City is not responsible for the accuracy and adequacy of the design, of dimensions, and elevations which shall be confirmed and correlated at the job site. The City of Aurora through the approval of this document assumes no responsibility other than as stated above for completeness and/or accuracy of this document."

BENCHMARK: CHISELED "X" IN TOP OF CURB AT THE NORTH END OF CURB RETURN AT THE N.E. CORNER OF HAMPDEN AVE. AND TOWER RD. C.O.A. BM 5-60 ELEV. = 5647.83.

APPROVED FOR ONE YEAR FROM THIS DATE

7-25-84

Director of Public Works
Director of Utilities

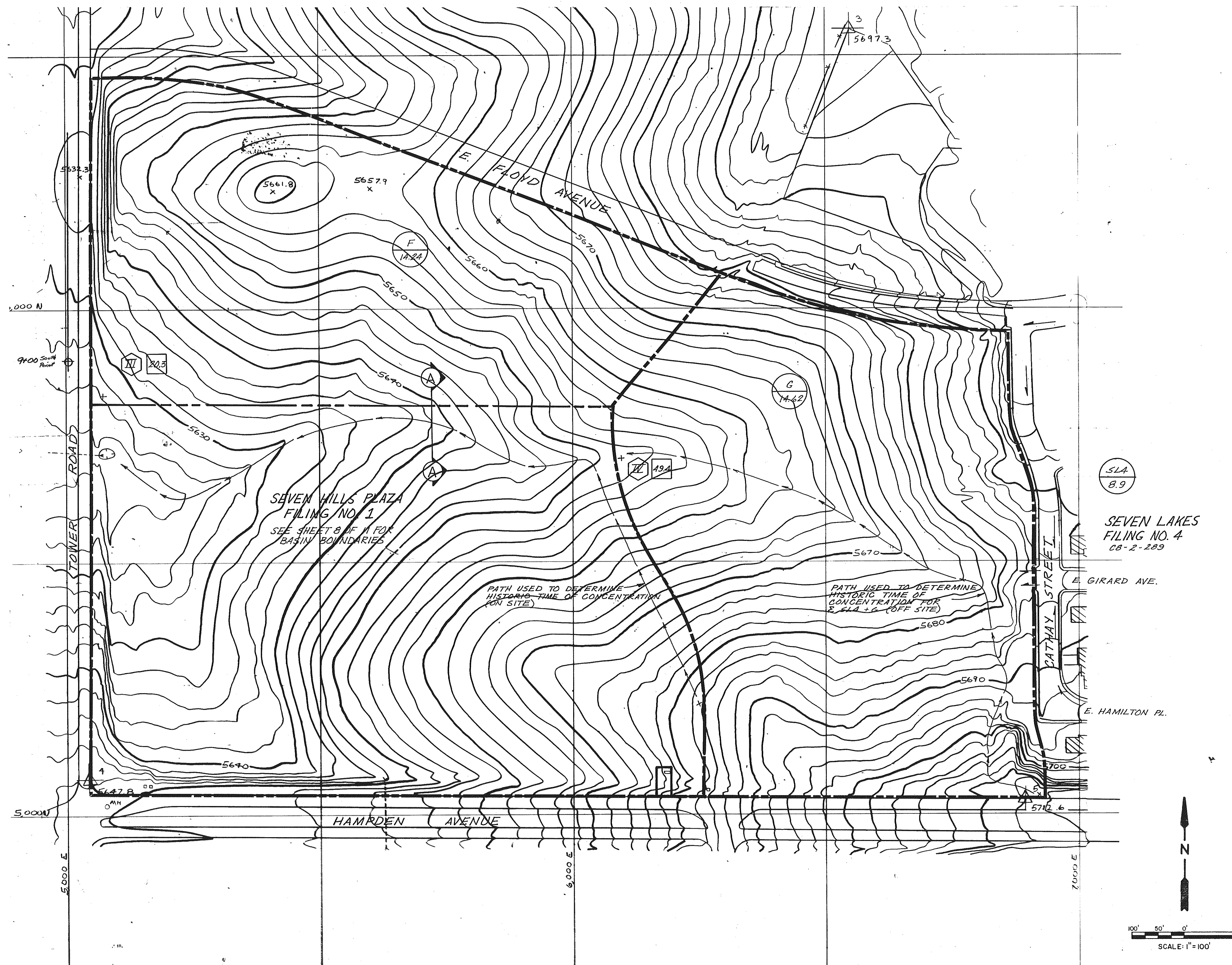
7/10/84
7/12/84

HOLLAND CORPORATION
PLANNING ENGINEERING LAND SURVEYING LANDSCAPE ARCHITECTURE
SUITE 1600, MERHAM PLACE 6535 SO. DAYTON STREET ENGLEWOOD, CO 80111 PH (303) 790-1082
SEVEN HILLS PLAZA
OVERLOT GRADING & FINAL DRAINAGE PLAN

REV 7-5-84 PER CITY COMMENTS

CS-2-613-9

NOTES:
1. CONTOURS SHOWN ON THIS SHEET ARE HISTORIC.
THE DASHED CONTOURS ON SHEET 8 OF 11 SHOW
TOPOGRAPHY AFTER REGRADING HAS OCCURED.



APPROX. 3.5 %

SECTION A-A
TYPICAL SECTION OF
HISTORIC DRAINAGE SWALE

7-25-84

Approved for one year from this date

CITY OF AURORA

Approved by

Engineering Department

7/10/84 J. R. Bonds 7/10/84

Utility Department

7/17/84 C. W. B. 7/17/84

HOLLAND CORPORATION
PLANNING
ENGINEERING
LAND SURVEYING
LANDSCAPE ARCHITECTURE
SUITE 1600, MERHAM PLACE
6535 SO. DAYTON STREET
ENGLEWOOD, CO 80111
PH (303) 790-1082

OFFICES IN:
LENEXA, KANSAS
HURST, TEXAS

DATE 6/18/84
DES/DFT DL/VS
PROJ. NO 0017
SHEET 9 OF 11

SEVEN HILLS PLAZA
FINAL DRAINAGE PLAN

REV. 7-5-84, PER CITY COMMENTS

CS-2-613

C5-2-613

C

15N
16N

C5-2-613

FINAL DRAINAGE STUDY
FOR
SEVEN HILLS PLAZA SUBDIVISION FILING NO. 1

JOB NO. 0017.061

Prepared for:

SEVEN HILLS PLAZA ASSOCIATES

c/o Bob Reynolds
F.R. ORR Construction Co. Inc.
4414 Vine Street
Denver, Colorado 80216
(303) 294-9211

Prepared by:

HOLLAND CORPORATION
6535 S. DAYTON ST., SUITE 1600
ENGLEWOOD, COLORADO 80111
(303) 790-1082

JUNE 12, 1984
REVISED JULY 3, 1984

C5-2-613

APPROVED FOR ONE YEAR FROM THIS DATE	
7-25-84	
<i>KW</i> 7/10/84	<i>HK LaBonde</i> 7/10/84
Director of Public Works	Date
<i>Edwin [Signature]</i>	7/17/84
Director of Utilities	Date

INTRODUCTION

PROPOSED DEVELOPMENT

The proposed Seven Hills Plaza is a 20.00 acre tract intended for commercial development. The property is located in a part of the southwest one-quarter of Section 34, Township 4 South, Range 66 West of the 6th Principle Meridian, City of Aurora, County of Arapahoe, State of Colorado.

This site is bounded by Tower Road on the west and East Hampden Avenue on the south. Undeveloped land exists immediately to the north and east consisting of bare and untilled earth.

An existing 48 inch RCP (see City of Aurora Drawing No. C6-2-398) running along Tower and passing under approximately 400 ft. north of Hampden will be utilized to convey the flows from this site to a tributary of West Toll Gate Creek.

PURPOSE

The purpose of this report is to show compliance with City of Aurora Regulations, which require that on-site detention be provided by the developer to detain the difference between the 100-year developed and undeveloped (historic) storm water flows.

GENERAL INFORMATION

Information for offsite areas including Seven Lakes No. 4 was obtained from the "Improvement District 3-80 Drainage Map 142-79-068-10". (COA No. C6-4-237)

CRITERIA

This study is based on an initial storm with a 2-year recurrence interval and a major design storm with a 100-year recurrence interval. The runoff coefficients used were 0.2 for historic conditions and 0.9 for the developed conditions. Coefficients were increased by 25% for the major storm analysis (not to exceed 1.00). Undeveloped times of concentration for each major area were calculated using the Overland Time of Flow Curves in U.D.F.C.D.

SCOPE

The rational method, as outlined in the "City of Aurora Storm Drainage Design Manual", was utilized to determine the generated flows. A volume versus time relationship was used to size proposed detention areas.

DRAINAGE

ONSITE

SITE PART OF AREA C



Areas A and B combine to generate flows to Design Point I, resulting in a 100-year storm of 50.5 cfs. These flows will be intercepted with Detention Area I consisting of surface and subsurface detention. The parking area will be utilized for above ground ponding (not to exceed 1.5 feet depth) with an underground reinforced concrete tank providing the extra volume needed to maintain a release rate of 10.1 cfs.

Area C generates flows to Design Point II resulting in a 100-year storm of 107.1 cfs. These flows will be intercepted with Detention Area II consisting of surface and subsurface detention similar to that described for Detention Area I, but with a release rate of 12.8 cfs.

Each tank utilized an orifice type outlet to restrict outfall to the specified amounts of 10.1 and 12.8 cfs.

Release from these detention areas will be piped to, and connected with, the existing 48 inch RCP's which eventually will reach West Toll Gate Creek.

Areas D₁, D₂ and D₃ are grassed fringe areas that will drain away from this site. The 2-year storm generated from these areas are negligible, but the 100-year storm of 1.3 cfs will be considered as release from the overall site.

The 100 year historic flows from all areas of Seven Hills Plaza are equal to 24.2 cfs. After development has occurred, the total releases, from this site only, will still be equal to 24.2 cfs. (10.1 + 12.8 + 1.3)

OFFSITE

Areas F & G will be required to detain the difference between the 100 year developed and undeveloped storm water flows. Seven Lakes Filling No. 4 (SL4) has been developed without providing for detention. Therefore, the 100 year developed flows from SL4 and 100 year historic flows from area G combine at Design Point IV, resulting in a 100 year storm of 45.2 cfs. These flows will be routed from Design Point IV to the existing 48" RCP on Tower Road strictly by surface drainage via the drive which parallels the N. Boundary.

A pipe system will be provided to allow historic flows from area F to reach the existing 48" RCP on Tower Road.

Adequate erosion protection (riprap) will be provided at all areas where erosive tendencies exist.

CONCLUSION

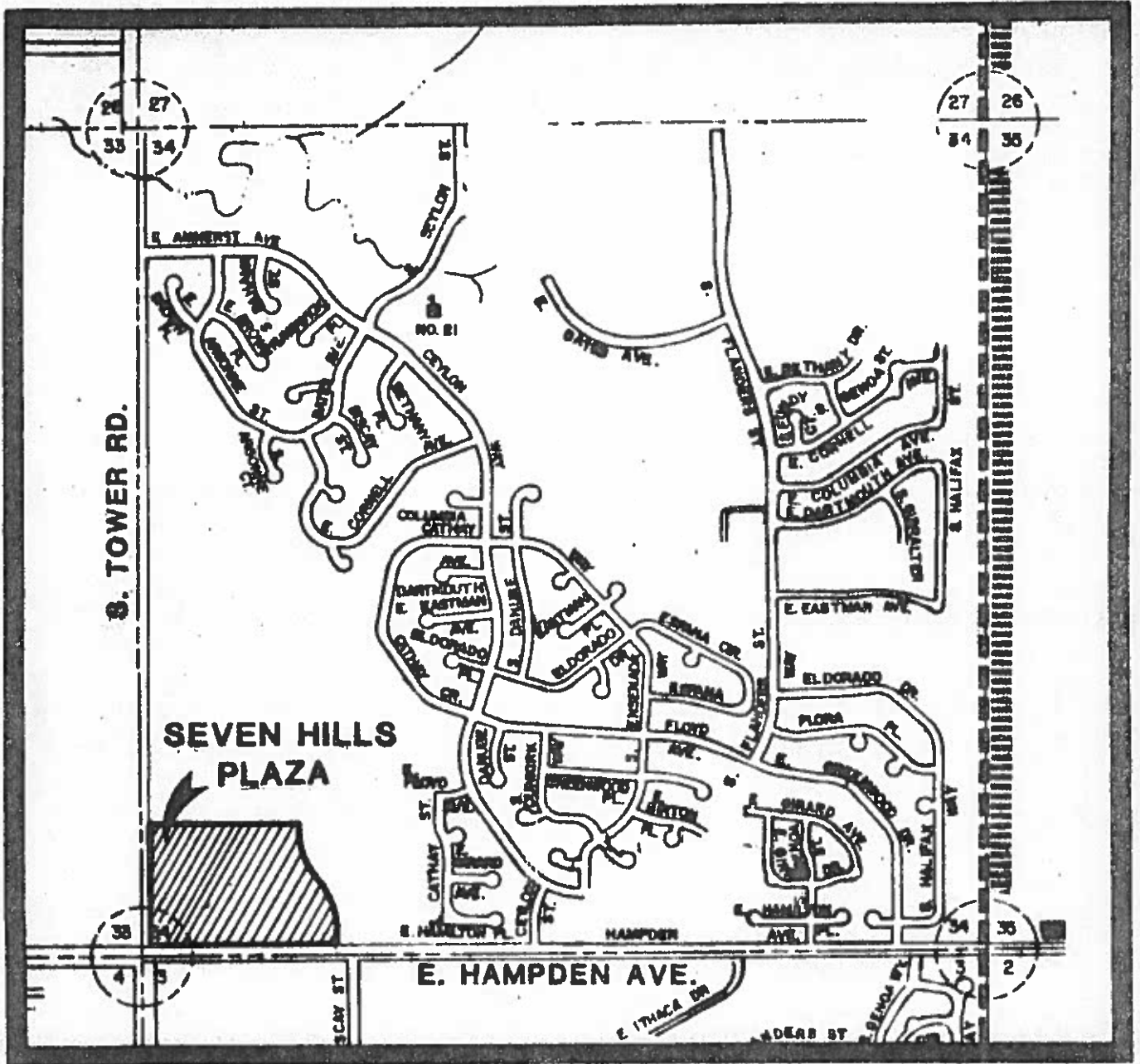
This report formulates a storm water management system which provides the detention storage required to control developed peak flows so as not to exceed existing conditions for runoff produced by the 100-year frequency rainfall.

Respectfully Submitted,
HOLLAND CORPORATION, INC.

David A. Lotter
David A. Lotter

Mace L. Pemberton
Mace L. Pemberton, P.E.







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(303) 790-1082

Project 7 HILLS PLAZA W.O. 0017

Title STORM SEWER DESIGN

By D.A.L. date 4/10/84 Checked MLP date _____

Scale _____ Sht. 1 of _____

STORM SEWER & DETENTION POND CALCULATIONS

REFERENCES USED

- #1 "DESIGN CHARTS FOR OPEN CHANNEL FLOW"; U.S. DEPT. OF TRANSPORTATION, FED. HIGHWAY ADMINISTRATION, PRINTED 1980
- #2 "ELEMENTARY FLUID MECHANICS"; VENNARD & STREET; FIFTH EDITION
- #3 URBAN STORM DRAIN MANUAL
- #4 STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA; CITY OF AURORA, MARCH 1983.
- #5 FINAL DRAINAGE REPORT, IMPROVEMENT DISTRICT 3-80 PROJECT #142-79-06B-10, APRIL 11, 1980, CITY OF AURORA.
- #6 "MODERN SEWER DESIGN"; AMERICAN IRON AND STEEL INSTITUTE; FIRST EDITION 1980

ABBREVIATIONS USED

SLA - SEVEN LAKES FILING No 4



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Project 7 HILLS PLAZA W.O. 0017
Title STORM DRAIN DESIGN
By D.A.L. date 6/7/84 Checked MLP date _____
Scale _____ Sht. 2 of _____

FIND HISTORIC T_C FOR THIS SITE ONLY

SEE SHEET 20F2 OF DRAINAGE PLAN FOR PATH & HISTORIC BASIN

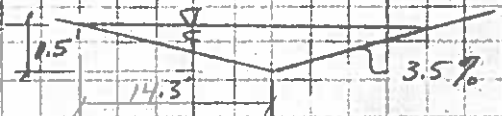
500' OVERLAND FLOW $S = 6.8\%$

0.20 = 5yr C VALUE

$$T_C = \frac{1.8 (1.1 - C_2) \sqrt{L}}{\sqrt[3]{S}} = \frac{1.8 (1.1 - .20) \sqrt{500}}{\sqrt[3]{6.8}} = 19.1 \text{ min}$$

900' CHANNEL FLOW $S = 3.3\%$

CHANNEL IS TRIANGULAR SECTION
AND DEPTH OF FLOW WILL BE
ASSUMED TO BE 0.50 ft.



$$A = 0.5(14.3) = 7.15 \text{ ft}^2$$

$$P = 2(14.3) = 28.6 \text{ ft}$$

$$R = A/P = 7.15/28.6 = 0.25 \text{ ft}$$

$n = .030$ FAIRLY REGULAR SECTION, SOME GRASS AND KEEPS.
(REF #1 PG 100)

$$V = \frac{1.49}{n} R^{2/3} S^{1/2} = \frac{1.49}{.030} (0.25)^{2/3} (.033)^{1/2} = 3.6 \text{ fps}$$

$$T_C = \frac{L}{V} = \frac{1050}{3.6 \text{ fps}} = 4.9 \text{ min}$$

$$T_C (\text{HISTORIC}) = 500' \text{ OVERLAND} + 900' \text{ CHANNEL}$$

$$= 19.1 \text{ min} + 4.9 \text{ min} = \underline{\underline{24.0 \text{ min}}}$$



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Project 7 HILLS PLAZA W.O. 0017

Title STORM DRAIN DESIGN

By D.A.L. date 6/6/84 Checked NLP date _____

Scale _____ Sht. 3 of _____

FIND HISTORIC T_0 FOR AREAS SL4 AND G COMBINED.

PATH 1

SL4 DEVELOPED

10 min (ASSUME MIN. T_0)

G 820' @ 3.3% CHANNEL FLOW
 $V = 3.0 \text{ fps}$

4.6 min

14.6 min

PATH 2

500' OVERLAND FLOW @ 6.9%
 $T = 0.20$

18.9 min

800' @ 3.3% CHANNEL FLOW
 $V = 3.0 \text{ fps}$

4.4 min

23.3 min

USE $T_0 = 23.3 \text{ min}$

SEE SHEET 2 OF 2 OF DRAINAGE PLAN FOR
DIRECTION OF PATH 2.



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Project 7 HILLS PLAZA W.O. 1017

Title STORM DRAIN DESIGN

By DAL date 7/3/84 Checked _____ date _____

Scale _____ Shl. 3A of _____

$T_c = 10 \text{ MIN}$ (DEVELOPED) THIS VALUE IS CONSERVATIVELY CHOSEN FOR AREAS $\Sigma A+B$ AND C , SINCE ITS USE IN THE RATIONAL METHOD PRODUCES RELATIVELY LARGE FLOWRATES. THE ACTUAL TIME OF CONCENTRATION WILL VARY DEPENDING UPON PATH OF FLOW FROM ROOFTOP TO STREET, STREET TO LOW POINT, FOR THE INDIVIDUAL SUBBASINS.

$T_c = 11.0 \text{ MIN}$ (DEVELOPED) FOR $\Sigma D_1 - D_3$

LENGTH = 1700'

AVE. SLOPE = 2.5%

ASSUME DISCHARGE = 1.3 CFS

FROM PAGE 43, $V = 2.6 \text{ FPS}$

$$T_c = \frac{1700'}{2.6(60)} = 11 \text{ MIN.}$$

$T_c = 18.5 \text{ MIN}$ (HISTORIC) AREA F

LENGTH = 500'

SLOPE = 7.5%

$C = 0.20$

$$T_c = \frac{1.8(1.1-C)\sqrt{L}}{\sqrt{S}} = \frac{1.8(1.1-.2)\sqrt{500}}{\sqrt{7.5}} = 18.5$$

SUBDIVISION _____
 LOCATION _____
 DESIGN STORM 100 YR RECURRENCE INTERVAL
 COMPUTATIONS BY P.A.L. DATE 6/7/84
 SUBMITTED BY _____ DATE _____
 (Engineering Firm)

CITY OF AURORA, COLORADO
 STORM DRAINAGE SPECIFICATIONS

RUNOFF COMPUTATIONS
 (Rational Method)

PAGE 4 OF _____

Design Point	Area Designation	A (Acres)	c	c _f	$\bar{c} =$ (avg)	A· \bar{c}	$\Sigma A \cdot \bar{c}$	t _a (min)	I (in/hr)	Q = ($\Sigma A \cdot \bar{c}$) · I cfs	Slope (S)	Length L (feet)	VEL* V (fps)	Δ (min)	Remarks	
I	A	4.79	0.2	1.25	.25	1.20	1.20	10*	80	9.6					CONTAINS SITE	100 YR HISTORIC
	B	1.52				0.38	1.58									
	C	13.39				3.35	4.93									
	D1	0.07				0.02	4.95									
	D2	0.22				0.05	5.00									
$\Sigma A - D_3$	D3	0.19	▼	▼	▼	0.05	5.05	24.0 ^A	4.0	24.2						
III	F	14.24	.2	1.25	0.25	3.56	3.56	18.5*	5.7	20.3						
IV	SL4	8.9	0.5	1.25	.625	5.56	5.56									(PER DRAINAGE REPORT, CGA #CB-2-288)
$\Sigma SL4 + G$	G	14.62	0.2	1.25	.25	3.66	9.22	23.3 ⁰	4.90	45.2						

SUBDIVISION 7 HILLS PLAZA
 LOCATION _____
 DESIGN STORM 2 YR RECURRENCE INTERVAL
 COMPUTATIONS BY D.M.L. DATE 4/10/04
 SUBMITTED BY _____ DATE _____
 (Engineering Firm)

STORM DRAINAGE SPECIFICATIONS

RUNOFF COMPUTATIONS (Rational Method)

PAGE 5 OF 41

Design Point	Area Designation	A (Acres)	c	c _f	S _x (csc _f)	A-E	I A-E	t _a (min)	I (in/hr)	Q _a (IAE) cfs	Slope (%)	Length L (feet)	VEL ^a V (fps)	d (min)	Remarks
I	A	4.79	0.9	1.0	0.9	4.31	4.31	10.0*	2.9	12.50					2 YR DEVELOPED
Σ A+B	B	1.52	0.9	1.0	0.9	1.37	5.68	10.0*	2.9	16.47					
II	C	13.39	0.9	1.0	0.9	12.05	12.05	10.0*	2.9	34.95					
FRINGE AREAS	D1	.07	0.3	1.0	0.3	.02	.02								
	D2	.22	0.3	1.0	0.3	.07	.09								
Σ D ₁ -D ₃	D3	.19	0.3	1.0	0.3	.06	.15	11.0*	2.7	.40					

CONTAINS SITE

* SEE PAGE 3A FOR T_C BASIS.

