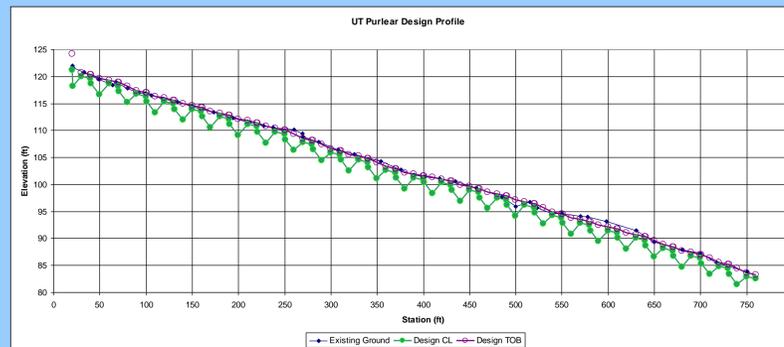


Project Size

- 730 foot reach with an overall slope of 5.4%
- Channelized approximately 40 years ago.
- Stream was very incised, 4-6 feet to top of bank.
- 0.5 square mile watershed, fully forested.
- Stream was heavily embedded with fine sediment.
- Valley is heavily wooded.
- Existing channel banks were well covered with shrubs and ferns.
- No pools along the entire reach.



Vegetation Plan

- Transplant all possible plants (over 200 were relocated).
- Irrigation used to improve transplant survival.
- Only transplanted shrubs, ferns, and trees were used to stabilize channel banks.
- The 38 large trees removed during construction will each be replaced by a 1-3 gal container tree transplant this winter.
- Approximately 100 additional smaller trees to be planted this winter as well as additional streamside vegetation.



Design Solutions

- Priority One channel relocation.
- Work in the dry as much as possible.
- Use a pump around to allow stone to be extracted from existing channel and reused.
- Used 24 double drop log vane with deep pools to dissipate energy and hold channel grade.
- One stone cross vane and one log cross vane.
- Steep riffles stabilized with sills and boulders
- Bankfull Cross sectional area 27 square feet. Riffle Depth 1.2 feet
- Culvert bottom was buried to allow fish passage.
- Add additional large woody debris for habitat.

Project Goals

- Reconnect stream to its floodplain to stop downcutting
- Re-establish pre-disturbance ground water levels.
- Recreate original step pool configuration and alignment.
- Reduce embeddedness in riffles.
- Use materials obtained onsite.
- Minimal impact to property and vegetation
- Improve water quality and habitat for trout.



Design Constraints

- Using a 0.5 foot drop at each structure, needed over 35 structures!
- Valley overgrown with *Microstegium vimineum*.
- Work to occur in July and August.

How will we know if it works?

- Annual monitoring with comprehensive 3D surveys and photo points
- Annual aquatic benthos surveys
- Permanent vegetation plots assessed annually
- Rainfall, stream velocity and flow volume are continuously recorded.
- All bankfull and higher events are sampled and tested for Total Solids, Total Suspended Solids and Turbidity.
- Summer water temperatures monitored

Want more information?

Michael Shaffer.....Mike_Shaffer@ncsu.edu.....336-312-8786
NCSU Campus Box 7625, Raleigh, NC 27509-7625



Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006



NC STATE UNIVERSITY



**North State
Environmental**

NC Division of Forest Resources
Forestry Nonpoint Source Unit
Rendezvous Mountain Educational
State Forest, Wilkes County

www.dfr.state.nc.us
www.ncesf.org



*Purlear Creek
Stream Restoration
Phase 1: UT of Purlear
Aug. 2006*

Before...



During....



...& After

Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006

*The old channel was
straight & level...*



*...but the new
channel is curvy
(sinuous) and
bumpy (step-pool).*

Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006

The old channel was deeply incised... The new channel is situated within the true floodplain contours.

A dis-connected floodplain...



Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006

Clearing the way...



Breaking new ground...



*...A new
stream
channel
results!*

*The new channel is
extended via a 'big bend'
through the former pasture.*

Big Bend



Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006



*We sought
out for
'greener
pastures'
with the
new
channel...*



Culvert too
small &
perched

Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006

Before...



...& After

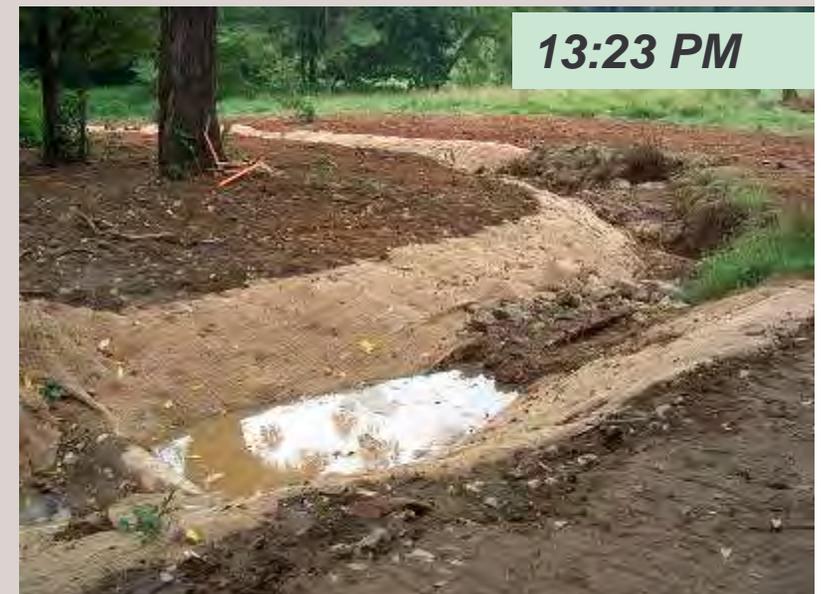


Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006



...and
actually
make
your new
'stream'
wet ?!

How long
does it take
to re-charge
the system...



Purlear Creek Stream Restoration Phase 1: UT of Purlear - Aug. 2006

Let's look at the big picture... (downstream view)

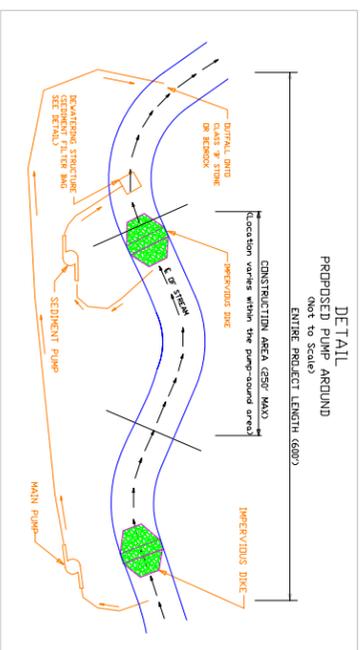


Spoil pile / berm from channelization of old stream.

