SOILS HYDROLOGY AND FORESTRY

NERCOFE 2018

FOCUS OF MY TALK WILL BE

LOGGING ROADS

LOGGING YARDS

AND SKID TRAILS

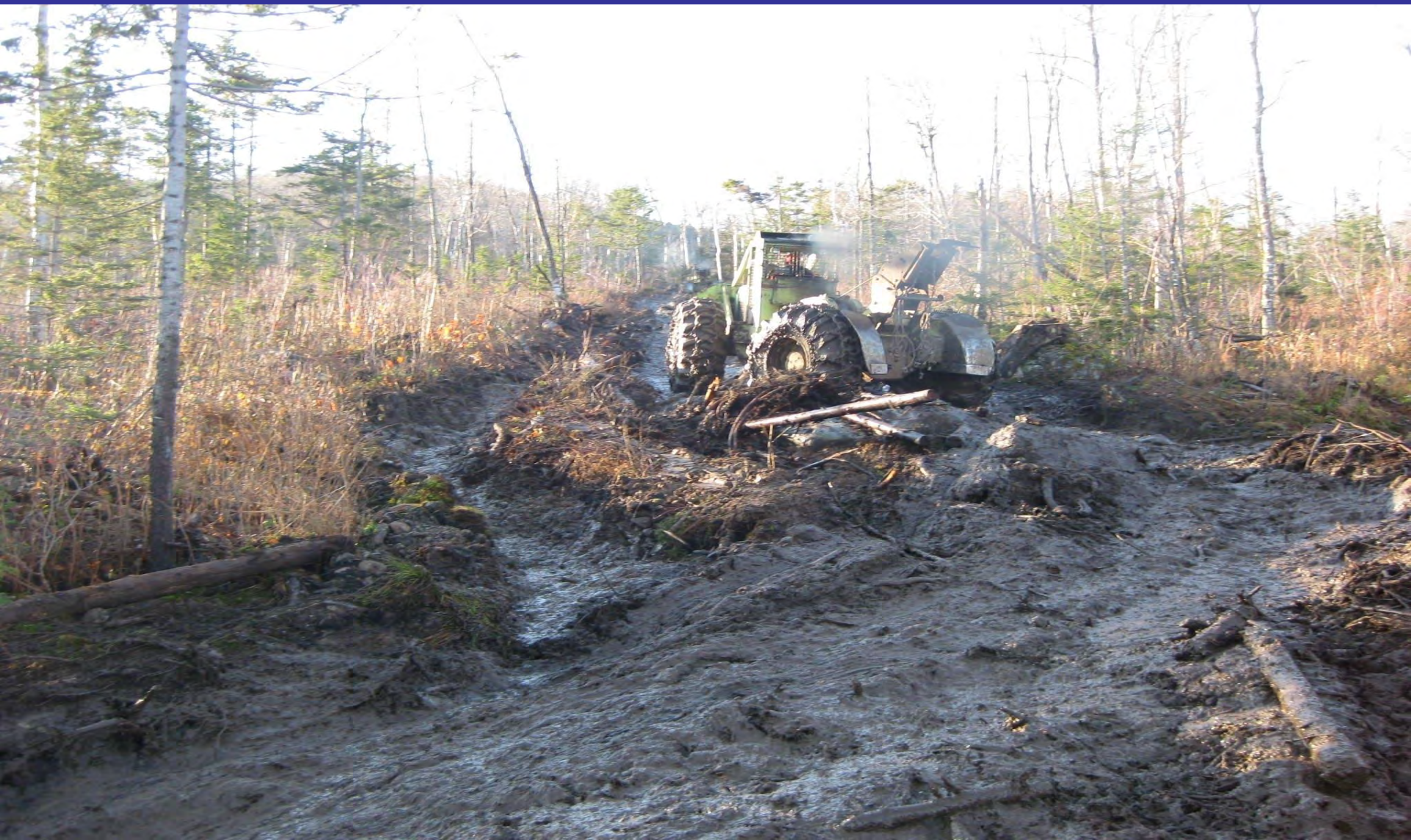
PRIMARY CONCERS:

RUTTING
COMPACTION
EROSION
SEDIMENTATION
HYDROLOGY
ROAD STABILITY

OTHER THAN TIME OF YEAR

WHAT SHOULD YOU KNOW TO AVOID ENDING UP WITH SKID TRAILS THAT LOOK LIKE

THIS



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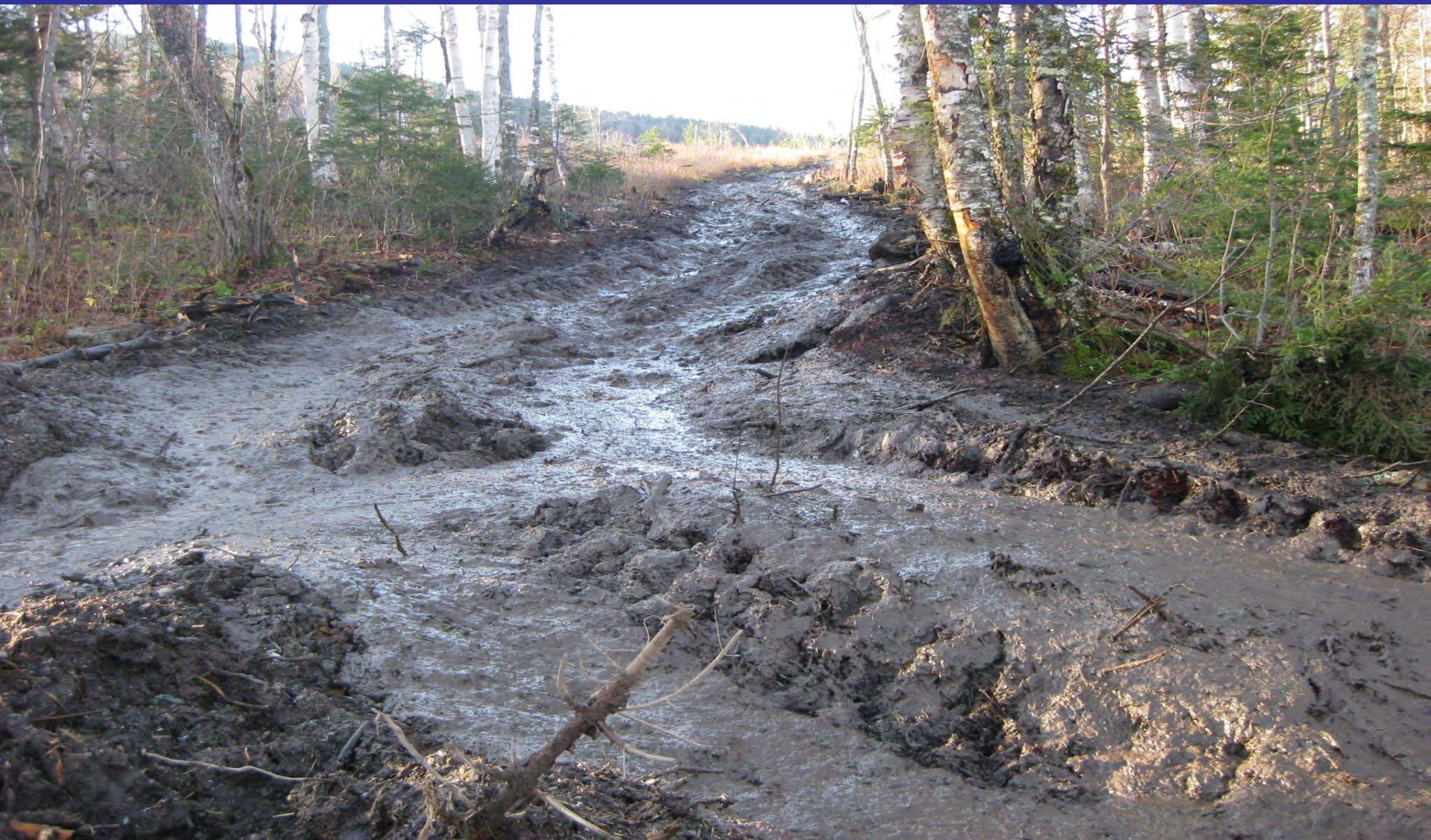
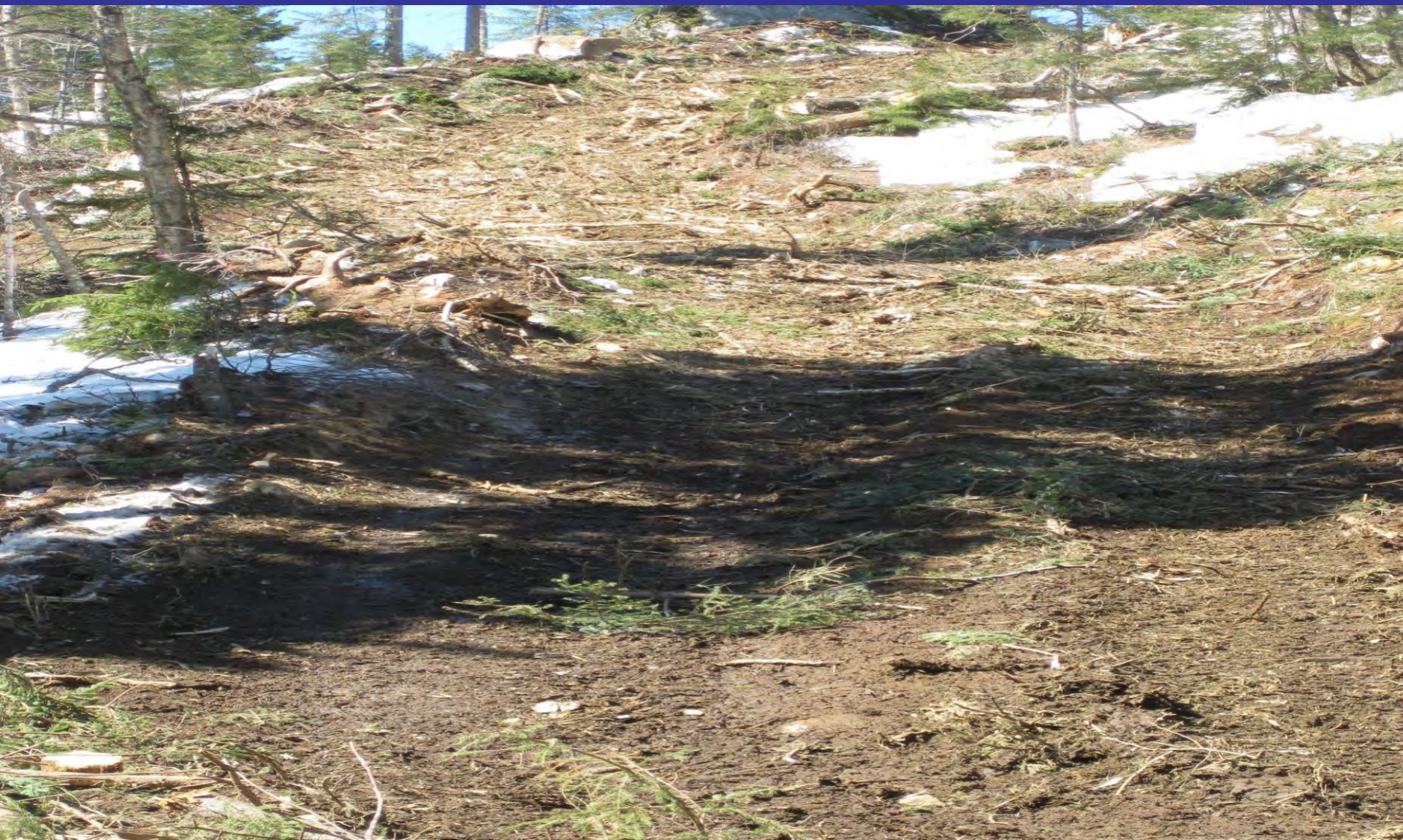