SUBDIVISION 7 HILLS PLAZA
 LOCATION _____
 DESIGN STORM 100 YR RECURRENCE INTERVAL
 COMPUTATIONS BY _____ DATE 6/6/84
 SUBMITTED BY _____ DATE _____
 (Engineering Firm)

STORM DRAINAGE SPECIFICATIONS

RUNOFF COMPUTATIONS
 (Rational Method)

PAGE 6 OF _____

Design Point	Area Designation	A (Acres)	c	c _f	E _s (ccsf)	A-E	IA-E	n (min)	l (in/hr)	Q _s (IA-E) x i etc	Slope (%)	Length L (feet)	VEL ^a V (fps)	d (min)	Remarks
I	A	4.79	0.9	1.25	1.0	4.79	4.79	*	10.0	8.0	38.32				100 YR DEVELOPED
Σ A + B	B	1.52	0.9	1.25	1.0	6.31	6.31	*	10.0	8.0	50.48				
II	C	13.39	0.9	1.25	1.0	13.39	13.39	*	10.0	8.0	107.10				
FRINGE AREAS	D1	0.07	0.3	1.25	.375	.03	.03								
	D2	0.22	0.3	1.25	.375	.08	.11								
Σ D ₁ - D ₃	D3	0.19	0.3	1.25	.375	.07	.18	*	11.0	7.35	1.3				

CONTAINS SITE

*SEE PAGE 3A FOR T_c BASIS.



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Project 7 HILLS PLAZA W.O. 0017

Title STORM DRAIN DESIGN

By D.A.L. date 6/7/84 Checked _____ date _____

Scale _____ Sht. 7 of _____

RELEASE RATES FROM DETENTION AREAS 1 & 2

FROM PAGE 4, THE 100YR HISTORIC FLOWS FROM ALL AREAS OF SEVEN HILLS PLAZA ARE EQUAL TO ~~25.8~~^{24.2} cfs. AFTER DEVELOPMENT HAS OCCURED, THE TOTAL RELEASES, FROM THIS SITE ONLY, MUST STILL BE EQUAL TO 24.2 cfs. ✓

DUE TO EXTREME SPACE LIMITATIONS IN THE VICINITY OF DETENTION AREA #1, THE RELEASE RATE FROM AREA #1 WILL BE LIMITED TO 10.1 cfs. THIS IS APPROXIMATELY EQUAL TO THE 100YR HISTORIC FLOWS THAT CONTRIBUTE TO THIS AREA.
SEE PAGE 4 (BASIN A)

THE RELEASE RATE FOR DETENTION AREA #2 MUST THEN BE AS FOLLOWS:

$$Q_{100}(\text{REL \#2}) = Q_{100}(\text{HISTORIC}) - Q_{100}(\text{REL \#1}) - Q_{100}(\text{REL. FRINGE AREAS})$$

$$Q_{100}(\text{REL \#2}) = 24.2 - 10.1 - 1.3 = \underline{12.8 \text{ CFS}}$$

THE REQUIRED VOLUMES FOR THESE DETENTION AREAS ARE CALCULATED ON THE FOLLOWING NEXT TWO PAGES, USING THEIR RESPECTIVE RELEASE RATES.

Holland Corporation

PROJECT NAME:

7 HILLS PLAZA

JOB NO.

0017

TITLE:

DETENTION PONDS

SHEET

8 OF

CALC.

DATE:

CHK'D.

DATE:

APP'D.

DATE:

BY: D.A.L.

3/15/04

BY:

BY:

POND:

DETENTION AREA #1

VOLUME PROVIDED:

TRIBUTARY AREAS

A
4.79

+

B
1.52

RATE: $Q_p = 10.10$ CFS

S = 1.0

AREA = 6.31

AZ = 6.31

TIME		INTENSITY IN/HR	ABI CFS	ABI x t FT ³	ADDITIONAL INFLOW FT ³	TOTAL INFLOW TO POND FT ³	RELEASE Q_R x t FT ³	DETENTION REQ'D FT ³
MIN	SECS							
5	300	10.75	67.63	20,350			3030	17,320
10	600	8.00	50.48	30,288			6060	24,228
15	900	6.40	40.38	36,346			9090	27,256
20	1200	5.40	34.07	40,889			12,120	28,769
25	1500	4.70	29.66	44,486			15,150	29,336
30	1800	4.25	26.82	48,272			18,180	30,092
35	2100	3.85	24.29	51,016			21,210	29,806
40	2400	3.55	22.40	53,761			24,240	29,521
45	2700	3.3	20.82	56,222			27,270	28,952
50	3000	3.1					30,300	
55	3300	2.9						
60	3600	2.7						
65	3900	2.6						
70	4200							
75	4500							
80	4800							

Holland Corporation

PROJECT NAME:

7 HILLS PLAZA

JOB NO.

0017

TITLE:

DETENTION PONDS

SHEET

5 OF

CALC.

DATE:

CHECKED

DATE:

APPROVED

DATE:

BY: D.A.L.

6/7/84

BY:

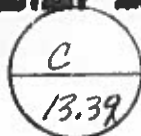
BY:

POND:

DETENTION #2

VOLUME PROVIDED:

TRIBUTARY AREAS



RATE: $Q_p =$

12.8 CFS

$T_p =$

1.0

AREA = 13.39

AT = 13.39

TIME		INTENSITY	ABI	ABI x T	ADDITIONAL	TOTAL	RELEASE	DETENTION
MIN	SECS	IN/HR	CFS	FT ³	INFLOW	INFLOW	Q _{RELEASE}	REQ'D
					FT ³	TO POND	FT ³	FT ³
						FT ³		
5	300	110.75						
10	600	8.00						
15	900	6.40						
20	1200	5.40						
25	1500	4.70						
30	1800	4.20						
35	2100	3.85	51.55	108,258				
40	2400	3.55	47.53	114,083			30,720	83,363
45	2700	3.30	44.19	119,305			34,560	84,745
50	3000	3.10	41.51	124,527			38,400	86,127
55	3300	2.90	38.83	128,142			42,240	85,902
60	3600	2.70	36.15	130,151			46,080	84,071
65	3900	2.60						
70	4200							
75	4500							
80	4800							



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Project 7 HILLS PLAZA W.O. 0017

Title DETENTION VOLUME

By DAL date 3/22/84 Checked _____ date _____

Scale _____ Shl. 10 of _____

THE VOLUMES FOR AVAILABLE SURFACE DETENTION HAVE BEEN CALCULATED ON PAGES 11 THROUGH 16.

THE RESULTS ARE SUMMARIZED BELOW.

MAXIMUM PONDING DEPTHS HAVE BEEN LIMITED TO 18 INCHES.
AS APPROVED IN THE PRELIMINARY DRAINAGE REPORT

DETENTION AREA #1

$$\text{TOTAL VOLUME REQ} = 30,092 \text{ ft}^3 \quad \text{pg. 6}$$

$$\text{SURFACE DET.} = 7,370 \text{ ft}^3 \quad \text{pg. 10}$$

$$\text{REQ. SUBSURFACE DET} = 22,722 \text{ ft}^3$$

$$\text{APPROX. REINFORCED CONCRETE TANK DIMENSIONS} = 101' \times 30' \times 7.59' = 23,000$$

DETENTION AREA #2

$$\text{TOTAL VOLUME REQ} = 86,127 \text{ ft}^3 \quad \text{pg. 7}$$

$$\text{AVAILABLE SURFACE} = 27,700 \text{ ft}^3 \quad \text{pg. 13}$$

$$\text{REQ. SUBSURFACE} = 58,427 \text{ ft}^3$$

$$\text{APPROXIMATE REINF. CONCRETE TANK DIM.} = 190' \times 32' \times 9.65' = 58,670 \text{ ft}^3$$



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Project 7 HILLS PLAZA W.O. 0017

Title SURFACE DET #1

By D.A.L. date 6/8/84 Checked _____ date _____

Scale _____ Shl. 11 of _____

END AREAS FOR SURFACE DETENTION #1

SECTION A-A

$$\text{AREA} = \frac{.6 + .7}{2} (7.5) + \frac{1.2 + 1.78}{2} (42) + \frac{1}{2} (1.78) (15) = 52.30 \text{ ft}^2$$

$$\text{AREA-SHADED} = 52.3 - 42(0.5) - 10(.5) = 26.30 \text{ ft}^2$$

SECT B-B

$$\text{AREA} = .8 (8.9) + \frac{1.37 + 1.01}{2} (36) + \frac{1}{2} (1.01) (13) = 55.81 \text{ ft}^2$$

$$\text{AREA-SHADED} = 55.81 - .5(13) = 49.31 \text{ ft}^2$$

SECT C-C

$$\text{AREA} = 1.0(7) + \frac{1.5 + 1.08}{2} (42) + \frac{1}{2} (1.08) (16) = 69.82 \text{ ft}^2$$

$$\text{AREA-SHADED} = 69.82 - .5(11) = 64.32 \text{ ft}^2$$

SECT D-D

$$\text{AREA} = 0.5(8) + 1.1(13.5) + \frac{1.1 + .81}{2} (28.5) + \frac{1}{2} (.81) (16) = 52.55 \text{ ft}^2$$

$$\text{AREA-SHADED} = 52.55 - .5(16) - .5(10) = 39.55 \text{ ft}^2$$

SECT E-E

$$\text{AREA} = \frac{1}{2} (26) (1.7) + \frac{1}{2} (.7 + .5) (10) = 12.10 \text{ ft}^2$$

SECT F-F

$$\text{AREA} = \frac{1}{2} (30) (.3) = 4.5 \text{ ft}^2$$



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Project 7 HILLS PLAZA W.O. 0017

Title SURFACE DET #1

By D.A.L. date _____ Checked _____ date _____

Scale _____ Sht. 12 of _____

VOLUME FOR SURFACE DET #1

	AVE. AREA	L	VOL
N. BDRY TO SECT A-A	$\frac{0 + 26.3}{2}$	6'	79
SECT A-A TO SECT B-B	$\frac{52.3 + 55.81}{2}$	26'	1405
SECT B-B TO SECT C-C	$\frac{49.31 + 64.32}{2}$	24'	1364
SECT C-C TO SECT D-D	$\frac{69.82 + 52.55}{2}$	58'	3549
SECT D-D TO SECT E-E	$\frac{39.55 + 12.10}{2}$	16'	414
SECT E-E TO SECT F-F	$\frac{12.10 + 4.5}{2}$	26'	216
SECT F-F TO END	$\frac{4.5 + 0}{2}$	18'	41
CORNER AREA BETWEEN SECT BB & CC			300
			<u>7370 ft³</u>



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Title SURFACE VOL OF DET #2

By D.H.C. date 5/22/04 Checked _____ date _____

Scale _____ Shl. 14 of _____

END AREAS DET #2 SEE PGS. 13 & 14

SECT A-A

$$AREA = \frac{1}{2}(0.98)(17) + \frac{0.98+1.5}{2}(103) + \frac{1.19+1.50}{2}(62) + \frac{1}{2}(1.19)(20) = 231.34$$

$$AREA - SHADED = 231.34 - 11(0.5) - 103(0.5) - 62(0.5) - 15(0.5) = 135.84 \text{ ft}^2$$

SECT B-B

$$AREA = \frac{1}{2}(0.68)(11.5) + \frac{0.68+1.22}{2}(106) + \frac{1.22+0.88}{2}(67) + \frac{1}{2}(0.88)(15) = 183.46 \text{ ft}^2$$

SECT C-C

$$AREA = \frac{1}{2}(0.38)(6) + \frac{0.38+0.95}{2}(114) + \frac{0.95+0.58}{2}(73) + \frac{1}{2}(0.58)(9) = 135.41 \text{ ft}^2$$

SECT D-D

$$AREA = \frac{1}{2}(1.35)(23) + \frac{1.35+1.50}{2}(24) + \frac{1.5+1.31}{2}(38) + \frac{1}{2}(1.31)(21) = 124.00 \text{ ft}^2$$

$$AREA - SHADED = 124.00 - 17(0.5) - 29(0.5) - 38(0.5) - 15(0.5) = 74.50 \text{ ft}^2$$

SECT F-F

$$AREA = \frac{1}{2}(1.28)(21) + \frac{1.28+1.40}{2}(23) + \frac{1.40+1.22}{2}(36) + \frac{1}{2}(1.22)(20) = 103.00 \text{ ft}^2$$



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DET #2 VOLUME

	AVE AREA (ft ²)	L	VOL (ft ³)
SECT A-A TO B-B	$\frac{231.34 + 183.46}{2}$	55'	11,407
SECT B-B TO C-C	$\frac{183.46 + 135.41}{2}$	55'	8,769
SECT C-C TO END	$\frac{135.41 + 0}{2}$	50'	3,385
SECT A-A TO D-D	$\frac{135.84 + 74.5}{2}$	7'	736
SECT D-D TO E-E	$\frac{124.0 + 103.62}{2}$	19'	2,162
SECT E-E TO END	$\frac{103.62 + 0}{2}$	24'	1,243
			<u>27,702 ft³</u>



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CAPACITY OF EXISTING 48" RCP

ALL ONSITE FLOWS AND OFFSITE FLOWS NORTH & EAST OF THIS SITE EVENTUALLY END UP IN THE EXISTING 48" RCP AT THE N.W. CORNER OF THE SITE. SEE SHEET 1 OF DRAINAGE PLAN FOR LOCATION.

THE FLOWS WHICH CONTRIBUTE TO THIS 48" RCP ARE AS FOLLOWS:

119 CFS EXISTING Q_{100} FLOW FROM REF #5 pg. 31

24.2 - 1.3 CFS TOTAL FLOWS RELEASED FROM SITE, (SEE NOTE #1 NEXT PG)

20.3 CFS OFFSITE HISTORIC FLOWS FROM AREA F.

45.2 CFS OFFSITE HISTORIC FLOWS FROM ~~SL4~~ + 6.

21.0 CFS EXIST 8' INLET FLOW (FROM REF #5 DRAINAGE MAP.)

17.5 CFS EXIST 10' INLET FLOW (SEE NOTE #2 NEXT PAGE)

245.9 CFS TOTAL HISTORIC FLOW

48" PIPE FLOWING FULL

$$A = \pi r^2 = 12.57 \text{ ft}^2$$

$$P = 2\pi r = 12.57 \text{ ft}$$

$$R = A/P = 1.0 \text{ ft}$$

MINIMUM EXIST. SLOPE = 2.31 % (FROM E. INV 48" RCP TO W. INV 48" RCP
HOLLAND SURVEY OFD. 3/23/84)

$$Q = \frac{1.49}{100} A R^{2/3} S^{1/2} = \frac{1.49}{100} (12.57) (1.0)^{2/3} (.0231)^{1/2} = 219.2$$

245.9 CFS > 219.2 CFS. THEREFORE, THE EXISTING 48" RCP IS CURRENTLY UNDERSIZED FOR NON-PRESSURIZED FLOW, SINCE THE HISTORIC FLOWRATE IS GREATER THAN THE CAPACITY. THE HYDRAULIC GRADE LINE ANALYSIS WHICH FOLLOWS WILL START AT THE EXISTING OUTLET (48" RCP) WEST OF TOWER ROAD AND PRESSURIZED FLOW WILL BE CONSIDERED IN THE ANALYSIS.



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NOTE #1: THE 1.3 CFS IS NOT INCLUDED HERE BECAUSE IT IS 100YR DEVELOPED FLOW FROM FRINGE AREAS D1, D2, & D3 AND THESE FLOWS ENTER THE 8' INLET AT THE CORNER OF TOWER RD AND HAMPTON AVE, AND THE 8' INLET AT THE NW CORNER OF THE SITE. THEREFORE, THE 1.3 CFS WOULD BE INCLUDED WITH THE 19 CFS AND THE 21 CFS.

NOTE #2: INFORMATION IS UNAVAILABLE FOR AMOUNT OF FLOW ENTERING THE EXISTING 10' C.O. INLET. ALSO, THE WEST SIDE OF TOWER RD HAS NOT YET BEEN CONSTRUCTED. THEREFORE, THE FUTURE FLOW ENTERING THE 10' C.O. INLET WILL BE ESTIMATED AS THE CAPACITY OF A 10' C.O. INLET UNDER 9" DE HEAD.

FROM CHART 1-6 REF #4 (SUMP INLET)

$$h = 0.5 \quad H/h = 9/6 = 1.5 \quad \Rightarrow \quad Q/L = 1.75 \quad \Rightarrow \quad Q = 1.75(10) = \underline{17.5}$$



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ORIFICE ANALYSIS

IN ORDER TO CALCULATE THE REQUIRED ORIFICE SIZES NEEDED TO MAINTAIN THE DESIRED RELEASE RATES, IT IS NECESSARY TO FIRST CALCULATE THE HEAD FROM TANK TO OUTFALL. METHOD AS DESCRIBED IN REFERENCE #3 WILL BE USED.

STARTING AT EXISTING OUTLET (48" DIAM RCP) WEST OF TOWER RD

SEE PROFILE A-A PG 31

FIND h_L , (PIPE LOSS, 48" RCP 50 L.F.)

$Q = \text{TOTAL HISTORIC FLOWS} = 245.9 \text{ CFS (SEE PG. 17)}$

48" PIPE FLOWING FULL: $A = \pi r^2 = 12.57 \text{ ft}^2$
 $P = 2\pi r = 12.57 \text{ ft}$
 $R = A/P = 1.0$

$V = Q/A = 245.9 / 12.57 = 19.56 \text{ FPS}$

SINCE PIPE IS FLOWING FULL, $h_L = \text{MANNING'S SLOPE} \times L$ (REF #6 PG. 1)

$$S = \left(\frac{Q n}{1.49 A R^{2/3}} \right)^2 = \left(\frac{245.9 (0.13)}{1.49 (12.57)^{2/3}} \right)^2 = .0291$$

$$h_L = .0291 (50') = 1.46'$$

$$H.G.L. = 16.3 + 1.46 = 17.76$$



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Scale _____ Sht. 20 of _____

FIND h_{L2} (LOSS THROUGH 10' JACKET)

REF #3 FIGURE B-8 $Q_4/Q_0 = \frac{228.4}{245.9} = .93$ $Q_6/Q_0 = 0.07$

$$K_{EST} = 3 Q_6/Q_0 = 3(.07) = .21 \quad h_{L2} = K_{EST} \frac{V^2}{2g} = .21 \left(\frac{19.56^2}{64.4} \right) = 1.25'$$

$$d_{EST} = 17.76 - 13.46 + 1.25 = 5.55'$$

$$d/D_0 = 5.55/4 = 1.39$$

$$K_{L4} = .38 + .02 - .1 = 0.30$$

MAY BE REDUCED BY .1 PER
REF #3 B.4.6

$$h_{L2} = K_{L4} \frac{V_0^2}{2g} = .3 \left(\frac{19.56^2}{64.4} \right) = 1.78'$$

$$H.G.L. = 17.76 + 1.78 = 19.54$$

FIND h_{L3} (PIPE LOSS, 48" RCP 88 L.F.)

$$Q = 228.4 \text{ CFS} \quad V = Q/A = 228.4/12.57 = 18.17 \text{ FPS}$$

h_L = MANNINGS SLOPE $\times L$

$$S = \left(\frac{Q_4}{1.49 AR^{2/3}} \right)^2 = \left(\frac{228.4(.013)}{1.49(12.57)(1^{2/3})} \right)^2 = .025$$

$$h_{L3} = .025(88) = 2.21'$$

$$H.G.L. = 19.54 + 2.21 = 21.75$$

FIND h_{L4} (LOSS THROUGH 8' INLET)

REF #3 FIGURE B-8 $Q_4/Q_0 = 207.4/228.4 = 0.91$ $Q_6/Q_0 = 0.09$

$$K_{EST} = 3 Q_6/Q_0 = 3(.09) = .27 \quad h_{L4} = K_{EST} \frac{V_0^2}{2g} = .27 \left(\frac{18.17^2}{64.4} \right) = 1.38'$$

$$d_{EST} = 21.75 - 15.45 + 1.38 = 7.68$$

$$d/D_0 = 7.68/4 = 1.92$$

$$K_{L4} = .41 + .05 - .10 = 0.36$$

MAY BE REDUCED BY .10 P
REF #3, B.4.6

$$h_{L4} = K_{L4} \frac{V_0^2}{2g} = 0.36 \left(\frac{18.17^2}{64.4} \right) = 1.85'$$

$$H.G.L. = 21.75 + 1.85 = 23.60$$



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Scale _____ Sht. 21 of _____

FIND h_{L5} (PIPE LOSS, 48" RCP)

$$Q = 207.4 \text{ CFS}$$

$$S = \left(\frac{207.4 (0.013)}{1.49 (12.57) (1.49)} \right)^2 = 0.0207$$

$$h_{L5} = 0.0207 (5') = 0.10'$$

$$H.G.L. = 23.60 + 0.10 = 23.70$$

FIND h_{L6} (LOSS AT JUNCTION OF BOTH EXISTING 48" AND PROPOSED 50" RCP)

REF #3 FIG B-15 WITH DEFLECTION ANGLE OF 45° , $K = 0.40$

h_{L6} WILL BE EQUAL TO THE SUMMATION OF THE HEADLOSSES FOR EACH OF THE INDIVIDUAL BRANCHES.

$$h_{L6} = .91' \text{ (SEE FOLLOWING PAGE)}$$

$$H.G.L. = 23.70 + .91 = 24.61$$

FIND h_{L7} (PIPE LOSS, 40" RCP)

$$Q = 119.0 + 12.8 = 131.8 \text{ CFS} = \text{EXIST 48" + DET \#2 RELEASE}$$

$$S = \left(\frac{131.8 (0.013)}{1.49 (12.57) (1.0^{3/4})} \right)^2 = .0091$$

$$h_{L7} = 0.0091 (10) = .09'$$

$$H.G.L. = 24.61 + .09 = 24.70$$

FIND h_{L8} (LOSS THROUGH EXISTING 6' DIAM. MH)

FROM REF #3 FIG B-15 FOR A DEFLECTION ANGLE OF 45° $K_B = 0.40$

$$V = Q/A = 131.8 / 12.57 = 10.49 \text{ FPS}$$

$$h_{L8} = K_B \frac{V^2}{2g} = (0.4) \frac{10.49^2}{64.4} = .68'$$

$$H.G.L. = 24.70 + .68 = 25.38$$



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Scale _____ Sht. 21A of _____