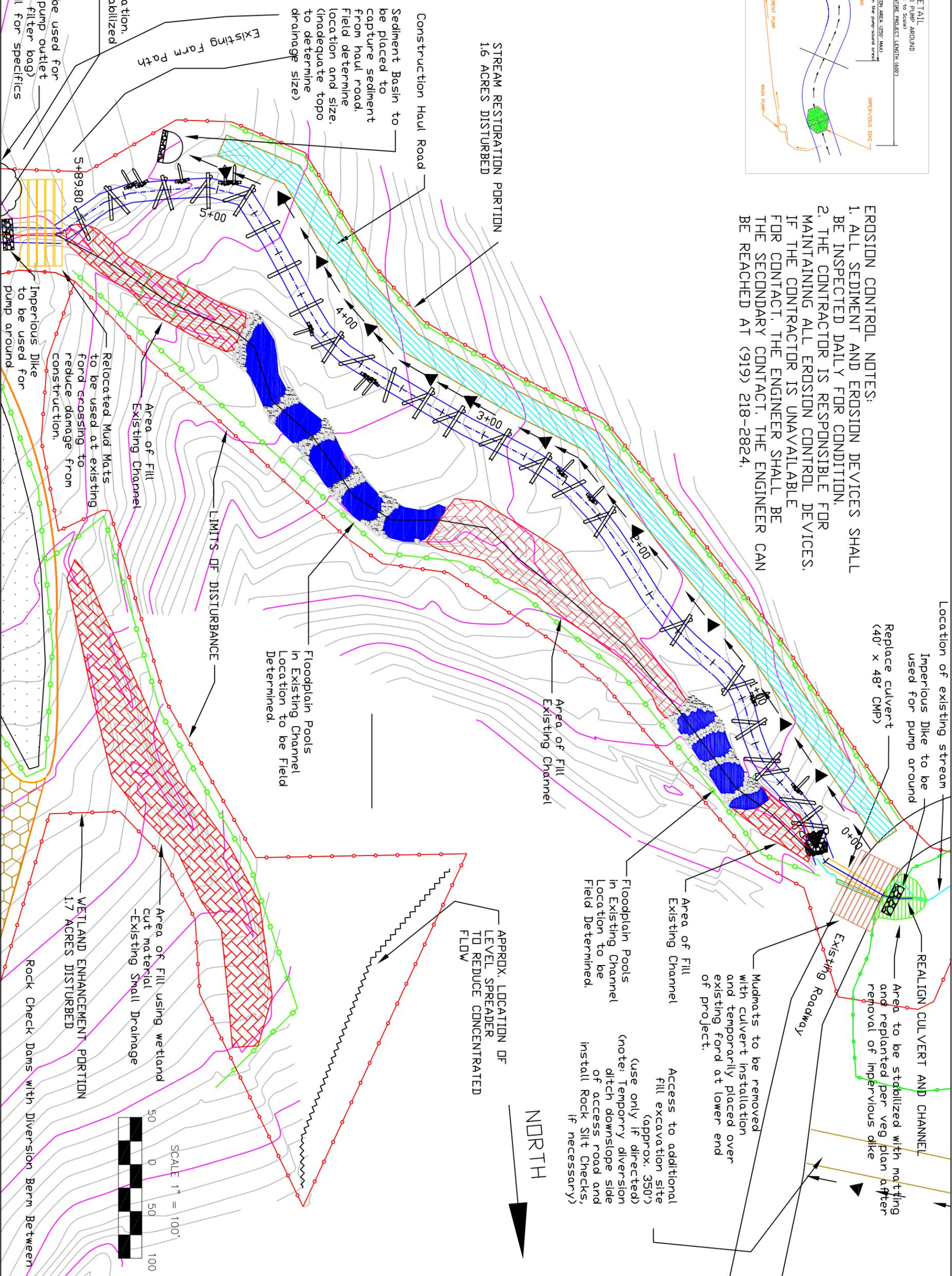
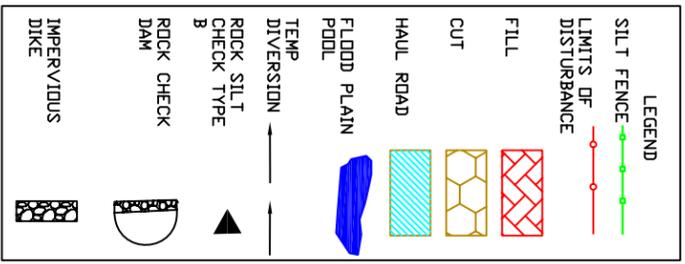
Old stream channel, incised & disconnected from floodplain.

Right bank of old channel. *Note the dramatic increase of elevation from the old streambed and new bed.*

New channel, with transplanted vegetation along left bank.



- EROSION CONTROL NOTES:**
1. ALL SEDIMENT AND EROSION DEVICES SHALL BE INSPECTED DAILY FOR CONDITION.
 2. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ALL EROSION CONTROL DEVICES. IF THE CONTRACTOR IS UNAVAILABLE FOR CONTACT, THE ENGINEER SHALL BE THE SECONDARY CONTACT. THE ENGINEER CAN BE REACHED AT (919) 218-2824.



Location of existing stream Imperious Dike to be used for pump around (40' x 48' CMP)

REALIGN CULVERT AND CHANNEL Area to be stabilized with matting and replanted per veg plan after removal of imperious dike

Mudmats to be removed with culvert installation and temporarily placed over existing ford at lower end of project.

Access to additional fill excavation site (approx. 350')

(note: Temporary diversion ditch downslope side of access road and install Rock Silt Checks, if necessary)

NORTH

APPROX. LOCATION OF LEVEL SPREADER TO REDUCE CONCENTRATED FLOW

Floodplain Pools in Existing Channel Location to be Field Determined.

Area of Fill Existing Channel



WETLAND ENHANCEMENT PORTION 1.7 ACRES DISTURBED

Pump around outlet location. Pipe outlet must be stabilized with Class B Rip-Rap.

