PEN 1 & PEN 2
Seepage and Stability Analyses

Flood Levels Analyzed:

- USACE Authorized Design Water Elevation
- Reverse Analysis to Check Max Flood Height

Levee Seepage & Stability (Cornforth)

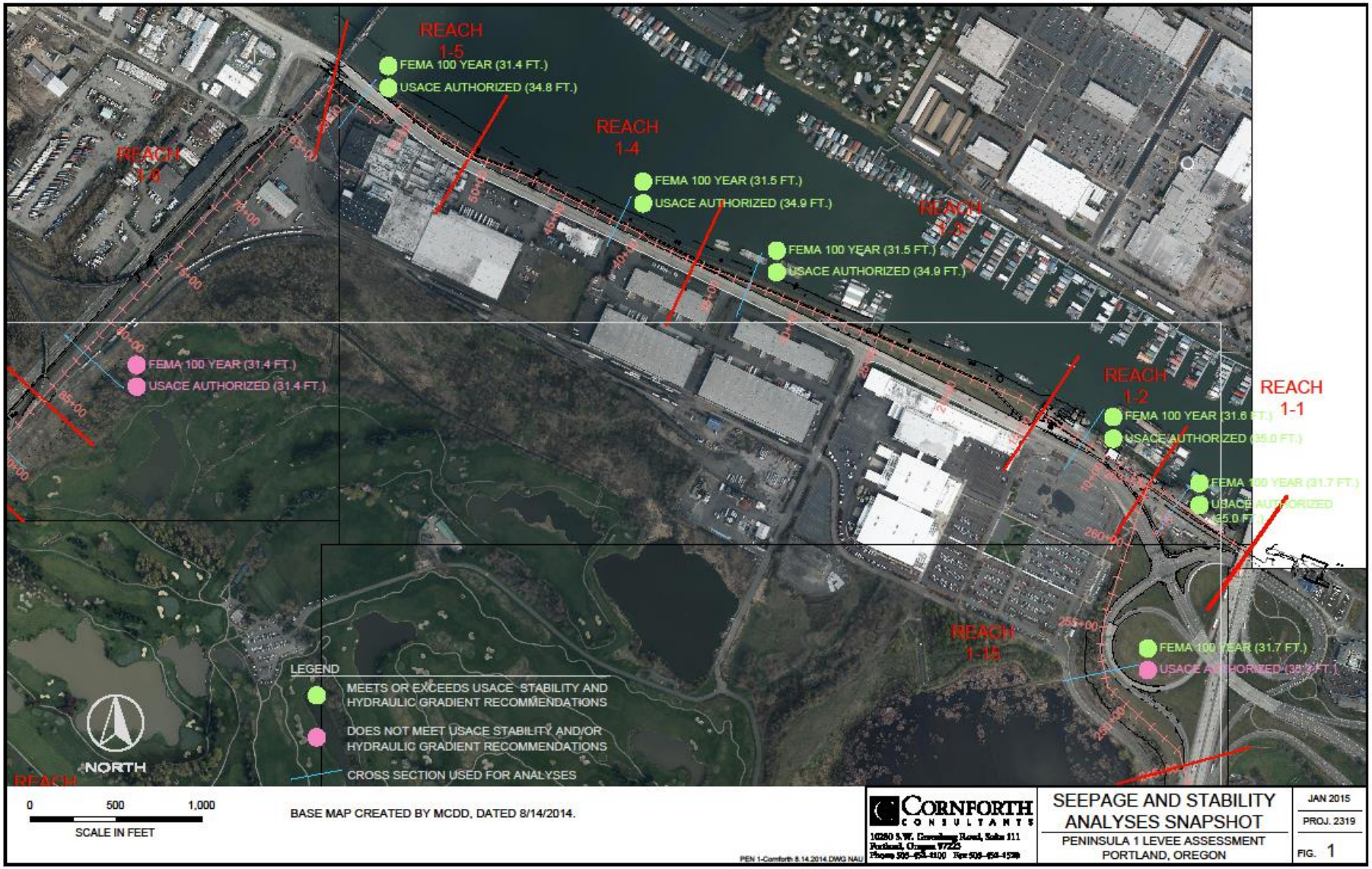
Freeboard (WEST)

Peninsula Drainage Districts No. 1 and No. 2

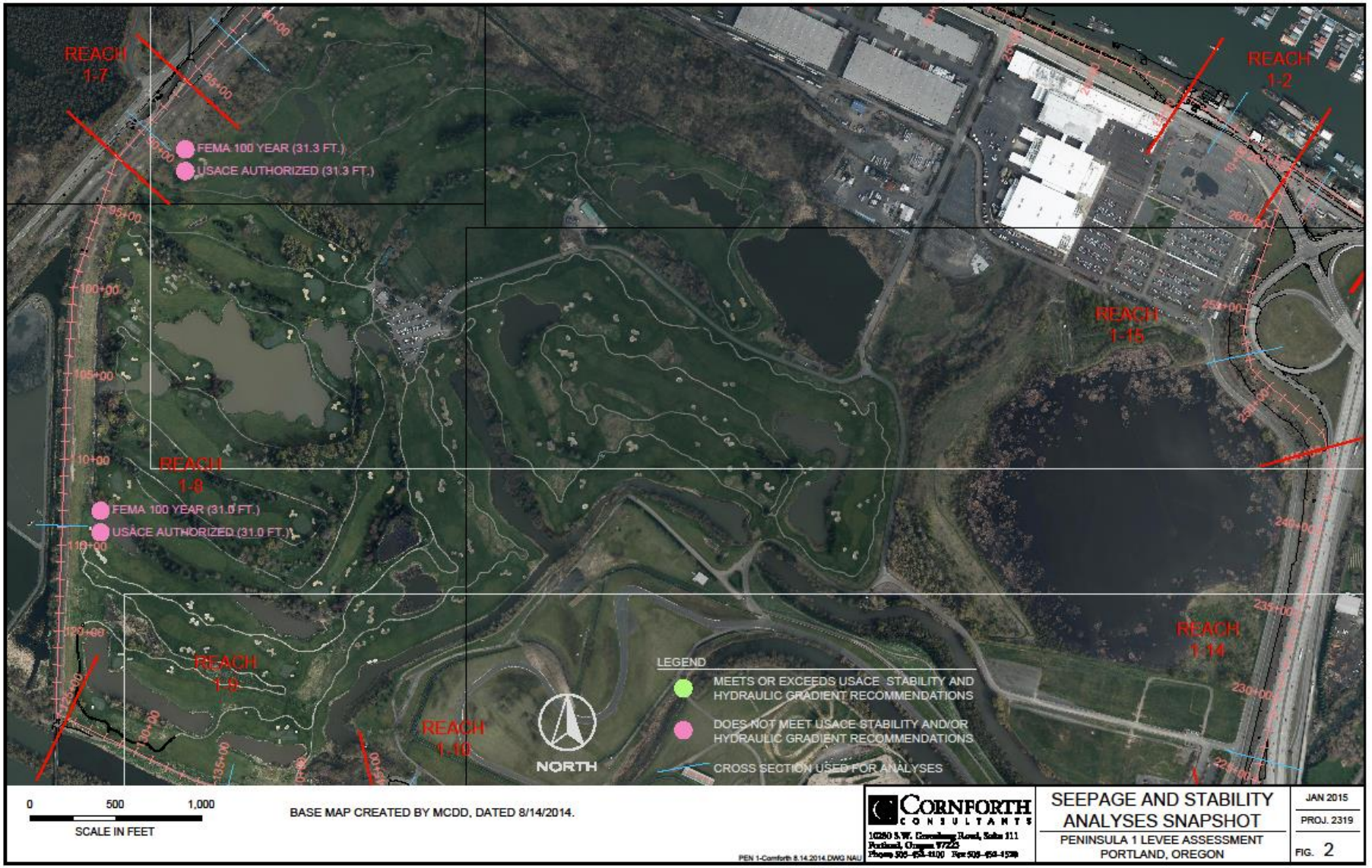
Authorized by the 1936 Flood Control Act – Columbia River flood of 1876

Summary Water Surface Elevations for PEN 1 & PEN 2 Levee System – NAVD88			
River Mile	1%-annual-chance (100 yr.) - FEMA	0.2%-annual-chance (500 yr.) – FEMA	DWSE (470 yr.) - USACE
PEN 1 - 106.0	31.5 ft.	35.0 ft.	34.8 ft.
PEN 2 - 107.4	31.8 ft.	35.3 ft.	35.1 ft.