FIND h_{L6} (CONTINUED)

h_{L6A} = HEADLOSS PROFILE A-A

$$V = Q/A = 131.8/12.57 = 10.49 \text{ FPS}$$

$$h_{L6A} = K \frac{V^2}{2g} = 0.4 \left(\frac{10.49^2}{64.4} \right) = .68'$$

h_{L6B} = HEADLOSS PROFILE C-C

$$V = Q/A = 55.3/12.57 = 4.40 \text{ FPS}$$

$$h_{L6B} = K \frac{V^2}{2g} = .4 \left(\frac{4.40^2}{64.4} \right) = .12$$

h_{L6C} = HEADLOSS PROFILE E-E

$$V = Q/A = 20.3/4.909 = 4.13 \text{ FPS}$$

$$h_{L6C} = K \frac{V^2}{2g} = 0.4 \left(\frac{4.13^2}{64.4} \right) = .11'$$

$$h_{L6} = h_{L6A} + h_{L6B} + h_{L6C} = .68 + .12 + .11 = \underline{\underline{.91'}}$$



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FIND h_{L9} (PIPE LOSS, 48" RCP 200 I.F.)

$$Q = 131.8 \quad h_L = \text{MANNINGS SLOPE} \times L$$

$$S = \left(\frac{131.8 (1.49)}{1.49 (12.57) (1.0^{2/3})} \right)^2 = 0.0091$$

$$h_{L9} = 0.0091 (200) = 1.82' \quad \text{H.G.L.} = 25.38 + 1.82 = 27.20$$

FIND h_{L10} (LOSS THROUGH MV)

$$V = Q/A = 131.8 / 12.57 = 10.49 \text{ FPS}$$

FROM REF #3, VOL 1, FIG B-9

$$Q_u/Q_o = 119/131.8 = 0.90 \quad D_u/D_o = 1.0 \quad K_u = K_{10} = 0.6$$

$$h_{L10} = K_{10} \frac{V^2}{2g} = (0.6) \frac{10.49^2}{64.4} = 1.03' \quad \text{H.G.L.} = 27.2 + 1.03 = 28.23$$

FIND h_{L11} (PIPE LOSS, 18" RCP ; SEE PROFILE B-B pg 32)

$$\text{WITH 18" DIAM RCP} \quad A = \pi (1.75)^2 = 9.62 \text{ ft}^2 \quad P = 2\pi (1.75) = 11.0 \text{ ft} \quad R = \frac{A}{P} = 0.87$$

$$Q = 12.8 \text{ CFS} = \text{RELEASE FROM DET \#2}$$

$$S = \left(\frac{12.8 (1.49)}{1.49 (1.77) (0.87^{2/3})} \right)^2 = 0.0261$$

$$h_{L11} = 0.0261 (118) = 3.08' \quad \text{H.G.L.} = 28.23 + 3.08 = 31.31$$

FIND h_{L12} (REQUIRED) (ENTRANCE LOSS)

THE FLOWRATE FROM SUBSURFACE DET #2 MUST BE LIMITED TO 12.8 CFS AND HEADLOSS AT THE OUTLET OF THE TANK MUST BE AS FOLLOWS:

$$h_{L12} (\text{REQ}) = \text{PONDING ELEV.} - \text{H.G.L. ELEV OUTSIDE OF TANK} \\ = 5636.5 - 5631.31 = 5.19'$$

$$\text{WITH NORMAL ENTRANCE} \quad V = Q/A = 12.8 / 9.62 = 1.33 \text{ FPS}$$

$$h_L = 0.5 \frac{1.33^2}{64.4} = 0.017' \quad \therefore \text{ORIFICE MUST BE USED W/ 18" DIAM RCP}$$



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DETERMINE REQ ORIFICE SIZE, DETENTION TANK #2

FROM REF #2 PG. 561 $K_{ORIF} = 0.80$

$$h_L = K_{ORIF} \frac{V_{ORIF}^2}{2g}$$

$$V_{ORIF} = \left(\frac{h_L 2g}{K_{ORIF}} \right)^{1/2} = \left(\frac{5.19 (64.4)}{0.80} \right)^{1/2} = 20.44 \text{ FPS}$$

$$A_{ORIF} = Q/V = \frac{12.8}{20.44} = .626 \text{ ft}^2$$

$$\text{IF ROUND ORIFICE, DIAM} = 2 \left(\frac{.626}{\pi} \right)^{1/2} = 0.893' \approx 10.7" \text{ DIAM}$$

$$\text{IF SQUARE ORIFICE, } 9 \frac{1}{2}" \times 9 \frac{1}{2}"$$



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SEE PROFILE C-C pg 31

FIND h_{L13} (PIPE LOSS)

$$Q = Q_{100} (\text{HISTORIC } \Sigma \text{ SL4+G}) + Q_{100} (\text{REL \#1}) = 45.2 + 10.1 = 55.3 \text{ CFS}$$

$$V = Q/A = 55.3 / 12.57 = 4.40 \text{ FPS}$$

$$S = \left(\frac{55.3 (0.013)}{1.49 (12.57)^{2/3}} \right)^2 = 0.0015$$

$$h_{L13} = L \times S = 12' \times 0.0015 = .02'$$

$$H.G.L. = 24.61 + .02 = 24.63$$

FIND h_{L14} (REQUIRED) ENTRANCE LOSS

THE FLOWRATE FROM SUBSURFACE DET #1 MUST BE LIMITED TO 55.3 THEREFORE THE HEADLOSS AT THE OUTLET OF THE TANK MUST BE AS FOLLOWS:

$$H = \text{EL } 5626.5 - \text{EL } 5624.63 = 1.87'$$

DETERMINE REQ ORIFICE SIZE DETENTION TANK #1

FROM REF #2 pg 561 $K_{ORIF} = 0.80$ (SHORT TUBE)

$$V_{ORIF} = \left(\frac{h_{L14} \times 2g}{K_{ORIF}} \right)^{1/2} = \left(\frac{1.87 (64.4)}{0.80} \right)^{1/2} = 12.27 \text{ FPS}$$

$$A_{ORIF} = Q/V = 55.3 / 12.27 = 4.507 \text{ ft}^2$$

$$\text{IF ROUND ORIFICE, DIAM} = 2 \left(\frac{4.507}{\pi} \right)^{1/2} = 2.40 \text{ ft} = 28 \frac{3}{4}'' \text{ DIAM}$$

IF RECTANGULAR ORIFICE, SEE NEXT PAGE.



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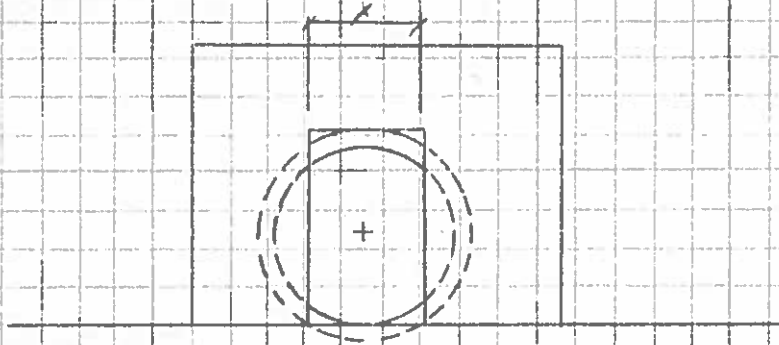
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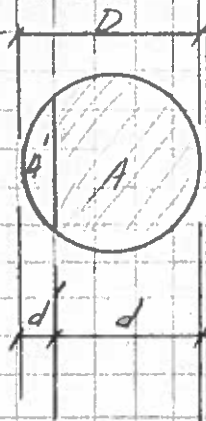
Scale _____ Sht. 25 of _____

FIND REQUIRED ORIFICE OPENING FOR DETENTION TANK #1

REQUIRED AREA = 4.507 ft^2



FROM DESIGN OF SMALL ORIFICES TABLE B-3 PG. 559



$$\text{AREA OF 48" RCP} = \pi r^2 = \pi 2^2 = 12.566 \text{ ft}^2$$

$$A' = \frac{12.566 - 4.507}{2} = 4.030 \text{ ft}^2 = 580.25 \text{ in}^2$$

$$A = \pi (24^2) - 580.25 = 1229.3 \text{ in}^2$$

$$A/D^2 = \frac{1229.3 \text{ in}^2}{48^2} = .533$$

$$d/D = .644$$

$$d = 48(.644) = 30.91 \text{ in}$$

$$X = D - 2(d')$$

$$d' = 48 - 30.91 = 17.09$$

$$X = 48 - 2(17.09) = 13.82$$

∴ MAKE OPENING 48" X 13.82"



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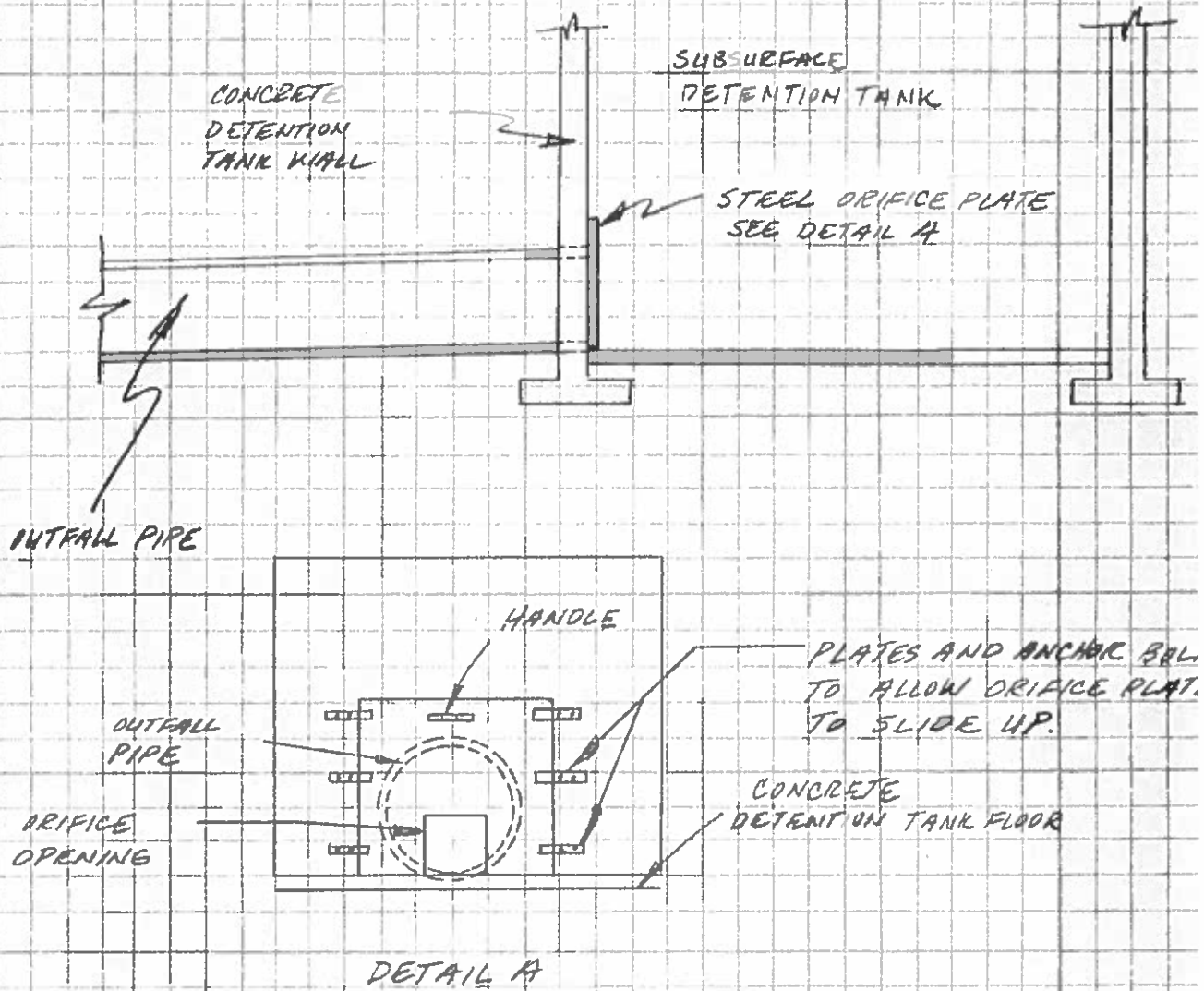
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TYPICAL ORIFICE DETAIL



DETENTION #1

ORIFICE OPENING = $48" \times 13 \frac{7}{8}"$
OUTFALL PIPE DIAM = $48"$

DETENTION #2

ORIFICE OPENING = $9 \frac{1}{2}" \times 9 \frac{1}{2}"$
OUTFALL PIPE DIAM = $18"$



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CHECK CAPACITY OF 30" STORM PIPE FROM OFFSITE AREA F

$$Q_{100} = 20.3 \text{ CFS}$$

MINIMUM SLOPE = 1.00%

$$\begin{aligned} 30" \text{ RCP FLOWING FULL : } A &= \pi 1.25^2 = 4.909 \text{ ft}^2 \\ P &= 2\pi 1.25 = 7.854 \text{ ft} \\ R &= A/P = 4.909/7.854 = .625 \end{aligned}$$

$$\text{CAPACITY } Q = \frac{1.49}{n} A R^{2/3} S^{1/2} = \frac{1.49}{.013} (4.909) (.625^{2/3}) (.01^{1/2}) = 41.1 \text{ CFS}$$

41.1 > 20.3 THE CAPACITY OF THE 30" RCP IS MUCH GREATER THAN SEEMS NECESSARY, BUT WILL BE REQUIRED TO REDUCE HEADLOSS SO THE INLET END WILL HAVE SUFFICIENT HEAD.

CHECK H.G.L. ALONG 30" RCP SEE PROFILE E-E

FIND h_{L15} (PIPE LOSS, 30" PIPE 10.0 L.F.)

PIPE IS UNDER PRESSURE, $\therefore h_L = \text{MANNING'S SLOPE} \times L$

$$Q = 20.3 \text{ CFS}$$

$$S = \left(\frac{Qn}{1.49 A R^{2/3}} \right)^2 = \left(\frac{20.3(.013)}{1.49(4.909)(.625^{2/3})} \right)^2 = .0024$$

$$h_{L15} = .0024(10) = .02'$$

$$\text{H.G.L.} = 24.61 + .02 = 24.63$$



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Scale _____ Sht. 28 of _____

FIND h_{L16} (LOSS THROUGH 6' DIAM MH)

FROM REF #3 FIG B-15 FOR A DEFLECTION ANGLE OF 45°, $K = 0.40$

$$V = Q/A = 203/4.91 = 4.13 \text{ FPS}$$

$$h_{L16} = K \frac{V^2}{2g} = 0.4 \left(\frac{4.13^2}{64.4} \right) = .11' \quad \text{H.G.L.} = 24.63 + .11 = 24.74$$

FIND h_{L17} (PIPE LOSS 30" RCP 90.27 L.F.)

$$Q = 20.3 \text{ CFS}$$

$$S = \left(\frac{20.3(.013)}{1.49(4.91)(1.625^{2/3})} \right)^2 = .0024$$

$$h_{L17} = .0024(90.27) = .22'$$

$$\text{H.G.L.} = 24.74 + .22 = 24.96$$

FIND h_{L18} (LOSS THROUGH 4' MANHOLE)

$$V = Q/A = 203/4.91 = 4.13 \text{ FPS}$$

FROM REF #3 FIGURE B-7 FOR FLOW STRAIGHT THROUGH ANY MANHOLE $K = .05$

$$h_{L18} = K \frac{V^2}{2g} = .05 \left(\frac{4.13^2}{64.4} \right) = .01'$$

$$\text{H.G.L.} = 24.96 + .01 = 25.02$$

FIND h_{L19} (PIPE LOSS 30" RCP 20 L.F.)

$$S = .0024$$

$$h_{L19} = .0024(20) = .05'$$

$$\text{H.G.L.} = 24.97 + .05 = 25.02$$



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Project 7 HILLS PLAZA W.O. 0017

Title STORM SEWER DESIGN

By D.A.L. date _____ Checked _____ date _____

Scale _____ Shl. 29 of _____

FIND h_{L20}

ENTRANCE LOSS

REF # 6 PG 112 $K = 0.5$

$$h_{L20} = K \frac{V^2}{2g} = 0.5 \left(\frac{4.73^2}{29} \right) = .13' \quad H.G.L. = 25.02 + .13 = 25.15$$

NOTE: THE HYDRAULIC GRADE LINE AT THE ENTRANCE IS AT ELEV 5625.15 AND THE EXISTING GROUND IS APPROXIMATELY 5626. THEREFORE, THE BERM WHICH FOLLOWS THE N. BOUNDARY NEAR THE N.W. CORNER OF THE SITE MUST TURN NORTHWARD AT THE R.O.W. OF TOWER ROAD AND THE MINIMUM ELEVATION OF THE TOP OF BERM MUST BE $5625.15 + 1.0 = 5626.2$



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Title STORM SEWER DESIGN

By D.A.L. date _____ Checked _____ date _____

Scale _____ Sht. 30 of _____

COMMENTS ON H.G.L.

MANHOLES #1 & #2 ARE 6' DIAM MANHOLES AND THE H.G.L. FOR EACH IS ABOVE THE RIM ELEVATIONS. THEREFORE, BOTH MANHOLES MUST BE SUPPLIED WITH "WATERTIGHT MANHOLE FRAMES AND BOLTED LIDS" (NEENAH R1916-D OR EQUIVALENT).

SIMILARLY, THE INLETS INTO DETENTION TANKS MUST ALSO BE EQUIPPED WITH BOLTED LIDS SO THAT THEY WILL NOT BE SEPARATED FROM THEIR FRAMES BY WATER PRESSURE, OR VANDALISM.

THE H.G.L. AT EXISTING 6' MANHOLE ALSO IS ABOVE THE EXISTING RIM ELEVATION OF 5623.16. THIS RIM MUST ALSO BE REPLACED WITH A WATERTIGHT MANHOLE FRAME AND BOLTED LID, IF NOT SO ALREADY.

FLOWLINES OF 10" Ø 10' D.O. INLETS ARE ABOVE THE H.G.L.



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Title STORM SEWER DESIGN

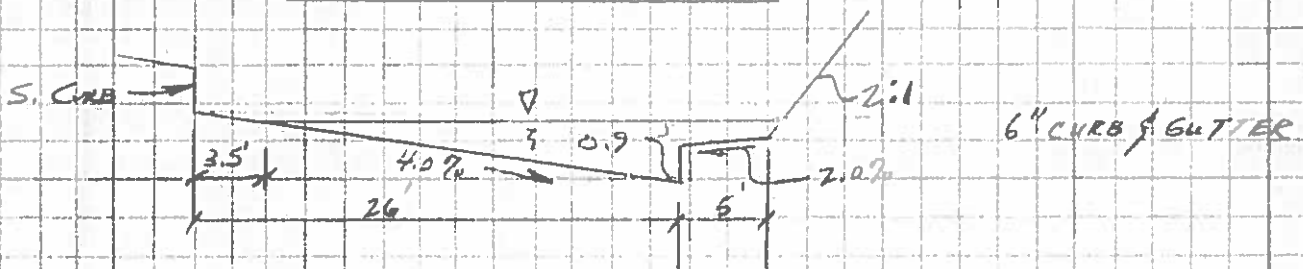
By D. A. L. date _____ Checked _____ date _____

Scale _____ Sht. 33 of _____

CHECK STREET CAPACITY

HISTORIC FLOWS FROM AREAS Σ SL4 + G WILL BE ROUTED TO THE UNDERGROUND DETENTION TANK AT THE N.W. CORNER OF THE SITE STRICTLY BY SURFACE DRAINAGE. THIS SURFACE DRAINAGE WILL FLOW THROUGH THE DRIVE WHICH PARALLELS THE N. BOUNDARY. ALSO FLOWING THROUGH DRIVE WILL BE THE 100 YR DEVELOPED FLOWS FROM AREA A. THE CROSS-SLOPE OF THE DRIVE WILL TYPICALLY BE 4% AND THE MINIMUM LONGITUDINAL SLOPE IS 1.5%.

TYPICAL CROSS-SECTION



CHECK STREET CAPACITY IF WATER ELEVATION IS BELOW BOTTOM OF CURB ON S. SIDE OF STREET.

$$A = \frac{1}{2}(25)(1.0) + \frac{.4 + .3}{2}(5) = 11.88 \text{ ft}^2$$

$$P = 25 + 1.5 + 5 + .6 = 28.6$$

$$R = A/P = 11.88/28.6 = .415$$

$$S = 1.5\%$$

$$n = .013$$

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} = \frac{1.49}{.013} (11.88) (.415)^{2/3} (.015)^{1/2} = 92.7 \text{ CFS}$$

THE MAXIMUM FLOW THROUGH STREET = $A + \Sigma$ SL4 + G

$$= 38.3 + 45.2 = 83.5 \text{ CFS}$$

$83.5 < 92.7$ THEREFORE STREET WILL EASILY CARRY THESE FLOWS.



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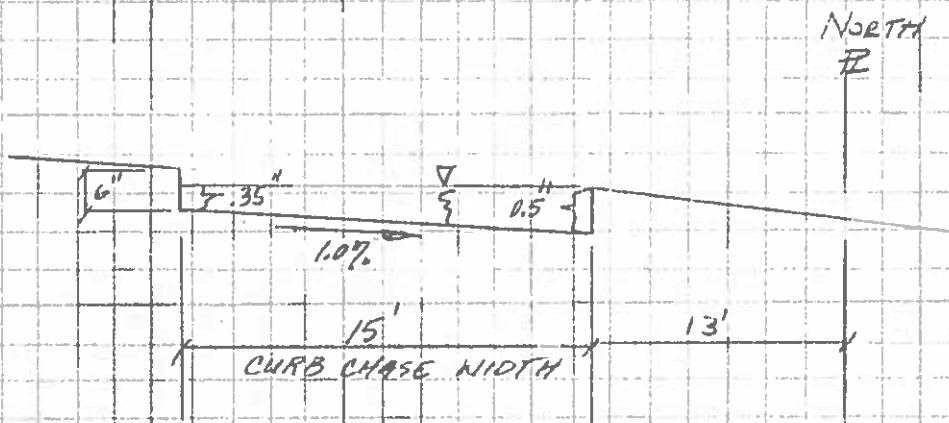
Title STORM DRAIN DESIGN

By D.A.L. date _____ Checked _____ date _____

Scale _____ Sht. 34 of _____

FIND REQUIRED CURB CHASE OPENING SIZE AT NE CORNER OF SITE.

$$Q_{100} = 45.3 \text{ CFS}$$



LONGITUDINAL SLOPE $\cong 2.5\%$

$$A = \frac{.35 + .5}{2} (15) = 6.375 \text{ ft}^2$$

$$P = .35 + .5 + 15 = 15.85 \text{ ft}$$

$$R = A/P = 6.375/15.85 = .402$$

$$Q = \frac{1.49}{.013} (A) (R^{2/3}) (S^{1/2}) = \frac{1.49}{.013} (6.375) (.402^{2/3}) (.025^{1/2}) = 62.9 \text{ CFS}$$

$62.9 > 45.3 \therefore$ USE 15' WIDE CURB CHASE OPENING.