Area to be used for sediment pump outlet (sediment filter bag) See-detail for specifics

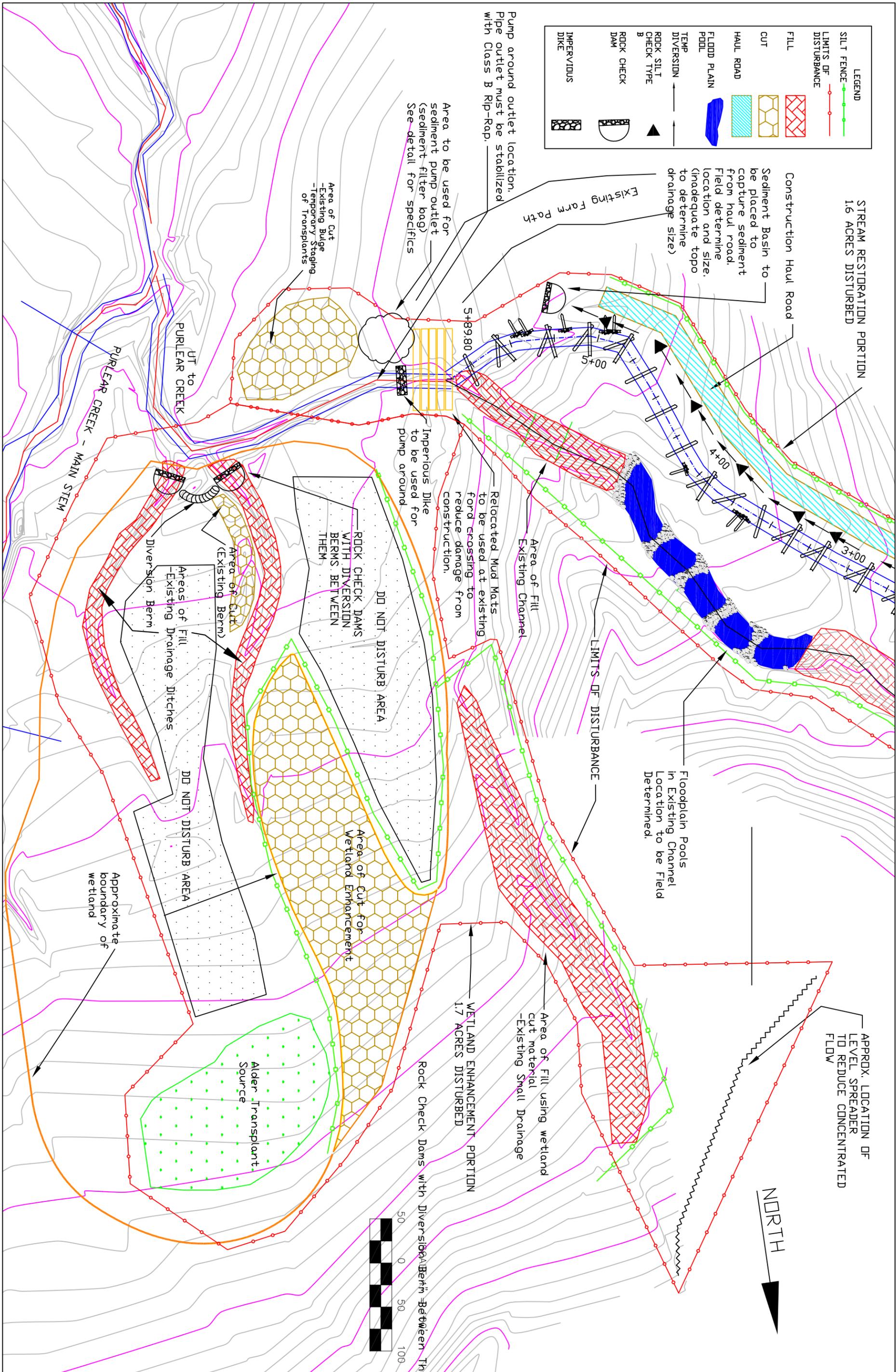
DATE	06/12/06
PROJECT NO.	
FILENAME	FILEDWG
SHEET NO.	PL - 1
DRAWING NO.	

PURLEAR CREEK AT RENDEZVOUS STATE EDUCATIONAL FOREST WILKES COUNTY, N.C.
STREAM RESTORATION PLAN SHEET



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North Carolina State University
Raleigh, NC 27695

1	INITIAL DESIGN	DAB	DRC	08/16/04
NO	REVISIONS	DRN	CHK	DATE



LEGEND

	SILT FENCE
	LIMITS OF DISTURBANCE
	FILL
	CUT
	HAUL ROAD
	FLOOD PLAIN POOL
	TEMP DIVERSION
	ROCK SILT CHECK TYPE B
	ROCK CHECK DAM
	IMPERIOUS DIKE
	PUMP OUTLET LOCATION

UT to PURLEAR CREEK AT RENDEZVOUS STATE EDUCATIONAL FOREST WILKES COUNTY, N.C.