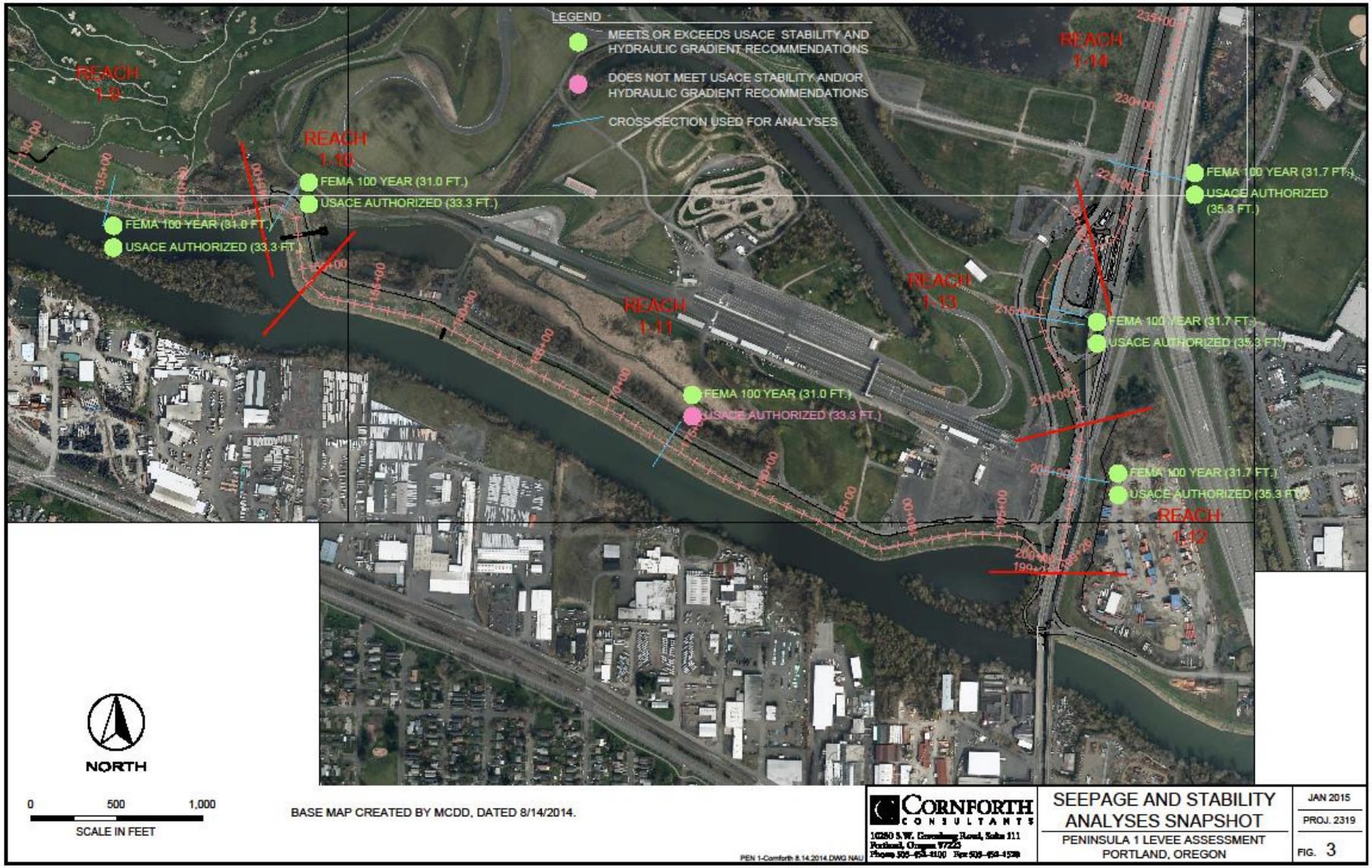
PEN 1 – NW Corner



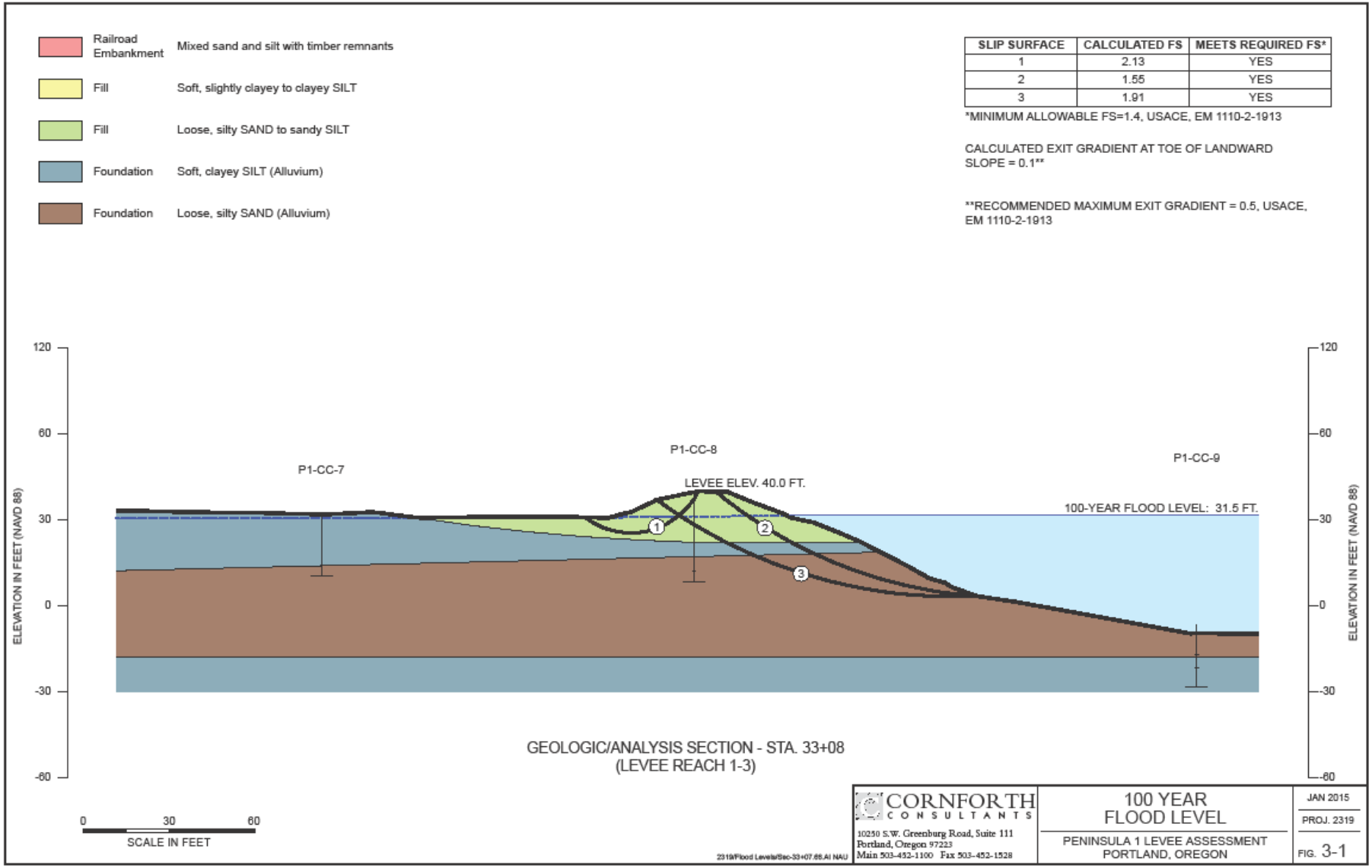
PEN 1 – SW Corner



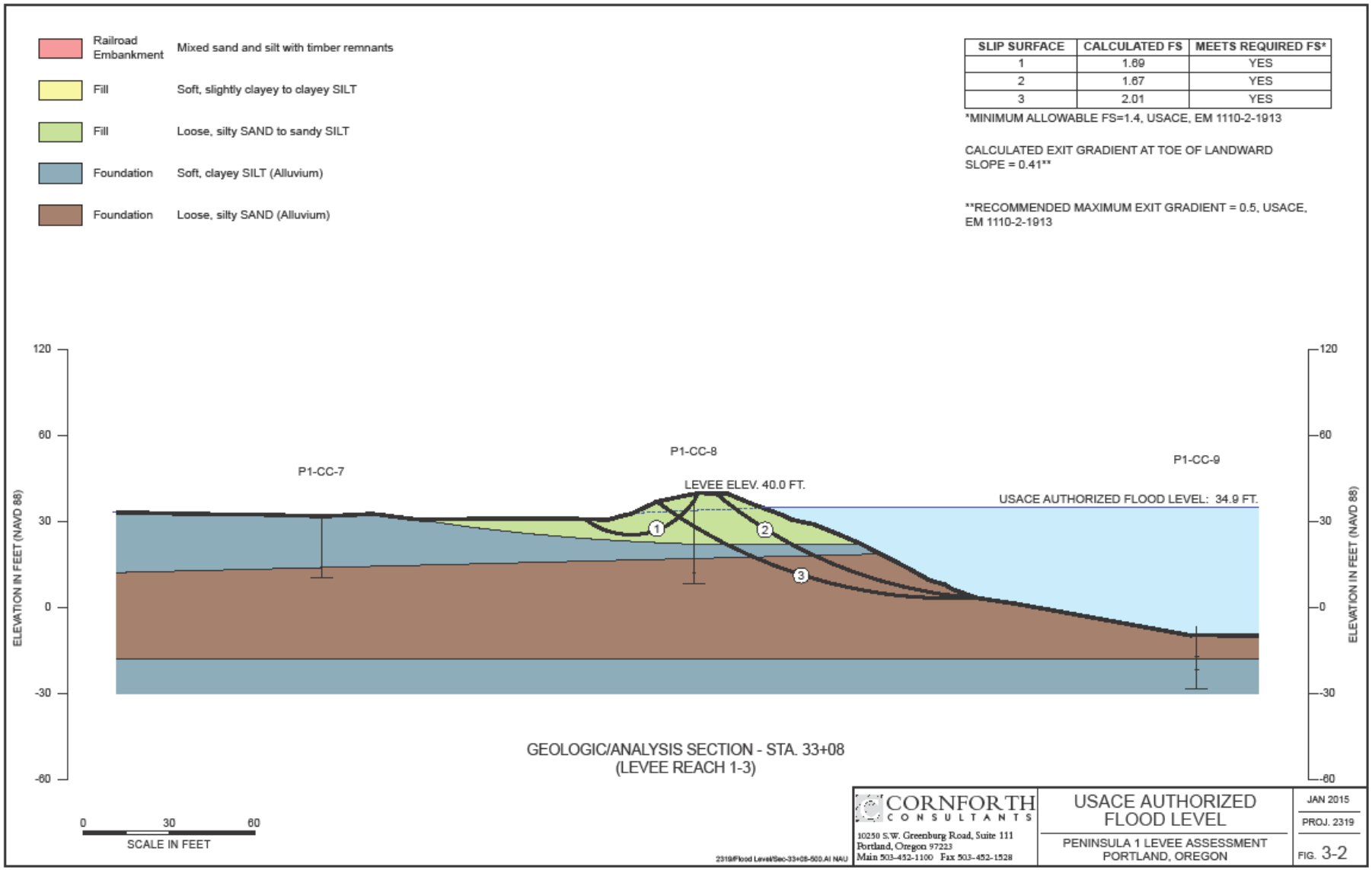
PEN 1 – SE Corner



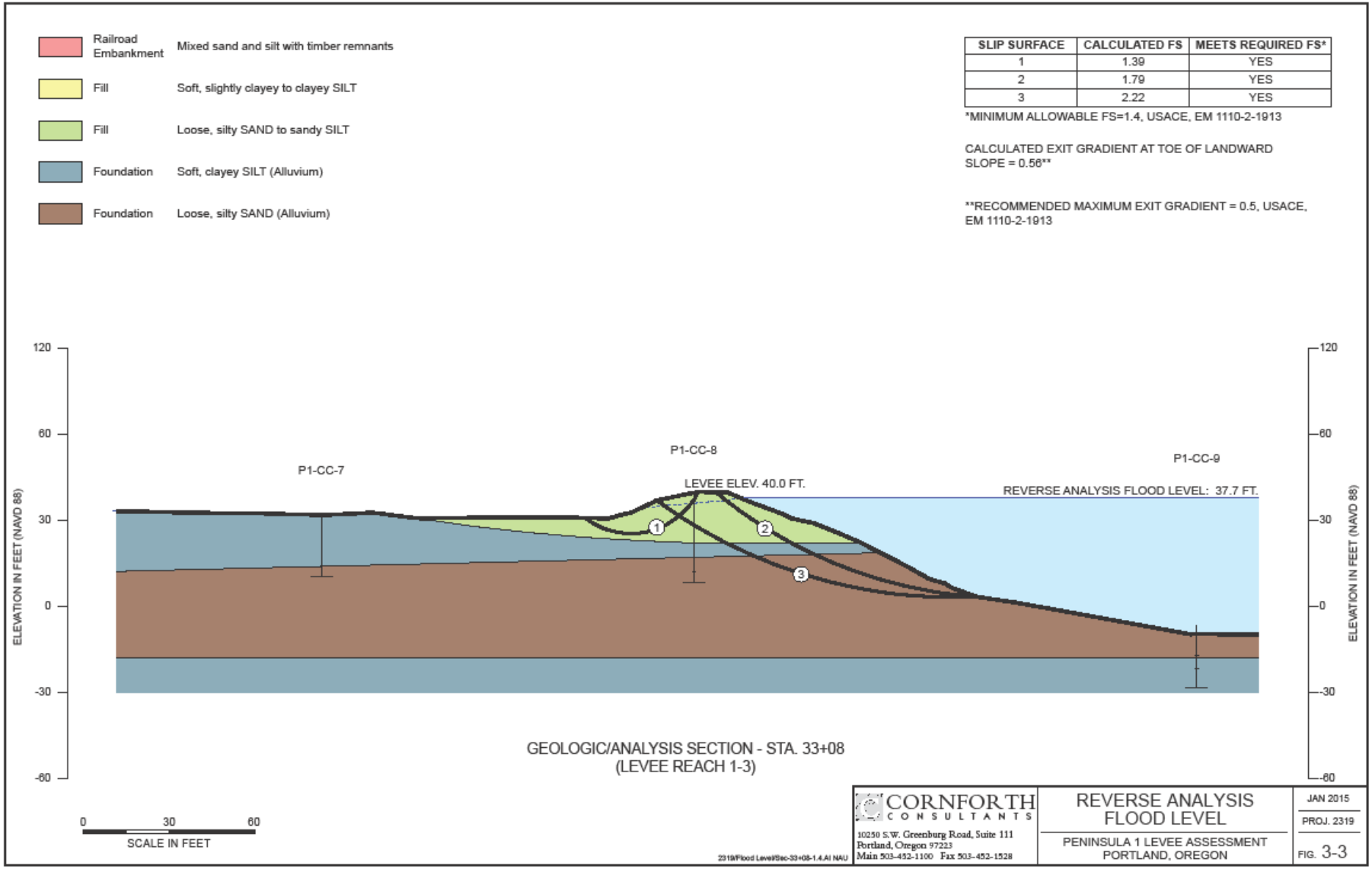
PEN 1 – N Marine Drive Levee - 100 Year Analysis



PEN 1 – N Marine Drive Levee - USACE authorized design water elevation analysis



PEN 1 – N Marine Drive Levee - Reverse Analysis



PEN 1 – N Marine Drive Floodwall - USACE authorized design water elevation analysis

Railroad Embankment	Mixed sand and silt with timber remnants
Fill	Soft, slightly clayey to clayey SILT
Fill	Loose, silty SAND to sandy SILT
Foundation	Soft, clayey SILT (Alluvium)
Foundation	Loose, silty SAND (Alluvium)

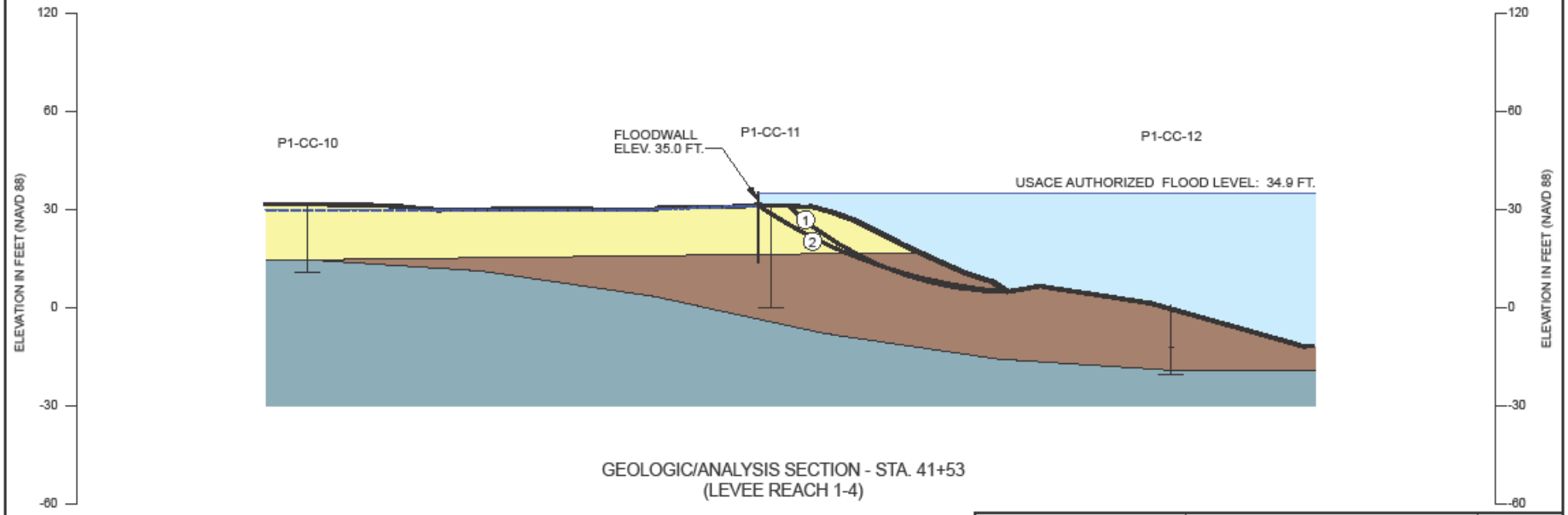
SLIP SURFACE	CALCULATED FS	MEETS REQUIRED FS*
1	1.73	YES
2	1.88	YES

*MINIMUM ALLOWABLE FS=1.4, USACE, EM 1110-2-1913

CALCULATED EXIT GRADIENT AT TOE OF LANDWARD SLOPE = 0.0**

**RECOMMENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, EM 1110-2-1913

NOTE: NO REVERSE ANALYSIS PERFORMED DUE TO FLOODWALL OVERTOPPING.



GEOLOGIC/ANALYSIS SECTION - STA. 41+53
(LEVEE REACH 1-4)

CORNFORTH CONSULTANTS
10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Main 503-452-1100 Fax 503-452-1528

USACE AUTHORIZED FLOOD LEVEL

PENINSULA 1 LEVEE ASSESSMENT
PORTLAND, OREGON

JAN 2015
PROJ. 2319
FIG. 4-2

PEN 1 – Columbia Slough Levee near PIR - 100 Year Analysis

Railroad Embankment	Mixed sand and silt with timber remnants
Fill	Soft, slightly clayey to clayey SILT
Fill	Loose, silty SAND to sandy SILT
Foundation	Soft, clayey SILT (Alluvium)
Foundation	Loose, silty SAND (Alluvium)