36.0

34

36

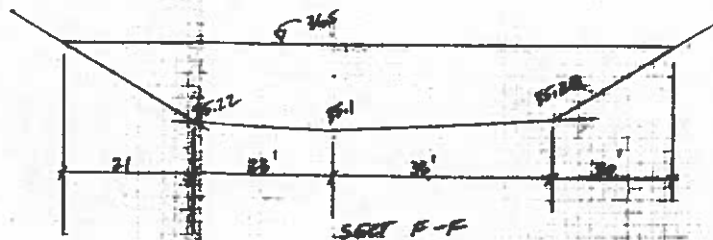
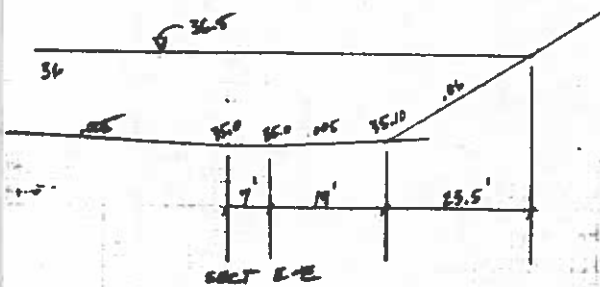
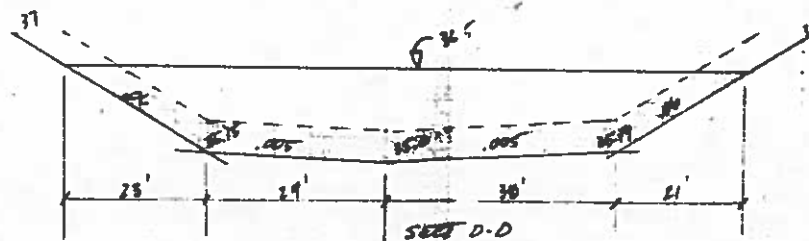
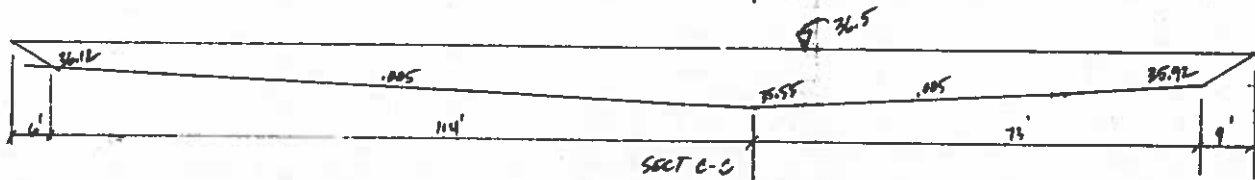
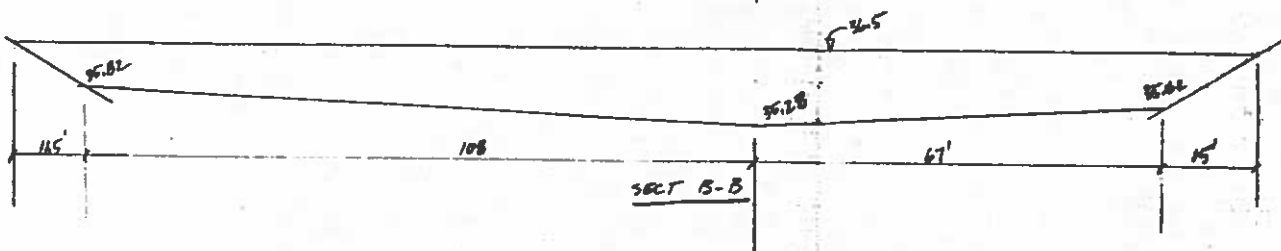
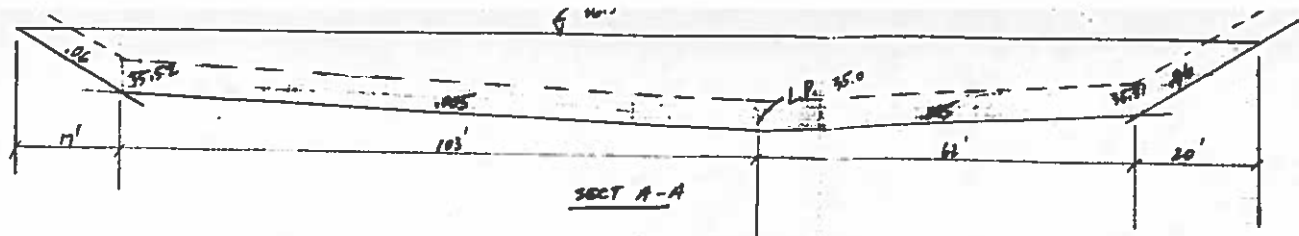
34

36

34

36

34

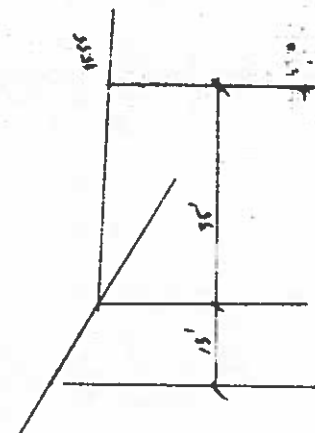


1" = 20' HORIZ
1" = 2' VERT

SECTIONS OF
DETENTION #2

D.R. 1/22/84

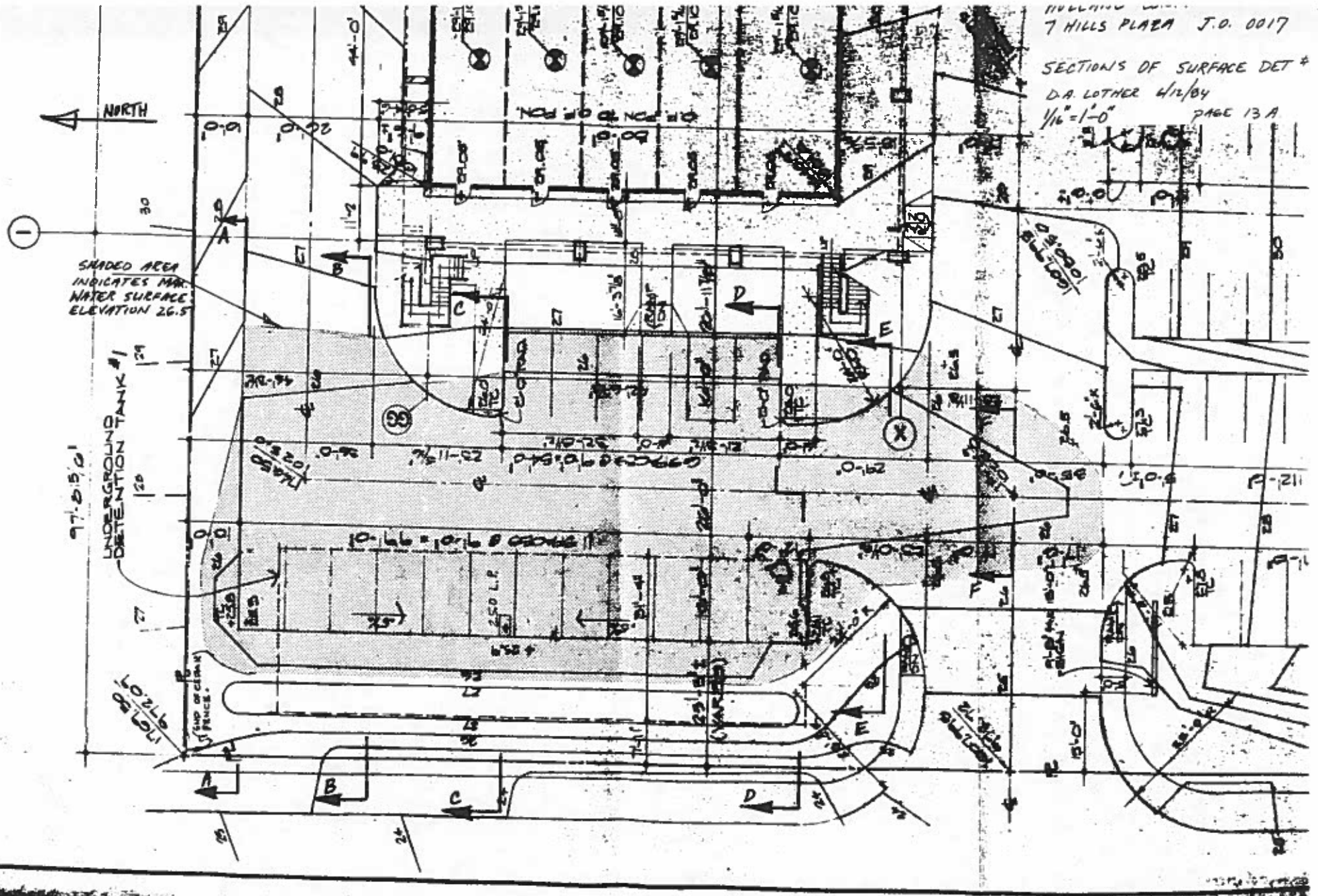
SH 15 OF

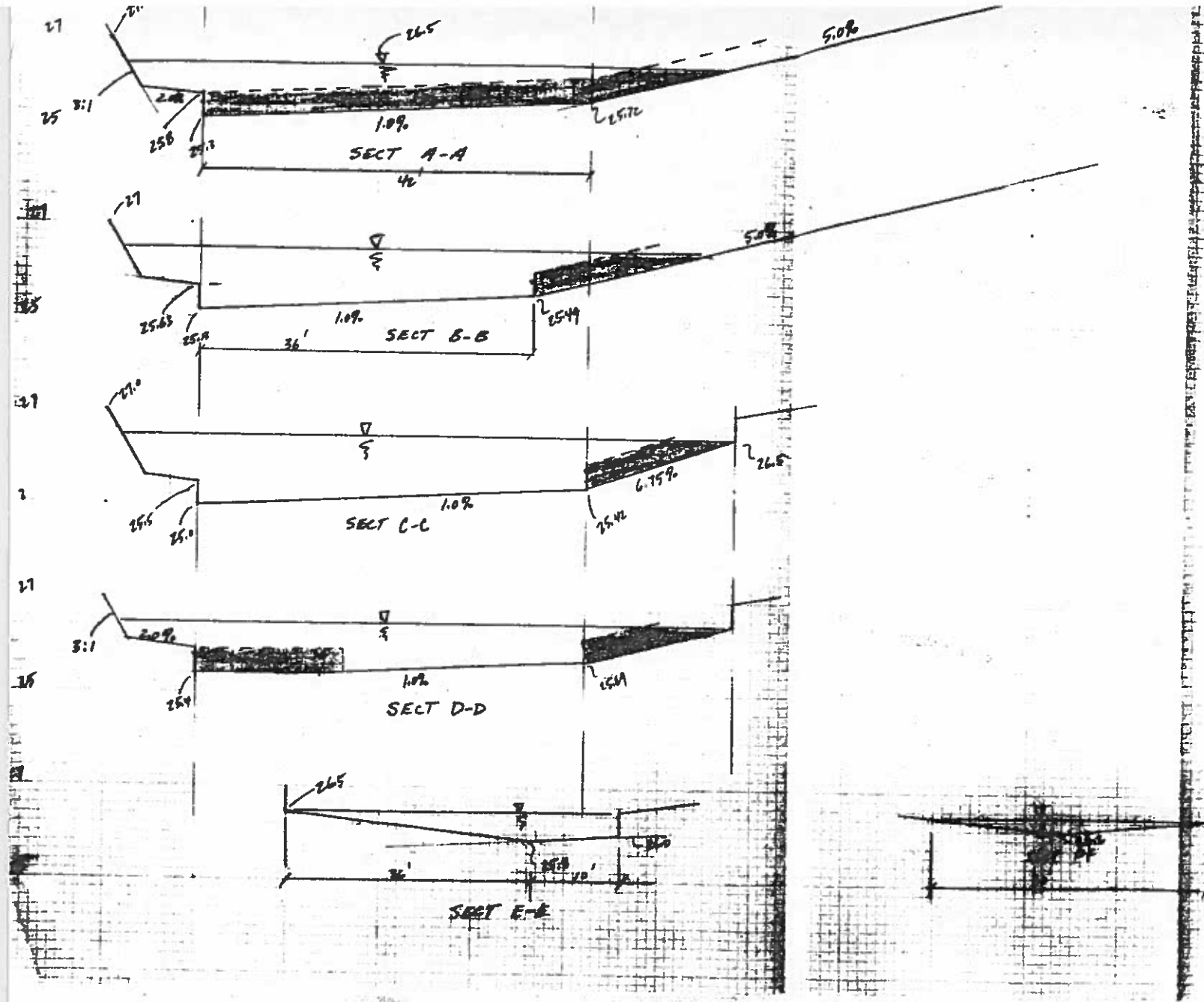


NOTE: SEE SHEET 1 OF
DRAINAGE PLAN FOR
SECTIONS.

7 HILLS PLAZA J.O. 0017

SECTIONS OF SURFACE DET #
D.A. LOTHER 4/12/84
1/16" = 1'-0" PAGE 13A





NOTE: SEE SHEET 13A FOR
PLAN VIEW OF
SECTIONS.

1" = 10' HORIZ
1" = 2' VERT

SECTIONS OF SURFACE
DET #1

7 HILLS ROAD
D.R. LUTHER 6/6/84



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Project 7 HILLS PLAZA W.O. 0017

Title INLETS TO DET. TANKS

By D. A. L. date _____ Checked _____ date _____

Scale _____ Sht. 35 of _____

INLET SIZING

DETENTION #1

THE DETENTION TANKS MUST HAVE INLETS THROUGH THEIR ROOFS WHICH WILL PASS THE 100 YR DEVELOPED FLOWS INTO THE TANKS.

DETENTION TANK #1 MUST PASS THE HISTORIC FLOWS FROM DEASTE AREAS Σ SL4 + G AND Q_{100} (DEV. Σ A + B) -

$$Q_{100} = 45.2 + 50.5 = 95.7 \text{ CFS}$$

AT PONDING DEPTH $h = 1.5$ FT, EACH SECTION OF 2 FT GRATE WILL ACCEPT 10.6 CFS.

$$* \frac{95.7 \text{ CFS}}{10.6 \text{ CFS/SECT}} = 9.03 \text{ SECTIONS} \quad \therefore \text{USE } 10, 2' \times 2' \text{ SECT.}$$

DETENTION #2

$$Q_{100} (\text{REVELOPED AREA C}) = 107.1 \text{ CFS}$$

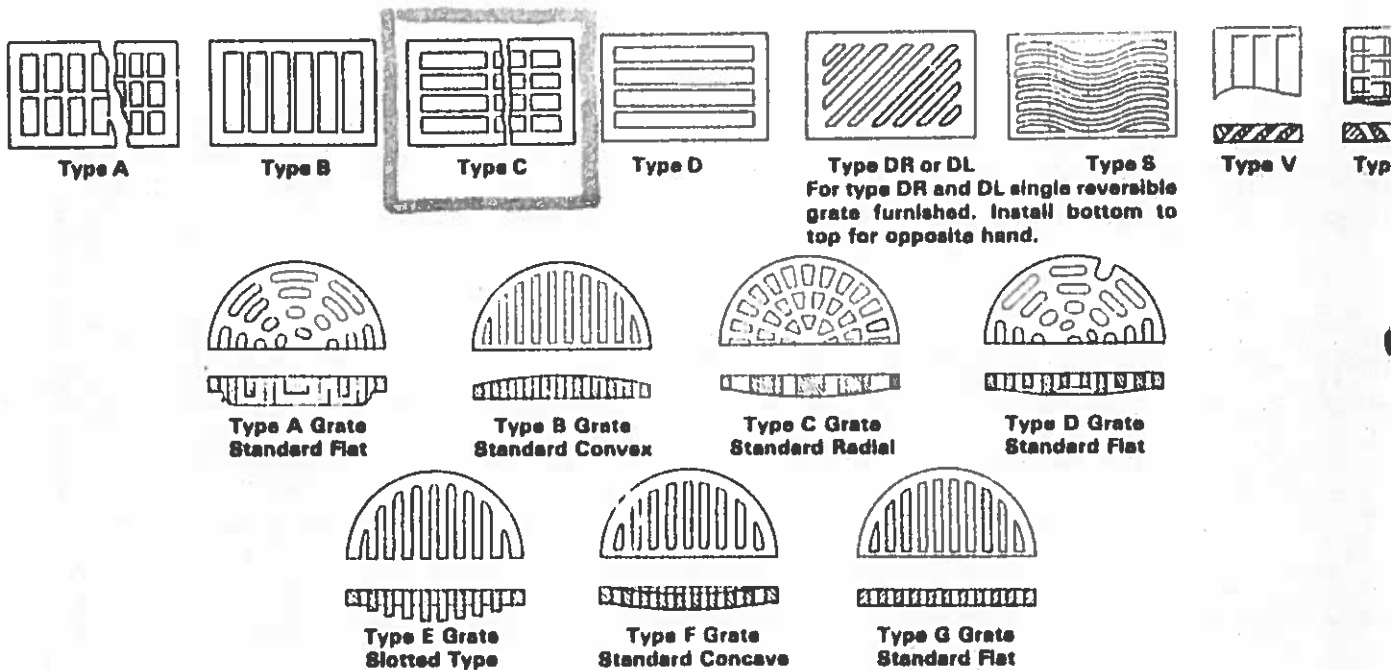
$$* \frac{107.1 \text{ CFS}}{10.6 \text{ CFS/SECT}} = 10.1 \text{ SECTIONS} \quad \therefore \text{USE } 10, 2' \times 2' \text{ SECT.}$$

* NEENAH TYPE C GRATE AND TYPE L FRAME #R7999 HF

INFORMATION ON NEENAH GRATES

The following pages 1 to 20 list the Neenah catalog designs furnished with gates. In addition to the free opening areas which are necessary to determine the discharge, the tables also show the grate type or style which are shown below for easy identification.

Grate Types



Special notes on Neenah grate types.

1. Type K indicates "Special" grate design and is not among standard types as illustrated.
2. Inlet grate type A or C can vary depending on how it is installed. If grate is installed with long side of openings perpendicular to flow, it is a type A grate, and if grate is installed with long side of openings parallel to flow, it is a type C grate.
3. Inlet grate type B or D can vary depending on how it is installed. If grate is installed with long slots perpendicular to flow, it is a type B grate, and if grate is installed with long slots parallel to flow, it is a type D grate.

SH 36 OF 41

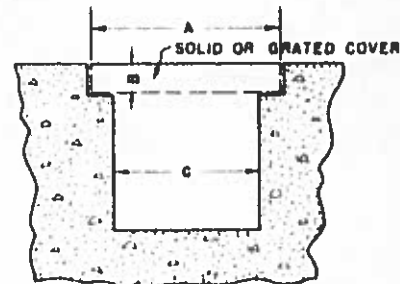
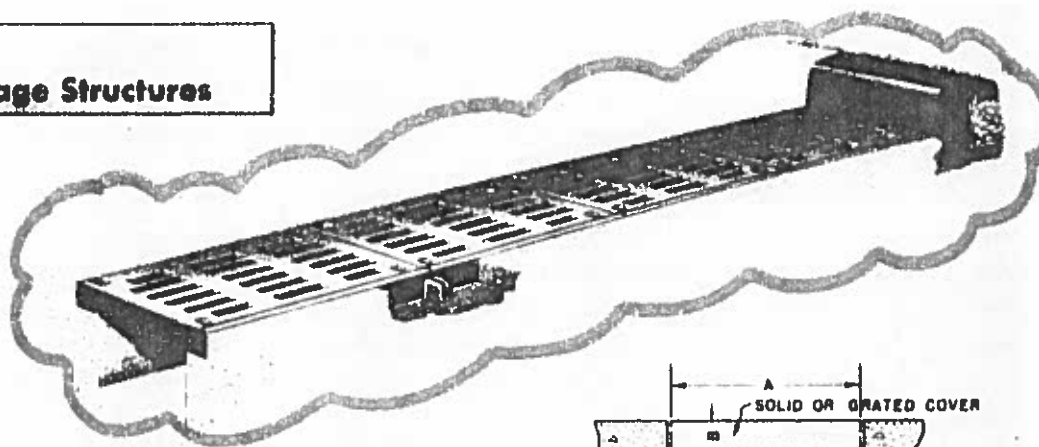
R-4999 Series Flat Transverse Drainage Structures

Heavy Duty — for Highways

Illustrating flat type surface with curb box, showing Type L frame and Type C grate.

Curb box (or curb inlet with adjustable box) and bolted-down covers are optional and are furnished only when specified.

Standard frame sections of this type are manufactured in 36" sections; covers are in 24" sections. When covers are required bolted in place, frames will be furnished in 24" standard lengths.



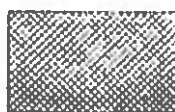
Read Carefully Before Ordering Specify:

1. Complete catalog number.
2. Length of structure from curb face to curb face.
3. Type of frame.
4. Type of cover.
5. Covers bolted to frames when required; bolts are stainless steel.
6. Curb box, inlets or end frame sections and number required per unit.
7. Strip lead gasket when required.
8. Machined bearing surfaces when required.
9. Ductile iron frames and/or Ductile iron covers.
10. If trench drain grates are to be installed in bicycle traffic areas, please advise so that safety standards described on catalog page 89 can be applied.

COVER TYPES



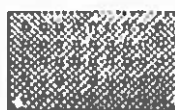
Grated Type A



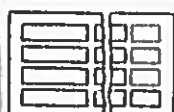
Solid Checkered Type D



Grated Type B



Solid Perforated Type E



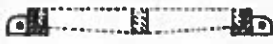
Grated Type C



Solid for Fill Type F

Catalog No.		Dimensions in inches		
Flat	Crowned	A	B	C
R-4999-AF	R-4999-AC	8	1 1/4	6
R-4999-BF	R-4999-BC	10	1 1/4	8
R-4999-CF	R-4999-CC	12	1 1/4	10
R-4999-DF	R-4999-DC	14	2	12
R-4999-EF	R-4999-EC	17	2	15
R-4999-FF	R-4999-FC	20	2	18
R-4999-GF	R-4999-OC	23	2	21
R-4999-HF	R-4999-HC	26	2	24
R-4999-JF	R-4999-JC	30	2 1/4	27
R-4999-KF	R-4999-KC	33	2 1/4	30
R-4999-LF	R-4999-LC	36	2 1/2	33
R-4999-MF	R-4999-MC	39	2 1/2	36
R-4999-NF	R-4999-NC	45	3	42
R-4999-OF	R-4999-OC	51	3	48

FRAME TYPES



TYPE L



TYPE H



TYPE X



TYPE Z

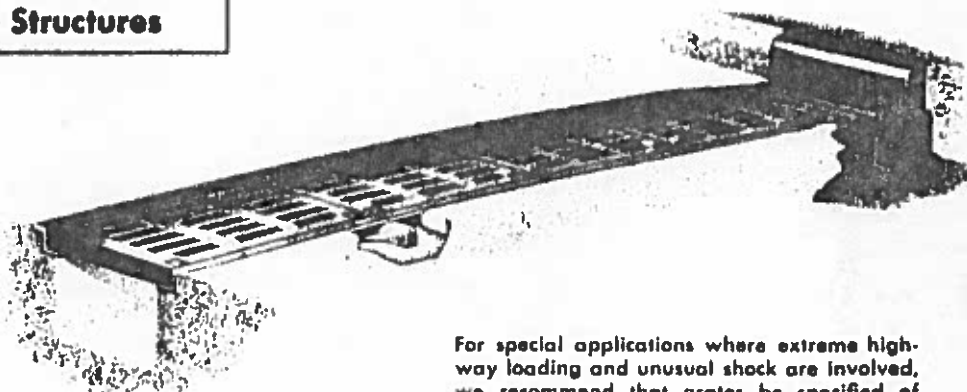
R-4999 Series Crowned Transverse Drainage Structures

Heavy Duty — for Highways

Illustrating crowned roadway surface and Type Z frame, Type C grate, and curb inlet with adjustable box.

