

Water Preserve Areas Feasibility Study  
Selected Plan  
c11 design region (C-11 Impoundment)

Levee, Canals, Earth and Sitework  
Submission to EN-C

Original Submission: 4 January 2001

Revised Submission: 29 January 2001

1. Cost estimates are needed for design features associated with the C-11 impoundment within the Water Preserve Areas (WPA) Feasibility Study. This cost estimate will be used as the Selected Plan in the study.
2. The point of contact for this request is Mr. Keith Jones, at extension 1127. Let me know if I can be of more assistance.

Attachments Provided:

1. Spreadsheet Analysis Report (revised) - 3 pages
2. Geotechnical Data and Assumptions (revised) - 4 pages
3. 11" x 17" Layout Drawings - 2 pages
  - Site Layout (xsect.dgn) - shows design and cross section location
  - Alignments/Locations (levee.dgn)(revised) - shows levee and canal centerlines, distances and areas used for calculation
4. 8½" x 11" Drawing - 1 page of C-11 Embankment Design
5. Cross Section Profiles - 6 pages
6. C-11 Design Region Scope - 2 pages
  - Contains a comprehensive list of design and cost feature

**Water Preserve Areas Feasibility Study  
Levees and Canals Summary of Material Quantities  
C-11 Impoundment and Design Region (revised 1/28/01)**

	Gross Volume cu-yds	Rock Volume cu-yds	Overburden Volume cu-yds	InRoads Volume cu-yds	Using full excavation borrow and fish refuge area shown on site layout cu-yds
<b>Excavated Materials</b>					
Conveyance or Seepage Canals	758889	388624	370265		758889
F&W Littoral Shelves	61463	0	61463	908730	61463
Intake and Discharge Basins (See Note 1)	145461	95603	49857		935795
Degraded Roads	14528				14528
<b>Totals</b>	<b>980341</b>	<b>484227</b>	<b>481585</b>	<b>908730</b>	<b>1770675</b>
Amount reusable= 70%	<b>686238</b>	<b>338959</b>	<b>337109</b>		<b>1239472</b>
Amount spoil= 30%	<b>294102</b>	<b>145268</b>	<b>144475</b>		<b>531202</b>
<b>Quality Construction Material Required</b>					
Fill Material Requirements	<b>743921</b>			<b>745224</b>	<b>743921</b>
Revetment - 12" Bedding Stone	<b>6461</b>				
Revetment - 18" Rip Rap	<b>13597</b>				
<b>Spoil Material Disposal Areas</b>					
Wind Breaks	58995				58995
Borrow Pits/Mined Lakes	821905				821905
Fill Areas	8000				8000
<b>Totals</b>	<b>888900</b>				<b>888900</b>
<b>Spoil Material Generated</b>					
Excavated Materials	294102				1026754 See Note 2
<b>Totals</b>	<b>294102</b>				<b>1026754</b>

**Notes:**

Note 1: The area used for the S-503 Discharge and S-504 Intake can be viewed as a minimum requirement to be used for cost estimating. A larger area "excavation borrow and fish refuge area" is shown on the site layout drawing. That area is quantified below in the event such a large area is excavated.

Note 2: Number represents Total Excavated Material minus the Quality Construction Material Required. Calculation shows larger "excavation borrow and fish refuge area" can be optimized in size to provide the necessary material required to build the impoundment levees.

Intake and Discharge Basins	Area sqft	Area Acres	Average			Gross Volume cu-yds	Rock Volume cu-yds	Overburden Volume cu-yds
			Ground ft-NGVD	Invert ft-NGVD	Cut Depth feet			
Excavation Borrow and Fish Refuge Area	3644430	83.7	5.5	-1.0	6.5	877363	404937	472426

Note: Due to the close proximity of US-27, earthwork will include 10500' in length of stormwater runoff design from US-27. The design will require earthwork grading to create a dry storage swale approximately 1' deep. Assume 20-30' width along the 10500' length. Assume one 10' long concrete weir every 500' (20 required).

**Water Preserve Areas Feasibility Study  
Levees and Canals Summary of Material Quantities  
C-11 Impoundment and Design Region (revised 1/28/01)**

**Excavation Requirements**

Rock at Elevation = **2.0** ft-NGVD and below

Conveyance or Seepage Canals	Length feet	Inside Slope 1V on ?H	Outside Slope 1V on ?H	Bottom Width feet	Average Ground ft-NGVD	Canal Invert ft-NGVD	Canal Cut Depth feet	Cross Section Area sqft	Gross Volume cu-yds	Rock Volume cu-yds	Overburden Volume cu-yds	InRoads Length cu-yds	InRoads Volume cu-yds
Northern Boundary	6315	3.0	3.0	10.0	6.7	-1.0	7.7	255	59611	13332	46280		
Eastern Boundary													
North of S-505B	2965	3.0	3.0	20.0	7.0	-2.5	9.5	461	50597	16555	34043		
South of S-505B	11745	2.0	2.0	40.0	6.7	-10.0	16.7	1226	533214	334080	199134		
Southern Boundary	1390	3.0	3.0	10.0	7.0	-1.0	8	272	14003	2934	11069	1388	16485
Western Boundary	10290	3.0	3.0	10.0	6.9	-1.0	7.9	266	101463	21723	79740	31395	892245
<b>Totals</b>	<b>32705</b>								<b>758889</b>	<b>388624</b>	<b>370265</b>	<b>32783</b>	<b>908730</b>