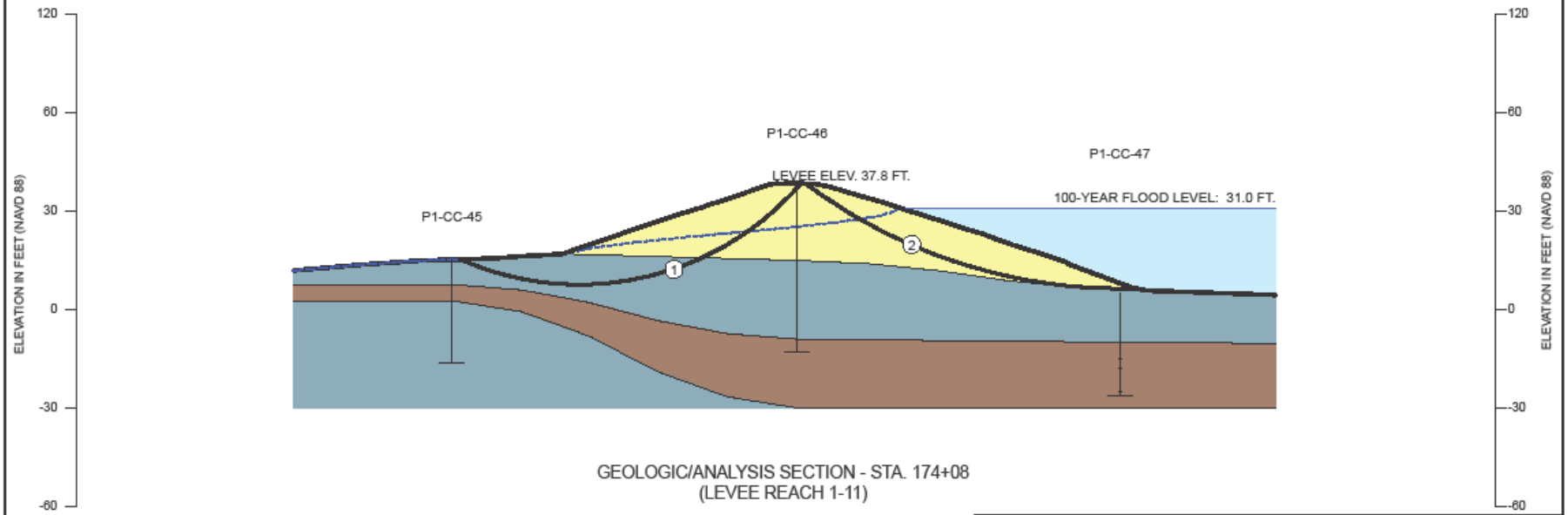
SLIP SURFACE	CALCULATED FS	MEETS REQUIRED FS*
1	1.40	YES
2	2.12	YES

*MINIMUM ALLOWABLE FS=1.4, USACE, EM 1110-2-1913

CALCULATED EXIT GRADIENT AT TOE OF LANDWARD SLOPE = 0.3**

**RECOMMENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, EM 1110-2-1913

NOTE: THIS ANALYSIS ALSO SERVES AS THE REVERSE ANALYSIS (SEE FS ABOVE).



GEOLOGIC/ANALYSIS SECTION - STA. 174+08
(LEVEE REACH 1-11)

2319\Flood Levels\Sec-174+08.11.AI NAU

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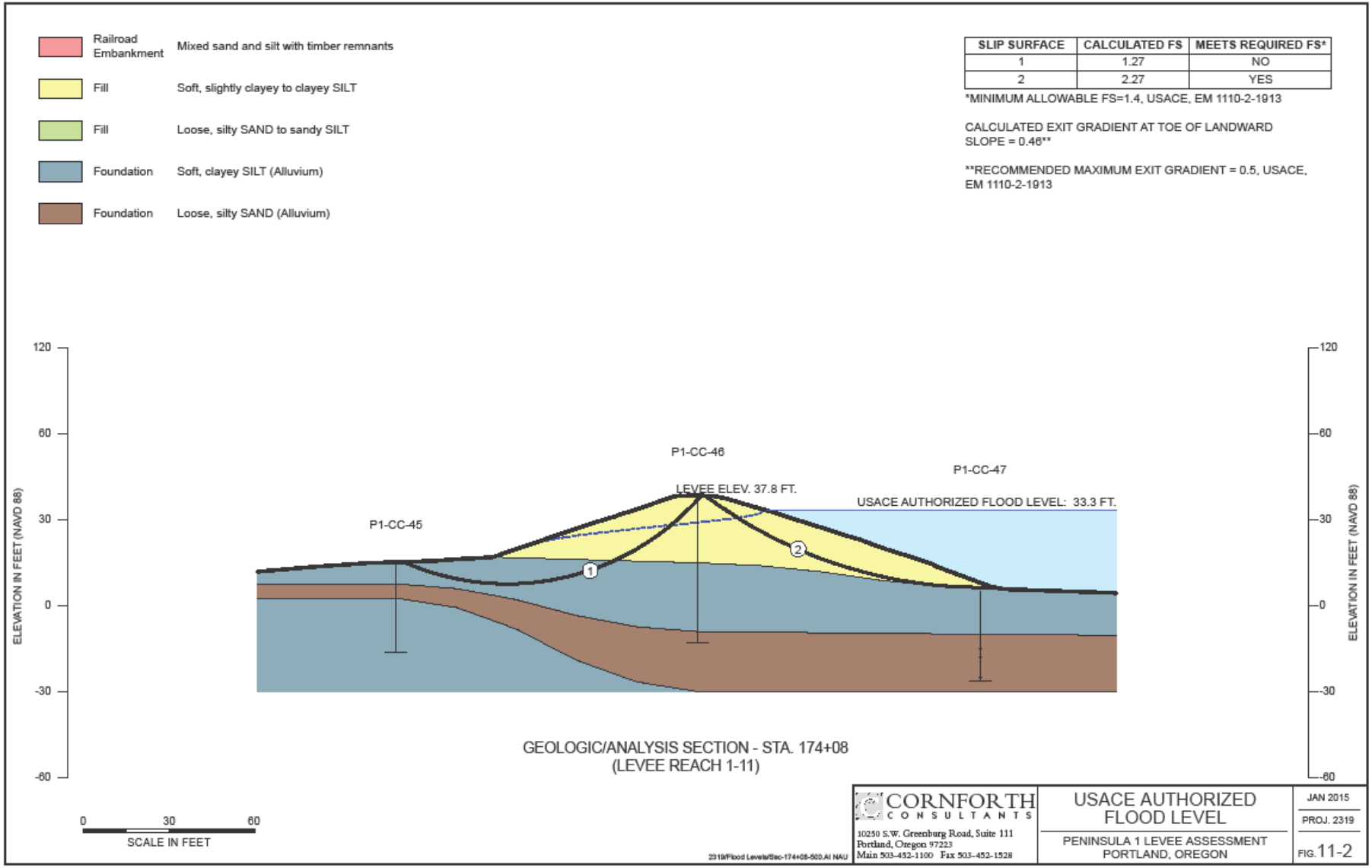
100 YEAR FLOOD LEVEL

PENINSULA 1 LEVEE ASSESSMENT
PORTLAND, OREGON

JAN 2015
PROJ. 2319
FIG. 11-1

PEN 1 – Columbia Slough Levee near PIR - USACE authorized design water elevation analysis



PEN 1 Summary

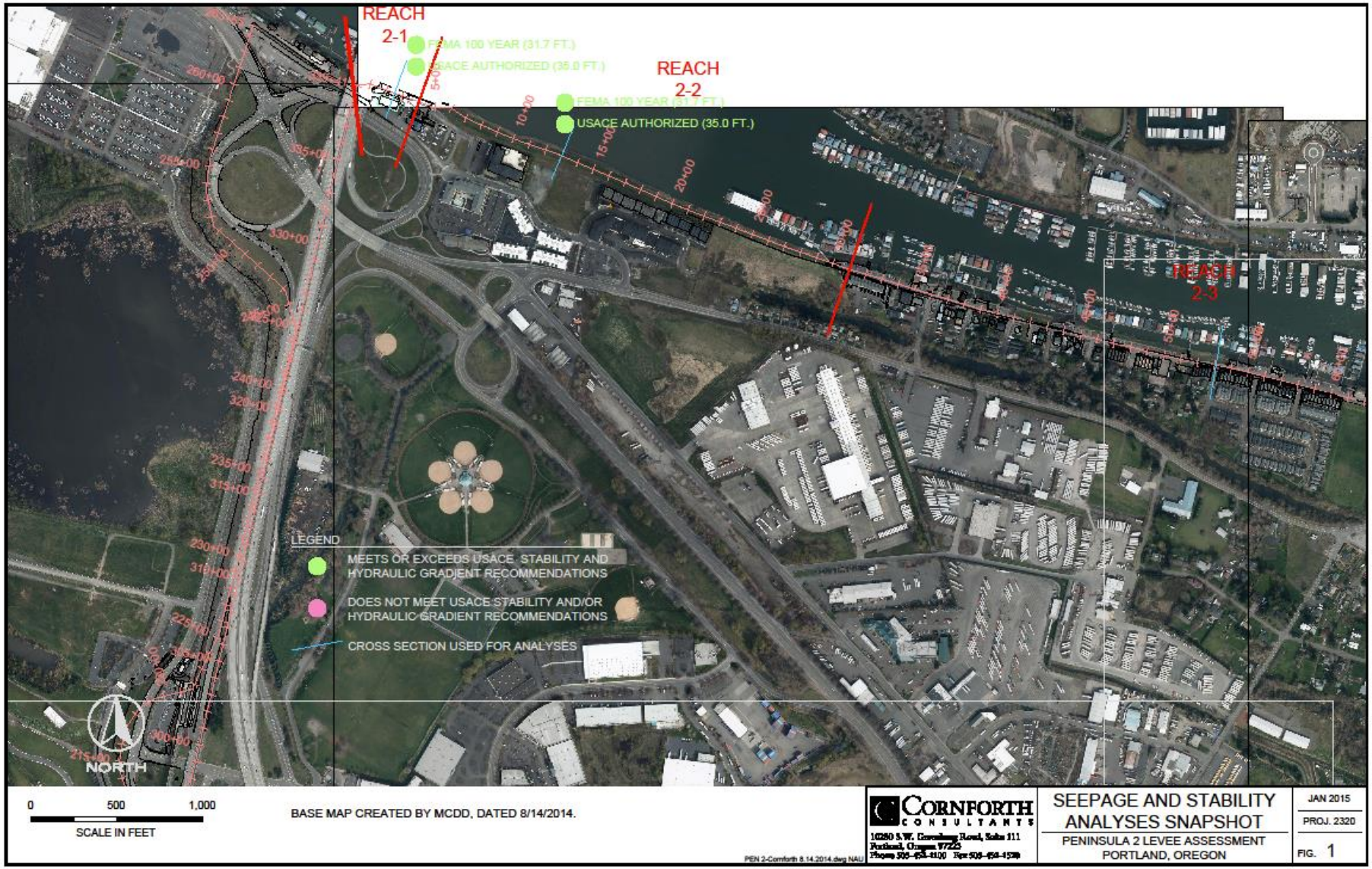
Problem areas focused on RR embankment & freeboard in Reach 1-15