Curb inlet (or curb box only) and bolted-down covers are optional and are furnished only when specified.

Frames manufactured in standard 24" sections; grates in 24" sections. Units can be made in any overall length.



For special applications where extreme highway loading and unusual shock are involved, we recommend that grates be specified of Ductile Iron, a new material of high corrosion-resistance but with the strength, toughness, ductility, and wear-resistance of steel. See complete specifications on page 6 or write for further information.

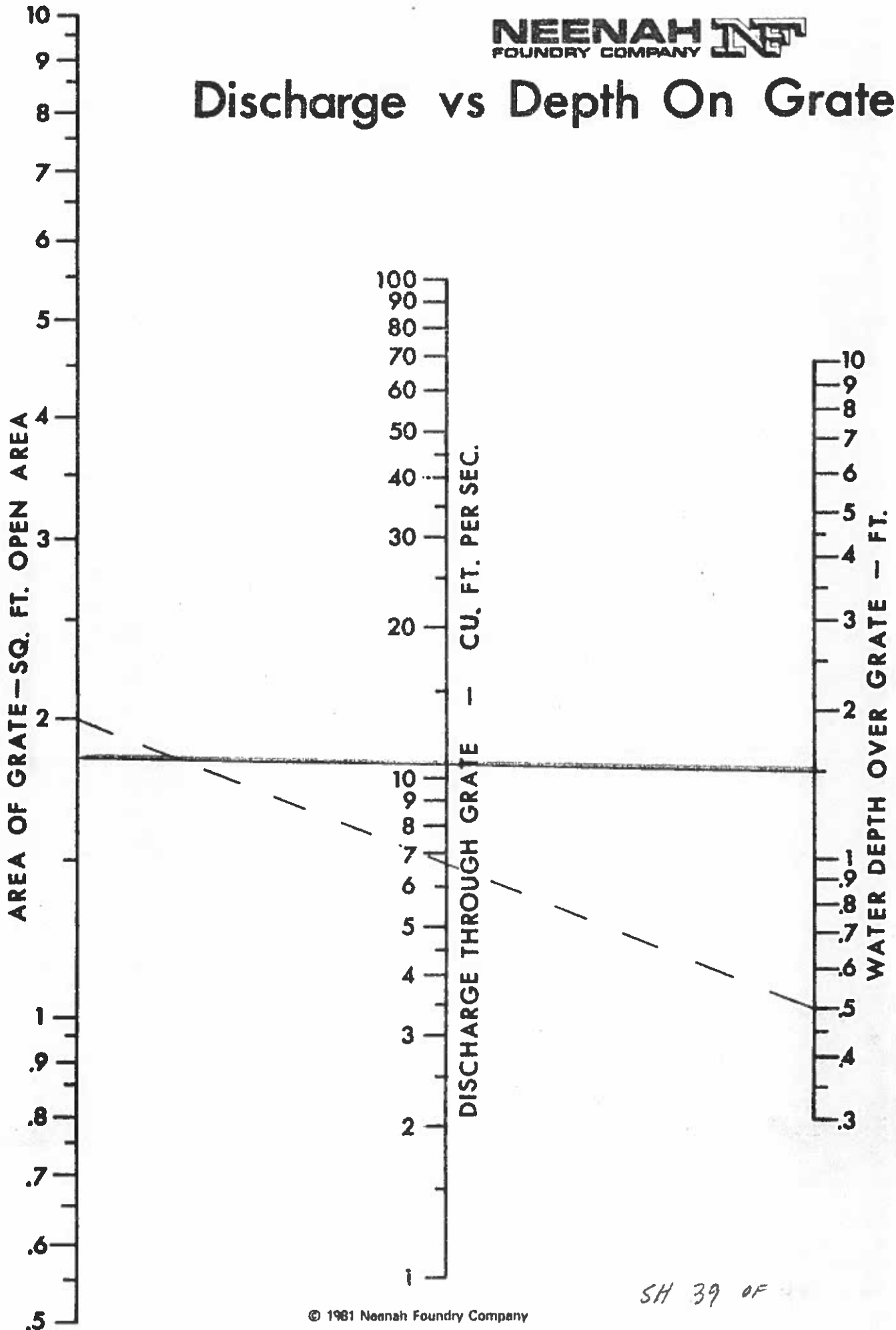
SECTION 8

NEENAH **INT**
 FOUNDRY COMPANY

CATALOG NO.	TYPE	SQ. FT. OPEN PER LIN. FT.
R-4990-A	A	0.2
	B	0.3
	C	0.3
R-4990-B	A	0.3
	B	0.3
	C	0.3
R-4990-C	A	0.3
	B	0.3
	C	0.4
R-4990-D	A	0.4
	B	0.5
	C	0.5
R-4990-E	A	0.6
	B	0.7
	C	0.5
R-4990-F	A	0.6
	B	0.7
	C	0.8
R-4990-G	A	0.7
	B	0.8
	C	0.7
R-4990-H	A	0.8
	B	1.1
	C	0.9
R-4990-J	A	0.8
	B	1.0
	C	1.1
R-4990-K	A	1.1
	B	1.2
	C	0.9
R-4995-A1	B	0.2
	C	0.3
R-4995-A2	B	0.2
R-4996-A1	DIAG BAR CONVEX	0.3
	C	0.3
R-4996-A2	B	0.2
R-4997-A	C	0.3
R-4998	C	0.9

CATALOG NO.	TYPE	SQ. FT. OPEN PER 2 FT. SECTION
R-4999-F	A	1.2
	B	1.4
	C	1.6
R-4999-G	A	1.4
	B	1.6
	C	1.4
R-4999-H	A	1.6
	B	2.2
	C	1.8
R-4999-J	A	1.6
	B	2.0
	C	2.2
R-4999-K	A	2.2
	B	2.4
	C	1.9

Discharge vs Depth On Grate





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Project 7 HILLS PLAZA W.O. 0017
Title RIPRAP DESIGN
By DSS date 4/11/84 Checked _____ date _____
Scale _____ Sht. 40 of _____

RIPRAP

DESIGN PT III $Q = 20.3 \text{ cfs}$

24" RCP @ 1.00%

$$\frac{Q}{D^{1.5}} = \frac{20.3}{(2)^{1.50}} = 2.83$$

$$\frac{V_c}{D} \text{ USE } 0.40$$

\Rightarrow TYPE L RIPRAP $d_{50} = 9"$

$$\frac{Q}{D^{2.5}} = \frac{20.3}{(2)^{2.5}} = 3.60 \quad \frac{1}{(2 \tan \theta)} = 3.90$$

$$A_c = \frac{Q}{V} = \frac{20.3}{7.0} = 2.90$$

$$L = \left(\frac{1}{2 \tan \theta} \right) (A_c / V_c - D) = (3.90) (2.90 / 0.80 - 2.0) = 6.33'$$

USE $L = 6.50'$

$$\text{DEPTH} = 2d_{50} = 2(0.75) = 1.5'$$

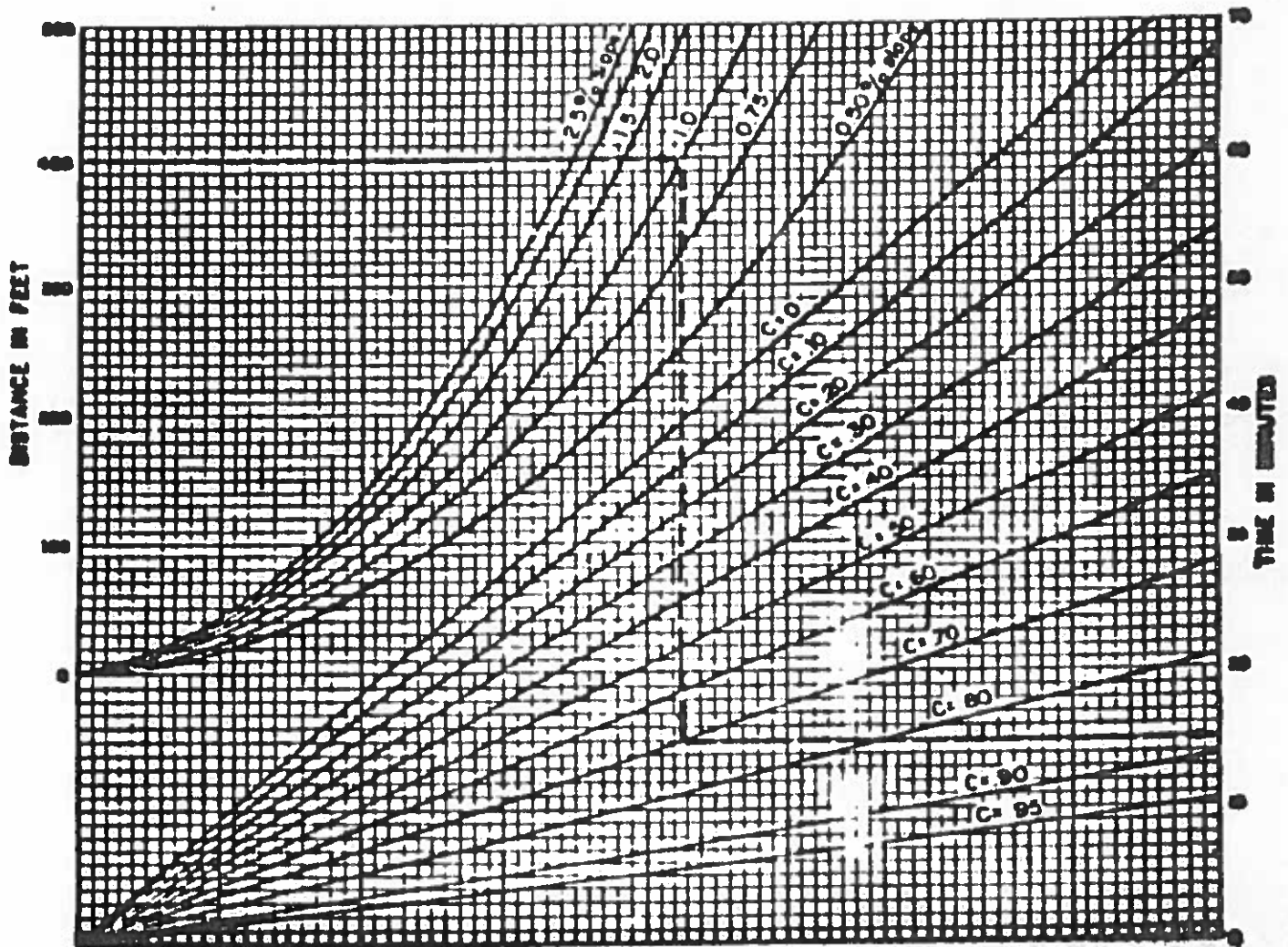
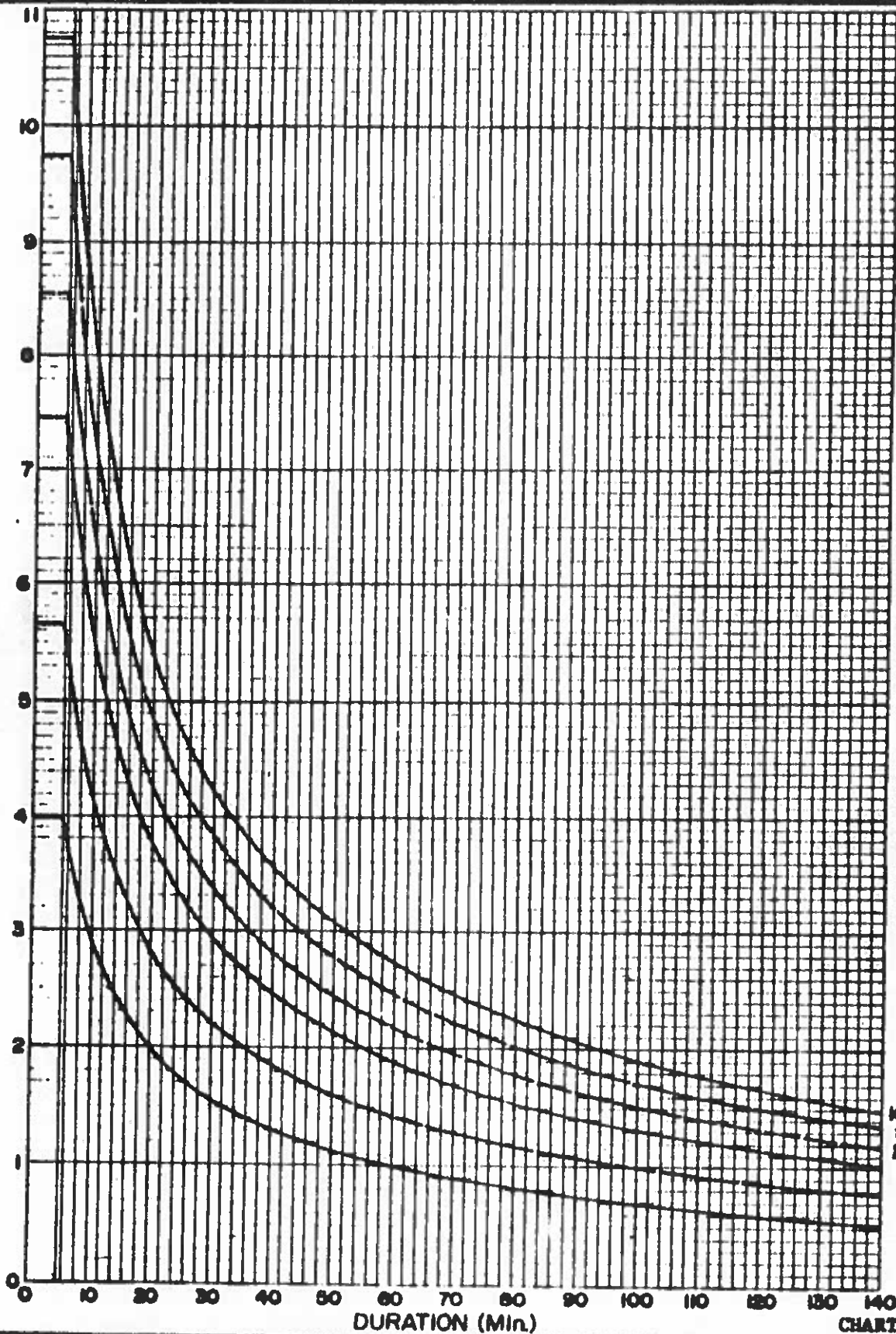


FIGURE 3-1. OVERLAND TIME OF FLOW CURVES(7)

RAINFALL INTENSITY (Inches/Hour)



100 YEAR
50 YEAR
25 YEAR
10 YEAR
5 YEAR
2 YEAR

CHART 1-2

CITY OF AURORA, COLORADO

H. C. Bonde
City Engineer

M. Haggerty
Drawn by
6/18/77

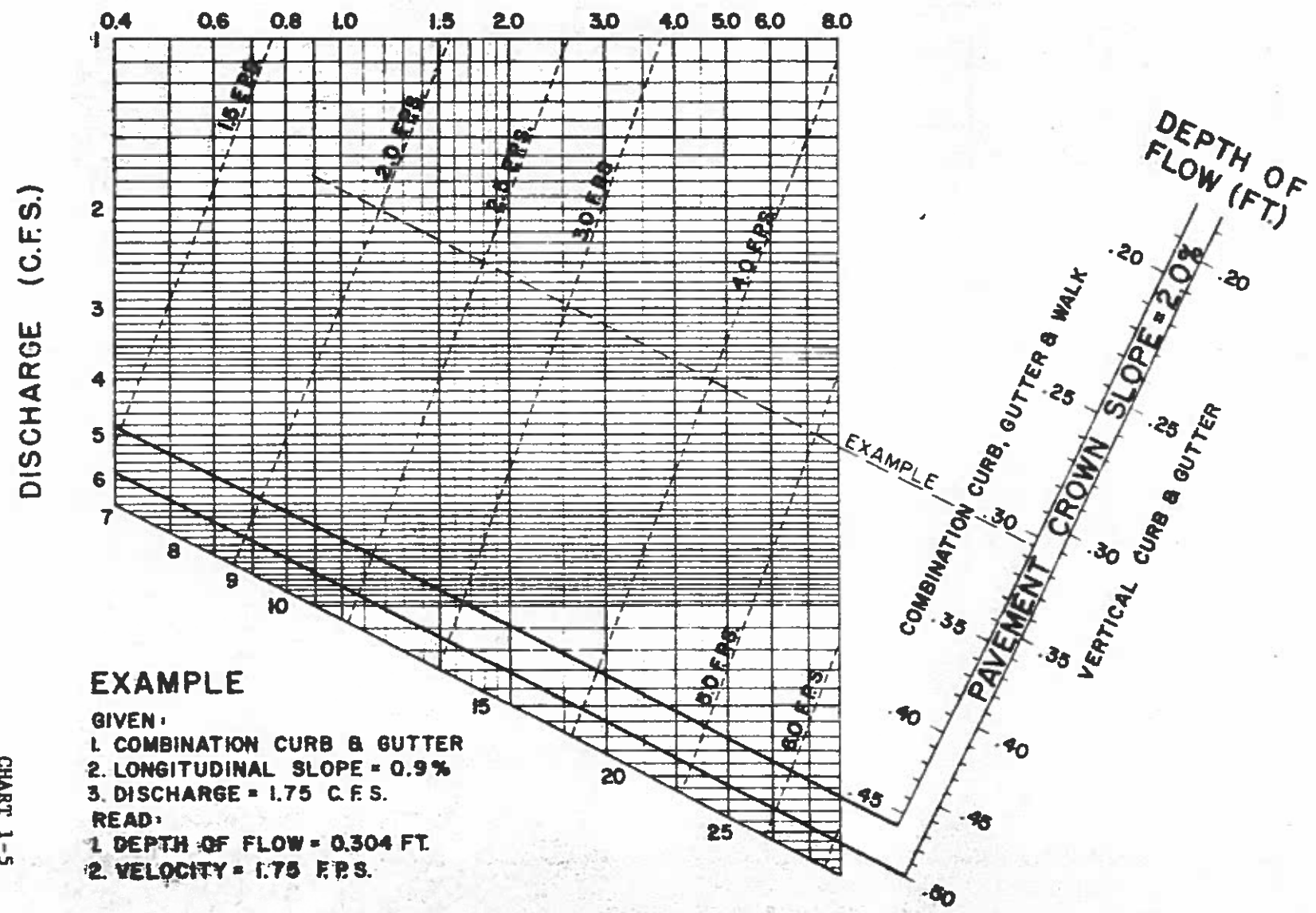
INTENSITY-DURATION-FREQUENCY CURVES

SOUTH OF E ALAMEDA AVE
0-140 MIN.

Sheet 2 of 2

H 42 OF

LONGITUDINAL CURB SLOPE (PERCENT)



EXAMPLE

- GIVEN:**
1. COMBINATION CURB & GUTTER
 2. LONGITUDINAL SLOPE = 0.9%
 3. DISCHARGE = 1.75 C.F.S.
- READ:**
1. DEPTH OF FLOW = 0.304 FT.
 2. VELOCITY = 1.75 F.P.S.

CHART 1-5

CITY OF AURORA, COLORADO

CURB CAPACITY
NOMOGRAPH

H.C. Bonde
City Engineer
Drawn by *GR Jan 21*
2/8/77
Date



HOLLAND CORPORATION
6535 S. DAYTON, SUITE #1600
ENGLEWOOD, COLORADO 80111
(303) 790-1082

Project SEVEN HILLS PLAZA W.O. _____

Title _____

By RAP date 7.5.84 Checked _____ date _____

Scale _____ Sht. 44 of _____

TOWER ROAD INLETS:

THE FOLLOWING CALCULATIONS ARE FOR INLET SIZES TO INTERCEPT FLOWS ALONG TOWER ROAD AND DUMP DIRECTLY INTO THE EXISTING 48" ϕ STORM SEWER LINE. THE INLETS ARE LOCATED ON THE UPHILL SIDE OF THE TWO PRIVATE DRIVES THAT INTERSECT WITH TOWER ROAD, AND INTERCEPT ALL FLOWS BEFORE THEY REACH THE EXISTING 8' C.O. INLET AT THE NORTH END OF THE PROPERTY.