Note1: InRoads length (31395') accounts for western, northern, and eastern boundary seepage canals

F&W Littoral Shelves	Length feet	Width feet	Area Acres	Average Ground ft-NGVD	Invert ft-NGVD	Cut Depth feet	Cross Section Area sqft	Gross Volume cu-yds	Rock Volume cu-yds	Overburden Volume cu-yds
North of S-505B	2965	30.0	2.0	7.0	3.0	4.0	120	13178	0	13178
South of S-505B	11745	30.0	8.1	6.7	3.0	3.7	111	48285	0	48285
<b>Totals</b>	<b>14710</b>		<b>10.1</b>					<b>61463</b>	<b>0</b>	<b>61463</b>

Intake and Discharge Basins	Area sqft	Area Acres	Average Ground ft-NGVD	Invert ft-NGVD	Cut Depth feet	Gross Volume cu-yds	Rock Volume cu-yds	Overburden Volume cu-yds
S-503 Intake	79860	1.8	7.4	-15.0	22.4	66254	50282	15972
S-503 Discharge	89930	2.1	5.4	-1.0	6.4	21317	9992	11325
S-504 Intake	86860	2.0	5.9	-1.0	6.9	22198	9651	12546
S-504 Discharge	69330	1.6	5.9	-8.0	13.9	35692	25678	10014
<b>Totals</b>		<b>7.5</b>				<b>145461</b>	<b>95603</b>	<b>49857</b>

Degraded Roads	Length feet	Width feet	Area Acres	Average Ground ft-NGVD	Surface Elevation ft-NGVD	Cut Depth feet	Cross Section Area sqft	Gross Volume cu-yds
SW 26th St	8000	30.0	5.5	6.9	7.7	0.8	24	7111
SW 36th St	5135	30.0	3.5	6.2	7.5	1.3	39	7417
<b>Totals</b>	<b>13135</b>		<b>9.0</b>					<b>14528</b>

**Water Preserve Areas Feasibility Study  
Levees and Canals Summary of Material Quantities  
C-11 Impoundment and Design Region (revised 1/28/01)**

**Fill Material Requirements**

Levees	Length feet	Inside Slope 1V on ?H	Outside Slope 1V on ?H	Top Width feet	Average Ground ft-NGVD	Top of Levee ft-NGVD	Levee Height feet	Cross Section Area sqft	Gross Volume cu-yds	InRoads Length cu-yds	InRoads Volume cu-yds	
Eastern Boundary	12020	3.0	3.0	12	6.4	18.0	11.6	543	241682			
Southern Boundary	5000	3.0	3.0	12	7.4	18.0	10.6	464	85978			
Western Boundary	10125	3.0	3.0	12	6.8	18.0	11.2	511	191520	35532	671147	See Note2
Mitigation Boundary	11230	3.0	3.0	12	6.8	11.0	4.2	103	42973	10998	70875	See Note3
S-504 Discharge Pool	1075	3.0	3.0	12	6.3	10.0	3.7	85	3403	1063	3202	
<b>Totals</b>	<b>48735</b>								<b>743921</b>	<b>47593</b>	<b>745224</b>	

Note2: InRoads length accounts for western, northern, eastern, and southern boundary levees  
 Note3: InRoads cross section used a 13.0 ft-NGVD top of levee instead of 11.0 ft-NGVD

Revetment	12" Bedding Stone					Rip Rap				
	Length feet	Width feet	Area acres	Depth feet	Gross Volume cu-yds	Length feet	Width feet	Area acres	Depth feet	Gross Volume cu-yds
Northwest Corner	4750	19.6	2.1	1.0	3448	4750	27.5	3.0	1.5	7257
Northeast Corner	1000	19.6	0.4	1.0	726	1000	27.5	0.6	1.5	1528
Eastern (inside corner)	1000	19.6	0.4	1.0	726	1000	27.5	0.6	1.5	1528
Eastern (outside corner)	1000	19.6	0.4	1.0	726	1000	27.5	0.6	1.5	1528
Southeastern Corner	1150	19.6	0.5	1.0	835	1150	27.5	0.7	1.5	1757
<b>Totals</b>	<b>8900</b>	<b>4.0</b>	<b>6461</b>		<b>8900</b>	<b>5.6</b>	<b>13597</b>			

Wind Breaks	Length feet	Inside Slope 1V on ?H	Outside Slope 1V on ?H	Top Width feet	Average Ground ft-NGVD	Top of Levee ft-NGVD	Levee Height feet	Cross Section Area sqft	Gross Volume cu-yds
Wind Break (east)	1605	4.0	4.0	12	6.1	16.0	9.9	511	30367
<b>Totals</b>	<b>3360</b>								<b>58995</b>

Borrow Pits/Mined Lakes	Area sqft	Area acres	Bottom Depth ft-NGVD	Finished Depth ft-NGVD	Fill Depth feet	Gross Volume cu-yds
#1 South	360220	8.3	-20.0	-2.0	18.0	240147
#2	577675	13.3	-20.0	-2.0	18.0	385117
#3	119975	2.8	-10.0	-2.0	8.0	35548
#4	206240	4.7	-20.0	-2.0	18.0	137493
<b>Totals</b>		<b>29.6</b>				<b>821905</b>