Floodwalls meet USACE structural stability standards

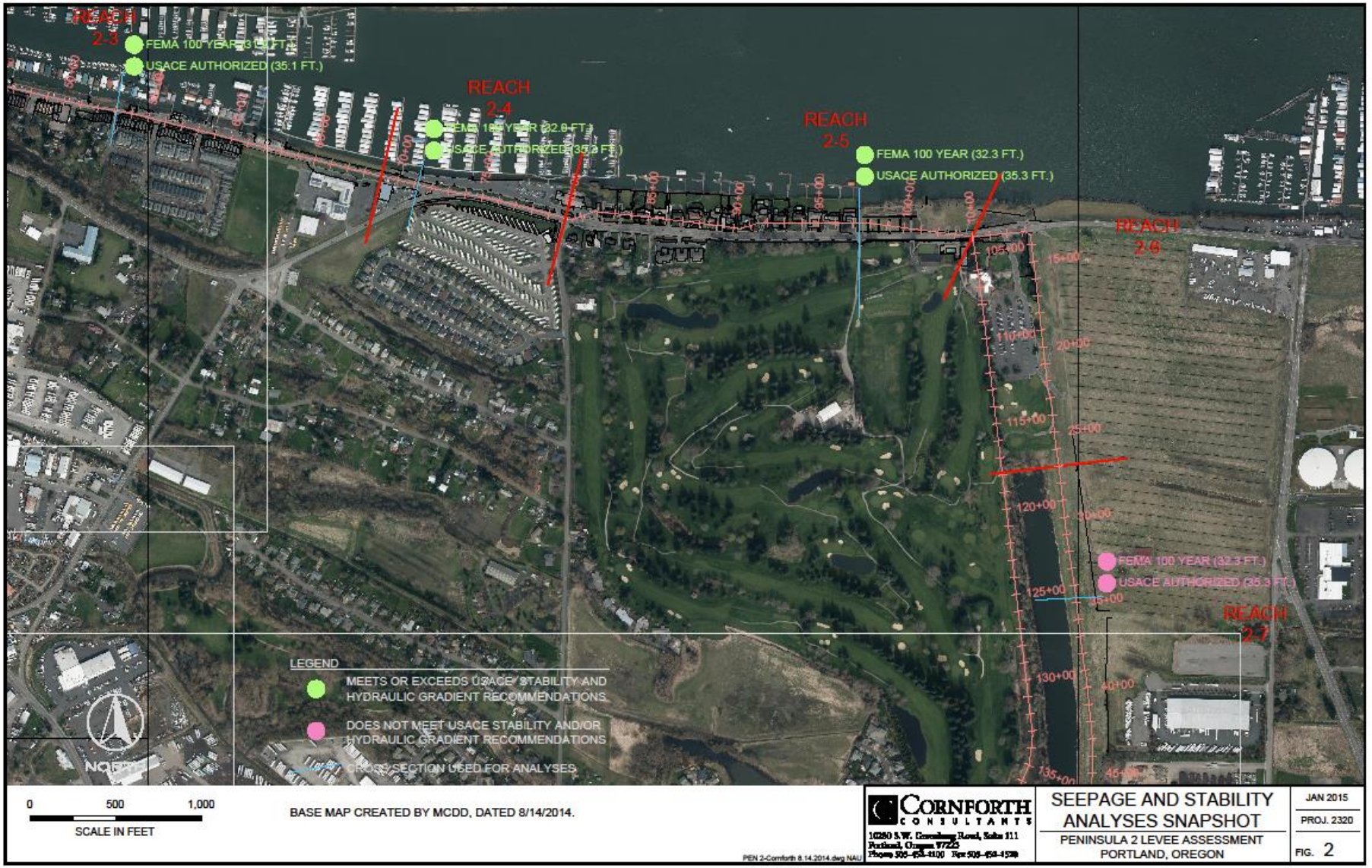
Reach 1-11 to be identified in O&M manual as “watch area” during flood events