SUBDIVISION _____
 LOCATION _____
 DESIGN STORM 2 YR RECURRENCE INTERVAL
 COMPUTATIONS BY _____ DATE _____
 SUBMITTED BY _____ DATE _____
 (Engineering Firm)

CITY OF AURORA, COLORADO
 STORM DRAINAGE SPECIFICATIONS

RUNOFF COMPUTATIONS
 (Rational Method)

PAGE 45 OF _____

Design Point	Area Designation	A (Acres)	c	c _f	$\bar{c} = (c+c_f)/2$	A· \bar{c}	$\Sigma A \cdot \bar{c}$	t _c (min)	i (in/hr)	Q = ($\Sigma A \cdot \bar{c}$) · i cfs	Slope (S)	Length L (feet)	VEL ^a V (fps)	T (min)	Remarks
	01	0.25	0.95	1.00	0.95	0.24	0.24	5.0	3.7	0.89	3.5%	175'			USE MINIMUM T _c
	02	0.64	0.95	1.00	0.95	0.61	0.61	5.0	3.7	2.26	1.45%	425'			USE MINIMUM T _c

^a These values must be substantiated with additional

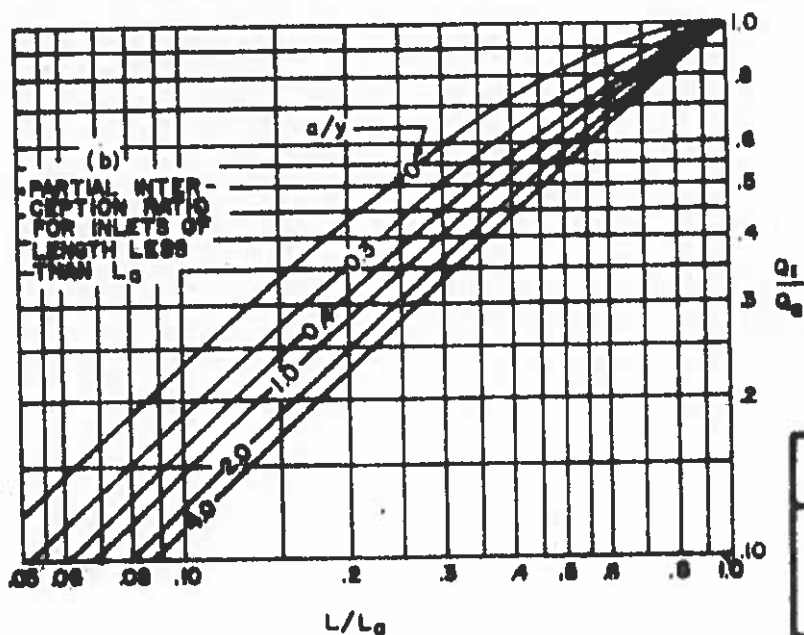
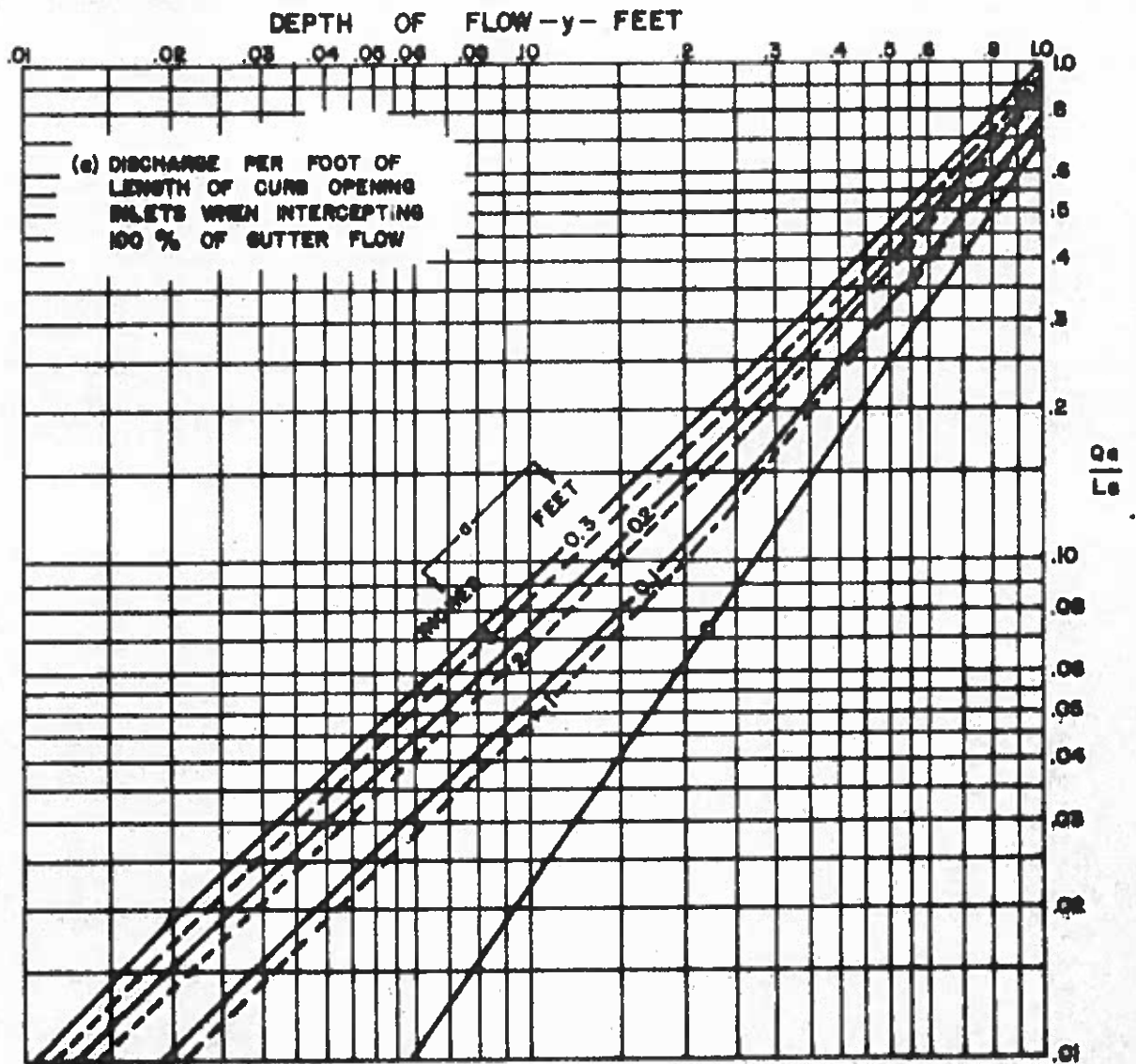


CHART 1-7

CITY OF AURORA, COLORADO

CAPACITY OF CURB OPENING INLETS
ON CONTINUOUS GRADE

102

2-2-72

SH 46

CURB OPENING (INTERCEPTION)

Given: (a) discharge $Q = \underline{0.89}$ CFS
(b) street slope $S = \underline{0.35}$ %
(c) curb type 6" VC or Type 4" Combination
(d) street section =

Solution:

$$Q_a/L_a = 0.18$$

$$L_a = 4.94$$

- (length for total interception)

$$L/L_a =$$

$$a/y = .25/$$

$$Q/Q_a =$$

$$Q = 0.89$$

- CFS (Intercepted)

$$Q_c =$$

- CFS (carryover to inlet)

CURB OPENING (INTERCEPTION)

Given: (a) discharge $Q = \underline{2.26}$ CFS
(b) street slope $S = \underline{0.045}$ %
(c) curb type 6" VC or Type 4" Combination
(d) street section =

Solution:

$$Q_a/L_a = 0.18$$

$$L_a = 12.56 \quad = \quad \text{(length for total interception)}$$

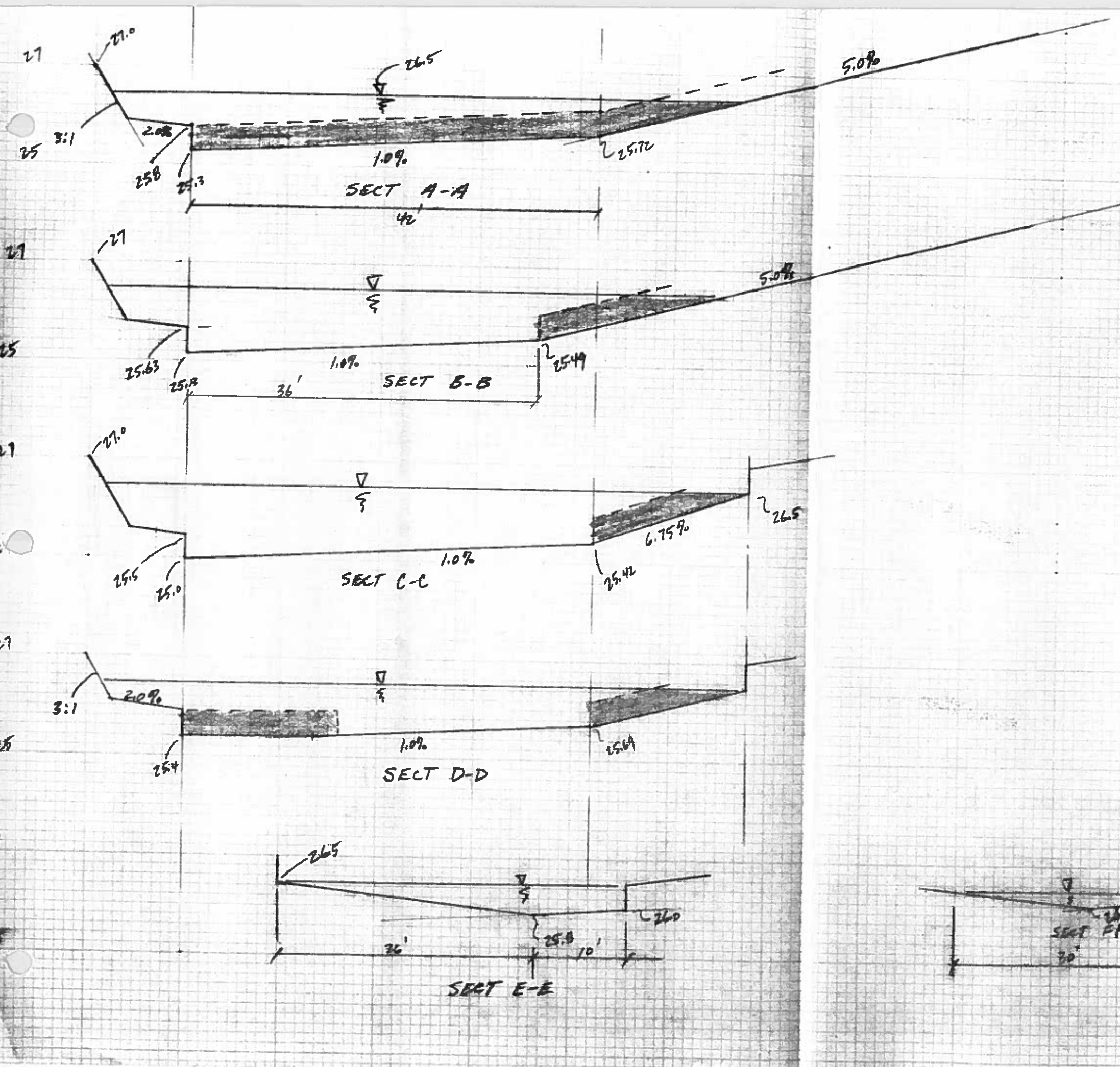
$$L/L_a = \quad =$$

$$a/y = .25/ \quad =$$

$$Q/Q_a =$$

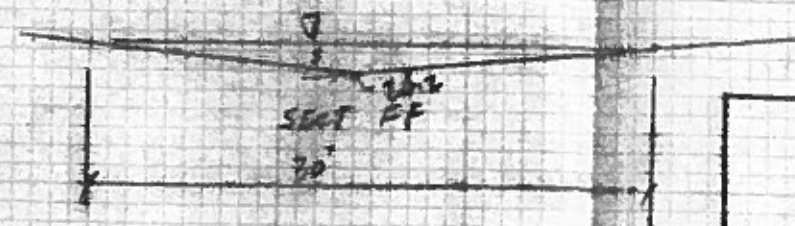
$$Q = 2.26 \quad = \quad \text{CFS (Intercepted)}$$

$$Q_c = \quad = \quad \text{CFS (carryover to inlet ____)}$$



NOTE: SEE SHEET 13A FOR
PLAN VIEW OF
SECTIONS.

1" = 10' HORIZ
1" = 2' VERT

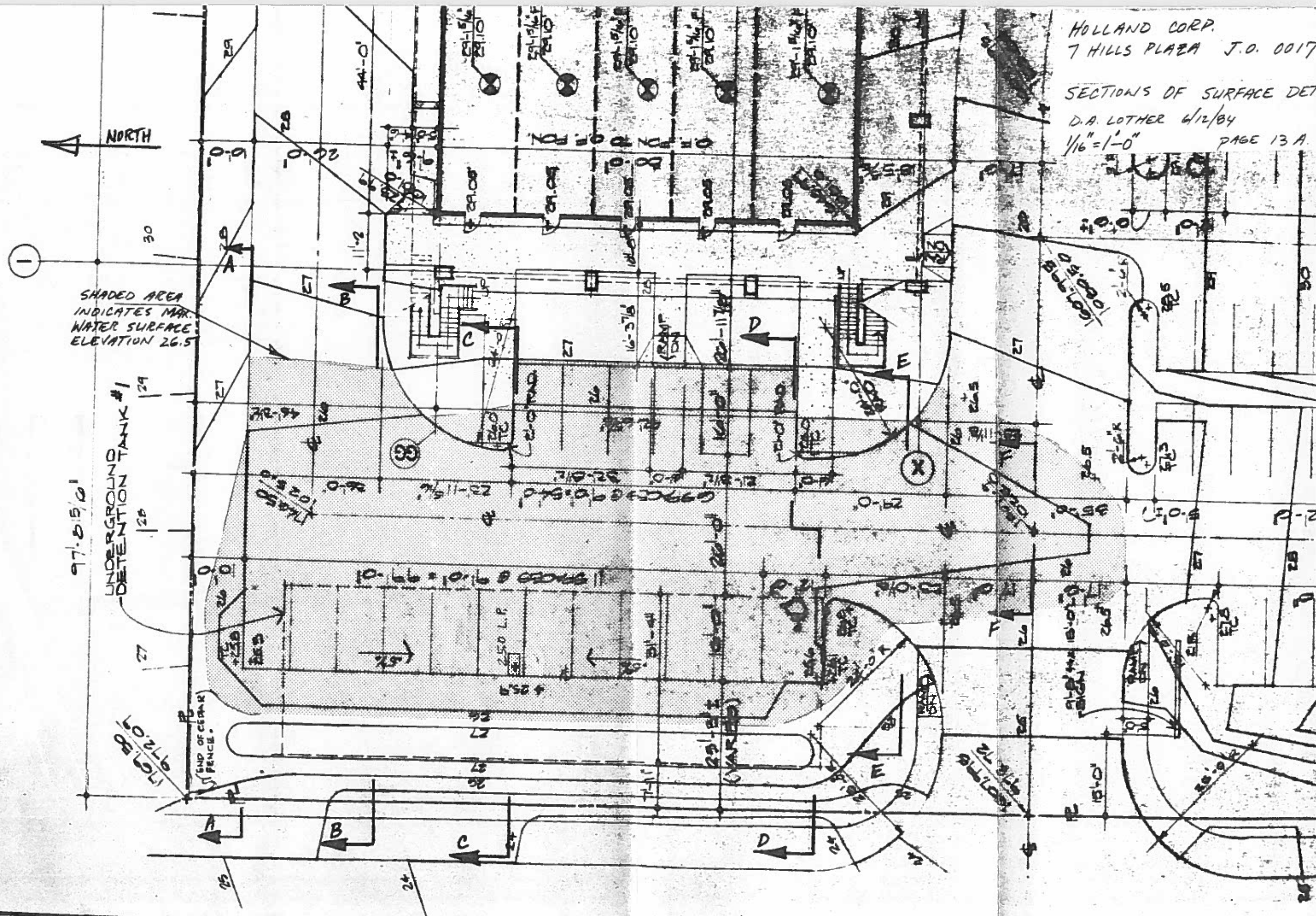


SECTIONS OF SURFACE
DET #1

7 HILLS PLAZA

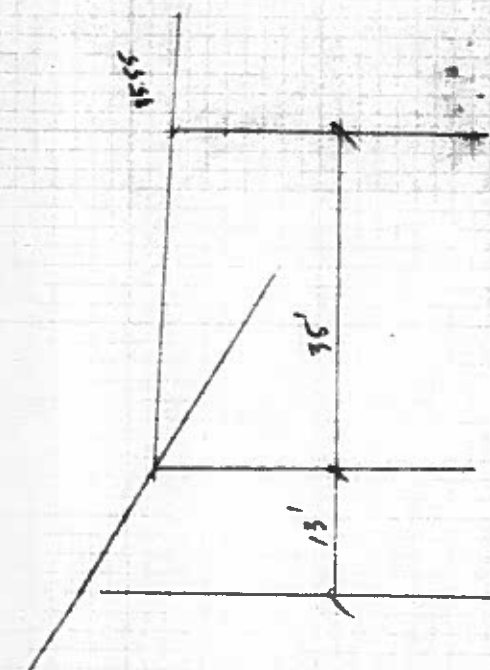
D. A. Laffer 6/6/84

SECTIONS OF SURFACE DET
D.A. LOTHER 6/12/84
1/16" = 1'-0" PAGE 13 A.

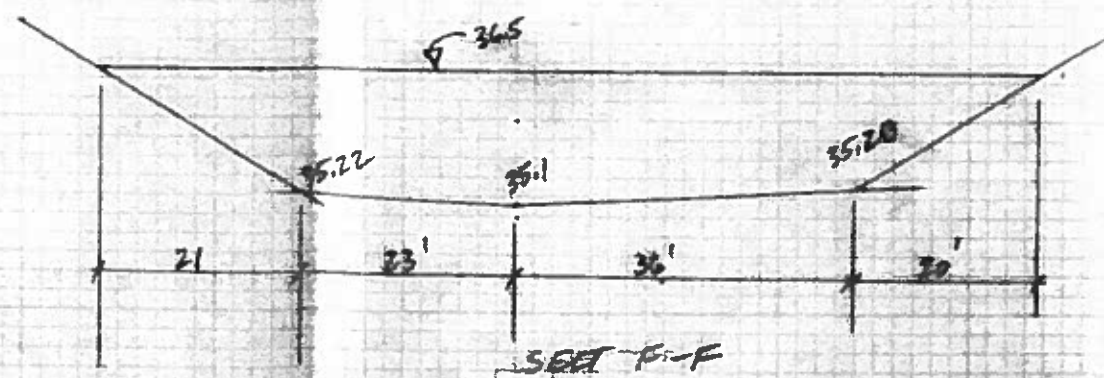


SECTIONS OF
DETENTION #2

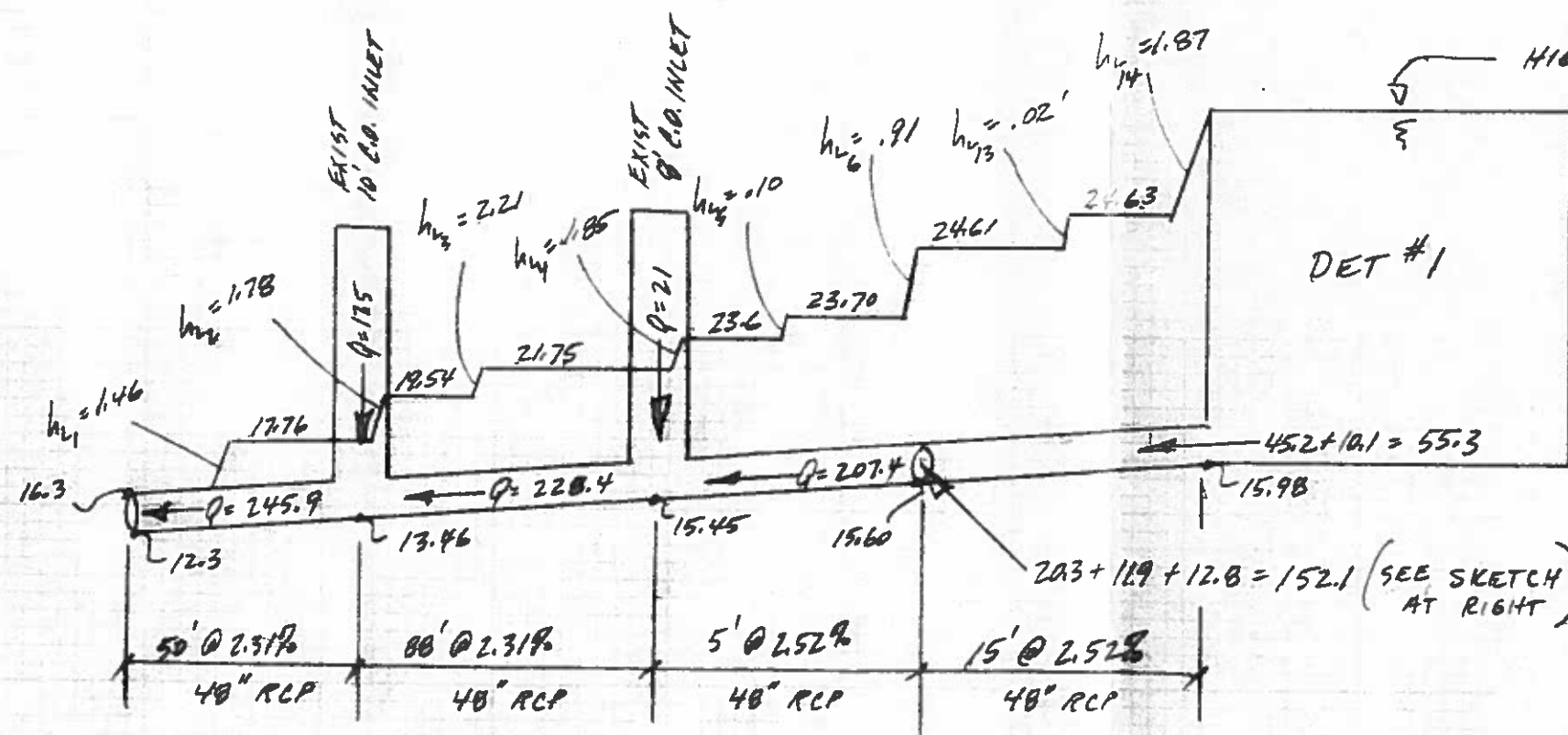
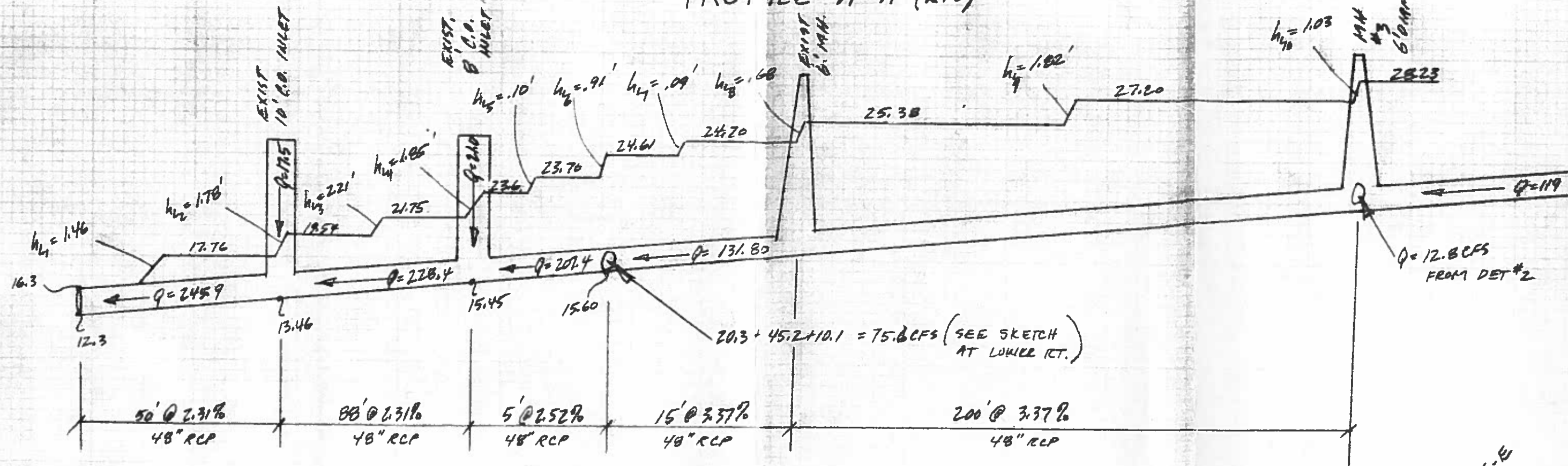
SH 16 OF



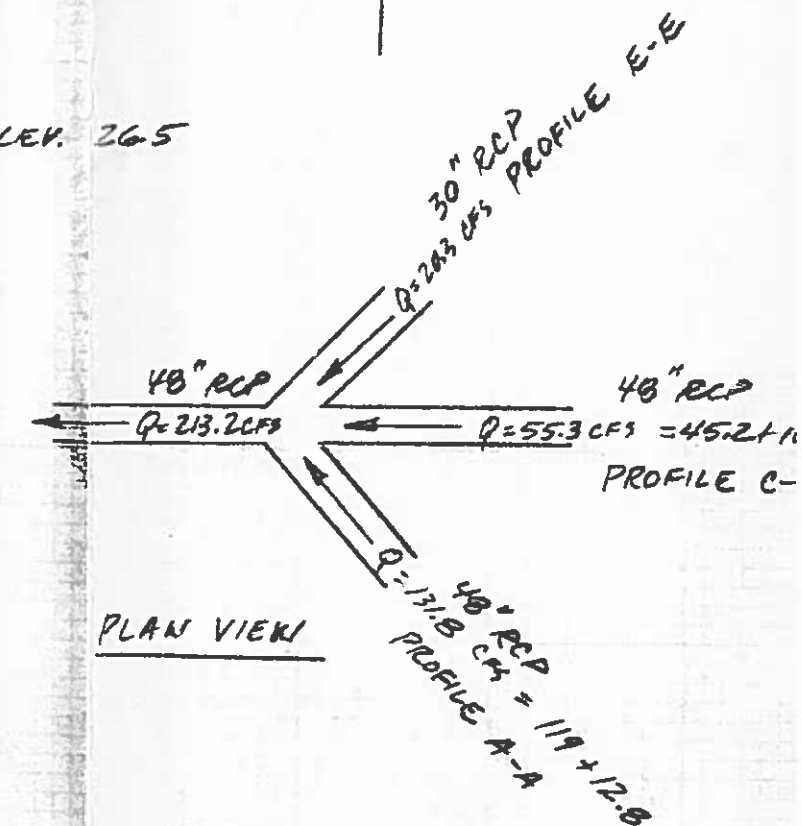
NOTE: SEE SHEET 1 OF
DRAINAGE PLAN FOR
SECTIONS.