Fill Areas	Area sqft	Area acres	Average Ground ft-NGVD	Finished Height ft-NGVD	Fill Depth feet	Gross Volume cu-yds

\*\*\*Geotechnical Data and Assumptions to Use for  
Feasibility Level Cost Estimates (Amended 1/29/01)

**Design Region: C11**

Compaction Factor for Sandy Overburden:  
Answer: 0.85

Swell Factor for Sandy Overburden:  
Answer: 1.10

Compaction Factor for Rock:  
Answer: 0.85

Swell Factor for Rock:  
Answer: 1.30

Material Makeup of Levee Embankment:

Answer: Crushed rock from Canals/Fish refugia. This material must be crushed to a maximum particle size of 3 inches or less in order to utilize for levee construction. The rock will also need to be processed to produce a well-graded material for dam construction. Material may also be utilized from the sand and gravel overburden excavated for the seepage canals/Fish refugia. A majority of the rock will be excavated from the adjacent C-502A Canal (Seep 3A Design Region). It is estimated that overburden exists from ground surface to elevation +2. From +2 to elevation -15 feet NGVD limestone bedrock will be encountered with intermittent Sand lenses. At elevation -15 and deeper, mostly hard limestone is in place.

Special Levee Construction Design Criteria:

Foundation Treatment:

Answer: Remove top 18 inches of overburden for levee width. In addition, assume 1% of levee length requires removal of 36 inches of overburden.

Seepage Control:

Answer: Toe drain not required.

Slope Protection:

Answer: Protect 19 feet of upstream levee slope for approximately 20% of levee perimeter (See Typical C-11

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\*\*\* Assumptions based upon limited subsurface information and prior projects, as of 1/21/01

Embankment Levee Design which includes 12 inches bedding stone plus 18 inches of rip rap from toe to elevation 12.2 ft NGVD+/-). Rip Rap to be placed in strategic locations including sharp corners, bends, and areas of long wind fetch. Use excess limestone from onsite excavations if available. Otherwise import limestone. Remaining 80% of upstream embankment perimeter will be grassed for erosion protection. Refer to Alignment/Locations design file and spreadsheet for locations of rip rap.

Where the material will come from?

Answer: Material for the C-11 Impoundment will be obtained from:

1. Usable excavated material from adjacent seepage canals
2. Limited excavation within the impoundment
3. Usable excavated material from construction of C-502A and C-502B (seep3a and seep3b area will be next priority)
4. Usable excavated material from construction of other WPA features in a 10 mile proximity of C-11

Notes:

Material balance will be developed showing how much will come from each location

-- When constructing the levee, the Contractor will be required to utilize 12 inch lifts which then will be compacted down to 10 to 11 inches. Compaction requirements will be to 98% maximum dry density based upon standard proctor compaction tests or a nuclear density meter. Also, control of excessive moisture shall be the responsibility of the Contractor.

Excavation Procedure/Technique and/or Blasting Requirements (at this location only):

Answer: Assume some blasting of rock will be required (Rios from EN-G will supply blasting patterns/plan). After initial rock blasting some additional ripping will be required with backhoe with ripper attachment. Following blasting and ripping, normal excavation equipment may be utilized.

**Percentage of Usable Excavated Overburden Soil Material:**

Answer: Assume 70% of the material can be reused. The remaining 30% should be disposed of onsite or at an

approved disposal area. Using excess unsuitable material to build wind breaks, boat ramps or to flatten interior slopes is recommended also. The distribution of overburden soil versus rock is detailed above in red.

**Percentage of Usable Excavated Rock Material:**

Answer: Assume 70% of the material can be reused. The remaining 30% should be disposed of onsite or at an approved disposal area. Using excess unsuitable material to build wind breaks, boat ramps or to flatten interior slopes is recommended also. The distribution of overburden soil versus rock is detailed above in red.

Other Considerations:

1. A rock crushing plant will be setup within the impoundment to process excavated material prior to placement.
2. Outside and inside impoundment slopes should be grassed and maintained by mowing. Selected areas where slope protection riprap will be placed will not be grassed.
3. Assume overburden soils have a unit weight of 115 pcf while limestone has unit weight of 145 pcf for hauling purposes.

Geotechnical Instrumentation:

NOTE: This instrumentation is required for monitoring and operational safety of project features within the design region.

1. Shallow Depth Piezometers ( $\pm$  5.0 feet from natural grade)  
Answer: Assume 3 piezometers will be included.
2. Medium Depth Piezometers (greater than 5.0 and less than 50 feet from natural grade) - Assume 10 piezometers will be included.
3. Deep Depth Piezometers (greater than 50 feet from natural grade) - Assume 3 piezometers will be included.
4. Inclinometers - Assume 1 constructed through final embankment downstream slope down to hard limestone. Locate on northeast section adjacent to housing development.
5. Others



50' OFF SOUTH POST RD.

MITIGATION AREA DESIGN ELEVATIONS (FT-NGVD)  
 TOP OF LEVEE 11.0  
 MAXIMUM MITIGATION POOL 8-8.5  
 AVERAGE LOCAL GROUND 6.5

MITIGATION STORAGE AREA = 205 ACRES

L-511M  
 CREST=11.0' NGVD  
 TOP WIDTH=12'  
 SS=1 ON 3  
 BW=42-45' EST

S-506

SW 26TH ST.