SO YOU CAN END UP WITH SKID TRAILS THAT LOOK LIKE

THIS

AND THIS



YOU ALSO DON'T WANT LOGGING YARDS THAT WILL END UP LOOKING LIKE

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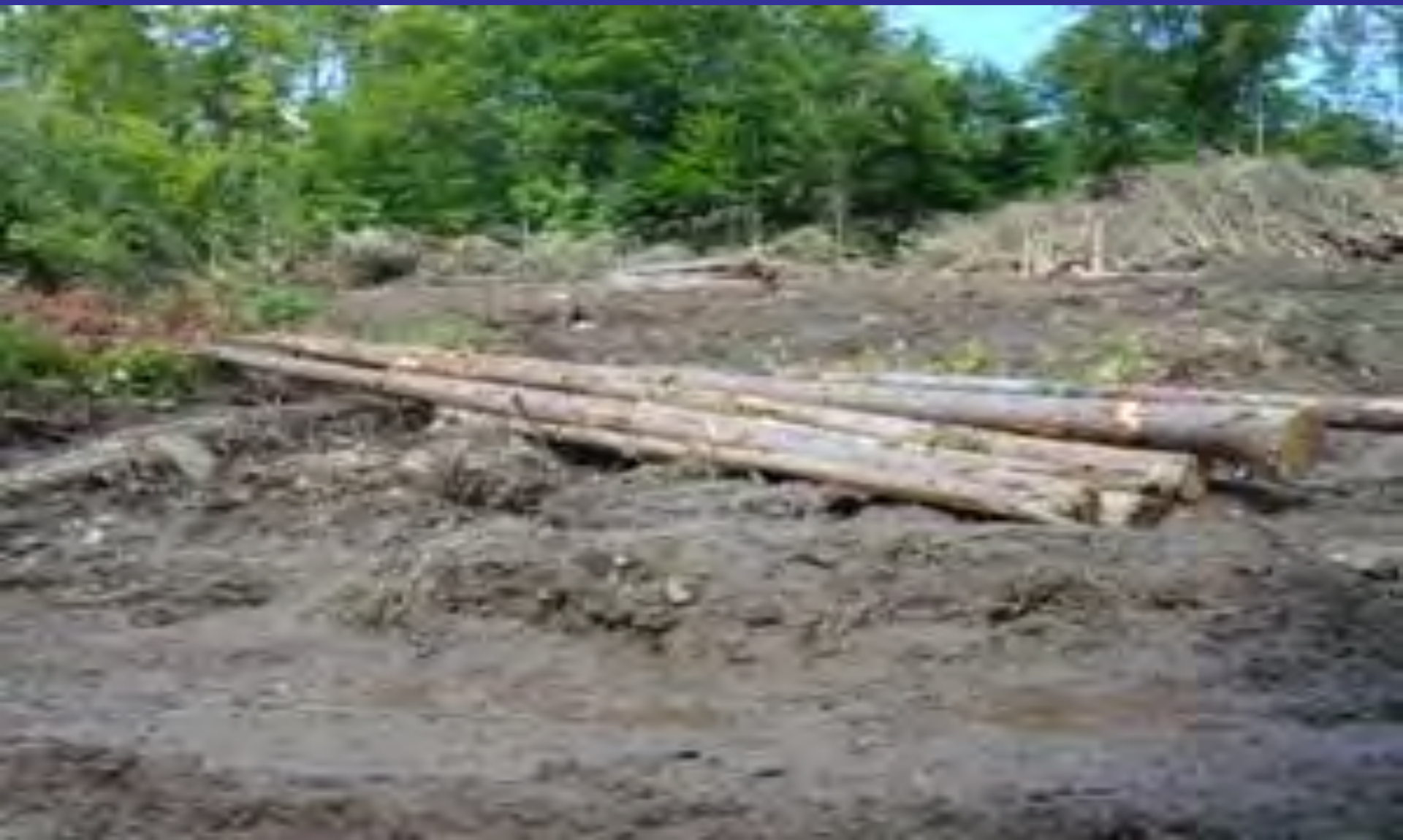
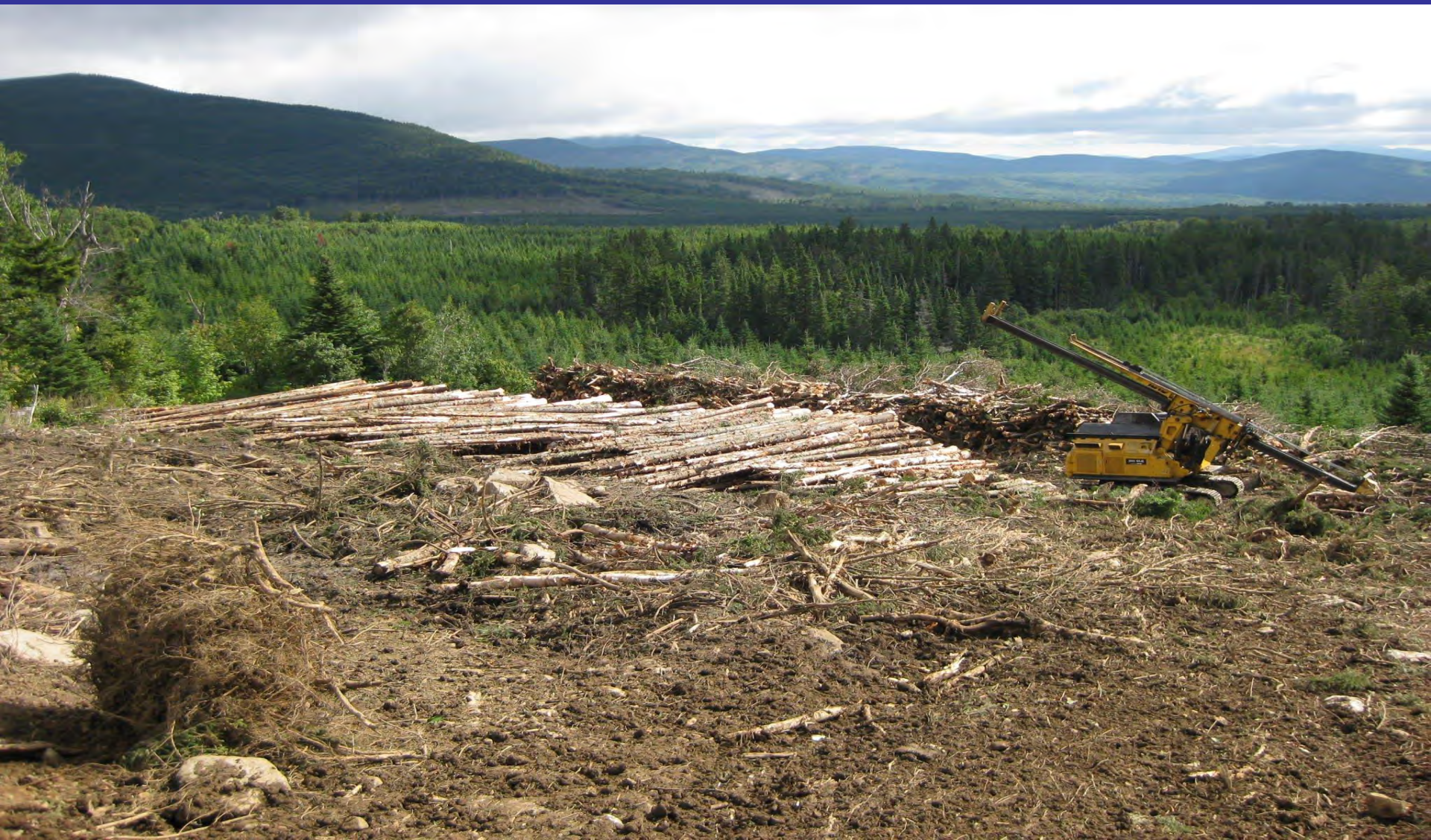


OR THIS

YOU WANT LOGGING YARDS THAT LOOK LIKE THIS



MOST FORESTERS NOT SOIL SCIENTISTS

CAN TELL WHICH TREE SPECIES ARE HAPPY AND WHICH ARE NOT

LAYING OUT LOGGING ROADS, SKID TRAILS AND LOGGING YARDS

CLUES ABOUT SOILS AND HYDROLOGY ARE UNDERGROUND MAKING THEM DIFFICULT TO FIGURE OUT

WHAT HAPPENS WHEN YOU WORK ON WET SOILS?