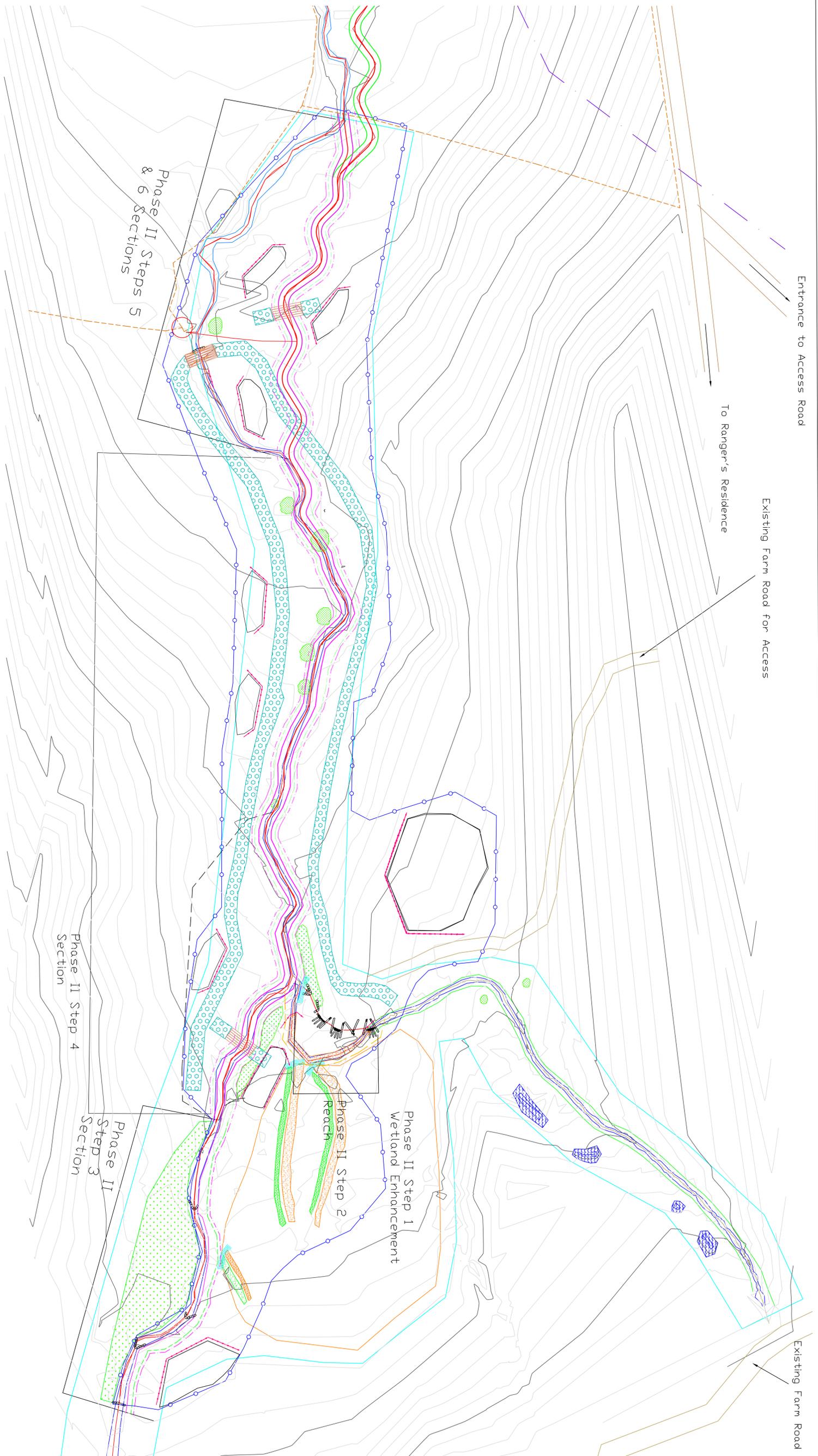
WETLAND ENHANCEMENT PLANSHEET

DATE: 06/12/06
 PROJECT NO.:
 FILENAME: FILEDWG
 SHEET NO.: PL - 1
 DRAWING NO.:

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1	INITIAL DESIGN	DAB	DRC	08/16/04
NO	REVISIONS	DRN	CHK	DATE



Drawing Legend

	Tree Protection Zone		Epimeral Pool		Proposed Channel		Silt Fence		Root Vad		Property Corner
	Wetland Ditch		Haul Road		Proposed Buffer		Rock Silt Screen		Rock Sill		Fence Line
	Wetland Level		Current Channel		Limits of Construction		Cross Vane		J Hook Vane		Power Line

Contour Interval 2 feet



DATE	07/24/07
PROJECT NO.	
FILENAME	RARESEF PH 2.DWG
SHEET NO.	PL - 1
DRAWING NO.	

Phase II PURLEAR CREEK AT RENDEZVOUS STATE EDUCATIONAL FOREST WILKES COUNTY, N.C.

OVERALL PROJECT PLAN SHEET
1:200 SCALE PLAN SHEET

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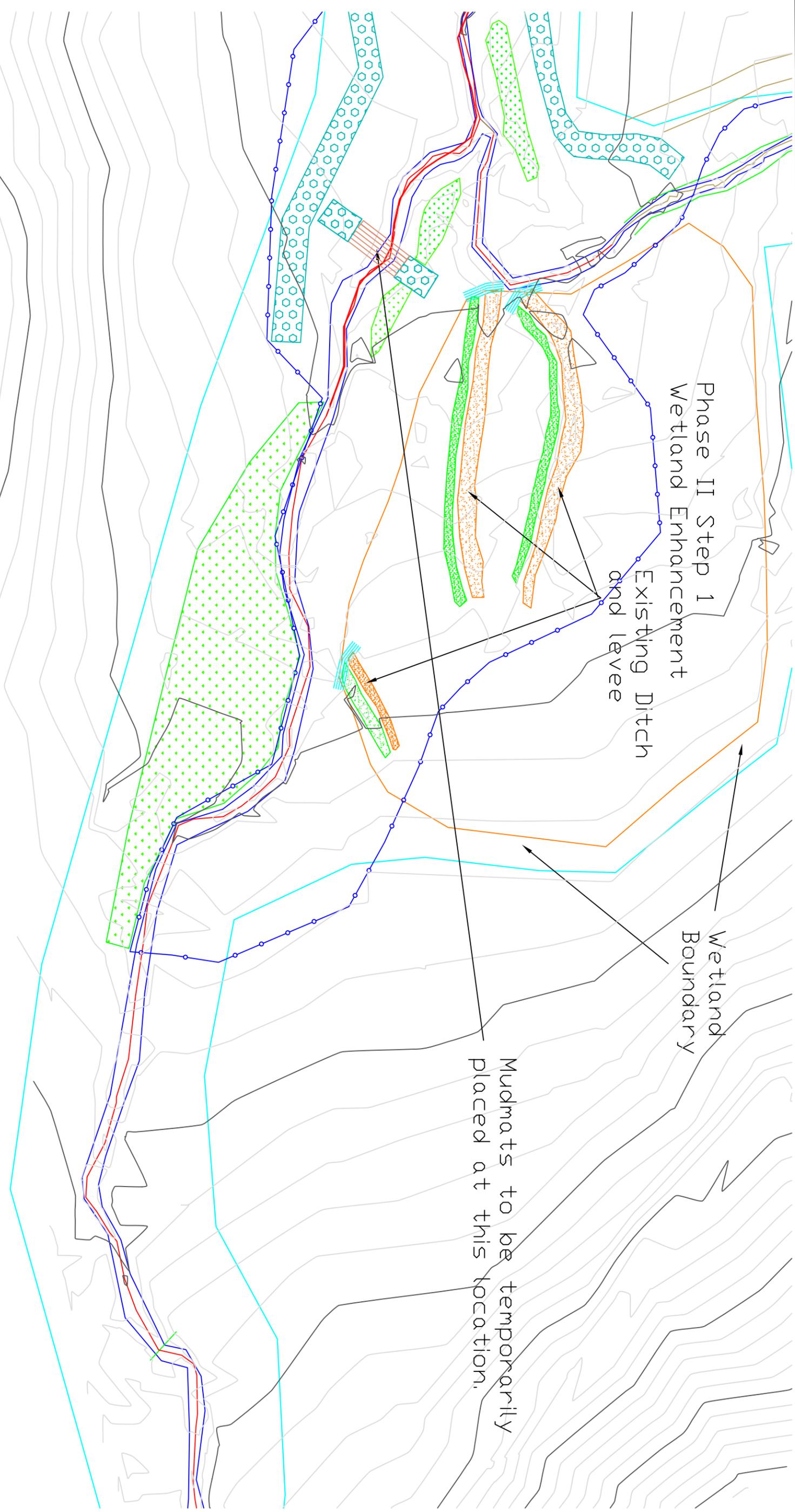
1	INITIAL DESIGN	DAB	DRC	3/22/07
2	INITIAL DESIGN	MBS	GDJ	7/24/07
REVISIONS				
NO.		DRN	CHK	DATE

	Tree Protection Zone		Epifaunal Pool		Silt Fence		Root Vial		Property Corner
	Wetland Ditch		Haul Road		Proposed Buffer		Rock Silt Screen		Rock Sill
	Vertical Levee		Current Channel		Limits of Construction		Cross Vane		J Hook Vane
									Power Line

Drawing Legend

Contour Interval 2 feet

SCALE 1" = 100'



DATE	03/23/07
PROJECT NO.	
FILENAME	RACESF PH 2.DWG
SHEET NO.	PH 2 ST 1
DRAWING NO.	