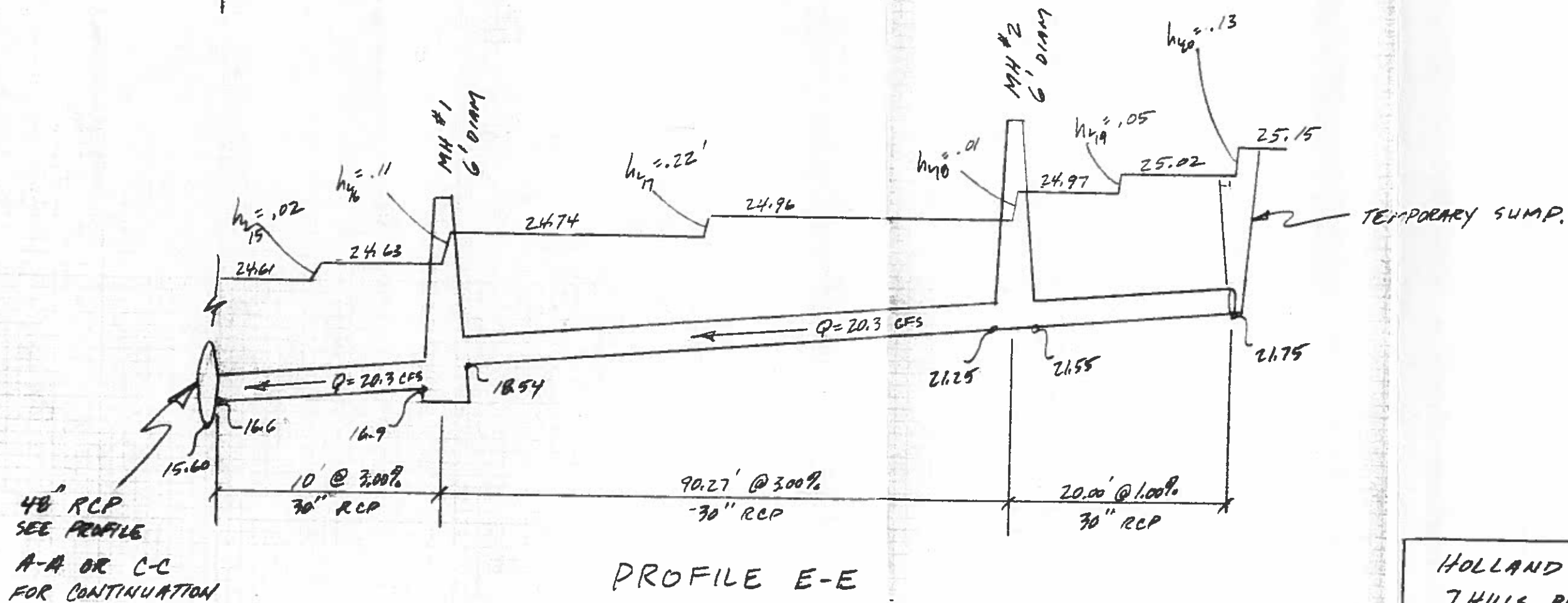
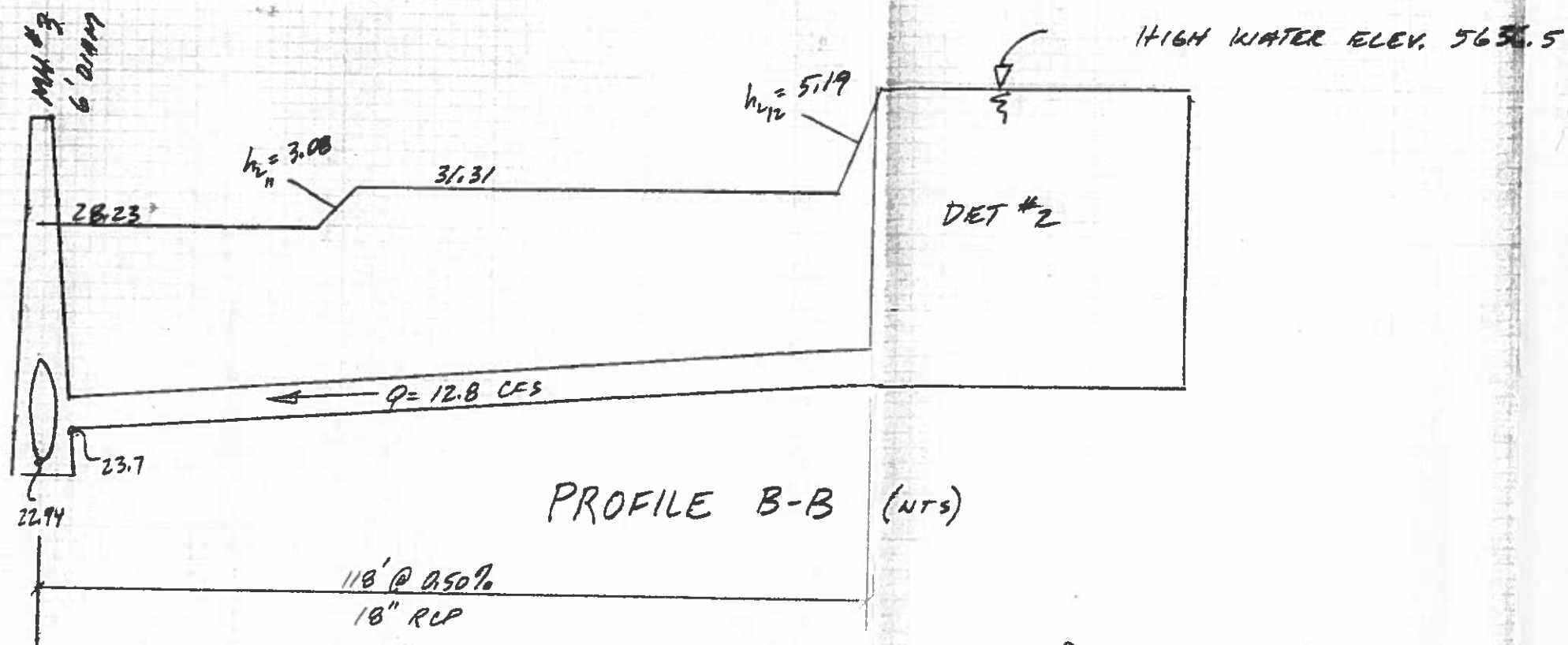
PROFILE A-A (NTS)



PROFILE C-C (NTS)



HOLLAND CORP.
 7 HILLS PLAZA 0017
 STORM SEWER DESIGN
 D. A. LOTHER 6/7/84
 SHT 31 OF



HOLLAND CORP.
7 HILLS PLAZA J.O. 0017
STORM SEWER DESIGN
D.A. LOTHER 6/8/84

APPENDIX B

Hydrologic Computations

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
<u>Business:</u>					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
<u>Residential:</u>					
Single-Family (**)	(*)	.40	.45	.50	.60
Multi-Unit (detached)	60	.45	.50	.60	.70
Multi-Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60
Apartments	80	.65	.70	.70	.80
<u>Industrial:</u>					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
<u>Parks, Cemeteries</u>	5	.10	.10	.35	.60
<u>Playgrounds</u>	10	.15	.25	.35	.65
<u>Schools</u>	50	.45	.50	.60	.70
<u>Railroad Yard Areas</u>	15	.40	.45	.50	.60
<u>Undeveloped Areas:</u>					
Historic Flow Analysis, Greenbelts, Agricultural	2	(See "Lawns")			
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
<u>Streets:</u>					
Paved	100	.87	.88	.90	.93
Gravel	40	.15	.25	.35	.65
Concrete Drive and Walks	96	.87	.87	.88	.89
Roofs	90	.80	.85	.90	.90
<u>Lawns, Sandy Soil (A and B Soils):</u>	2				
2% Slope		.05	.06	.08	.10
2-7% Slope		.10	.11	.13	.15
>7% Slope		.15	.16	.18	.20
<u>Lawns, Clay Soil (C and D Soils):</u>	5				
2% Slope		.13	.14	.15	.17
2-7% Slope		.18	.19	.20	.22
>7% Slope		.25	.27	.30	.35

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures *RO-3 through RO-5* of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit/detached

Soils are type D - please correct the highlighted area above to reflect the correct soils.

Galloway Response: highlighted area has been updated to highlight soils C and D.

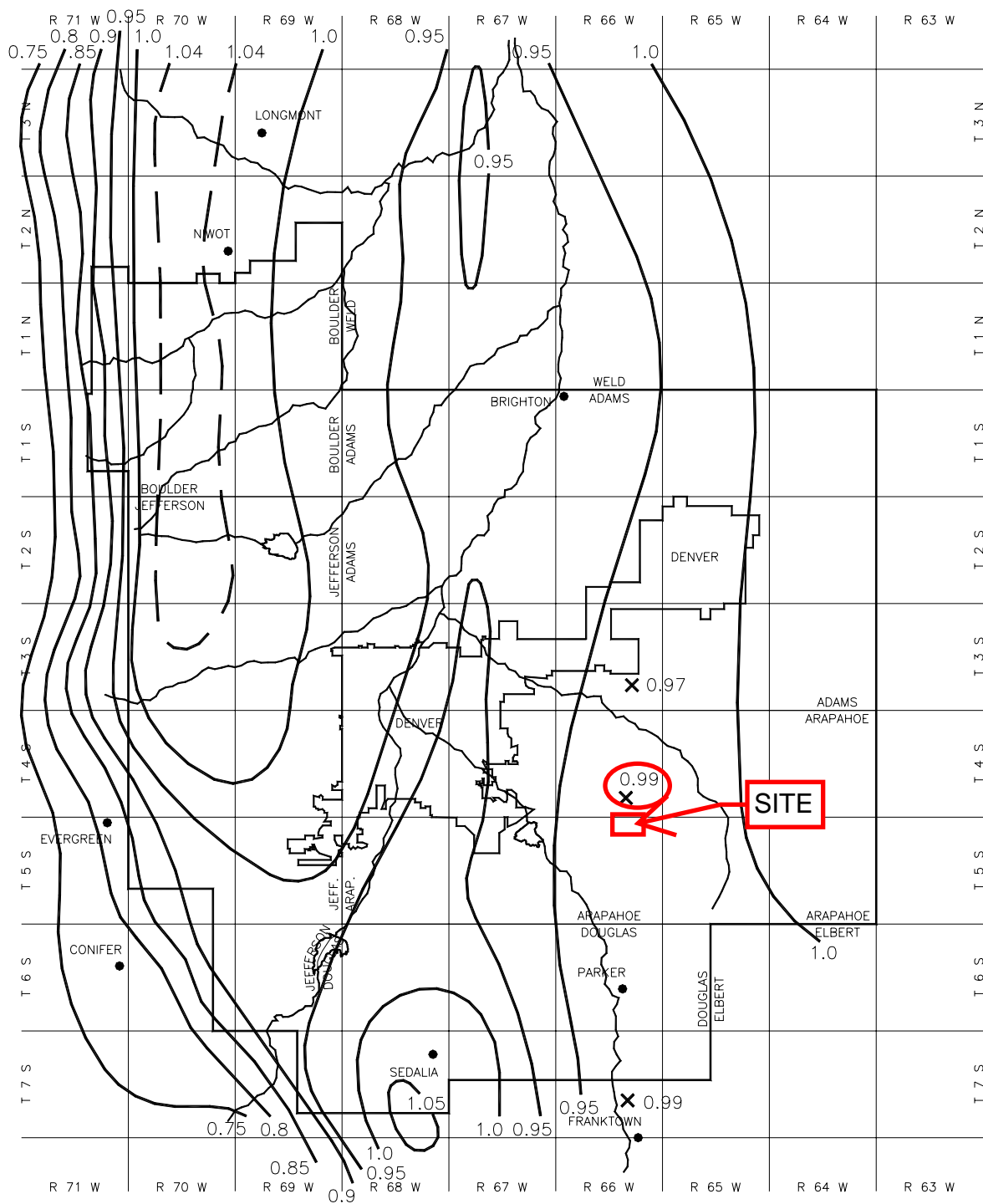


Figure RA-1—Rainfall Depth-Duration-Frequency: 2-Year, 1-Hour Rainfall

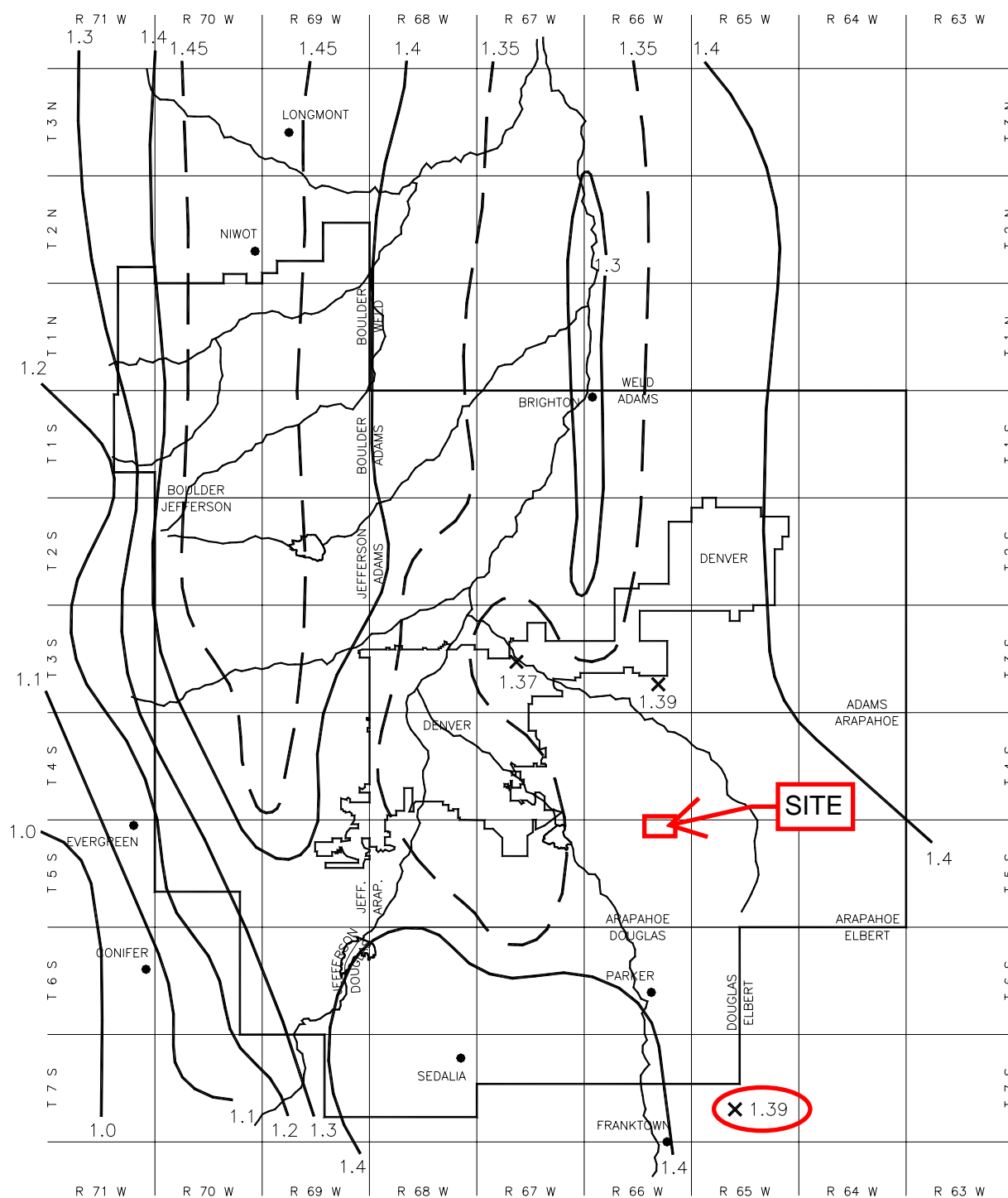


Figure RA-2—Rainfall Depth-Duration-Frequency: 5-Year, 1-Hour Rainfall

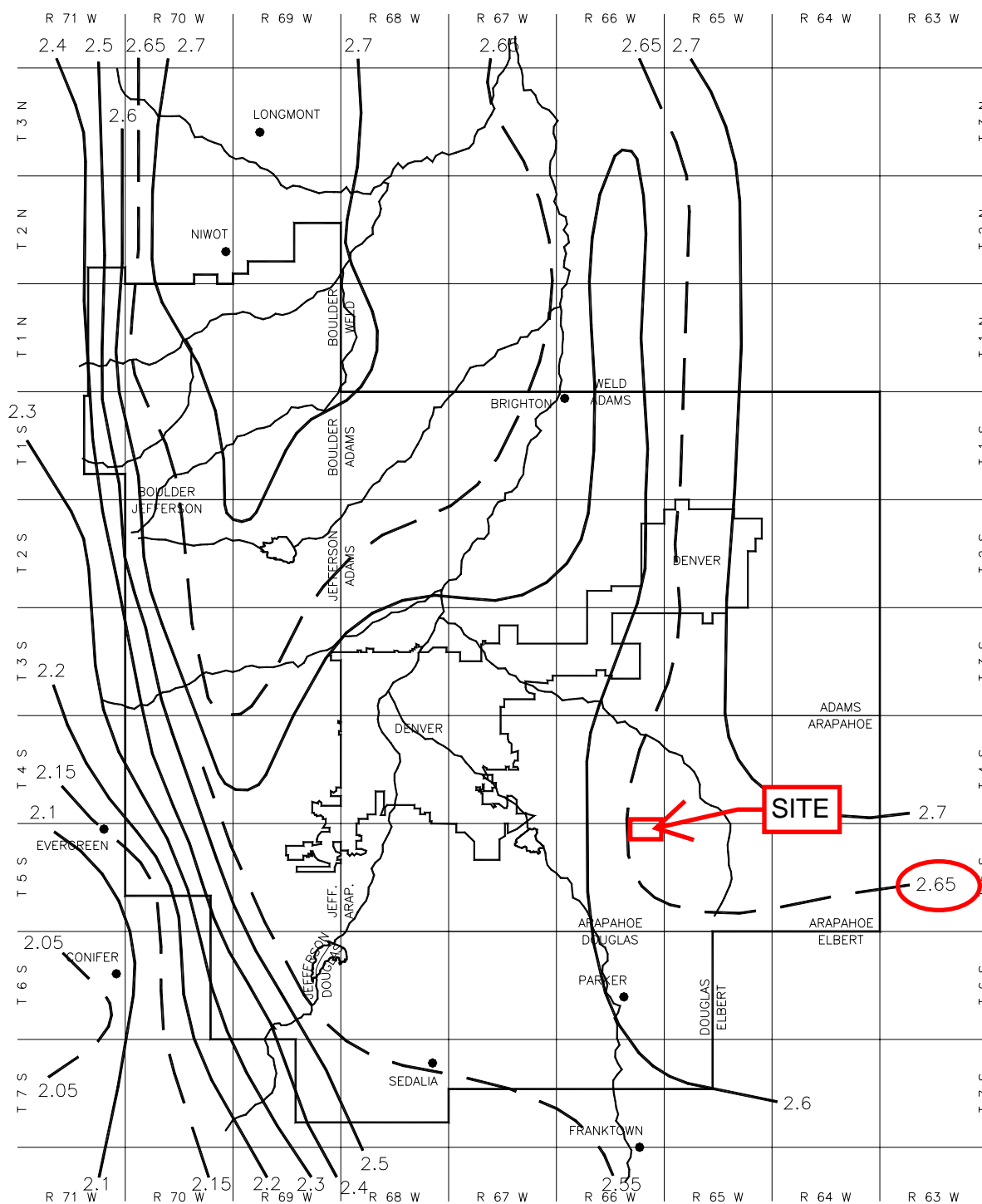


Figure RA-6—Rainfall Depth-Duration-Frequency: 100-Year, 1-Hour Rainfall

COMPOSITE % IMPERVIOUS AND RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Lot 1 Block 1 Firestone Subdivision

Location: CO, Aurora

Project Name: Ent Credit Union - Hampden Ave. & Tower Rd.