DAMAGED SOIL

IMPACTS FUTURE PRODUCTIVITY

RESULTS IN EROSION AND SEDIMENTATION

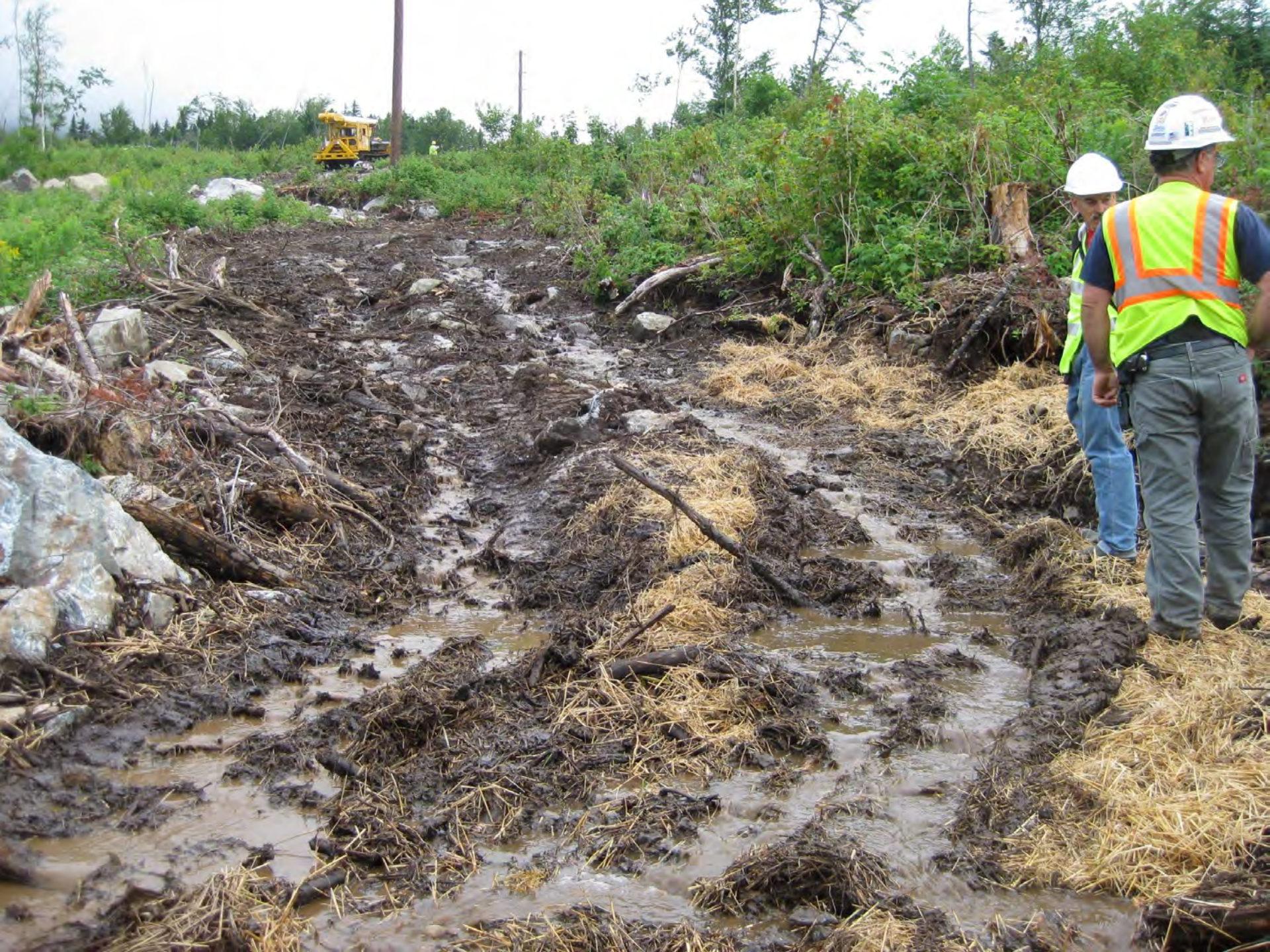
CAUSE ROAD INSTABILITY

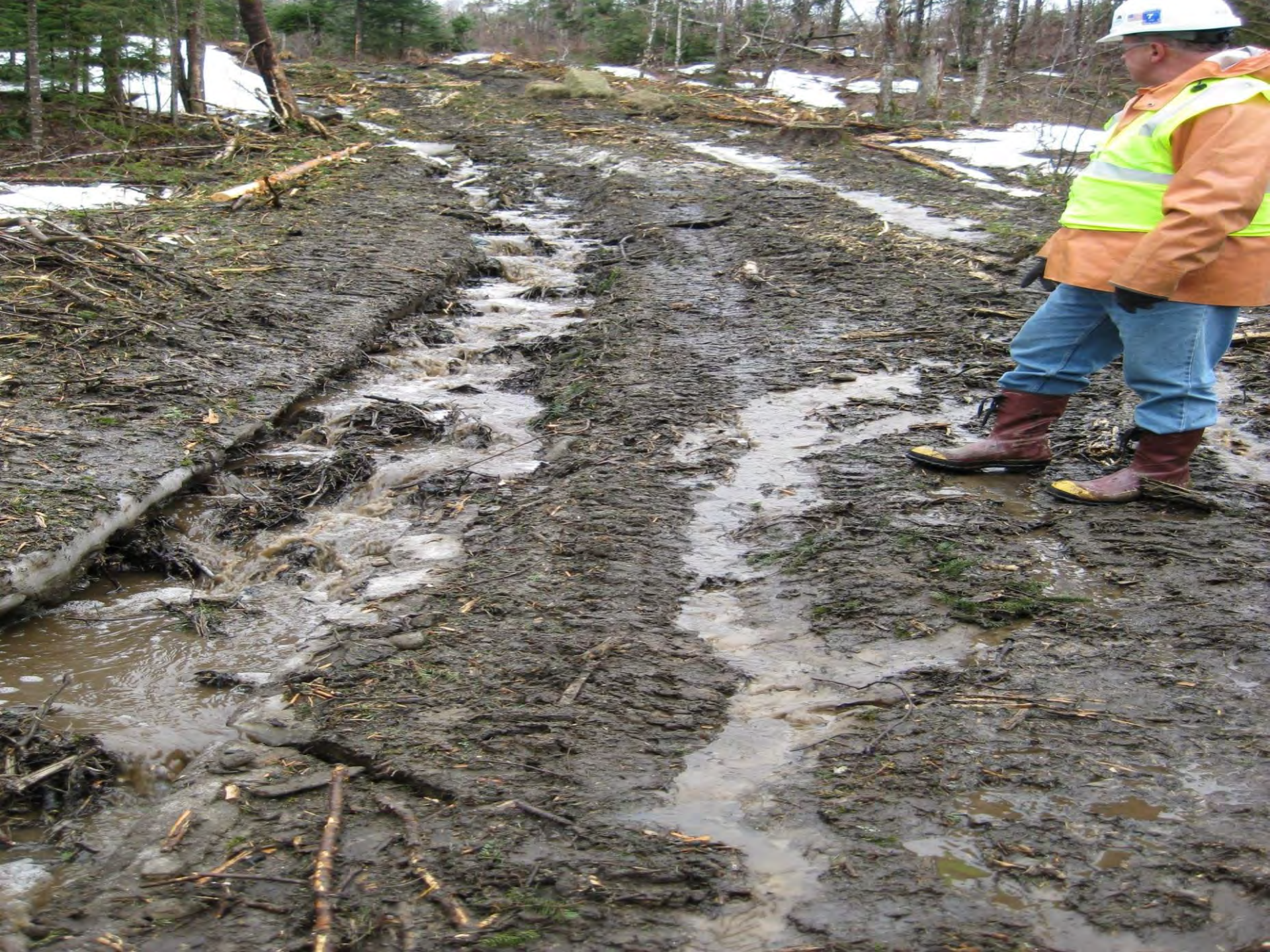
REGULATORY VIOLATIONS

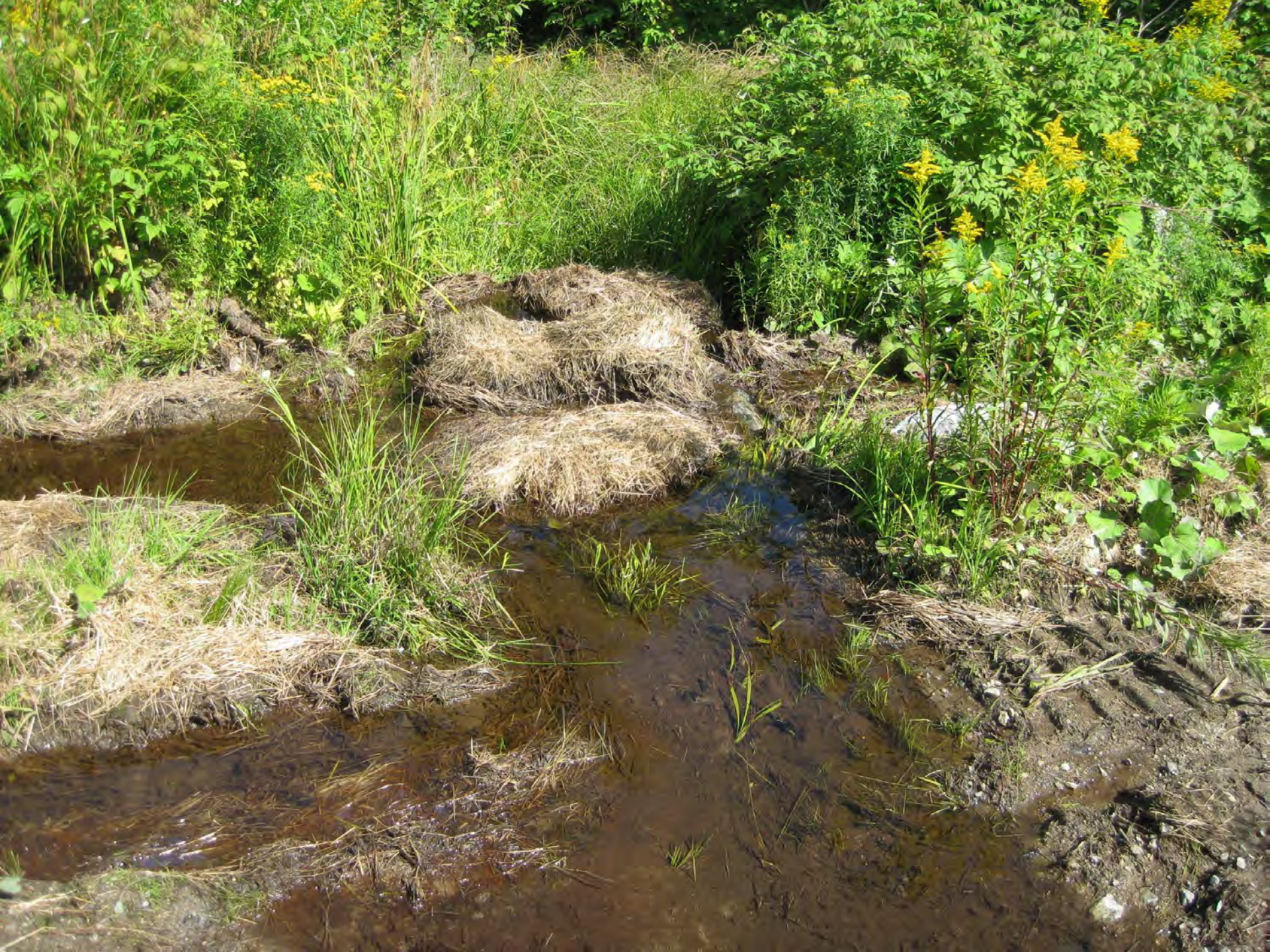
WHEN YOU RUT UP SLOPING SOILS THAT ARE SHALLOW TO HARDPAN OR BEDROCK

INTERCEPT GROUNDWATER TABLE

BECOME CONCENTRATED FLOW



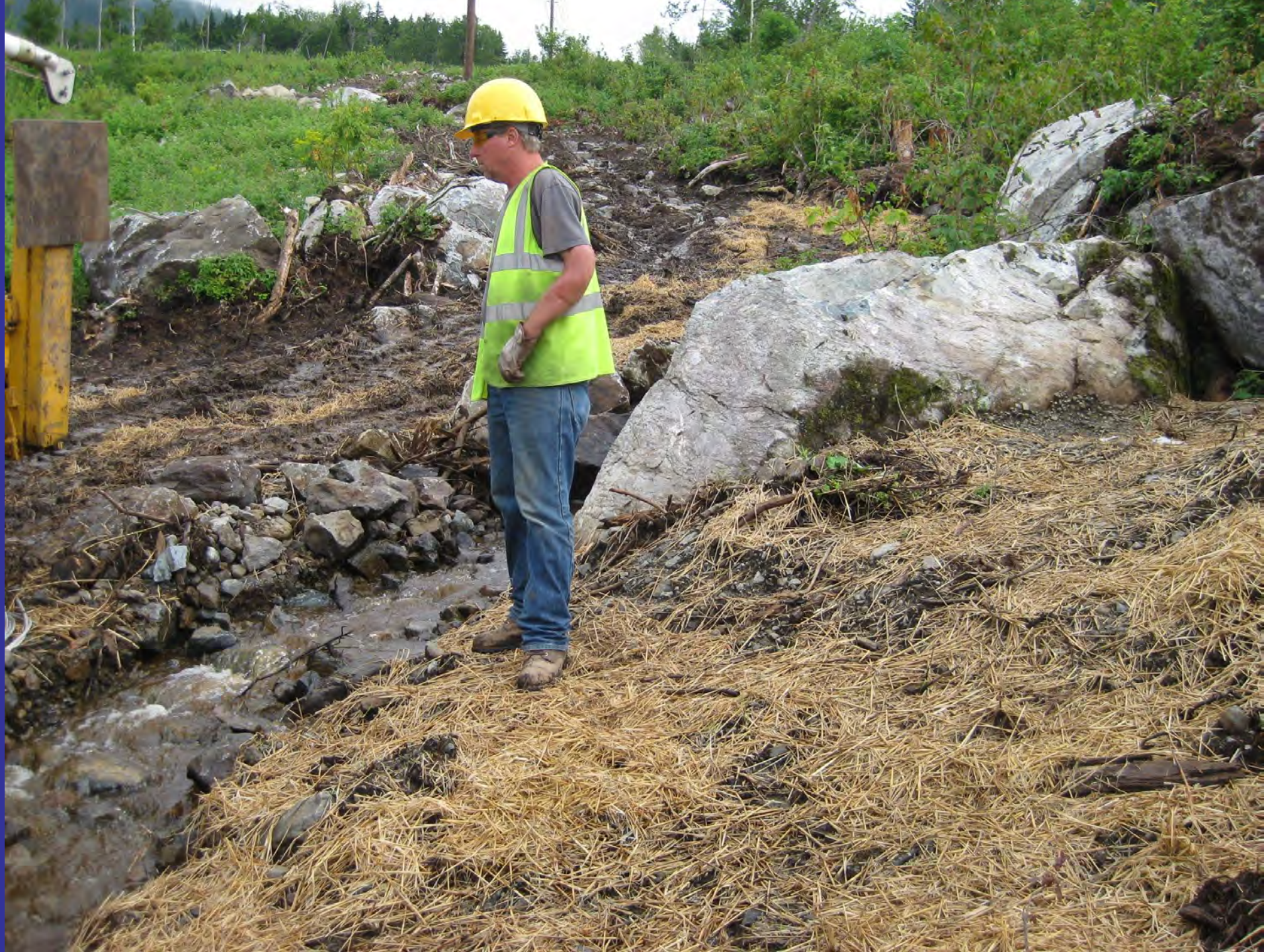


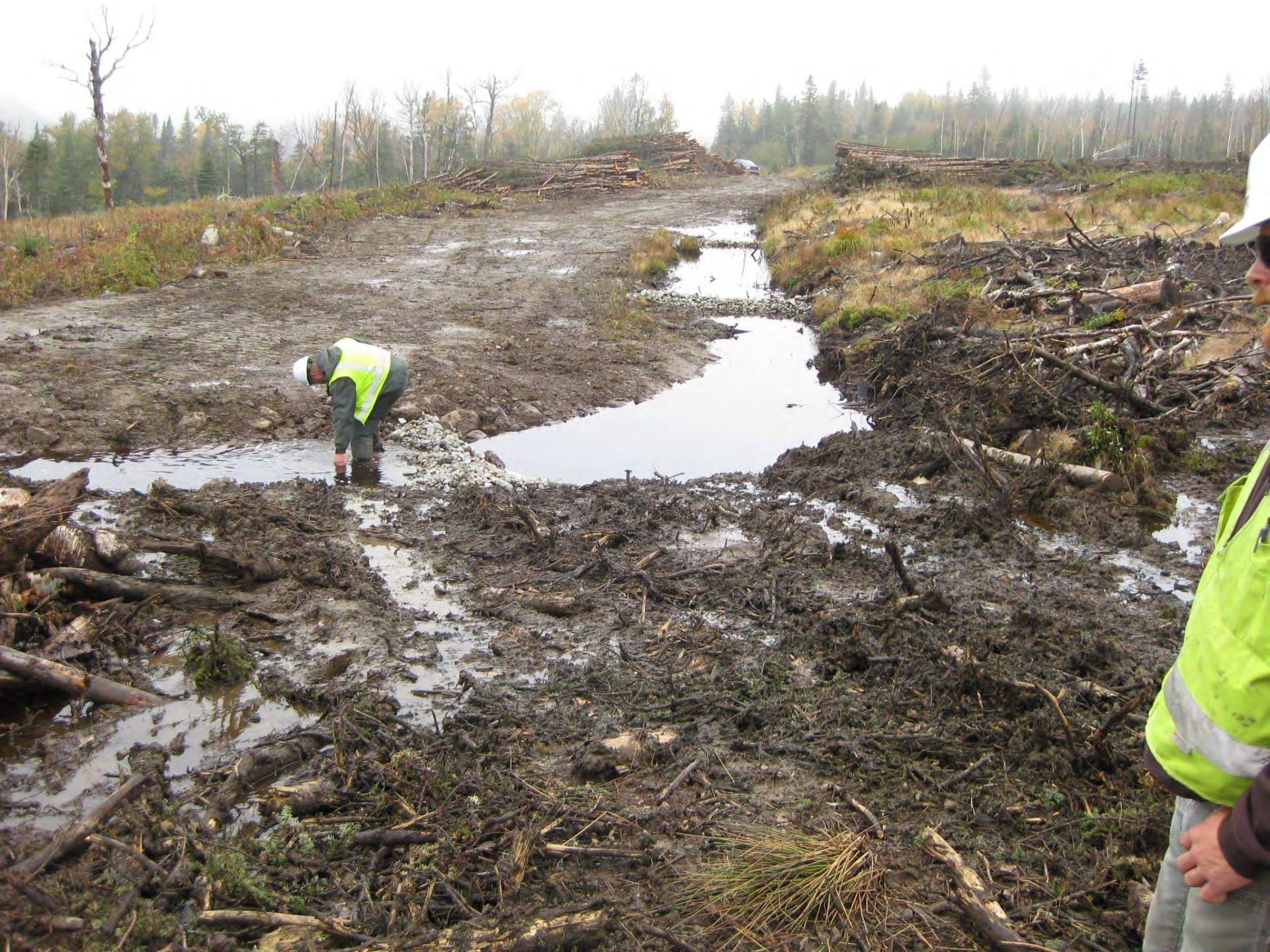


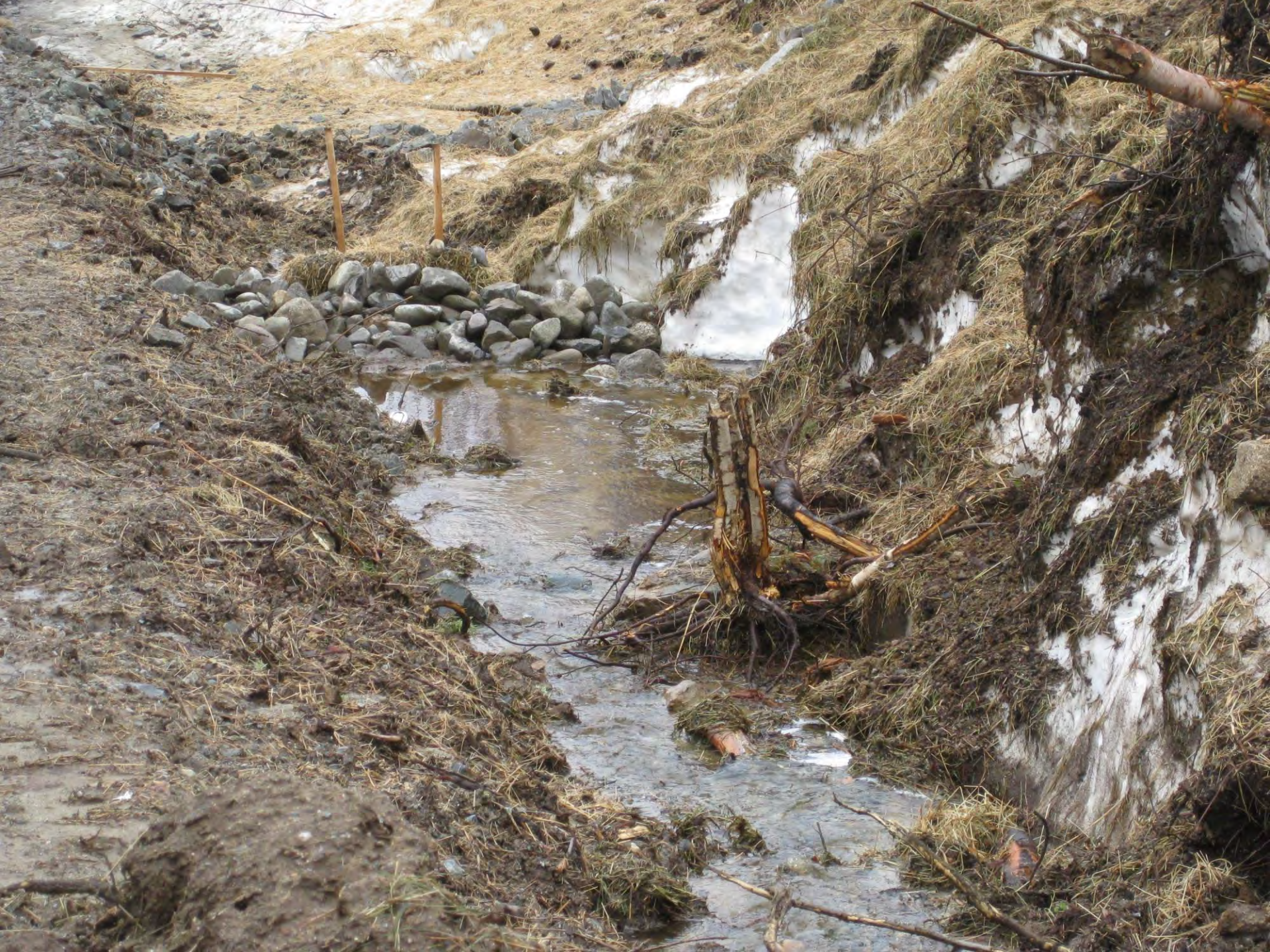
MORE COMMONLY

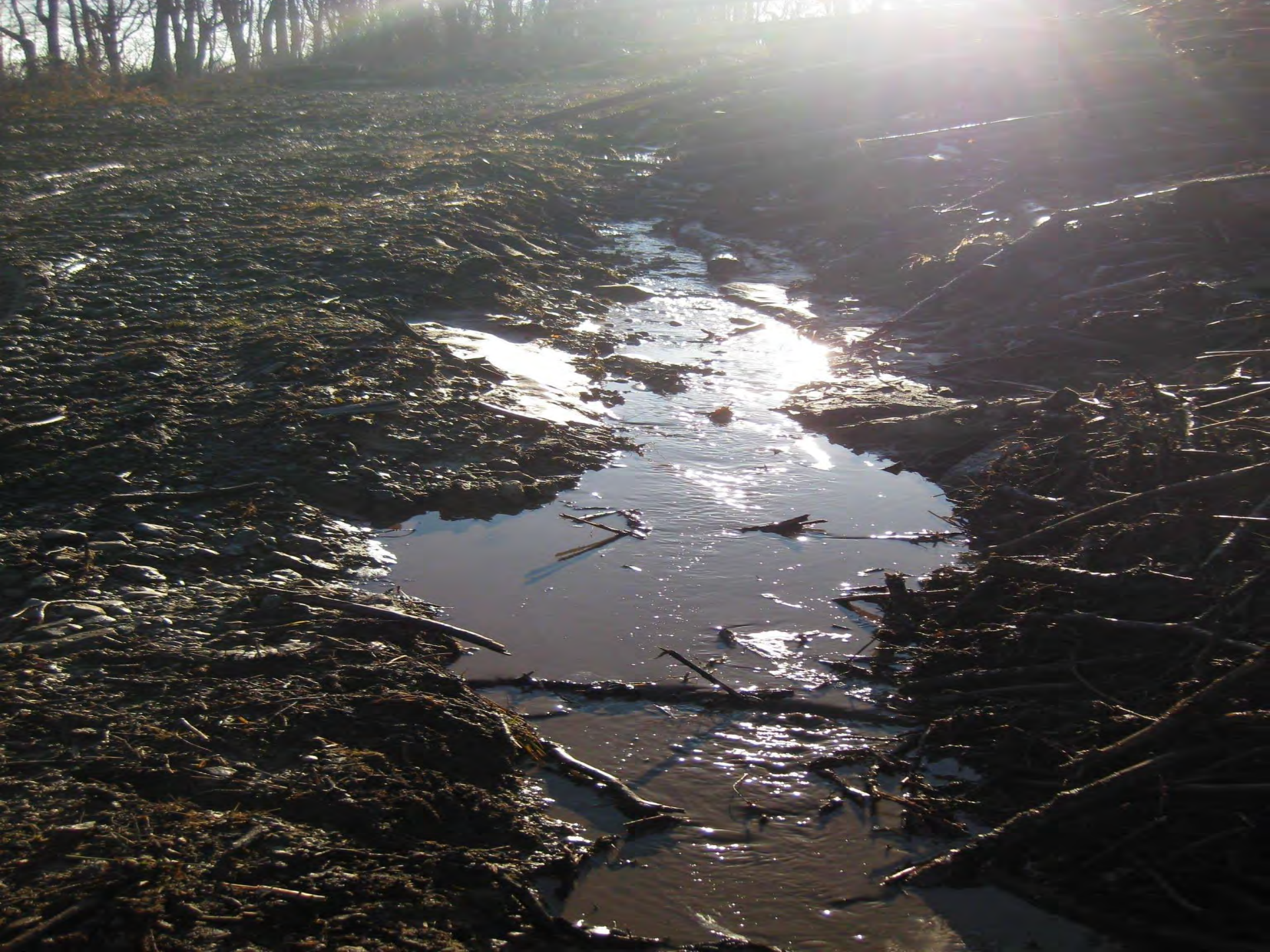
GROUNDWATER DIRECTED INTO ROAD DITCH

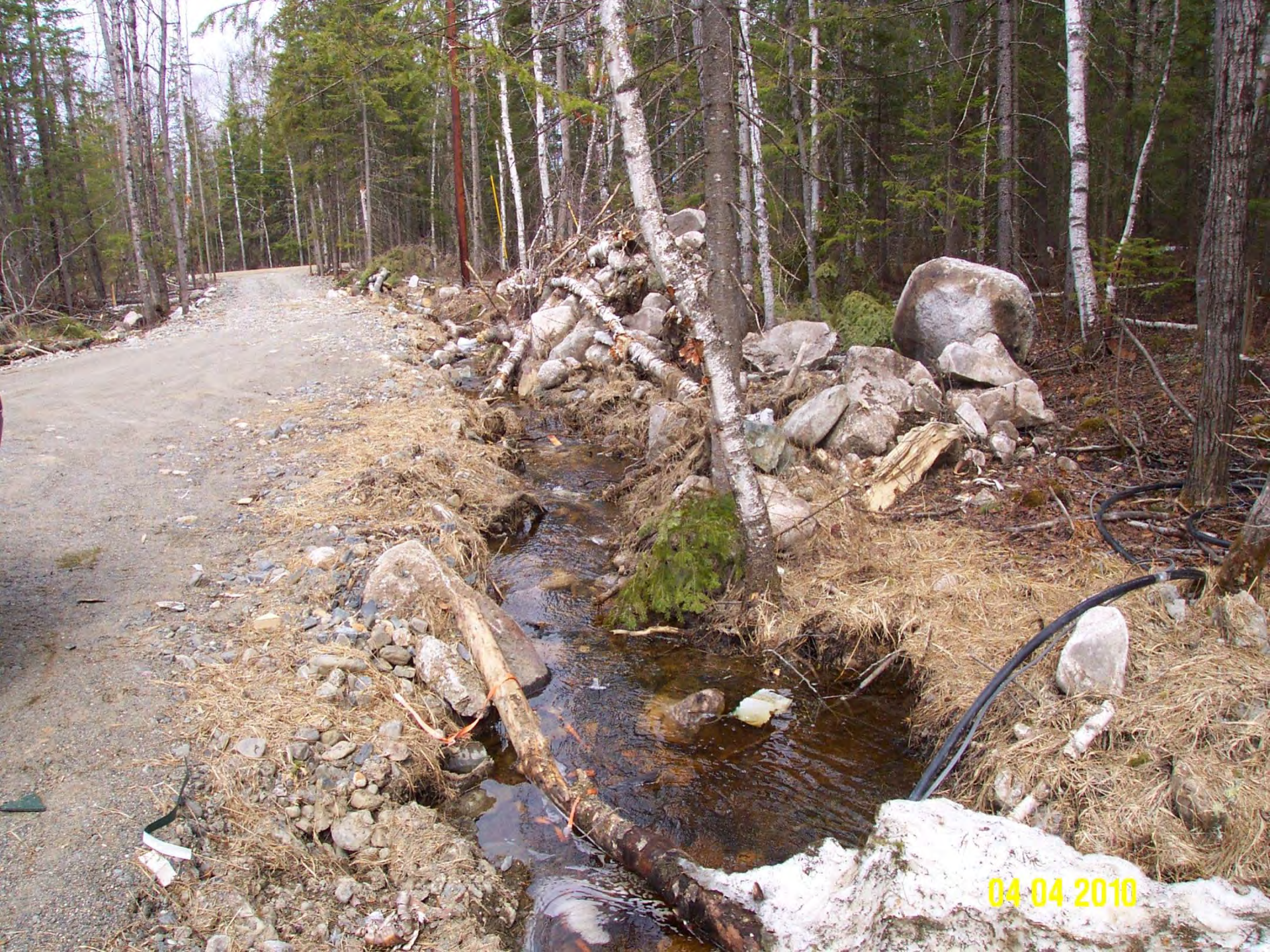
CAN BECOME A STREAM







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NEWLY CREATED DITCH STREAMS

EASILY ERODE
CONTRIBUTE SEDIMENT TO WETLANDS AND WATERBODIES
DAMAGE ROADS
OVERWHELM CULVERTS

DIFFICULT AND COSTLY TO STABILIZE

RUTTING AND COMPACTION ARE PRIMARILLY A FUNCTION OF

SOIL MOISTURE CONTENT

SOIL MOISTURE CONTENT IS PRIMARILY A FUNCTION OF

SOIL TEXTURE
LANDSCAPE POSITION
TIME OF YEAR

FINE TEXTURED SOILS HOLD ONTO WATER LONGER

AND

LARGER CONTRIBUTING WATERSHED = GREATER GROUNDWATER SUPPLY = LONGER DURATION OF SOIL SATURATION

COMPACTION AND RUTTING