Phase II PURLEAR CREEK AT RENDEZVOUS STATE EDUCATIONAL FOREST WILKES COUNTY, N.C.

PHASE II STEP 1 PLAN SHEET

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1	INITIAL DESIGN	DAB	DRC	6/12/06
NO	REVISIONS	DRN	CHK	DATE

Drawing Legend

Contour Interval 2 feet

	Tree Protection Zone		Ephemeral Pool		Proposed Channel		Silt Fence		Root Wad		Property Corner
	Wetland Ditch		Haul Road		Proposed Buffer		Rock Silt Screen		Rock Sill		Fence Line
	Wetland Level		Current Channel		Limits of Construction		Cross Vane		J Hook Vane		Power Line

nger's Residence

Existing Farm Road for Access

Phase II Step 2
Material Storage Area

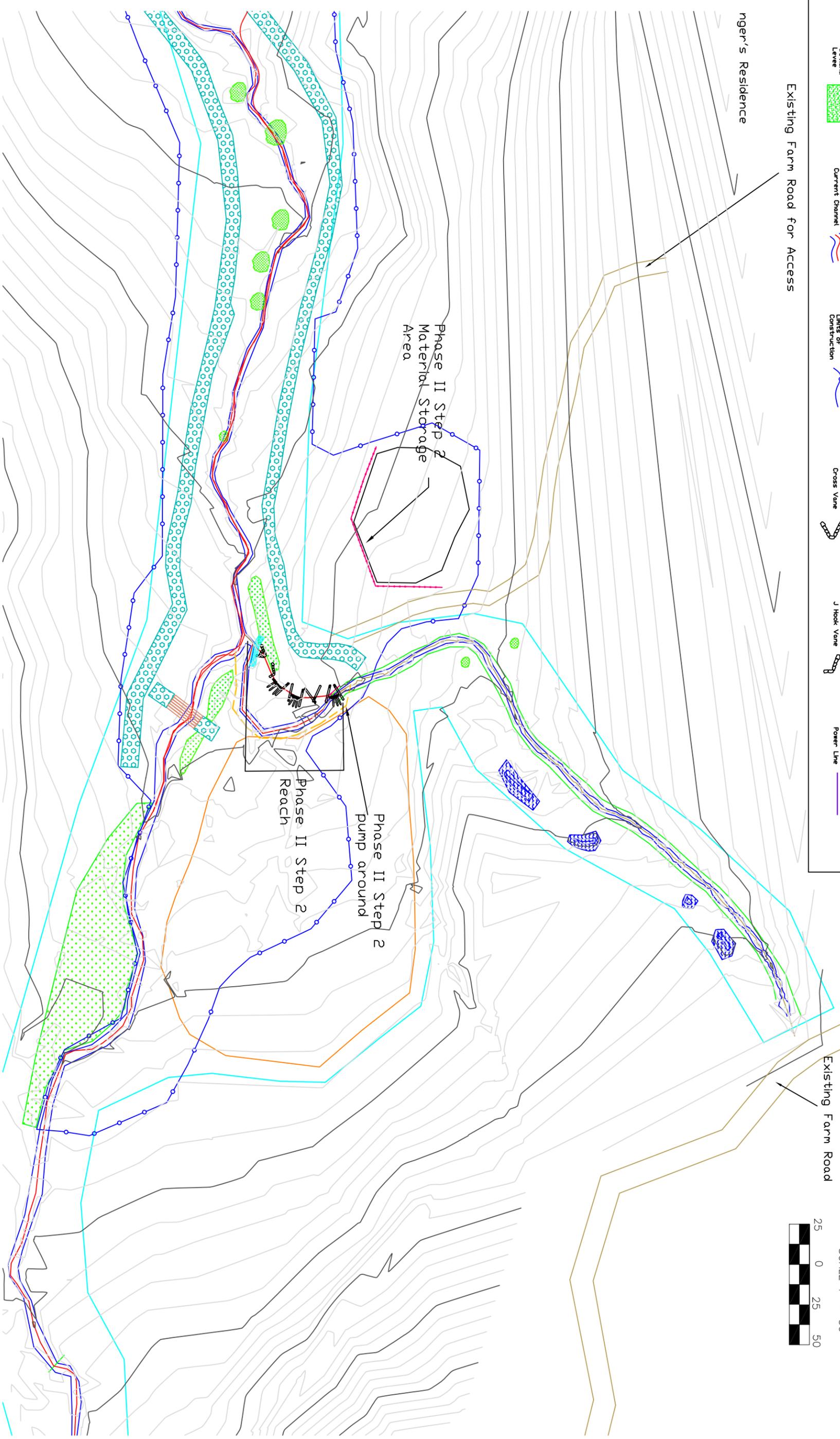
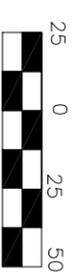
Phase II Step 2
pump around

Phase II Step 2
Reach

Existing Farm Road



SCALE 1" = 50'