Project No.: KEL000018

Calculated By: DLR

Checked By: JRR

Date: 2/23/21

Basin ID	Total Area (ac)	Hydrologic Soils Group	Paved Roads			Lawns			Roofs			Basins Total Weighted % Imp.
			% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
EX-A	0.543	D	100	0.331	61.0	5	0.060	0.6	90	0.152	25.20	86.8
PR-A	0.614	D	100	0.360	58.6	5	0.152	1.2	90	0.102	15.00	74.8
Pre-Site	0.849	D	100	0.494	58.2	5	0.203	1.2	90	0.152	16.10	75.5
Post-Site	0.849	D	100	0.520	61.3	5	0.227	1.3	90	0.102	10.80	73.4

Basin ID	Total Area (ac)	Hydrologic Soils Group	Paved Roads			Lawns			Roofs			Basins Total Weighted C2
			C2	Area (ac)	Weighted C2	C2	Area (ac)	Weighted C2	C2	Area (ac)	Weighted C2	
EX-A	0.543	D	0.87	0.331	0.5	0.13	0.060	0.0	0.80	0.152	0.22	0.76
PR-A	0.614	D	0.87	0.360	0.5	0.13	0.152	0.0	0.80	0.102	0.13	0.67
Pre-Site	0.849	D	0.87	0.494	0.5	0.13	0.203	0.0	0.80	0.152	0.14	0.68
Post-Site	0.849	D	0.87	0.520	0.5	0.13	0.227	0.0	0.80	0.102	0.10	0.66

Basin ID	Total Area (ac)	Hydrologic Soils Group	Paved Roads			Lawns			Roofs			Basins Total Weighted C5
			C5	Area (ac)	Weighted C5	C5	Area (ac)	Weighted C5	C5	Area (ac)	Weighted C5	
EX-A	0.543	D	0.88	0.331	0.5	0.14	0.060	0.0	0.85	0.152	0.24	0.80
PR-A	0.614	D	0.88	0.360	0.5	0.14	0.152	0.0	0.85	0.102	0.14	0.69
Pre-Site	0.849	D	0.88	0.494	0.5	0.14	0.203	0.0	0.85	0.152	0.15	0.69
Post-Site	0.849	D	0.88	0.520	0.5	0.14	0.227	0.0	0.85	0.102	0.10	0.68

Basin ID	Total Area (ac)	Hydrologic Soils Group	Paved Roads			Lawns			Roofs			Basins Total Weighted C100
			C100	Area (ac)	Weighted C100	C100	Area (ac)	Weighted C100	C100	Area (ac)	Weighted C100	
EX-A	0.543	D	0.93	0.331	0.6	0.17	0.060	0.0	0.90	0.152	0.25	0.84
PR-A	0.614	D	0.93	0.360	0.6	0.17	0.152	0.0	0.90	0.102	0.15	0.74
Pre-Site	0.849	D	0.93	0.494	0.5	0.17	0.203	0.0	0.90	0.152	0.16	0.74
Post-Site	0.849	D	0.93	0.520	0.6	0.17	0.227	0.1	0.90	0.102	0.11	0.73

Subdivision: Lot 1 Block 1 Firestone Subdivision

Location: CO, Aurora

Project Name: Ent Credit Union - Hampden Ave. & Tower Rd

Project No.: CO, Aurora

Calculated By: DLR

Checked By: JRR

Date: 2/23/21

2-YR STORM EVENT

BASIN INFORMATION				DIRECT RUNOFF				
DESIGN PT.	BASIN	AREA (acres)	RUNOFF COEFF.	Tc (min)	C x A (acres)	P1	I (in/hr)	Q (cfs)
1	PR-A	0.61	0.67	5.00	0.41	0.99	3.36	1.38
1	EX-A	0.54	0.76	5.00	0.41	0.99	3.36	1.39
1	Pre-Site	0.85	0.68	5.00	0.58	0.99	3.36	1.94
1	Post-Site	0.85	0.66	5.00	0.56	0.99	3.36	1.88

5-YR STORM EVENT

BASIN INFORMATION				DIRECT RUNOFF				
DESIGN PT.	BASIN	AREA (acres)	RUNOFF COEFF.	Tc (min)	C x A (acres)	P1	I (in/hr)	Q (cfs)
1	PR-A	0.61	0.69	5.00	0.42	1.39	4.71	2.00
1	EX-A	0.54	0.80	5.00	0.43	1.39	4.71	2.05
1	Pre-Site	0.85	0.69	5.00	0.59	1.39	4.71	2.76
1	Post-Site	0.85	0.68	5.00	0.58	1.39	4.71	2.72

100-YR STORM EVENT

BASIN INFORMATION				DIRECT RUNOFF				
DESIGN PT.	BASIN	AREA (acres)	RUNOFF COEFF.	Tc (min)	C x A (acres)	P1	I (in/hr)	Q (cfs)
1	PR-A	0.61	0.74	5.00	0.45	2.65	8.99	4.08
1	EX-A	0.54	0.84	5.00	0.46	2.65	8.99	4.10
1	Pre-Site	0.85	0.74	5.00	0.63	2.65	8.99	5.65
1	Post-Site	0.85	0.73	5.00	0.62	2.65	8.99	5.57

$$I = 28.5(P1)/(10+Tc)^{0.786}$$

Use minimum Time of Concentration = 5 minutes

Use composite coefficients

Ration Method: Q = CIA

need to include the off-site basin flows in analysis and calculations

Galloway Response:
Off-site area has been added.

APPENDIX C

Hydraulic Computations

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Monday, Mar 8 2021

WQ Grass Swale

Trapezoidal

Bottom Width (ft)
Side Slopes (z:1)
Total Depth (ft)
Invert Elev (ft)
Slope (%)
N-Value

Calculations

Compute by:
Known Q (cfs)

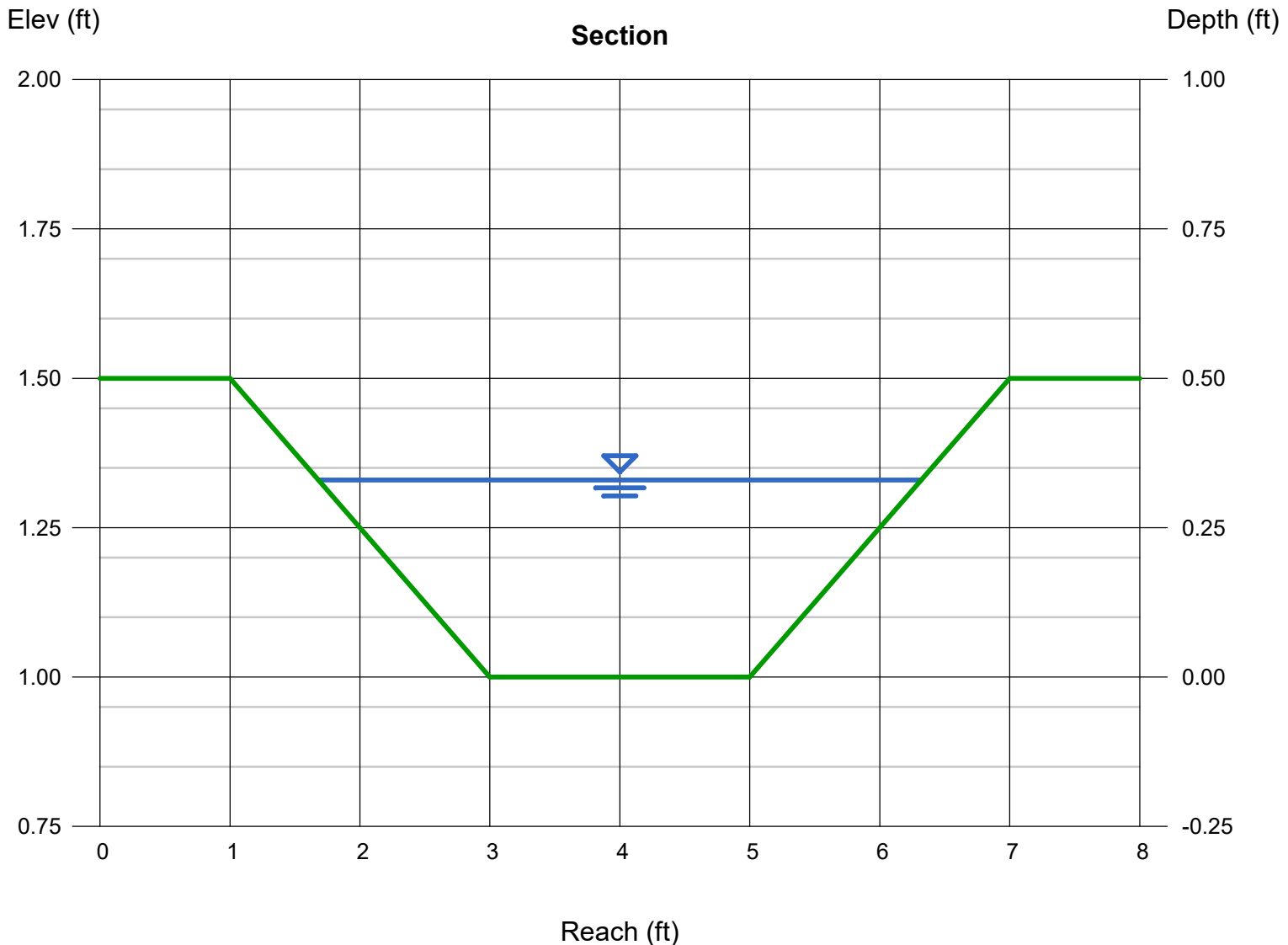
Galloway Response:
Off-site basin has
been re-routed to re-
main offsite and not
enter swale. Additional
reports have been
added to provide more
information on the
100-year flow within
the swale

Known Q
= 1.38

Highlighted

Depth (ft) = 0.33
Q (cfs) = 1.380
Area (sqft) = 1.10
Velocity (ft/s) = 1.26
Wetted Perim (ft) = 4.72
Crit Depth, Yc (ft) = 0.22
Top Width (ft) = 4.64
EGL (ft) = 0.35

Per Volume 3 of the USDCM for grass swale -
Check the conditions for the 100-year flow to
ensure that drainage is being handled without
flooding structures or adjacent streets.
Off site flows through site need to flow through WQ
swale - so include these flows in the Q analyzed.



Channel Report

Concrete Flume

Rectangular

Bottom Width (ft) = 2.00
Total Depth (ft) = 0.50

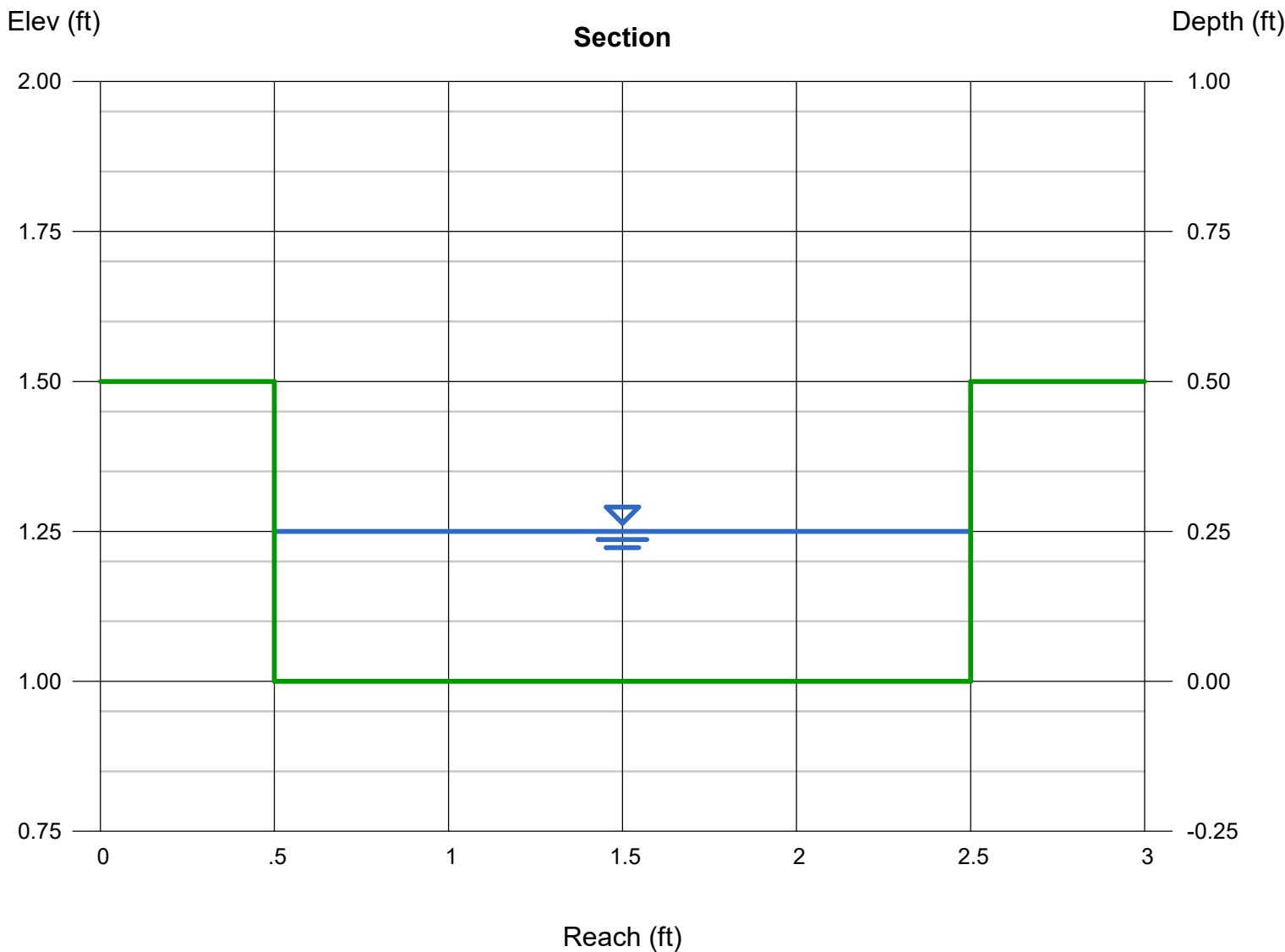
Invert Elev (ft) = 1.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 1.38

Highlighted

Depth (ft) = 0.25
Q (cfs) = 1.380
Area (sqft) = 0.50
Velocity (ft/s) = 2.76
Wetted Perim (ft) = 2.50
Crit Depth, Yc (ft) = 0.25
Top Width (ft) = 2.00
EGL (ft) = 0.37



APPENDIX D

Drainage Map

Drainage plan must be uploaded as separate full size PDF (24 x 36).

Galloway Response: Understood

Galloway Response: C&G labels added

Galloway Response: A drainage easement has been added to contain the WQ swale.

Galloway Response: Understood, thank you.

drainage easement will be required for WQ swale.

Advisory Note - at time of civils submittal - I&M plan will be required for WQ swale.

Galloway Response: Top width of swale added to sheets.

Galloway Response: Off-site area added.

Galloway Response: Ramp grades higher than the gutter.

Per COA SDDTC Manual Section 2.22, off site basins must be shown. Can be shown on separate map.

Galloway Response: This is a high point, additional slope arrows have been added to clarify.

Galloway Response: This chase continue along the gutter within the site to the southern curb cut for the swale

concern with this area being a low point. Must provide positive drainage and no ponding by building allowed. Slope shown for this area in the site plan grading sheet is incorrect based on the contours.

Galloway Response: Grades slope away from building. Additional slope labels have been added for clarification. Spill curbs so no flow within gutter

drainage along curb immediately adjacent to the north side of the building. Clearly show slopes away from building. Compare the 100-year flow depth along this curb to the FFE, must provide a min. of 1' of freeboard. Account for the off site flow from the northern run down that will flow toward this area.

Galloway Response: Existing contours have been added to show 50' beyond boundary.

Per SDDTC Sect 2.34, show contours a min. of 50' past property boundary on all sides of property.

Galloway Response: 1. Existing/Proposed Esmts added
2. Maintenance responsibility indicated.
3. Design storm frequency indicated.
4. COA benchmark added

Galloway Response: Slope labels have been added to show slope compliance

Galloway Response: Off-site basin has been re-routed to remain offsite and not enter swale.

Galloway Response: Understood, a comment has been added to each comment on this document.

1st Review - please contact Rifka Wine with any questions. rwine@bhinc.com

Please provide responses to the provided comments to expedite the next review.

Advisory Note: PDR approval is required prior to Civil Plan Approval

Galloway Response: Understood, thank you.

COA Benchmark must be shown & referenced. Include elevation & NAVD 1988 reference.

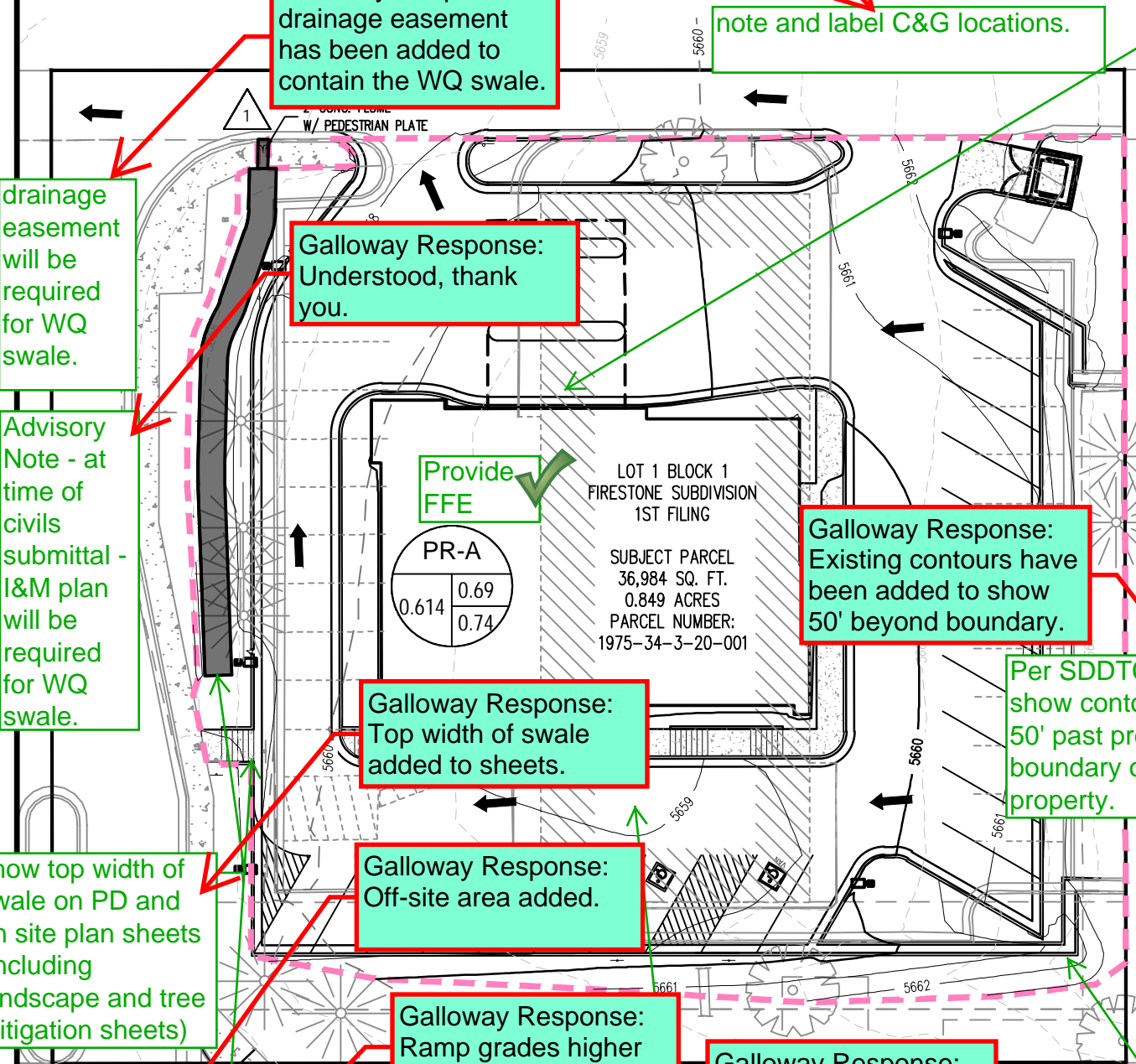
Required plan items missing (see SDDTC Sect 2.34 for more information):
1. Existing and proposed easements (drainage, utility, fire, etc). Show dimensions of each, with dimension arrows.
2. indicate public or private maintenance of all storm infrastructure (swales, etc.).
3. indicate design storm frequency required to be shown for swale.
4. COA benchmark missing, include COA ID, elevation & NAVD 1988 datum reference.

Include Block #, Lot # after filing No. 1

Galloway Response: Title has been revised.

ENT CREDIT UNION

LOCATED IN THE SOUTHWEST CORNER OF SECTION 34, TOWN OF HAMPDEN, RANGE 66 WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF AURORA, COUNTY OF ARAPAHOE, STATE OF COLORADO



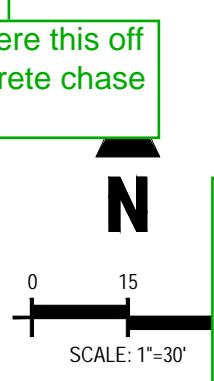
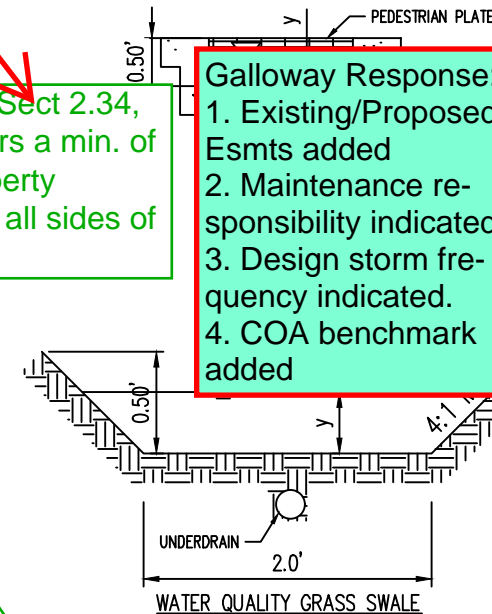
PROPOSED MAJOR		PROPOSED MINOR	EXISTING MAJOR	EXISTING MINOR
TOTAL				
PRE-C	SI			
POST-C	SI			
		% IMPERV		
		(C)	75.5 %	
		(C)	73.4 %	
		(C)	86.8 %	
		(C)	73.4 %	

DRAINAGE LEGEND

- MAJOR BASIN BOUNDARY LINE
- LOT BOUNDARY
- WQCV CHANNEL

VICINITY MAP

SCALE: 1" = 1'



APPROVED FOR ONE YEAR FROM THIS DATE

Show all slopes (slope requirements in the COA Roadway Design and Construction Specifications Manual). Minimum 0.50% slope on all concrete surfaces, minimum 1% slope on all asphalt surfaces, minimum 2% slope on all grass-lined swales and landscape areas. The slope away from the buildings shall have a minimum grade of 5% for the first 10' or to the property line for landscape areas, whichever occurs first, then a minimum of 2% until the slope reaches the swale around the building. Impervious surfaces within 10' of the building foundation shall be sloped a minimum of 2% away from the building.