MOST PREVALENT IN SATURATED LOAMY SILTY AND CLAYEY SOILS WITH GRANULAR SOIL STRUCTURE

FINE TEXTURED SOIL STRUCTURE IN TOPSOIL LAYER

FUNCTION OF SOIL DEVELOPMENT

RESPONSIBLE FOR PORE SPACE NECESSARY FOR GOOD DRAINAGE AND FOREST PRODUCTIVITY

PORES BETWEEN THE SOIL STRUCTURAL UNITS HOLD AIR AND/OR WATER AND IS WHERE PLANT ROOTS GROW

50 PERCENT OF THE VOLUME OF THE AVERAGE TOPSOIL IS PORE SPACE

COMPACTION IS THE ELIMINATION OF THIS PORE SPACE

FINE TEXTURED SOILS

SATURATED UP TO 18”ABOVE THE GROUNDWATER TABLE BECAUSE OF CAPILLARY FRINGE

DRIVING ON FINE TEXTURED SOIL WHEN WET WILL DESTROY STRUCTURE

ELIMINATING THE PORE SPACE MAKING THE SOIL MORE DENSE OR COMPACT

STRUCTURAL INTEGRETY (BEARING STRENGTH OF THE SOIL) IS HIGHEST WHEN SOIL IS DRY

LOWEST WHEN THE SOIL IS SATURATED

WATER IS A LUBRICANT

CAN DRIVE ON A CLAY SOIL IN AUGUST WITHOUT CAUSING DAMAGE

NOT IN SPRING OR FALL

YANKEE WOODLOT

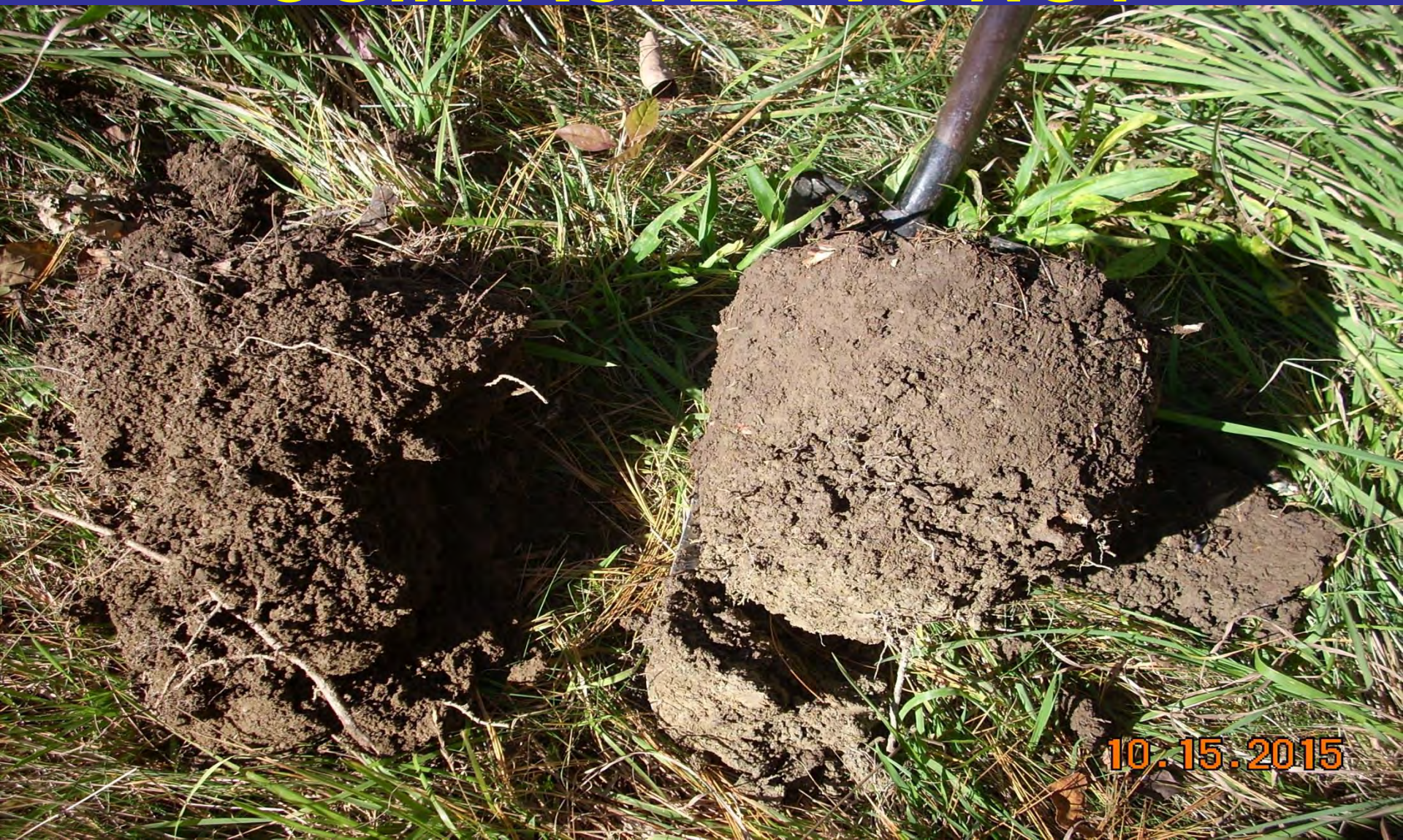
SKOWHEGAN
MAINE

WELL DRAINED
HIGHLY PRODUCTIVE SOILS

SOIL NOT COMPACTED
GOOD HERBACEOUS COVER

COMPACTED SOIL
NO HERBACEOUS COVER

SAME SOIL
COMPACTED VS NOT



TYPICAL WET AREAS

GROUND AND SURFACE WATER OFTEN ACCUMULATE IN LOW AND FLAT AREAS CREATING WETLANDS

GROUND WATER IS STAGNENT AND BECOMES ANAEROBIC

WETLANDS RELATIVELY EASY TO RECOGNIZE