Freeboard issues in Reach 1-15 need to be addressed

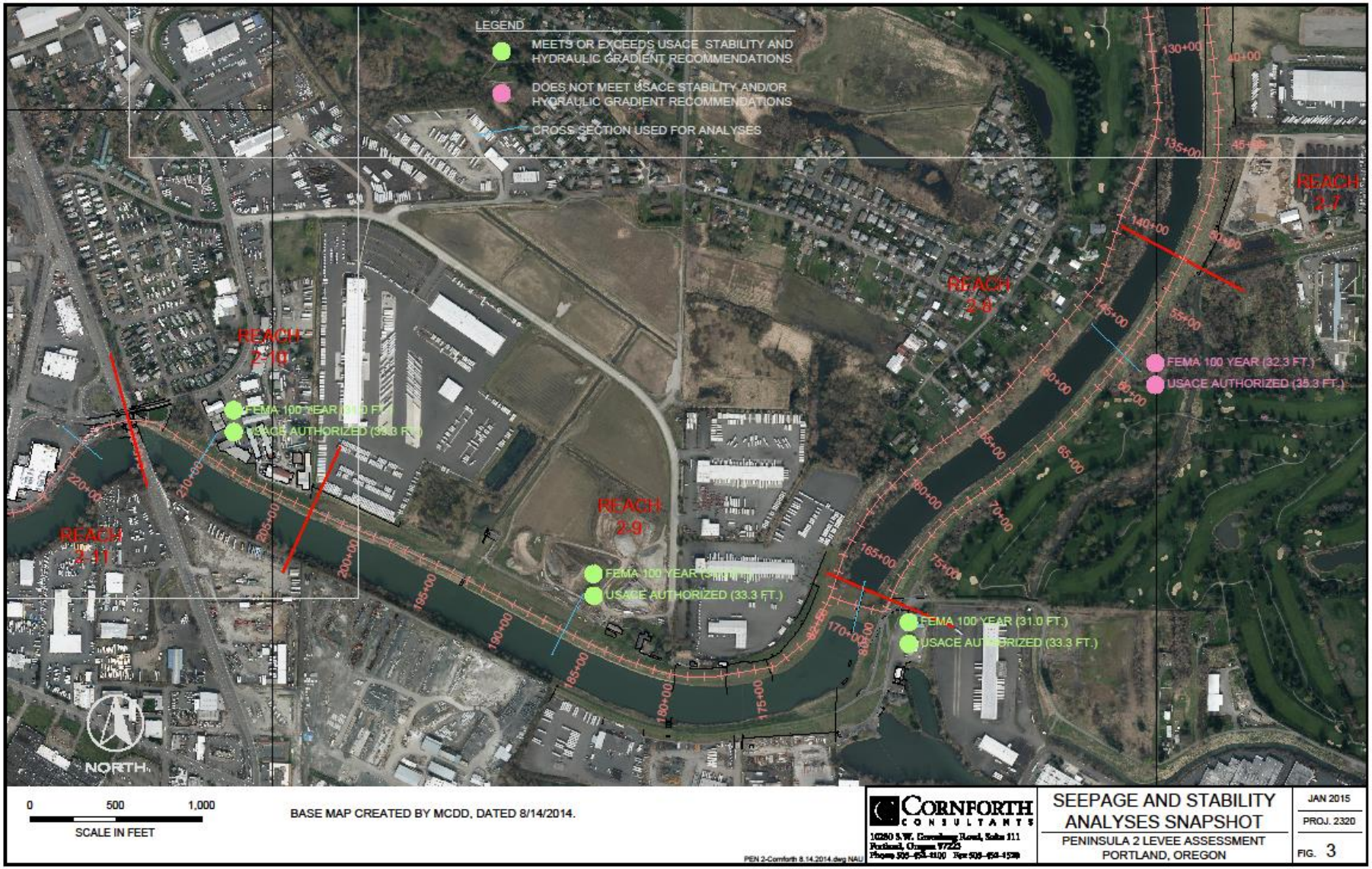
PEN 2 – NW Corner



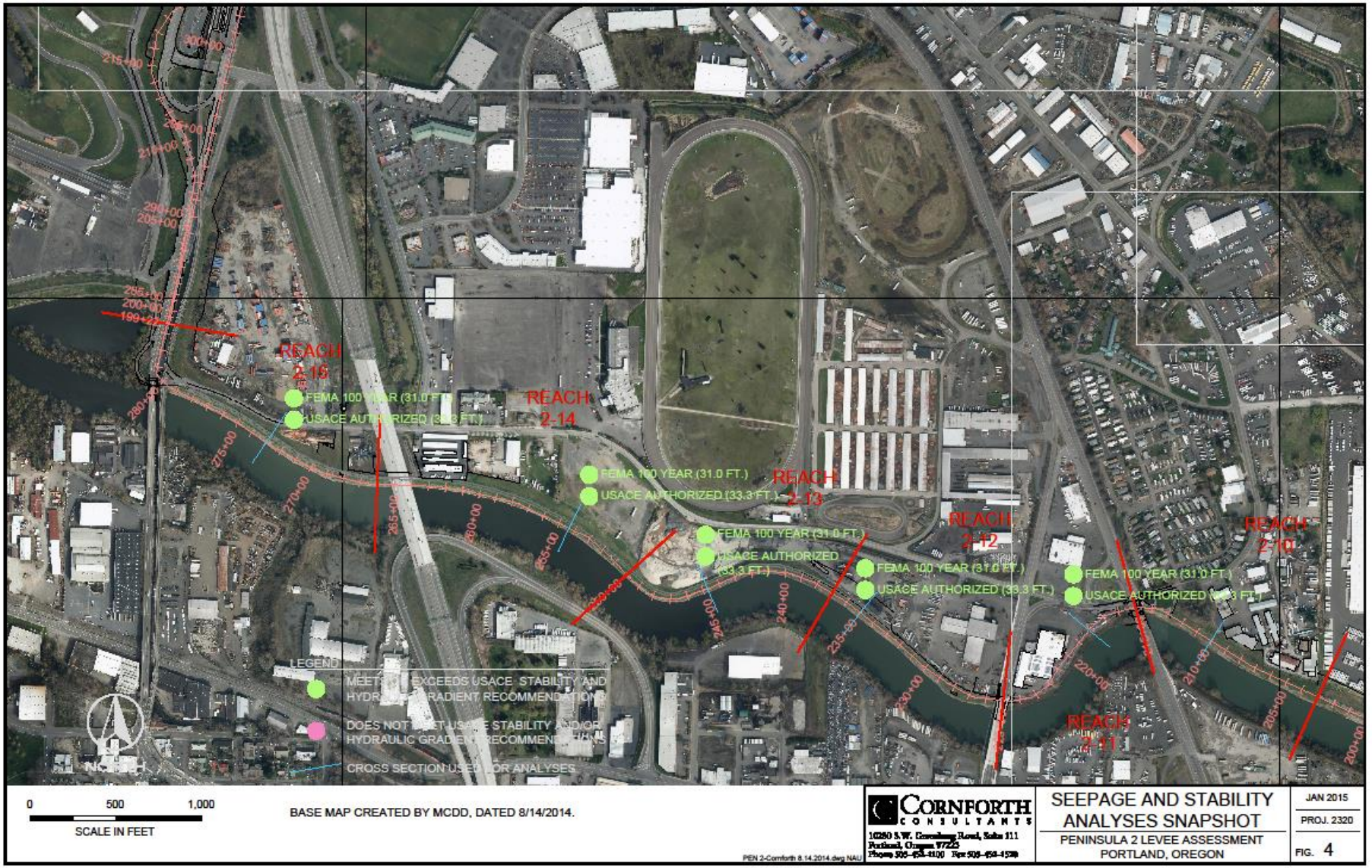
PEN 2 – NE Corner



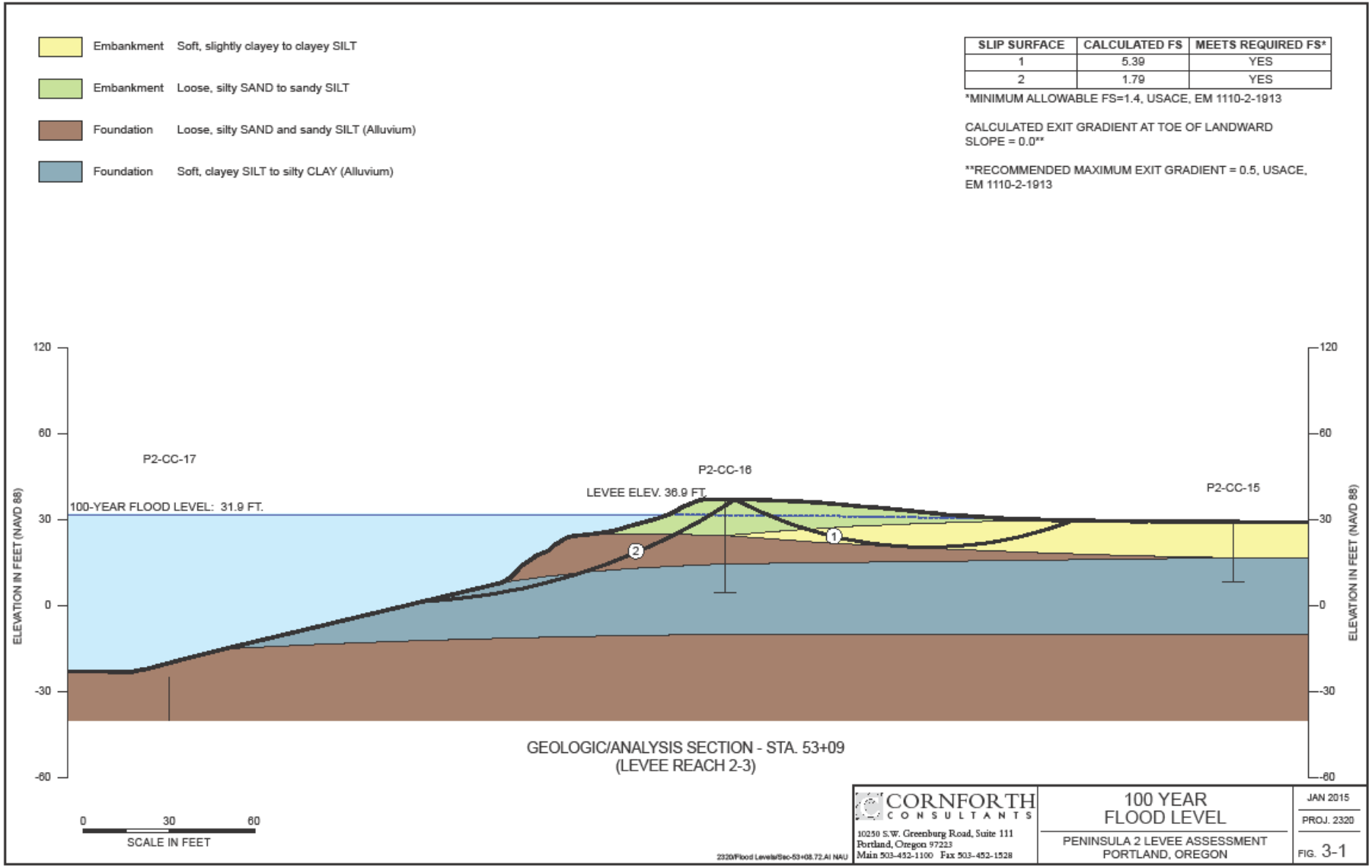
PEN 2 – SE Corner



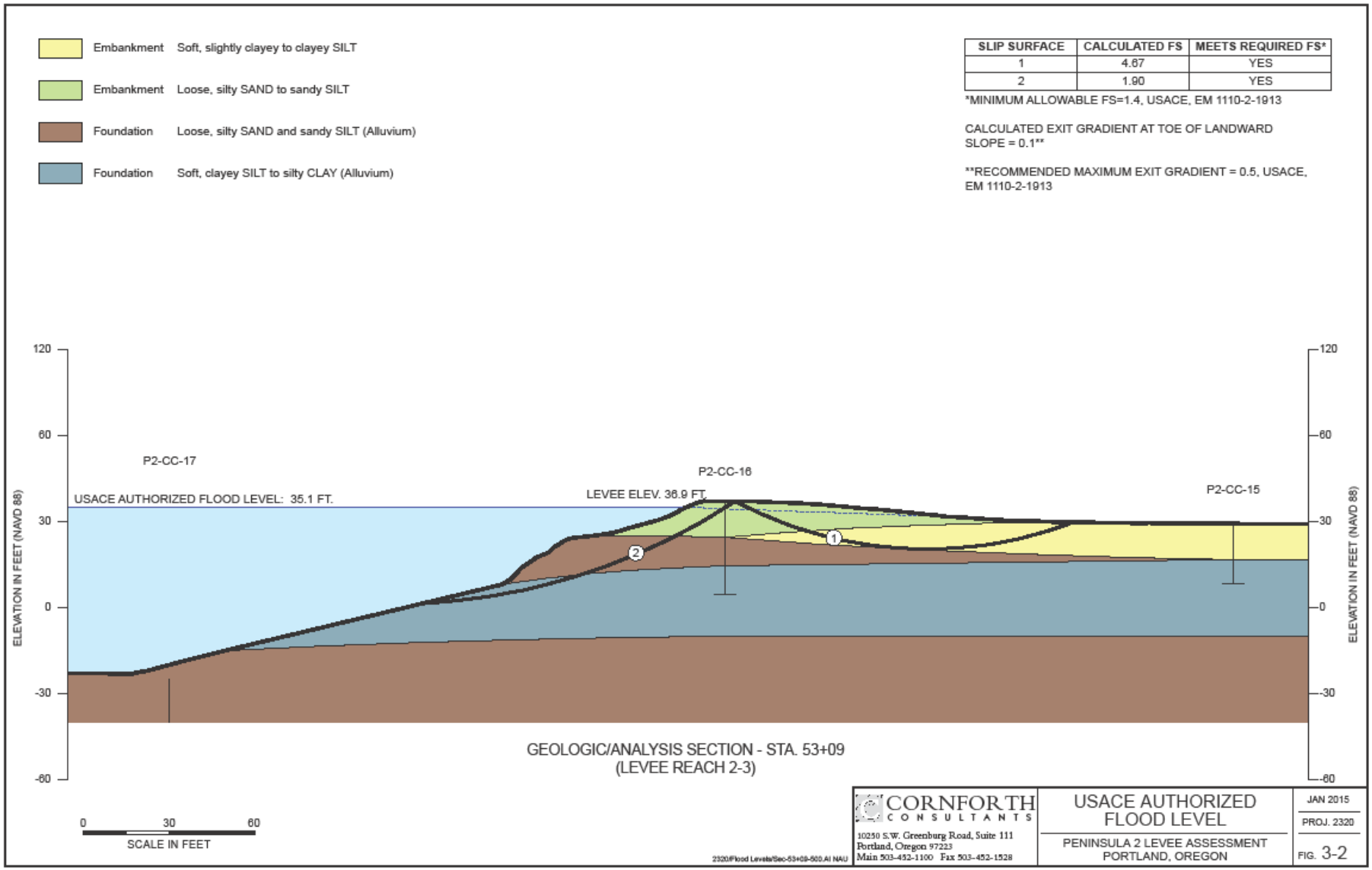
PEN 2 – SW Corner