SW 26TH ST.

S-505B

ws=5.0

ws=4.0

WIND SETUP BREAK  
 AND SPOIL DISPOSAL MOUND  
 CREST=16.0' NGVD  
 TOP WIDTH=12'  
 SS=1 ON 4  
 BW=92-95' EST

L-511  
 CREST=18.0' NGVD  
 TOP WIDTH=12'  
 SS=1 ON 3  
 BW=84-88' EST

SW 36TH ST.

EASTERN ROW BOUNDARY

C-II IMPOUNDMENT

DESIGN ELEVATIONS (FT-NGVD)  
 TOP OF LEVEE 18.0  
 SURCHARGE POOL 13.0  
 FULL POOL (SPILLWAY INVERT) 11.2  
 NORMAL POOL 10.0  
 AVERAGE IMPOUNDMENT GROUND 6.0  
 EXCAVATION MAX DEPTH -1.0

STORAGE AREA = 1490 ACRES  
 NORMAL POOL DEPTH = 4 FEET  
 STORAGE = 5960 ACFT

70' OFF US-27

S-505C  
 S-504A  
 HEAD=7.65  
 TAIL=7.00  
 S-504  
 HEAD=8.75  
 TAIL=7.70

BOAT RAMP

SEEPAGE CANAL

SPILLWAY

S-502

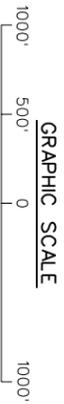
EXCAVATION BORROW  
 AND FISH REFUGE AREA