DOMINATED BY WETLAND PLANTS

IN LOW POSITIONS ON THE LANDSCAPE

HAVE STANDING WATER OR SATURATED SOILS

LESS FAMILIAR

WET LOAMY SOILS ON SLOPES WITH SHALLOW DEPTH TO HARDPAN OR BEDROCK

TYPICALLY HAVE STONY SURFACE

TYPICALLY SUPPORT UPLAND HARDWOODS NOT USUALLY ASSOCIATED WITH WET AREAS

SUGAR MAPLE
WHITE ASH
YELLOW BIRCH

THESE SOILS HAVE

FLOWING GROUNDWATER TABLE WITH OXYGEN

UNIQUE HYDROLOGY FEATURES

MANY TIMES DO NOT LOOK AS WET AS THEY ARE

LEARN HOW TO IDENTIFY THESE SITES

BEFORE BEGINING HARVEST

WHEN LAYING OUT SKID TRAILS/LOGGING ROADS

CLUES

SOIL COLORS INDICATING WETNESS

GROUNDWATER SEEPS

STONE LINED CHANNELS

STONE COVERED WET AREAS

SOIL DRAINAGE INDICATORS

WELL DRAINED SOILS

WELL DRAINED SOILS WITH BRIGHT COLORS HAVE FEW LIMITATIONS FOR HARVESTING OPERATIONS AND SKID TRAIL/ROAD CONSTRUCTION

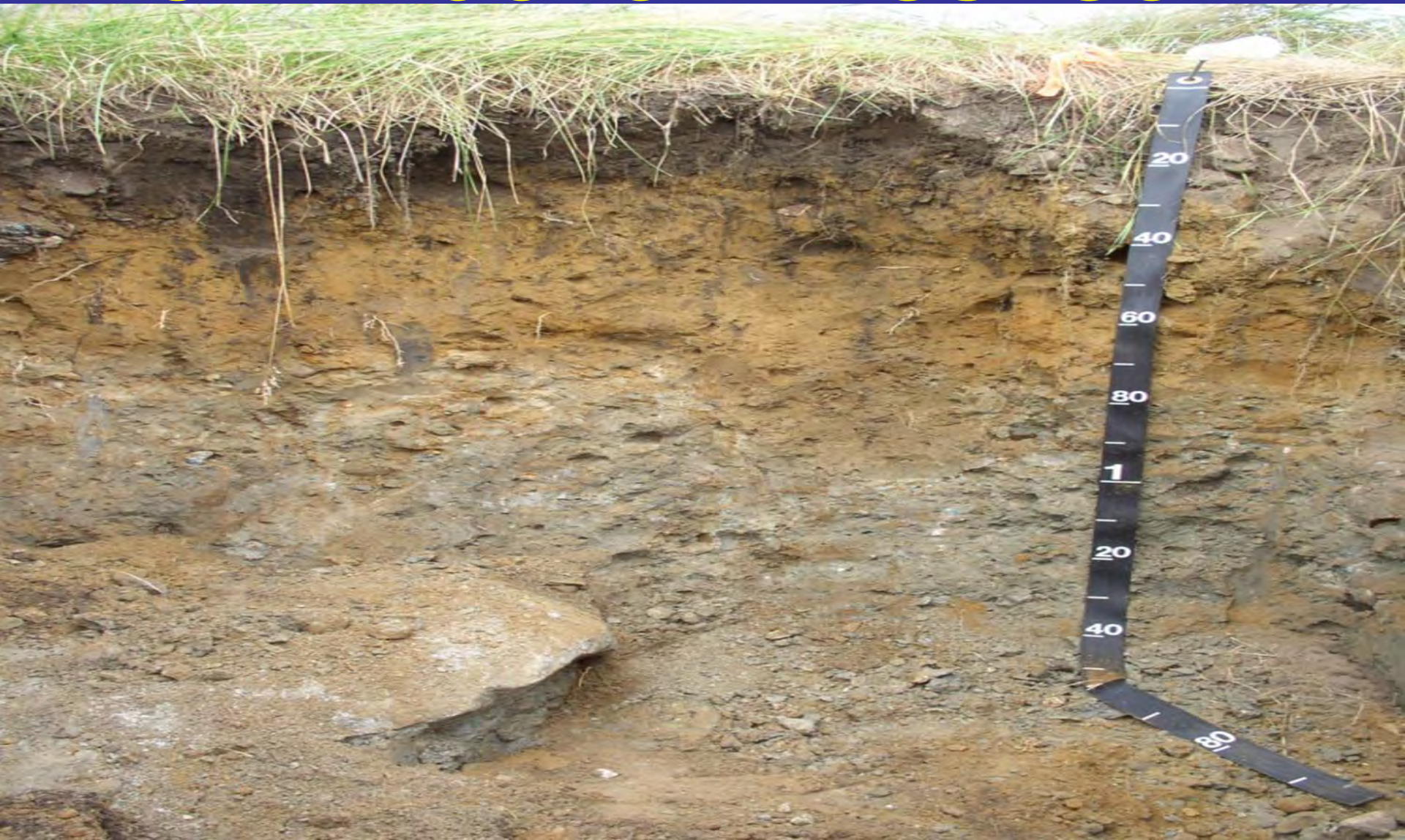
OTHER THAN MUD SEASON

LOOK FOR BRIGHT SOIL COLORS

MODERATELY WELL DRAINED SOILS

HAVE DRAINAGE MOTTLES INDICATING A SEASONAL PERCHED GROUNDWATER TABLE

GRAY AND RED SPOTS IN OLIVE COLORED SUBSOIL

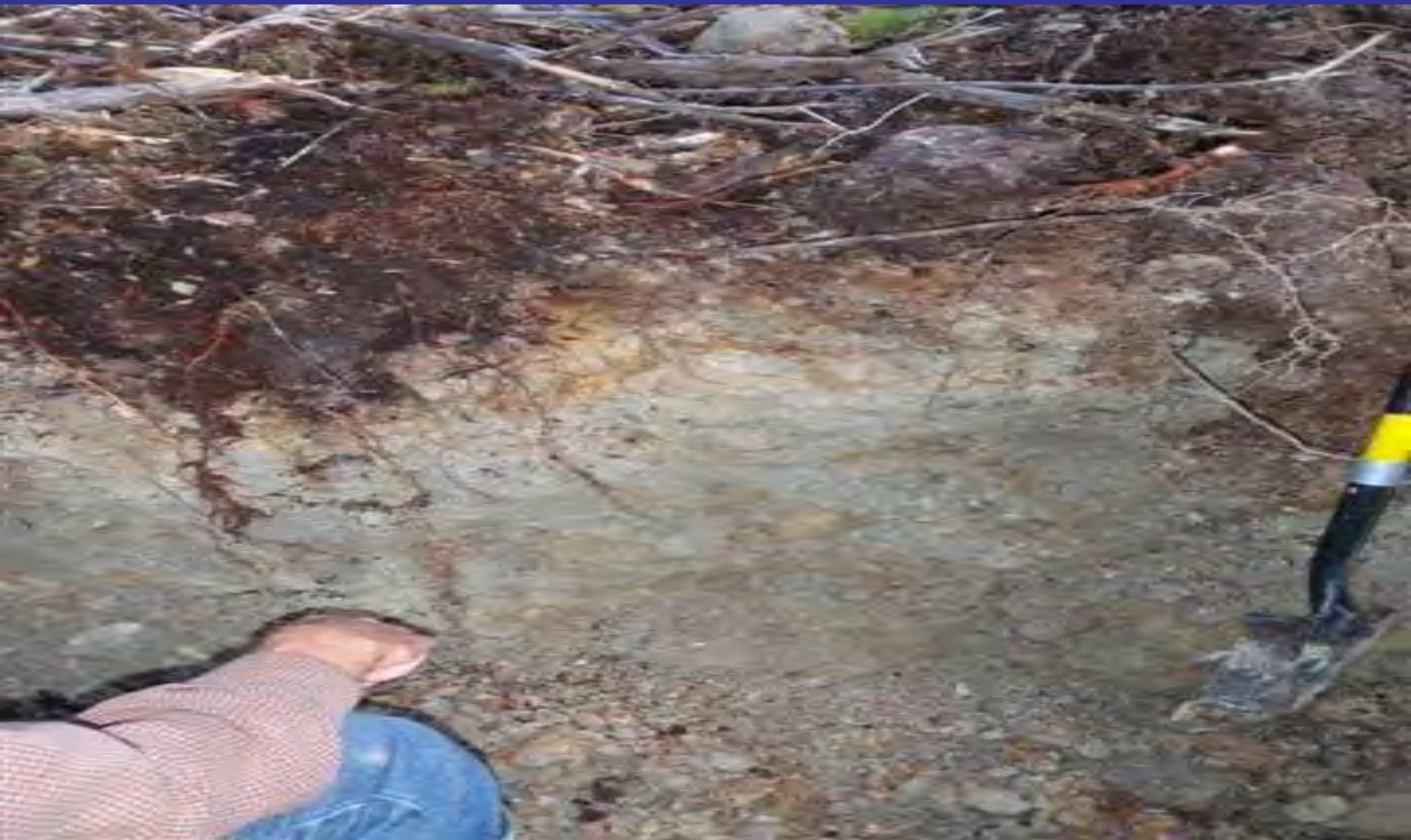


SOILS THAT ARE PRIMARILY BLACK AND GRAY

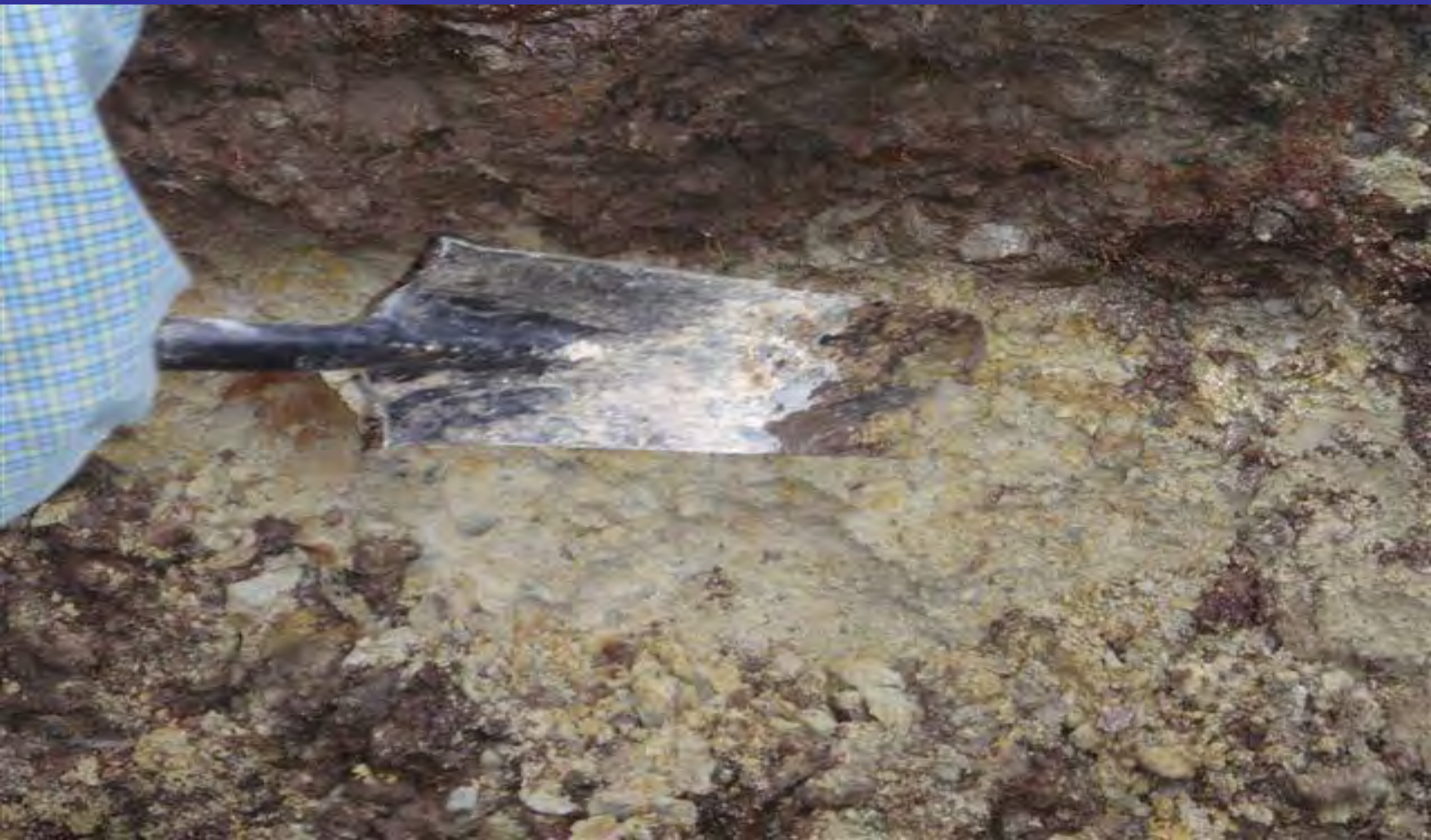
INDICATION OF SATURATION MOST OF THE YEAR