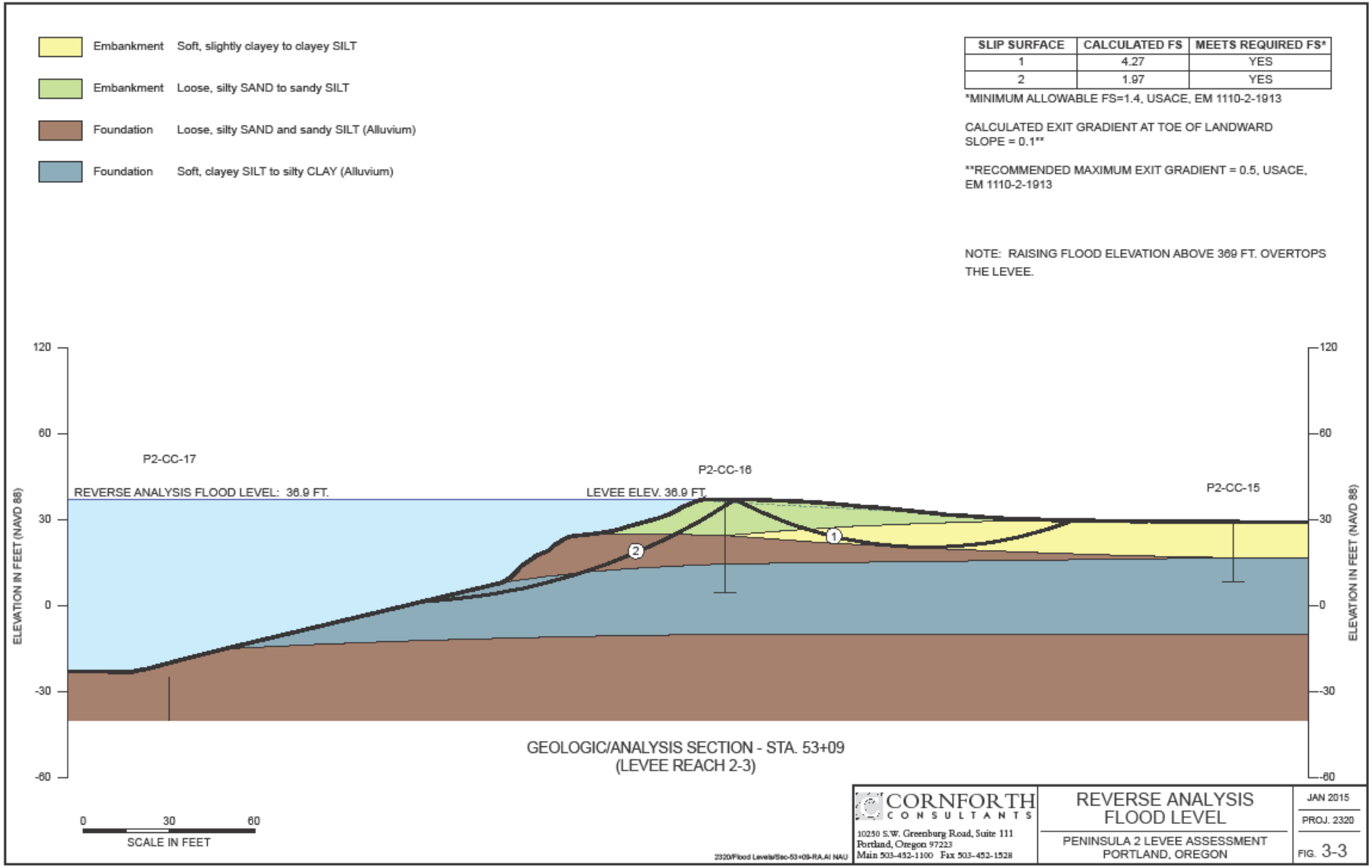
PEN 2 – Bridgeton Road Levee - 100 Year Analysis



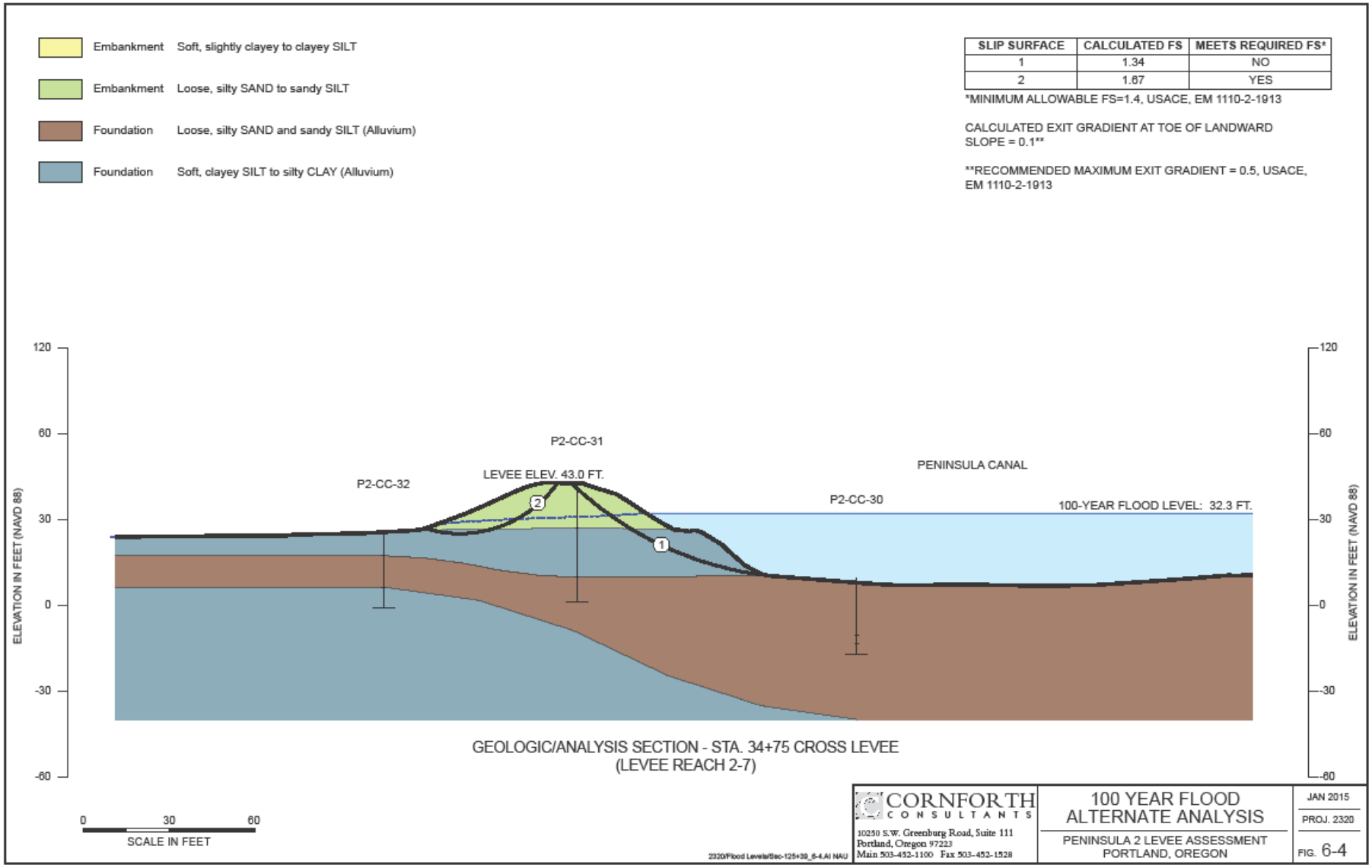
PEN 2 – Bridgeton Road Levee - USACE authorized design water elevation analysis



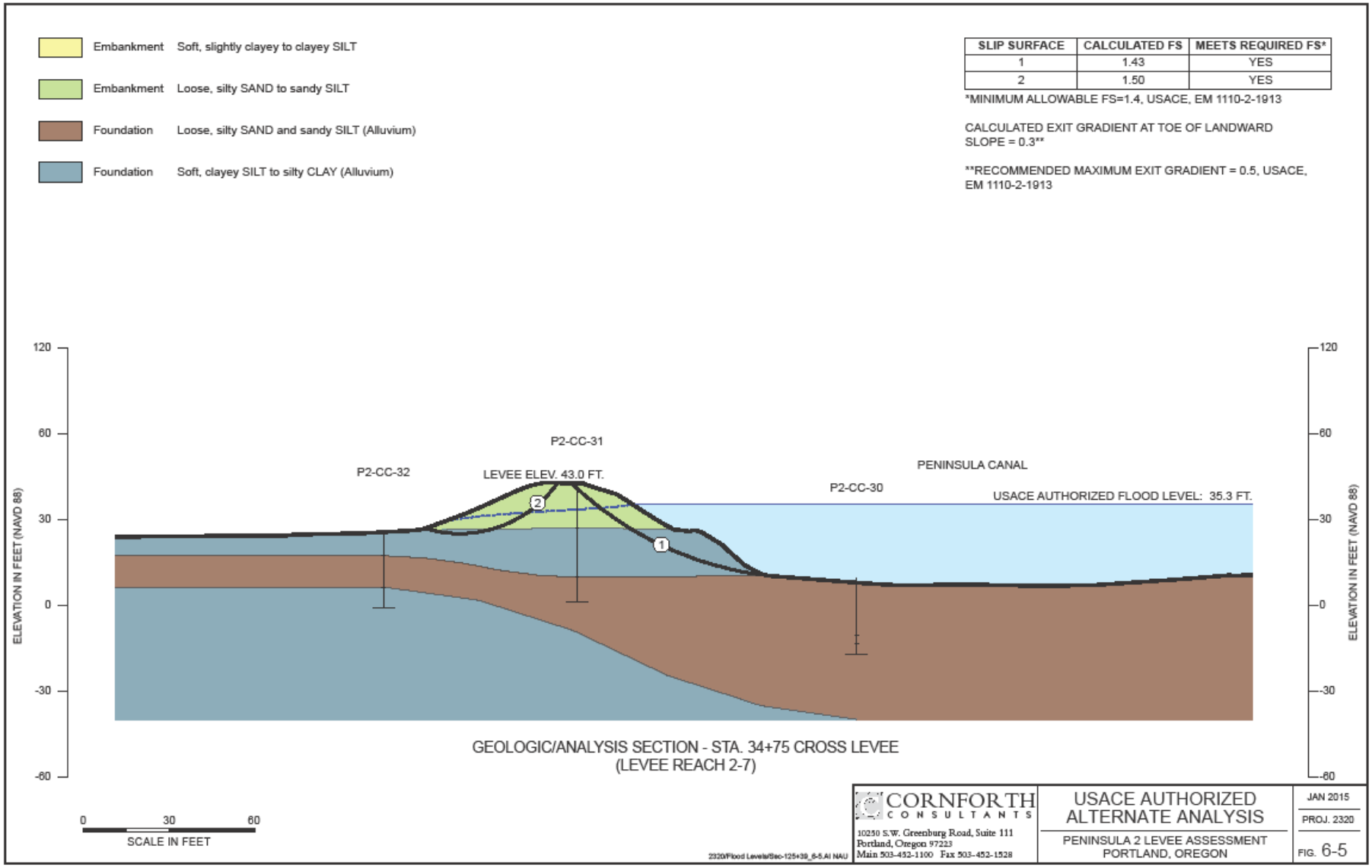
PEN 2 – Bridgeton Road Levee - Reverse Analysis