S-503

S-505A

C-II

S-381



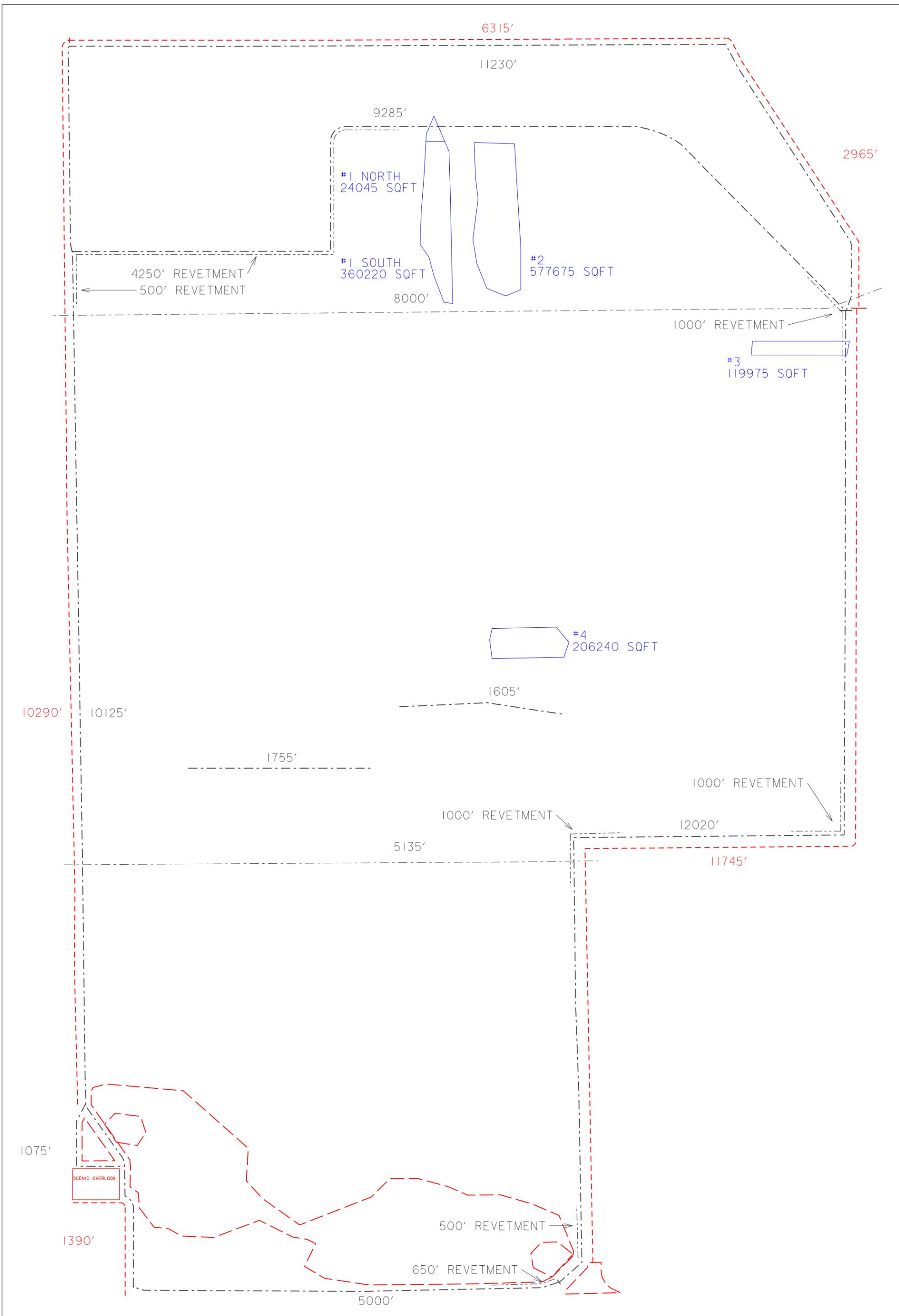
C11-01  
 PLATE

CENTRAL AND SOUTHERN FLORIDA PROJECT  
 WATER PRESERVE AREAS FEASIBILITY REPORT  
 C-11 IMPOUNDMENT AREA

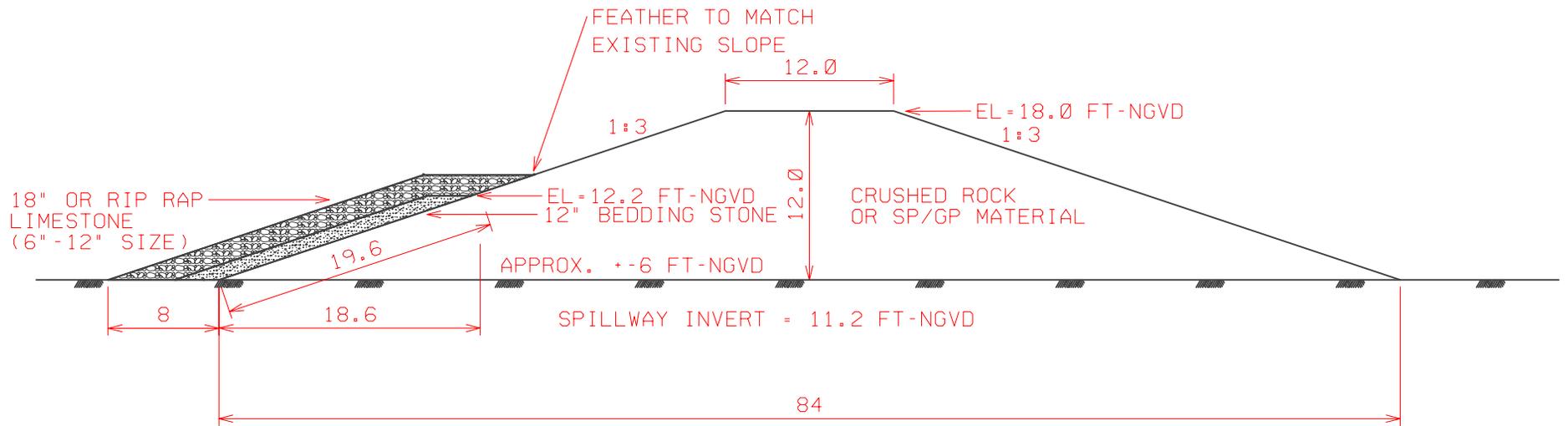
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Dated: NOV 2000		
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DEPARTMENT OF THE ARMY  
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS  
 JACKSONVILLE, FLORIDA