GROUNDWATER TABLE IS ANAEROBIC

WETLAND OR HYDRIC SOIL
NOTE ROOTING DEPTH



WETLAND OR HYDRIC SOIL
RUSTY STAINS NO ROOTS



WET OXYGENATED GROUNDWATER TABLE SOILS ARE NOT GRAY AND DO NOT HAVE GRAY SPOTS

THEY ARE TYPICALLY OLIVE BROWN COLORED WITH ORGANIC MATTER STREAKING

THE DURATION OF HIGH GWT IN OXYGENATED GWT SOILS IS USUALLY SHORTER THAN FOR ANAEROBIC GROUNDWATER TABLE SOILS

DEPENDS ON THE SIZE OF CONTRIBUTING WATERSHED

UNLIKE SOILS WITH A STAGNANT GROUND WATER TABLE

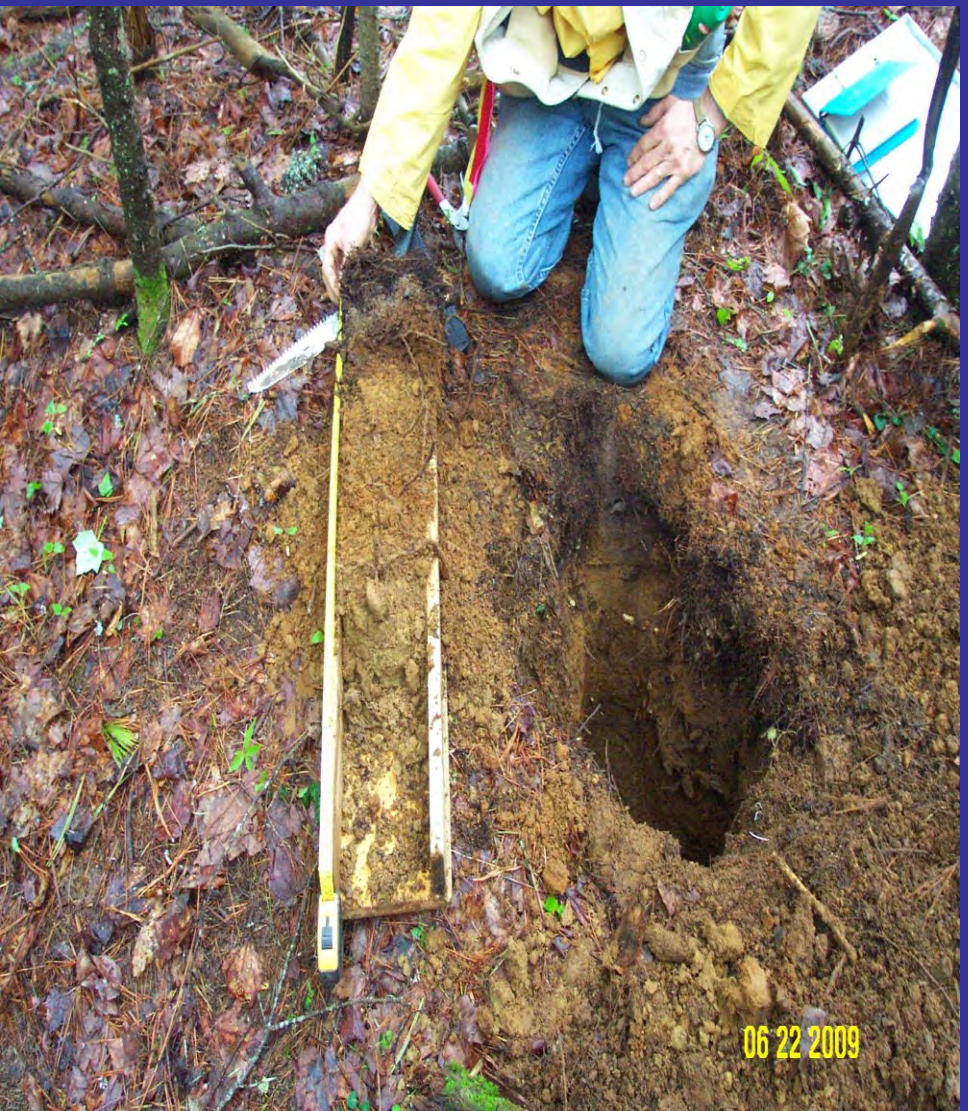
SOILS WITH OXYGEN IN THE GROUNDWATER TABLE COMMONLY HAVE TREE ROOTS GROWING BELOW THE GROUNDWATER TABLE