1	INITIAL DESIGN	DAB	DRC	3/23/07
2	UPDATED PER DESIGN CHANGES	MBS	GDJ	7/24/07
NO	REVISIONS	DRN	CHK	DATE

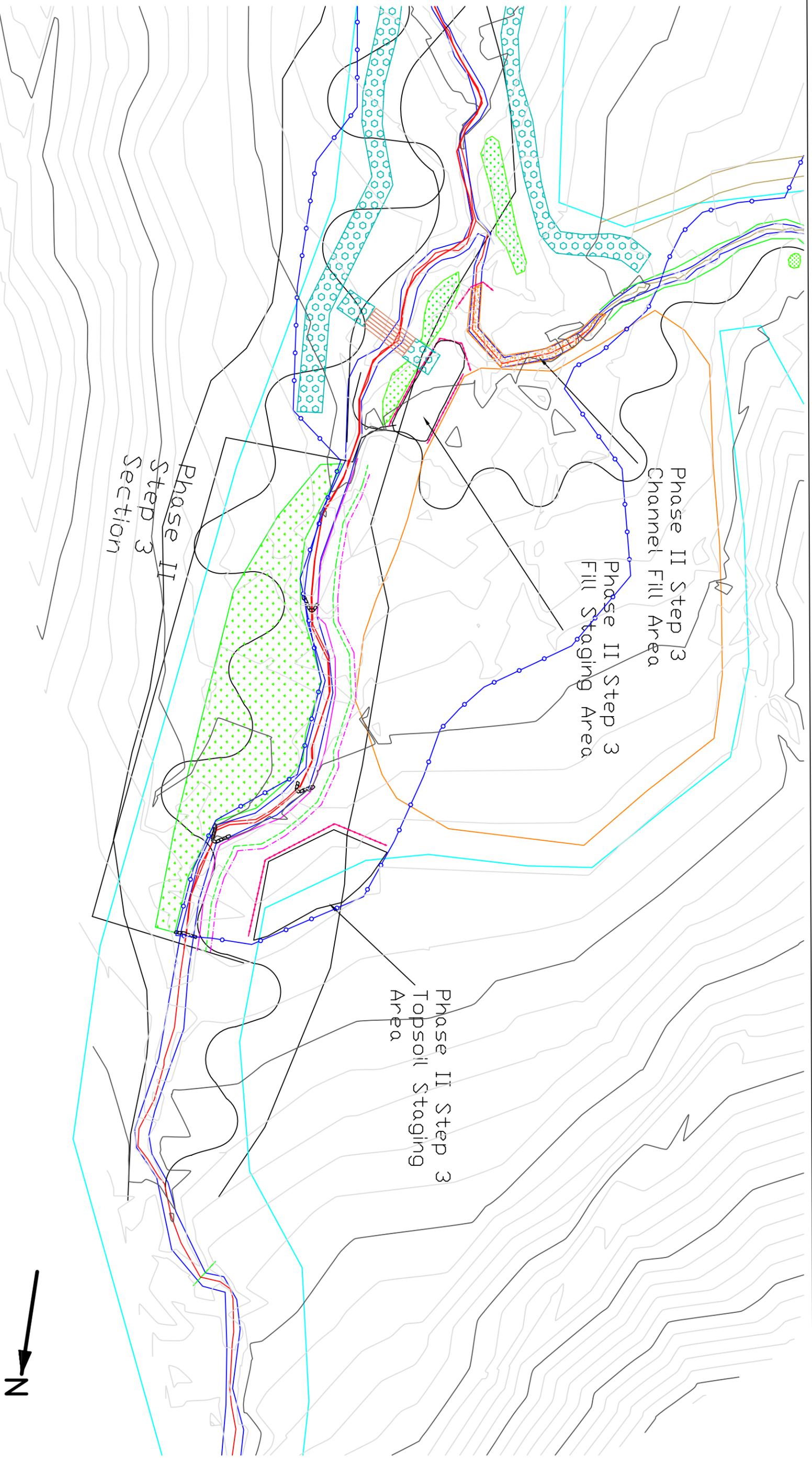


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Phase II PURLEAR CREEK AT
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WILKES COUNTY, N.C.

PHASE II STEP 2 PLAN SHEET

DATE	07/24/07
PROJECT NO.	
FILENAME	RAESCF PH 2.DWG
SHEET NO.	PH 2 ST 2
DRAWING NO.	



Drawing Legend

Contour Interval 2 feet

	Tree Protection Zone		Ephemeral Pool		Proposed Channel		Silt Fence		Root Wad		Property Corner
	Wetland Ditch		Haul Road		Proposed Buffer		Rock Silt Screen		Rock Sill		Fence Line
	Wetland Levee		Current Channel		Limits of Construction		Cross Vane		J Hook Vane		Power Line



DATE	07/24/07
PROJECT NO.	
FILENAME	RMESEF PH 2.DWG
SHEET NO.	PH 2 ST 3
DRAWING NO.	

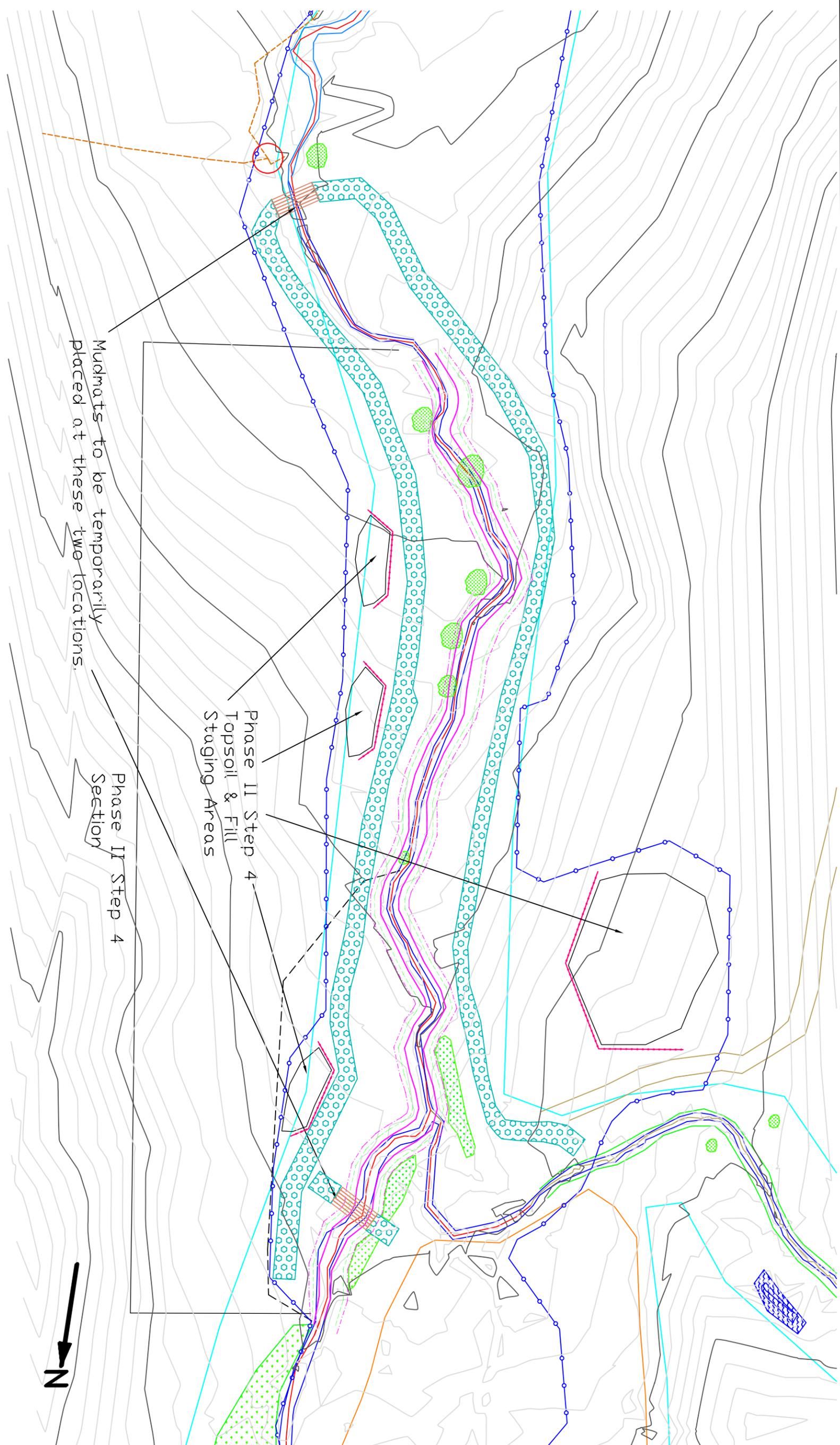
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PHASE II STEP 3 PLAN SHEET