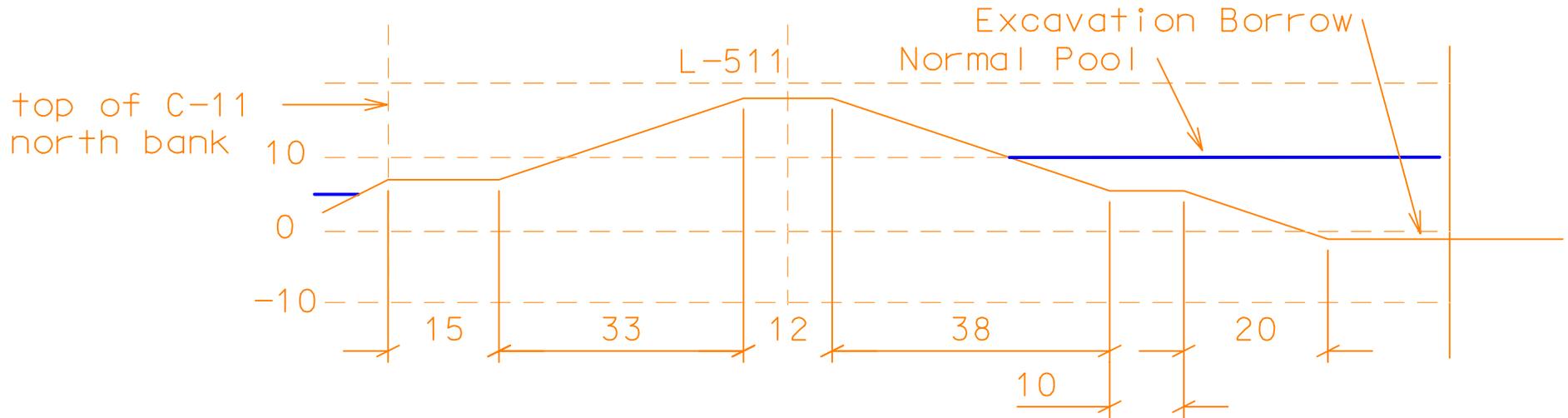




TYPICAL C-11  
EMBANKMENT



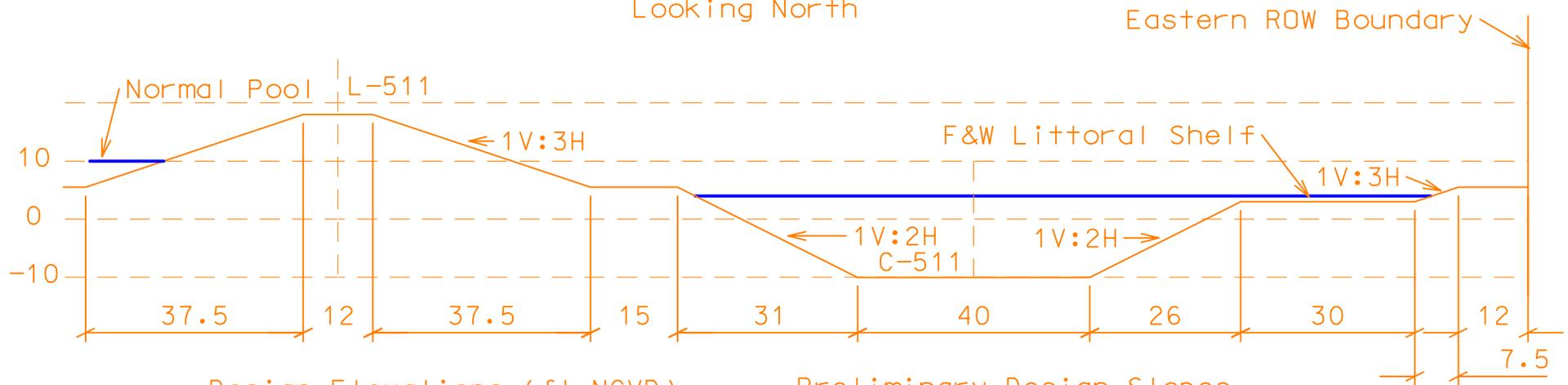
Xsection 1 of L-511  
 Southern Level of C-11 Impoundment  
 Looking West



Design Elevations (ft-NGVD)  
 Top of Levee 18.0  
 Surcharge Pool 13.0  
 Full Pool (Spillway Invert) 11.2  
 Normal Pool 10.0  
 Average Impoundment Ground 6.0  
 Average Local Ground 5.5  
 C-11 Optimum 4.0  
 Excavation Max Depth -1.0  
 C-11 Canal Bottom -15.0

Preliminary Design Slopes  
 Outside Levee Slope = 1V:3H  
 Inside Levee Slope = 1V:3H  
 Excavation Borrow Slope = 1V:3H

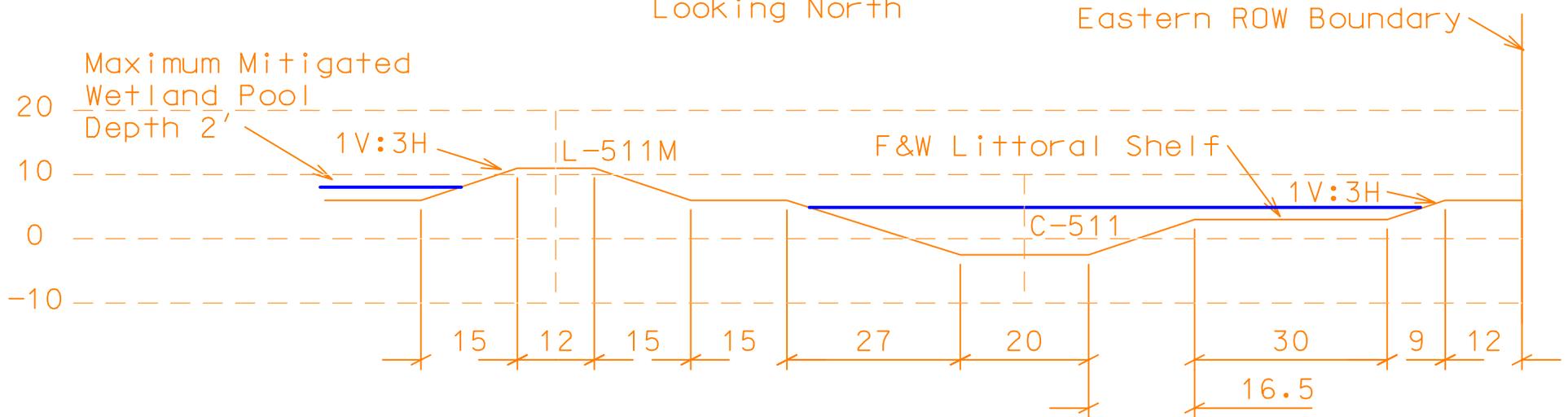
Xsection 2 of L-511  
 Eastern Level of C-11 Impoundment  
 with C-11 extension profile  
 Looking North



Design Elevations (ft-NGVD)  
 Top of Levee 18.0  
 Surcharge Pool 13.0  
 Full Pool (Spillway Invert) 11.2  
 Normal Pool 10.0  
 Average Impoundment Ground 6.0  
 Average Local Ground 5.5  
 C-11 Extension Optimum 4.0  
 F&W Littoral Shelf 3.0  
 C-11 Extension Bottom -10.0

Preliminary Design Slopes  
 Outside Levee Slope = 1V:3H  
 Inside Levee Slope = 1V:3H  
 C-11 Extension Slope = 1V:2H