NOT AS SUBJECT TO TREE THROW AS WET SOILS THAT ARE ANAEROBIC

SOILS WITH OXYGEN IN THE GROUNDWATER TABLE ARE SOMETIMES REFERRED TO AS "ENRICHED" SITES

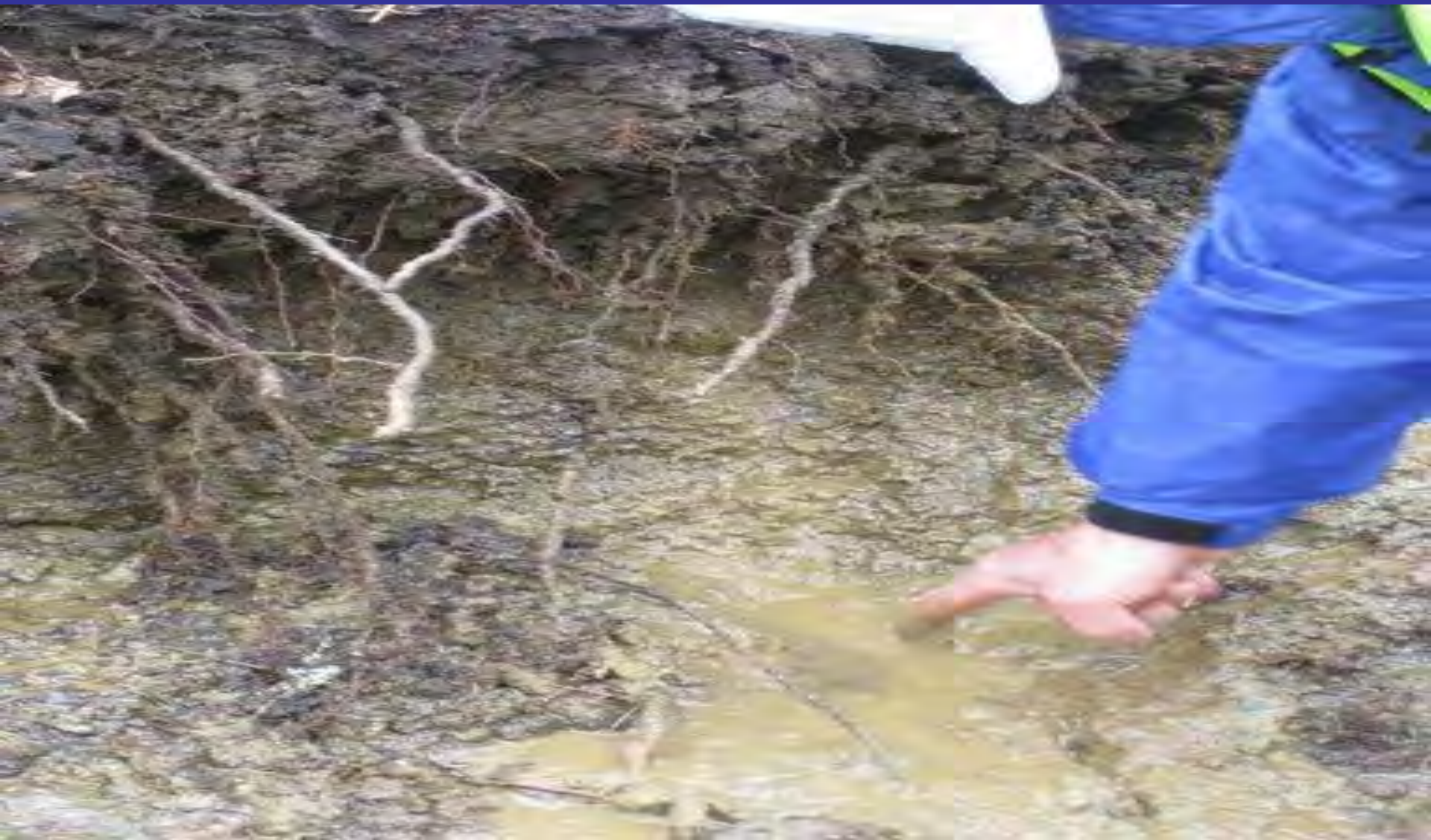
PREFERED BY SUGAR MAPLE
PRODUCE HIGH QUALITY EASTERN WHITE CEDAR

WELL DRAINED VS OXYGEN RICH WET SOIL PROFILE

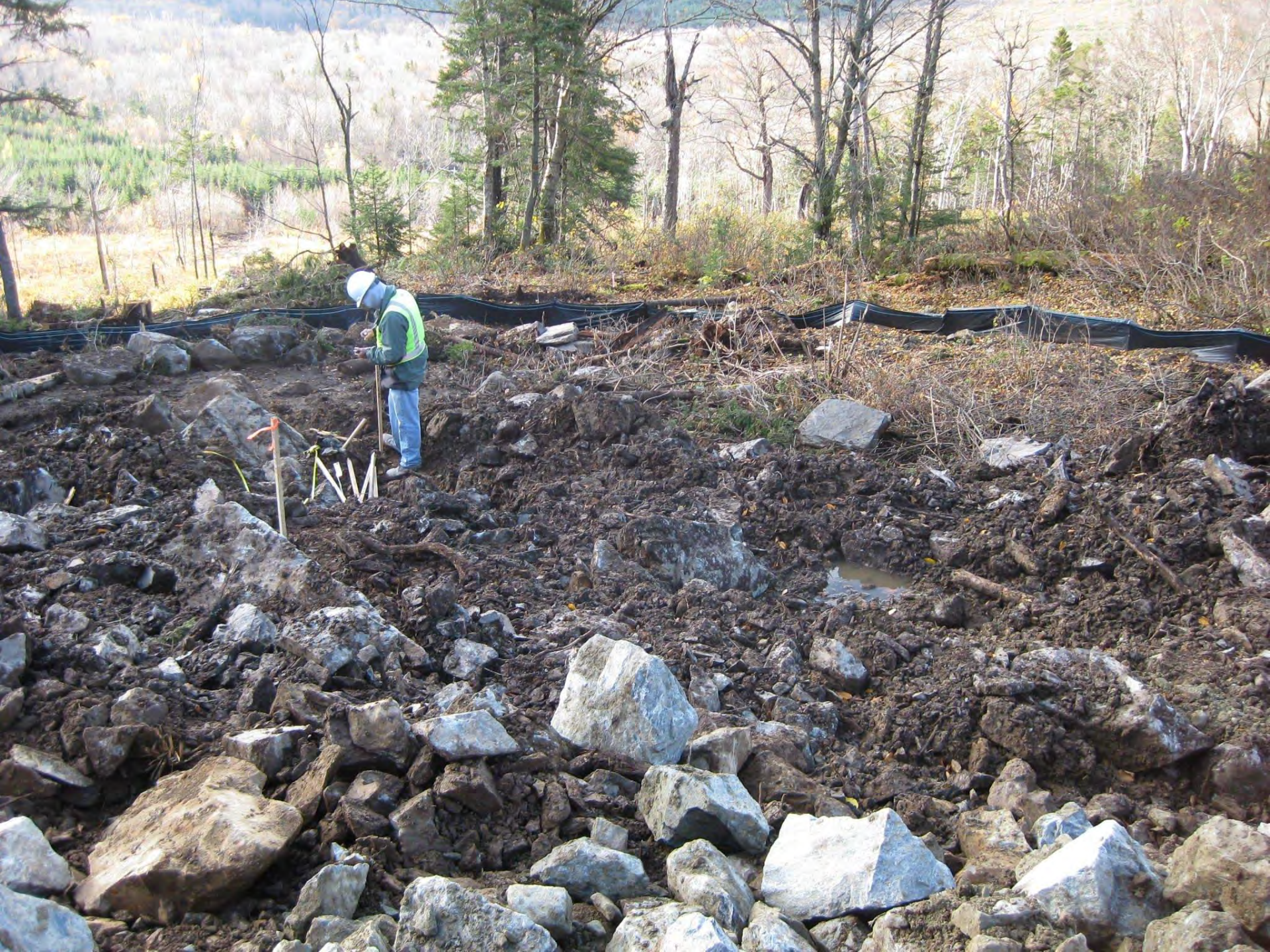


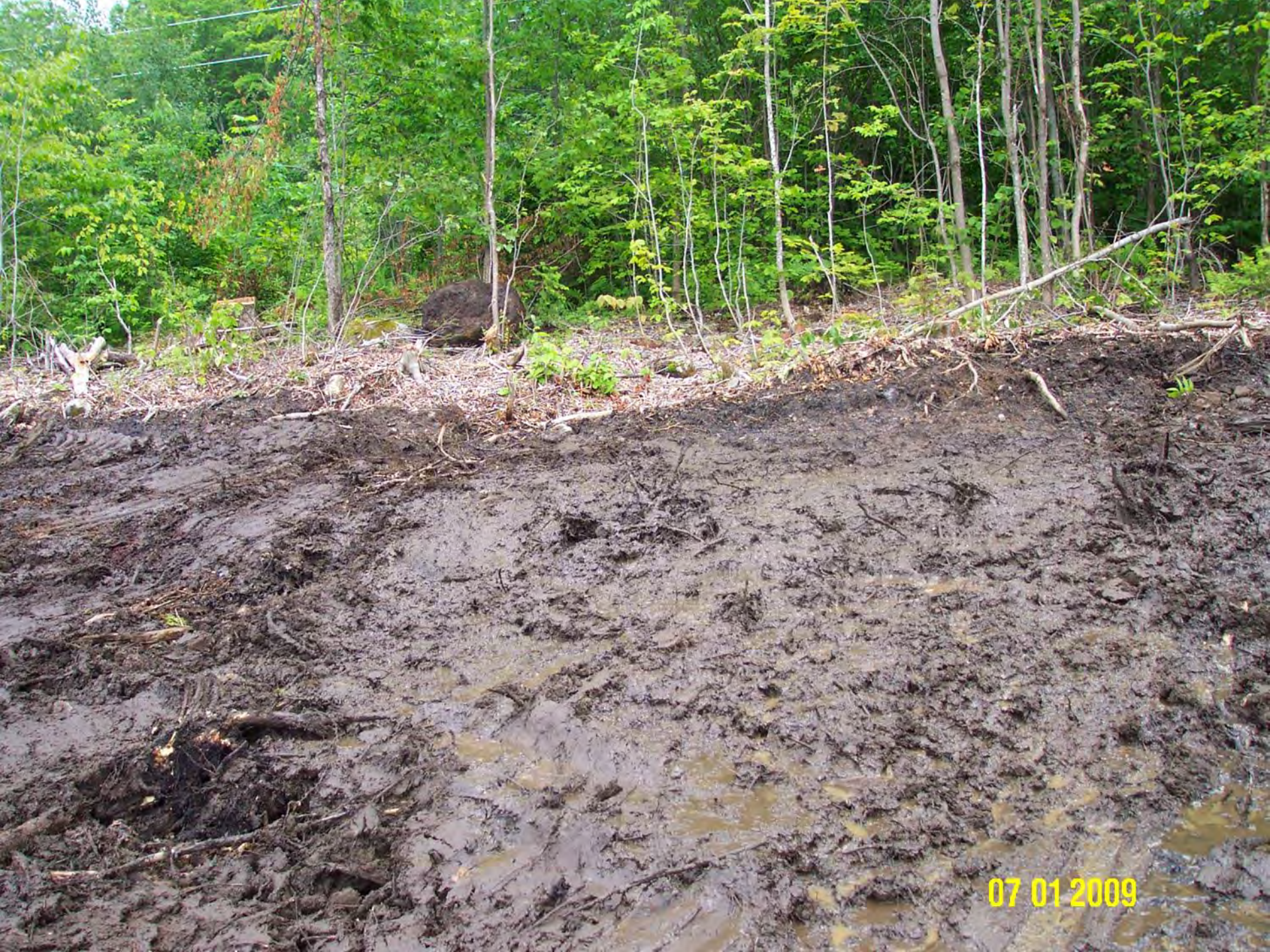
BROWNER THAN TYPICAL WET SOIL (NOTE OM ACCUM)

OXYGENATED GROUNDWATER SEEPING FROM SOIL



NOTE LARGE ROOT AND ORGANIC MATTER ACCUM

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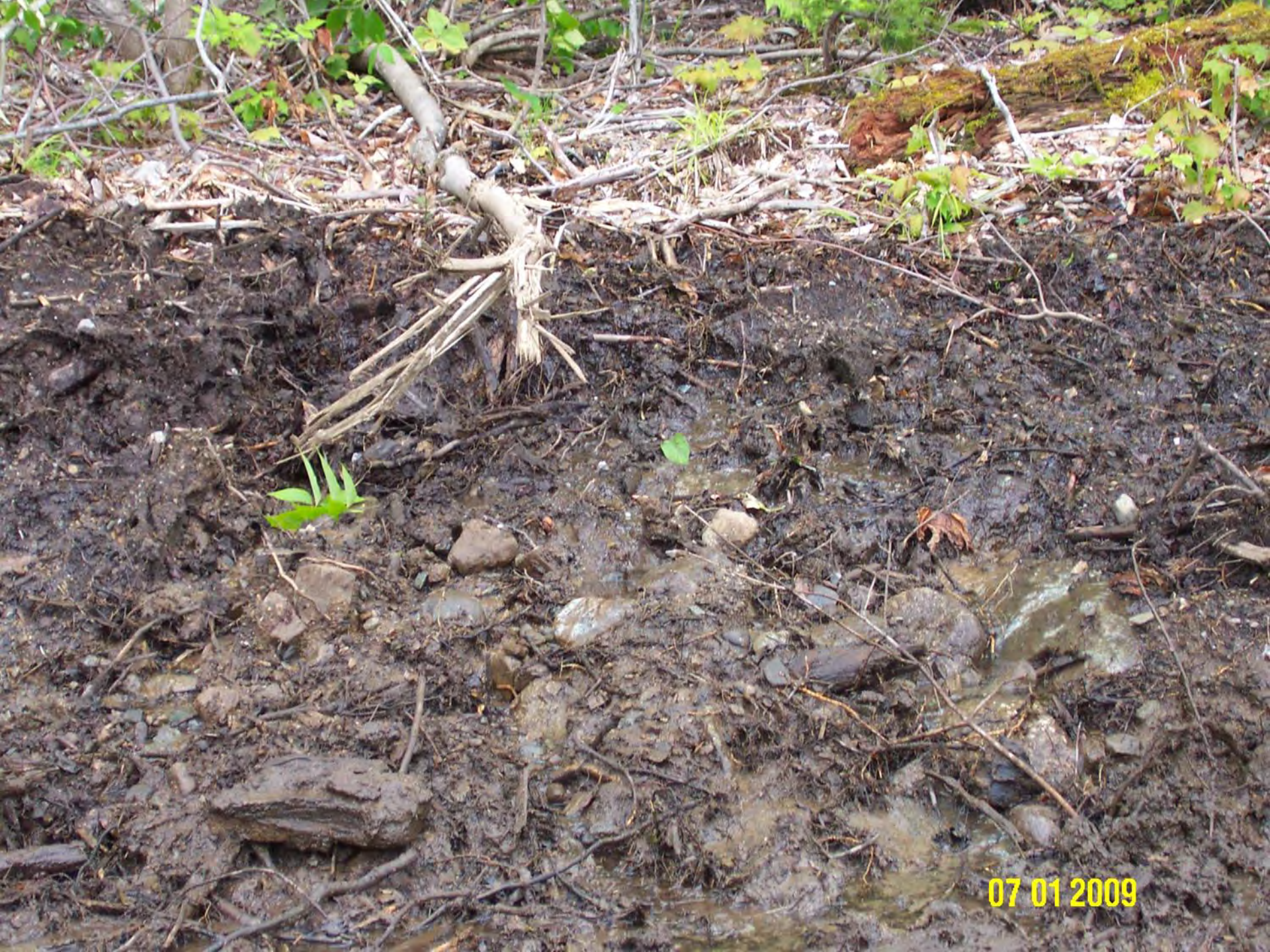
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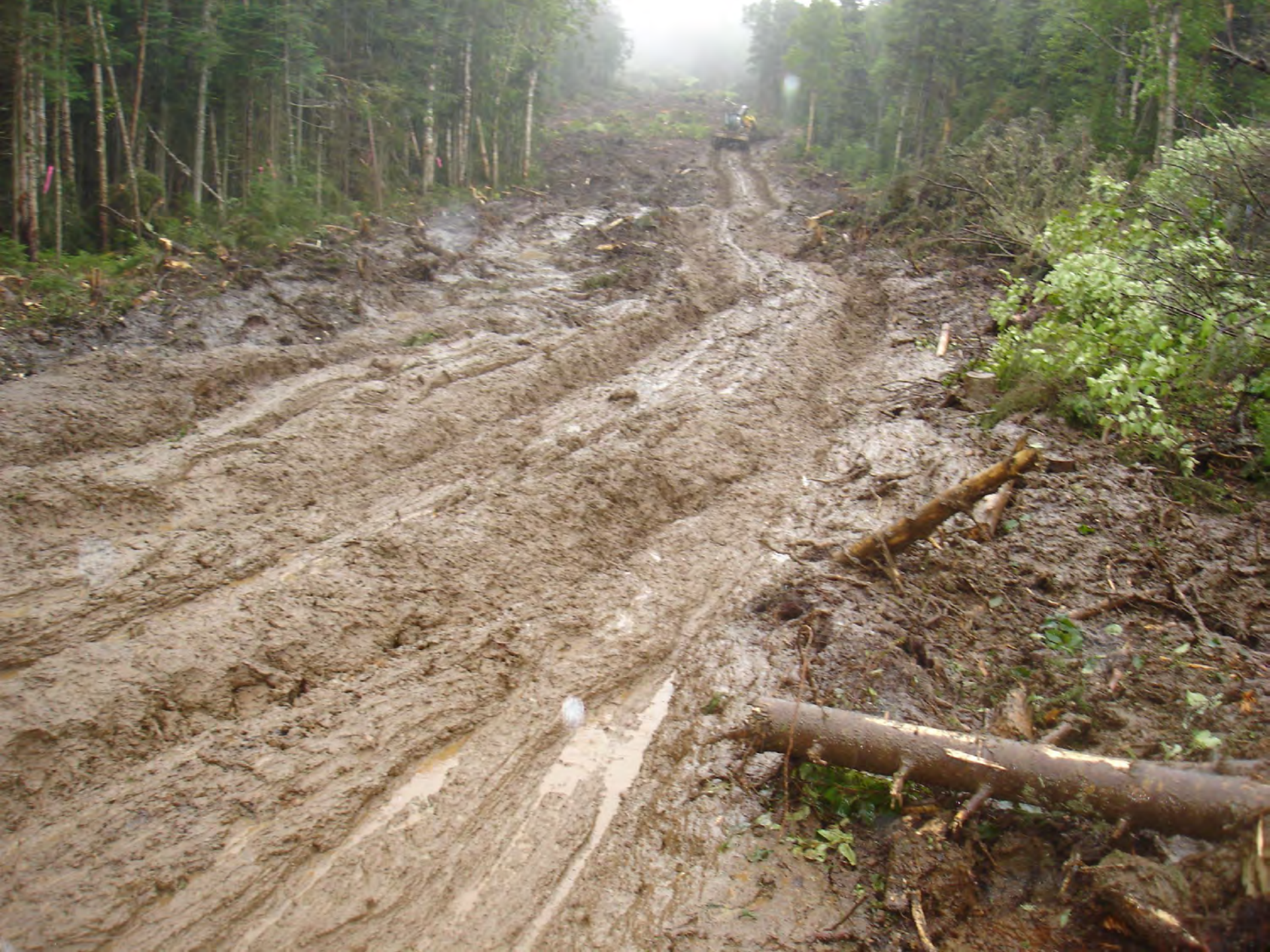
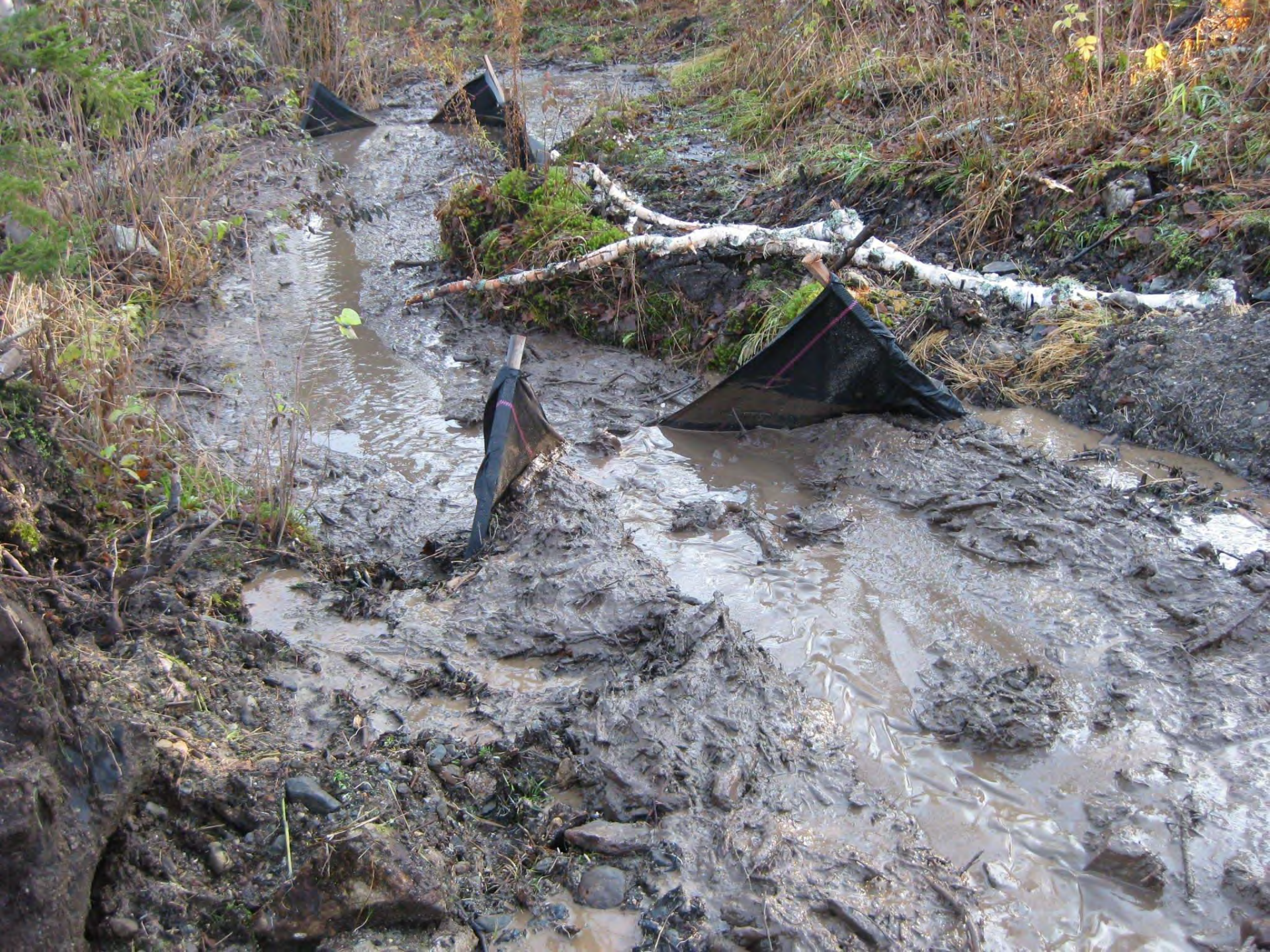
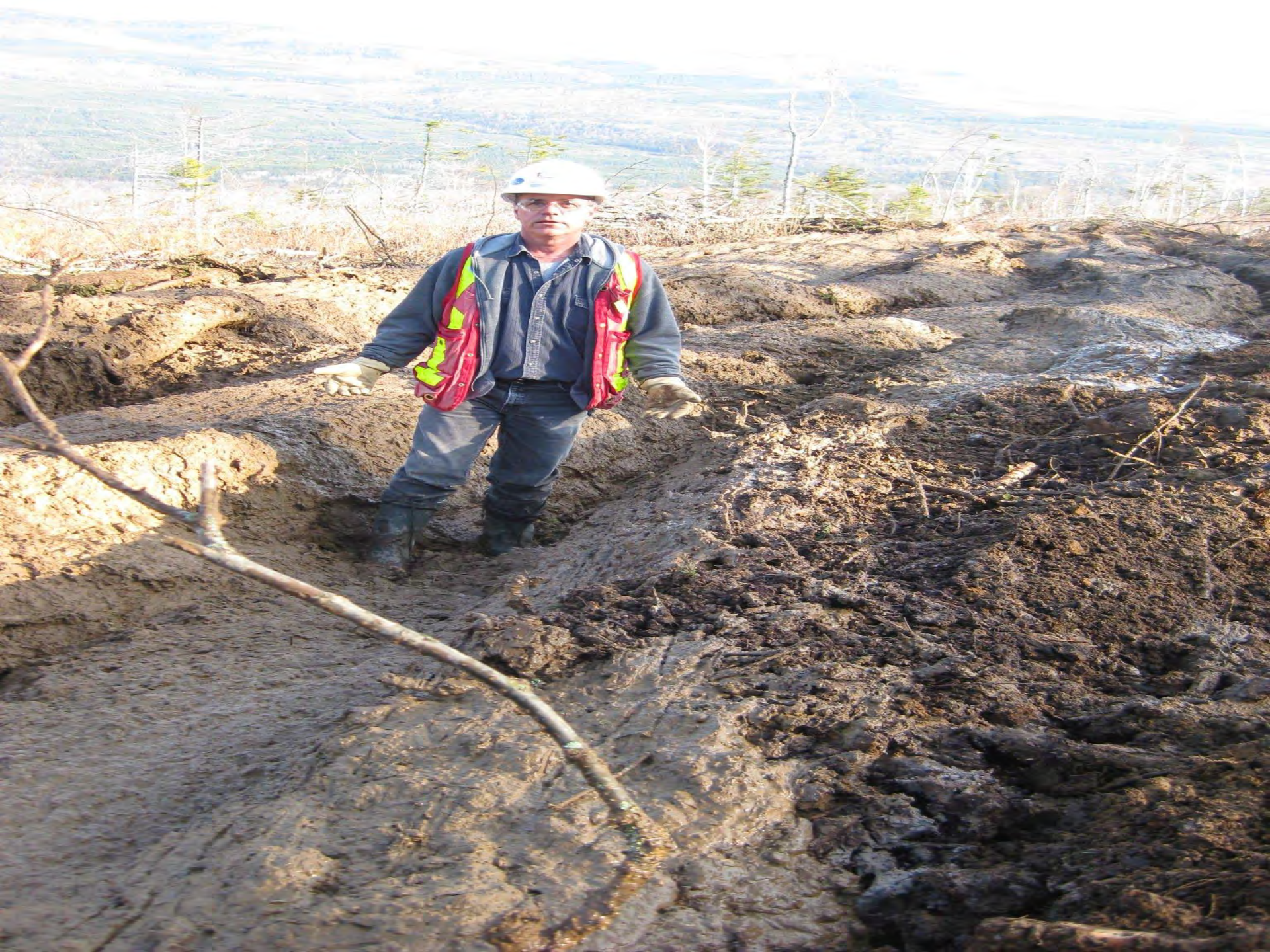
INTERCEPTED WATER IN OXYGENATED GROUNDWATER TABLES IS MOVING