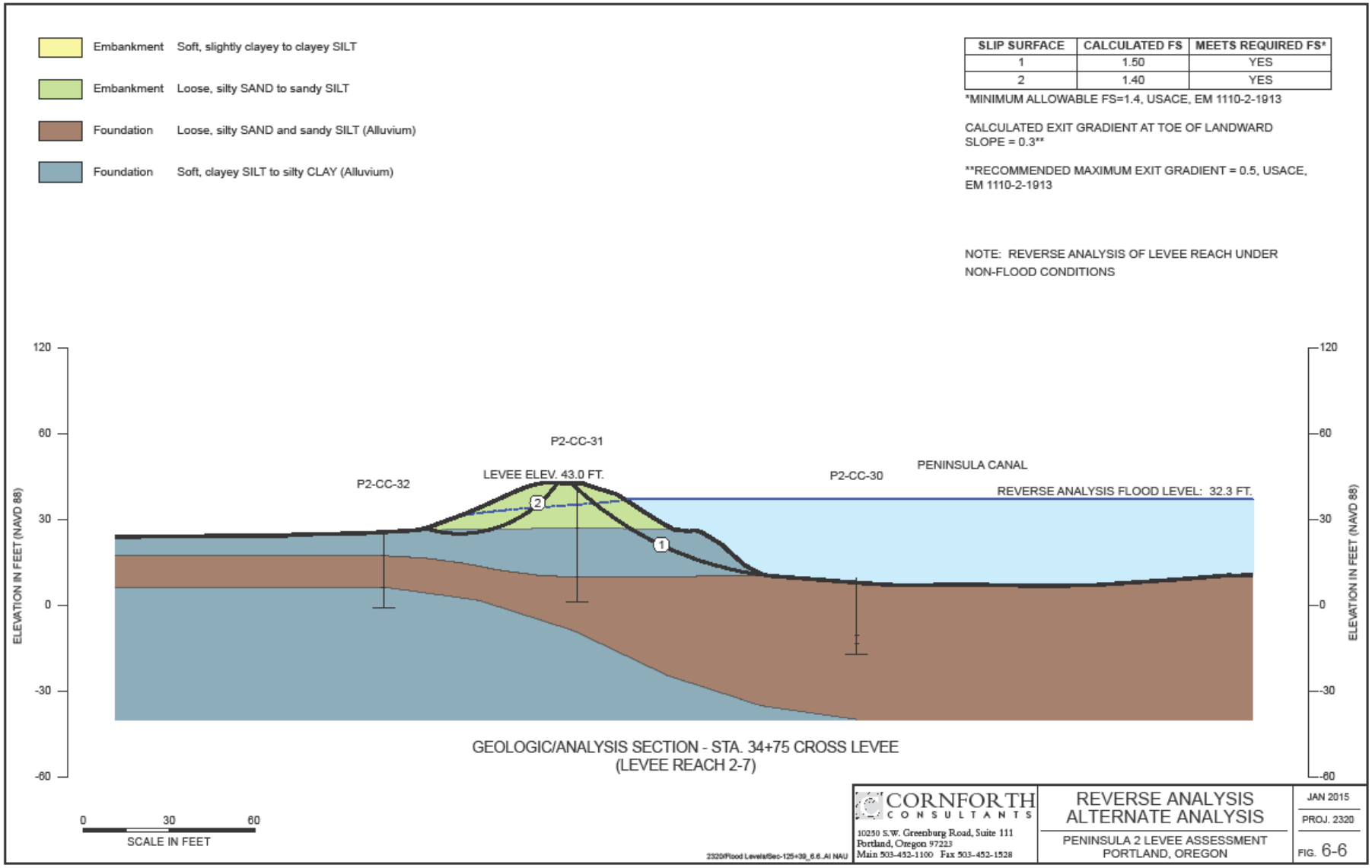
PEN 2 – Peninsula Drainage Canal - 100 Year Analysis



PEN 2 – Peninsula Drainage Canal - USACE authorized design water elevation analysis



PEN 2 – Peninsula Drainage Canal - Reverse Analysis



PEN 2 Summary

Problem areas focused on Peninsula Drainage Canal & freeboard in Reach 2-5

Seepage & stability issues along Peninsula Drainage Canal could likely be addressed with modifications to existing levee

Freeboard issues in Reach 2-5 need to be addressed

General Conclusions

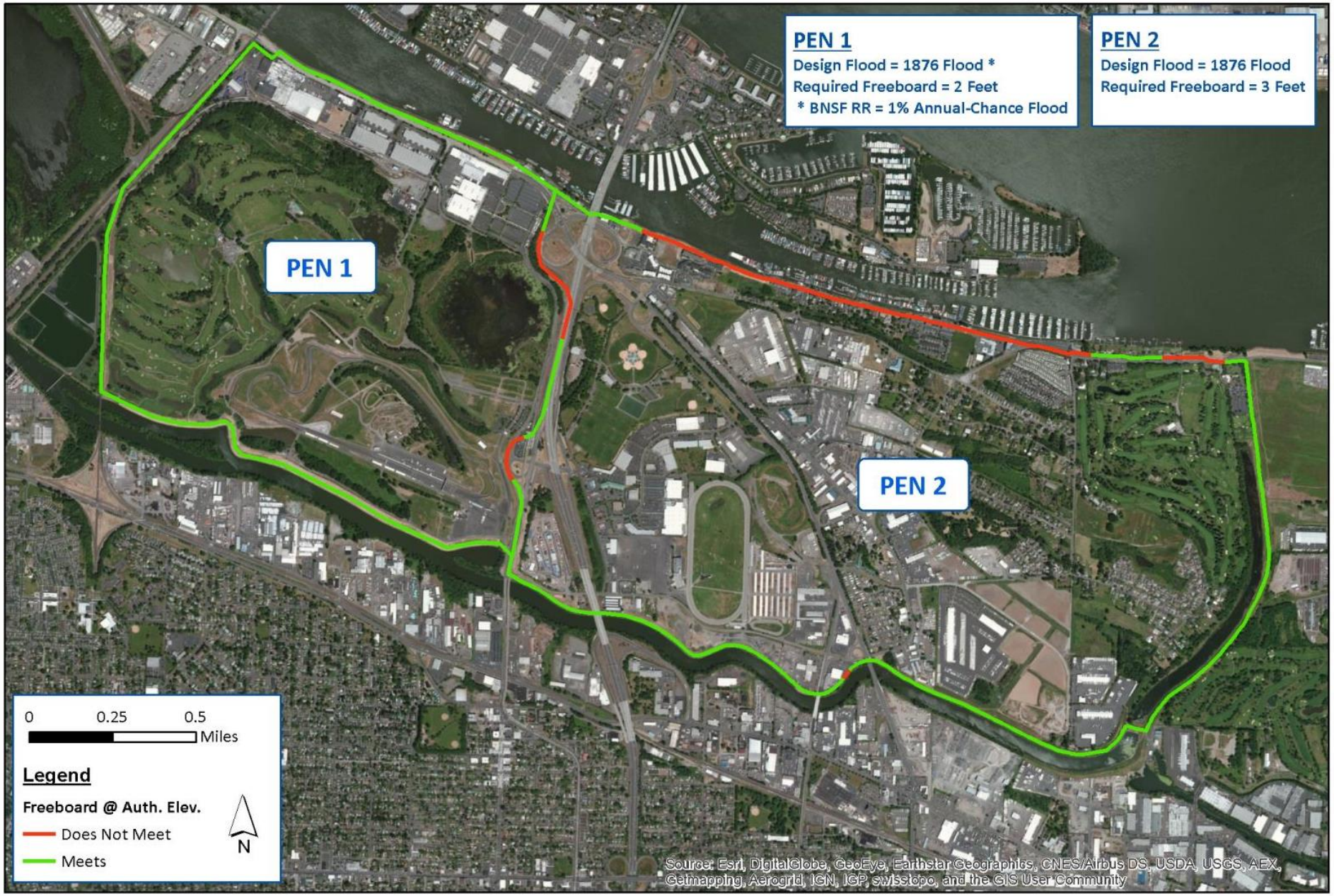
Results are positive - majority of systems perform to much higher standard

No problems under USACE authorized design water elevation that did not exist under FEMA 100 year flood

Deficiencies identified in the October 2014 Levee Engineering Assessments still need to be addressed

Analyses will be helpful to address encroachments & inform the Districts' O&M and Emergency Plans

Analyses are valuable for FEMA accreditation


PEN 1
Design Flood = 1876 Flood *
Required Freeboard = 2 Feet
* BNSF RR = 1% Annual-Chance Flood
PEN 2
Design Flood = 1876 Flood
Required Freeboard = 3 Feet
PEN 1
PEN 2
0
0.25
0.5
Miles
Legend
Freeboard @ Auth. Elev.
Does Not Meet
Meets
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community