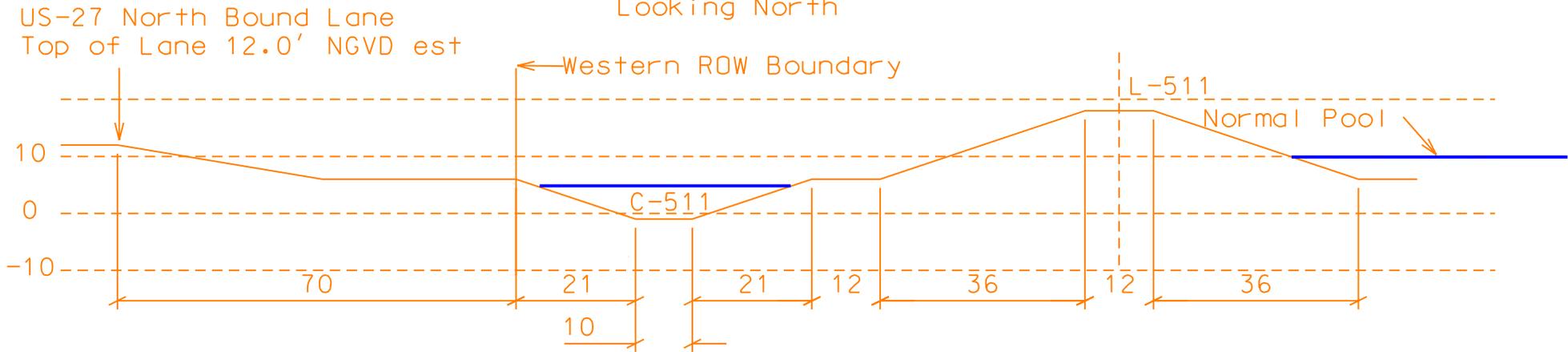
Xsection 3 of L-511  
 Eastern Levee of C-11 Impoundment Mitigation Area  
 with seepage canal profile  
 Looking North



Design Elevations (ft-NGVD)  
 Top of Mitigation Area Levee 11.0  
 Maximum Mitigation Pool Depth 2.0 feet  
 Maximum Mitigation Pool Elev 8-8.5  
 Average Impoundment Ground 6.0  
 Average Local Ground 6.5  
 Seepage Canal Optimum 5.0  
 F&W Littoral Shelf 3.0  
 Seepage Canal Bottom -2.5

Preliminary Design Slopes  
 Outside Levee Slope = 1V:3H  
 Inside Levee Slope = 1V:3H  
 Seepage Canal Slope = 1V:3H

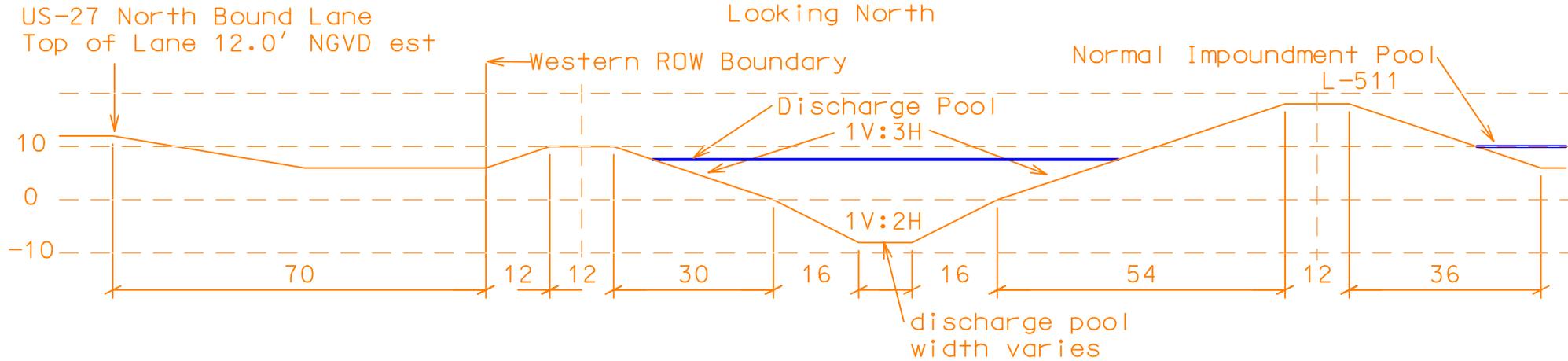
Xsection 4 of L-511  
 Western Level of C-11 Impoundment  
 with seepage canal profile  
 Looking North



Design Elevations (ft-NGVD)  
 Top of Levee 18.0  
 Surcharge Pool 13.0  
 Full Pool (Spillway Invert) 11.2  
 Normal Pool 10.0  
 Average Impoundment Ground 6.0  
 Average Local Ground 6.0  
 Seepage Canal Optimum 5.0  
 Seepage Canal Bottom -1.0

Preliminary Design Slopes  
 Outside Levee Slope = 1V:3H  
 Inside Levee Slope = 1V:3H  
 Seepage Canal Slope = 1V:3H