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NO.	REVISIONS	DRN	CHK	DATE
1	INITIAL DESIGN	DAB	DRC	3/22/07
2	MODIFIED PER DESIGN CHANGES	MBS	GDJ	7/24/07



Drawing Legend

	Tree Protection Zone		Ephemeral Pool		Silt Fence		Root Void		Property Corner
	Wetland Ditch		Haul Road		Proposed Buffer		Rock Silt Screen		Rock Silt
	Wetland Levee		Current Channel		Limits of Construction		Cross Vane		J Hook Vane
									Power Line

Contour Interval 2 feet



Mudmats to be temporarily placed at these two locations.

Phase II Step 4 Topsoil & Fill Staging Areas

Phase II Step 4 Section

DATE	07/24/07
PROJECT NO.	
FILENAME	RWESF PH 2.DWG
SHEET NO.	PH 2 ST 4
DRAWING NO.	

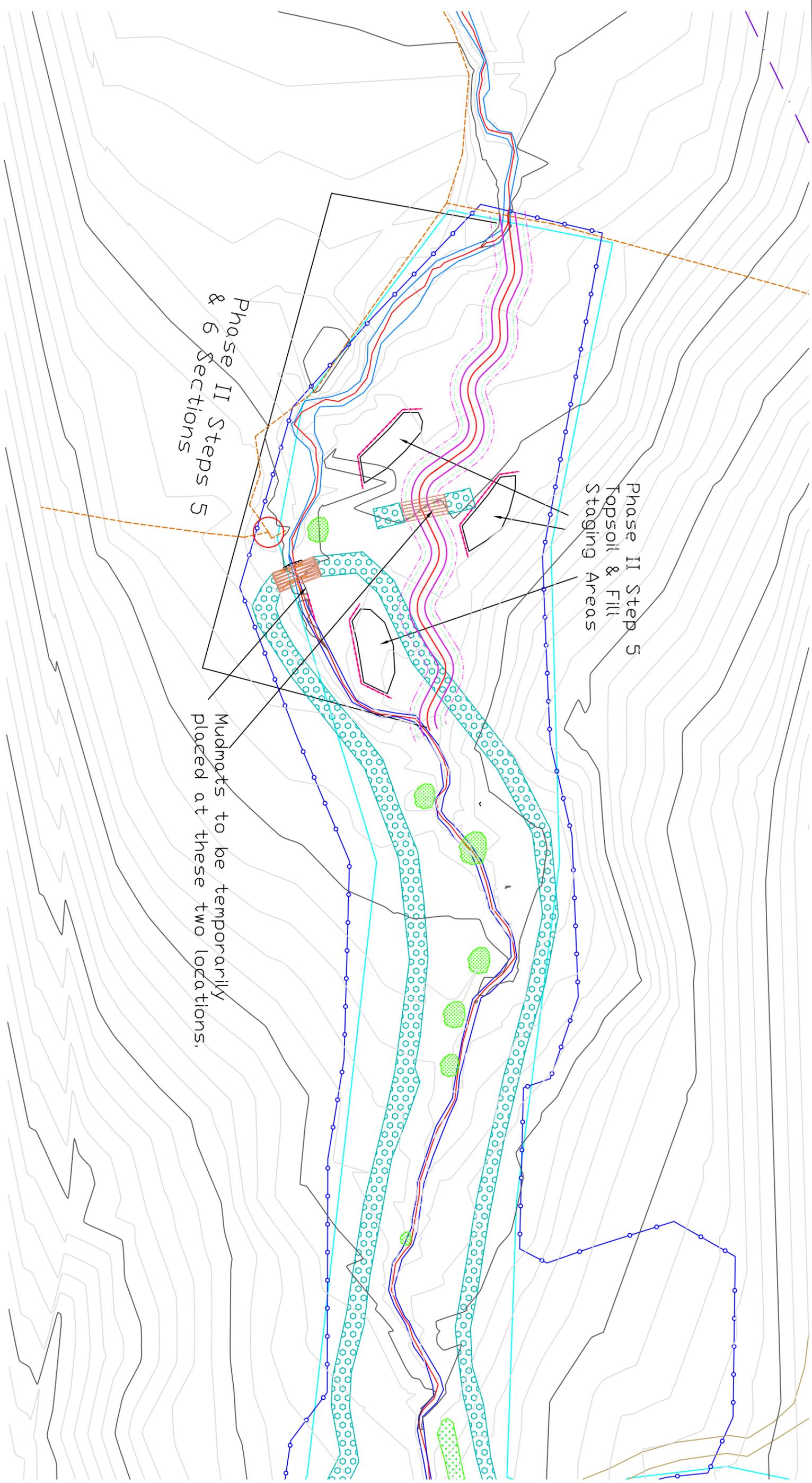
Phase II PURLEAR CREEK AT RENDEZVOUS STATE EDUCATIONAL FOREST WILKES COUNTY, N.C.

PHASE II STEP 4 PLAN SHEET

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1	INITIAL DESIGN	DAB	DRC	3/22/07
2	MODIFIED PER DESIGN CHANGES	MBS	GDJ	7/24/07
NO	REVISIONS	DRN	CHK	DATE



Drawing Legend

	Tree Protection Zone		Epithermal Pool		Proposed Channel		Silt Fence		Root Vad		Property Corner
	Wetland Ditch		Haul Road		Proposed Buffer		Rock Silt Screen		Rock Sill		Fence Line
	Wetland Levee		Current Channel		Limits of Construction		Cross Vane		J Hook Vane		Power Line

Contour Interval 2 feet



Phase II Steps 5 & 6 Sections

Phase II Step 5 Topsoil & Fill Staging Areas

Mudmats to be temporarily placed at these two locations.