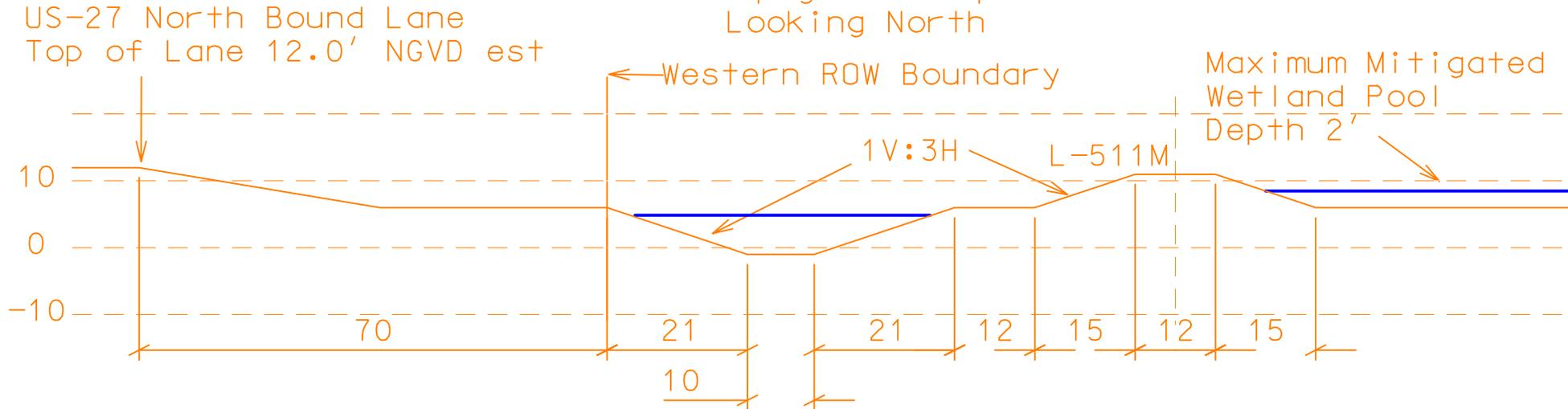
Xsection 5 of L-511  
 S-504 Discharge Pool Levee  
 of C-11 Impoundment  
 Looking North



Design Elevations (ft-NGVD)  
 Top of Impoundment Levee 18.0  
 Top of S-504 Discharge Pool Levee 10.0  
 Normal Discharge Pool 7.0-7.7  
 Average Local Ground 6.0  
 Discharge Pool Bottom -8.0

Preliminary Design Slopes  
 Outside Levee Slope = 1V:3H  
 Inside Levee Slope = 1V:3H  
 Discharge Pool Slope = 1V:2H below 0.0 NGVD

Xsection 6 of L-511M  
 Western Level of C-11 Impoundment  
 adjacent to mitigation area  
 with seepage canal profile  
 Looking North



Design Elevations (ft-NGVD)  
 Top of Mitigation Area Levee 11.0  
 Maximum Mitigation Pool Depth 2.0 feet  
 Maximum Mitigation Pool Elev 8-8.5  
 Average Impoundment Ground 6.0  
 Average Local Ground 6.5  
 Seepage Canal Optimum 5.0  
 Seepage Canal Bottom -1.0

Preliminary Design Slopes  
 Outside Levee Slope = 1V:3H  
 Inside Levee Slope = 1V:3H  
 Seepage Canal Slope = 1V:3H

Design Region: c11 (C-11 Impoundment)

Design:

- a) Design levees and seepage canals for 4' deep impoundment. Provide revetment for inside slope protection where sharp corners occur.
- b) Design gated spillway and a pump station for a 6' deep impoundment.
- c) Design gated culvert structures for seepage control.
- d) Degrade SW 26<sup>th</sup> and SW 36<sup>th</sup> St inside impoundment boundary.
- e) Clear and grub within impoundment.
- f) Relocate SBA communications tower outside impoundment.
- g) Partial backfill rock/sand mining pits within impoundment if they are deep enough to contribute to seepage problems.
- h) Provide parking, scenic overlook, and boat ramp in southwest area off of US-27.

Impoundment Design Elevations (ft-NGVD)

Top of Levee 18.0  
Surcharge Pool 13.0  
Full Pool (Spillway Invert) 11.2  
Normal Pool 10.0  
Average Impoundment Ground 6.0  
Excavation Max Depth -1.0

Impoundment Storage Area = 1490 acres

Mitigation Area Design Elevations (ft-NGVD)

Top of Levee 11.0  
Maximum Mitigation Pool 8-8.5  
Average Local Ground 6.5

Mitigation Storage Area = 205 acres

Pumps:

1. S-503 Impoundment inflow
2. S-505C Seepage control on western boundary

Spillways:

1. S-504 Impoundment discharge

Gated Culverts:

1. S-505B Seepage control on eastern boundary
2. S-506 Control discharge from impoundment into mitigation area

Un-Gated Culverts:

1. S-505A Weir control to prevent backpumping from drawing down canal upstream

Un-Gated Tunnels:

1. S-504A

Levees:

1. L-511 4' deep impoundment levee
2. L-511M 2' deep impoundment area around mitigation

Canals:

1. C-511 Seepage canals around perimeter of impoundment - Due to the close proximity of US-27, earthwork will include 10500' in length of stormwater runoff design from US-27. The design will require earthwork grading to create a dry storage swale approximately 1' deep. Assume 20-30' width along the 10500' length. Assume one 10' long concrete weir every 500' (20 required).

Utilities:

1. Fiber optics along SW 26<sup>th</sup> St
2. SBA communications tower
3. Phone and electric