DATE: 07/24/07
 PROJECT NO.:
 FILENAME: RAESEF PH 2.DWG
 SHEET NO.: PH 2 ST 5-6
 DRAWING NO.:

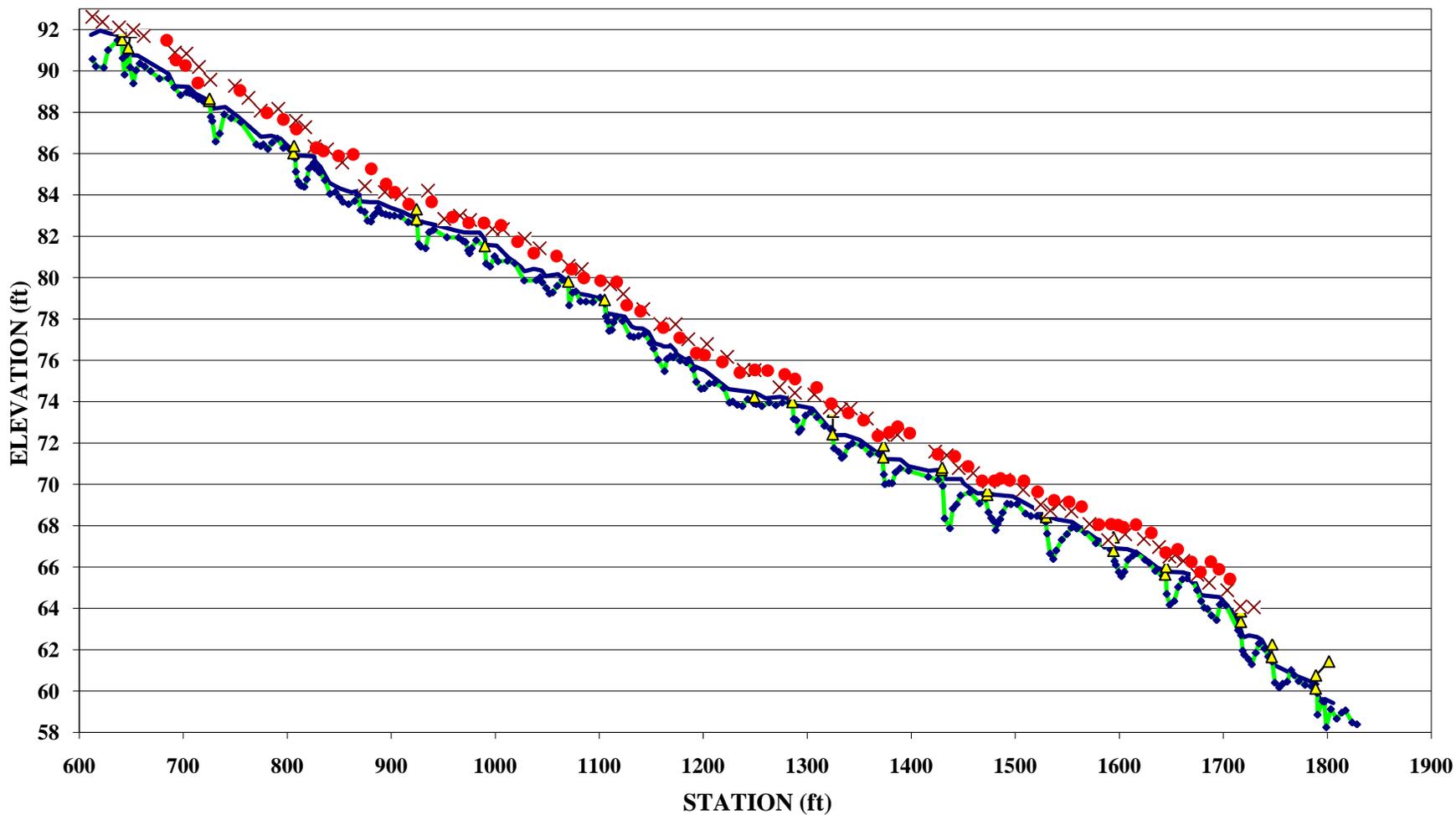
Phase II PURLEAR CREEK AT RENDEZVOUS STATE EDUCATIONAL FOREST WILKES COUNTY, N.C.
 PHASE II STEP 5-6 PLAN SHEET

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1	INITIAL DESIGN	DAB	DRC	3/22/07
2	MODIFIED PER DESIGN CHANGES	MBS	GDJ	7/24/07
NO	REVISIONS	DRN	CHK	DATE

Rendezvous Mountain
 STA 6+00 - STA 19+00
 2007 MONITORING - AS BUILT

Bankfull = $-0.0254 \cdot \text{STA} + 107.76$
 Water Surface = $-0.0256 \cdot \text{STA} + 106.9$



Aug 29th 2007 GPS Survey
 By: MJG and MS



Phase 1 Culvert before replacement



Mining cobble from the old channel



Phase 1 Culvert after replacement



Placing cobble as part of a riffle



Phase 1 Upper Stream Before



Phase 1 Wetland Before



Phase 1 Upper Stream After



Phase 1 Wetland After



Phase 1 Before



Phase 1 Before



Phase 1 After



Phase 1 After



Phase 1 with Mined and transplants



Phase 1 First flow



Phase 1 old channel



Phase 1 restored channel



Phase 1 old channel



Phase 1 restored channel



Phase 2 Upper Priority 1 Reach before



Phase 2 constructing a log vane



Phase 2 Upper Priority 1 Reach after



Phase 2 completed log vane



Phase 2 Upper Priority 1 Reach before



Phase 2 connecting tributary under construction



Phase 2 Upper Priority 1 Reach after



Phase 2 connecting tributary after construction



Phase 2 Priority 1 Reach before (no pools)



Phase 2 Priority 1 Reach before



Phase 2 Priority 1 Reach after



Phase 2 Priority 1 Reach after



Phase 2 Priority 1 Reach before



Phase 2 Priority 1 Reach before



Phase 2 Priority 1 Reach after



Phase 2 Priority 1 Reach after



Phase 2 Priority 2 Reach before



Phase 2 Priority 2 Reach before



Phase 2 Priority 2 Reach after



Phase 2 Priority 2 Reach after



Phase 2 Manually watering transplants



Phase 2 Log Vane Construction



Phase 2 Auto watering transplants



Phase 2 Completed Log Vane



Phase 2 GPS Base Station



Phase 2 GPS Rover



Phase 2 GPS on excavator



Installing the bank matting (the hardest part!)



Geo textile backing on the vanes



Phase 2 planting vegetation



Everyone enjoyed the water!



All creatures, both great



and small!



A beautiful scene