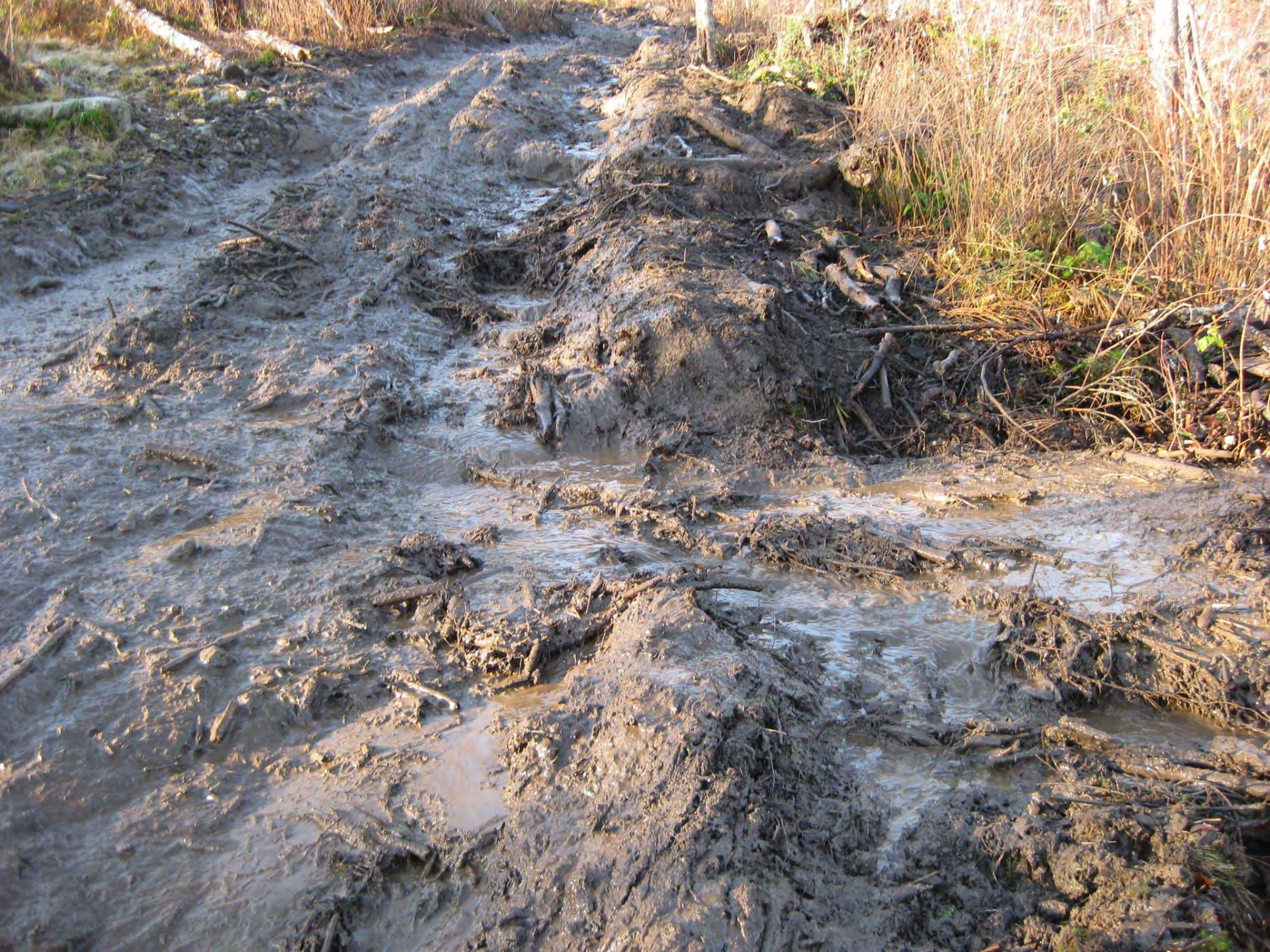
PROVIDES ENERGY TO CAUSE EROSION

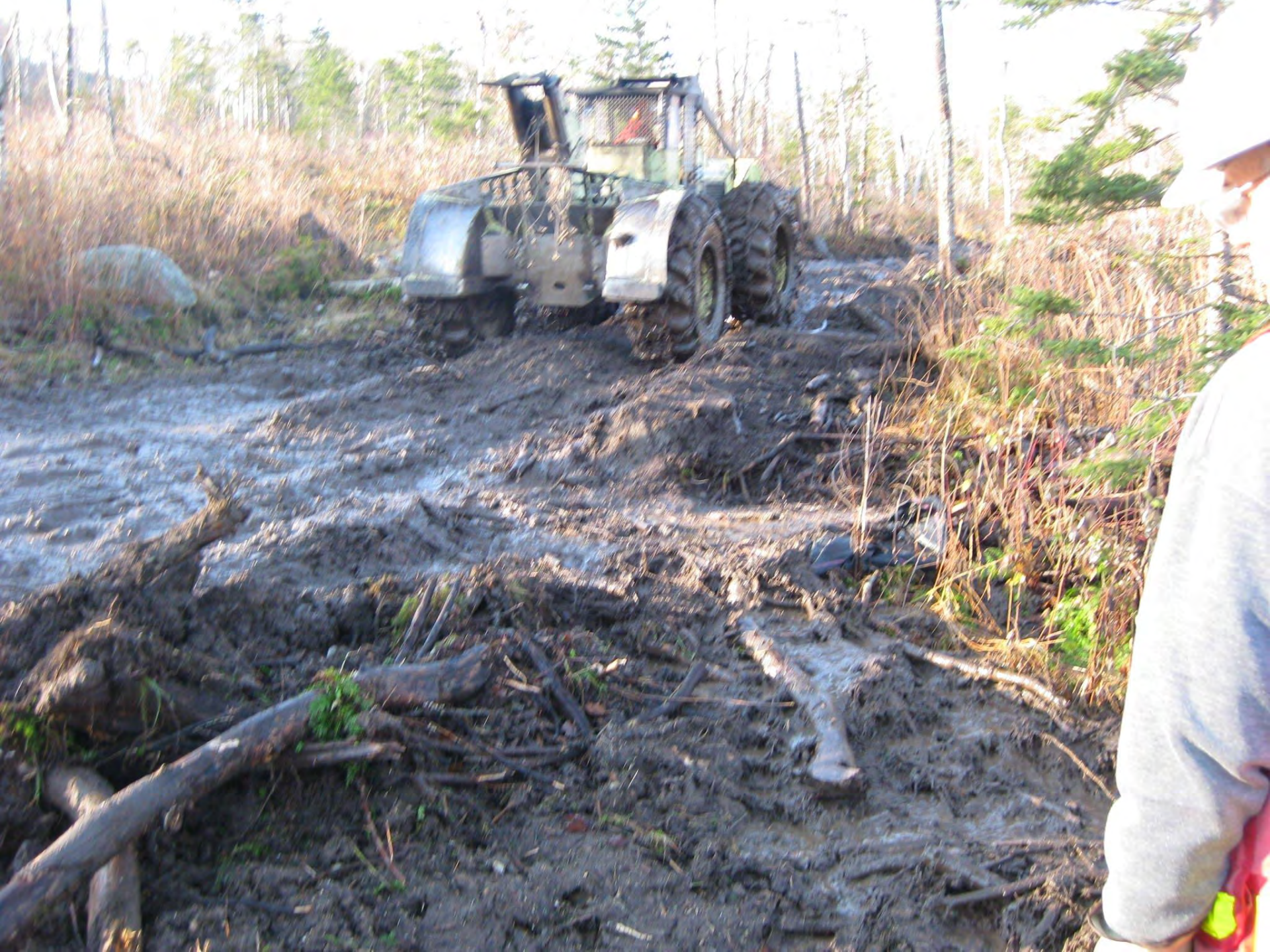
SKID TRAILS ON OXYGENATED GROUNDWATER SOILS

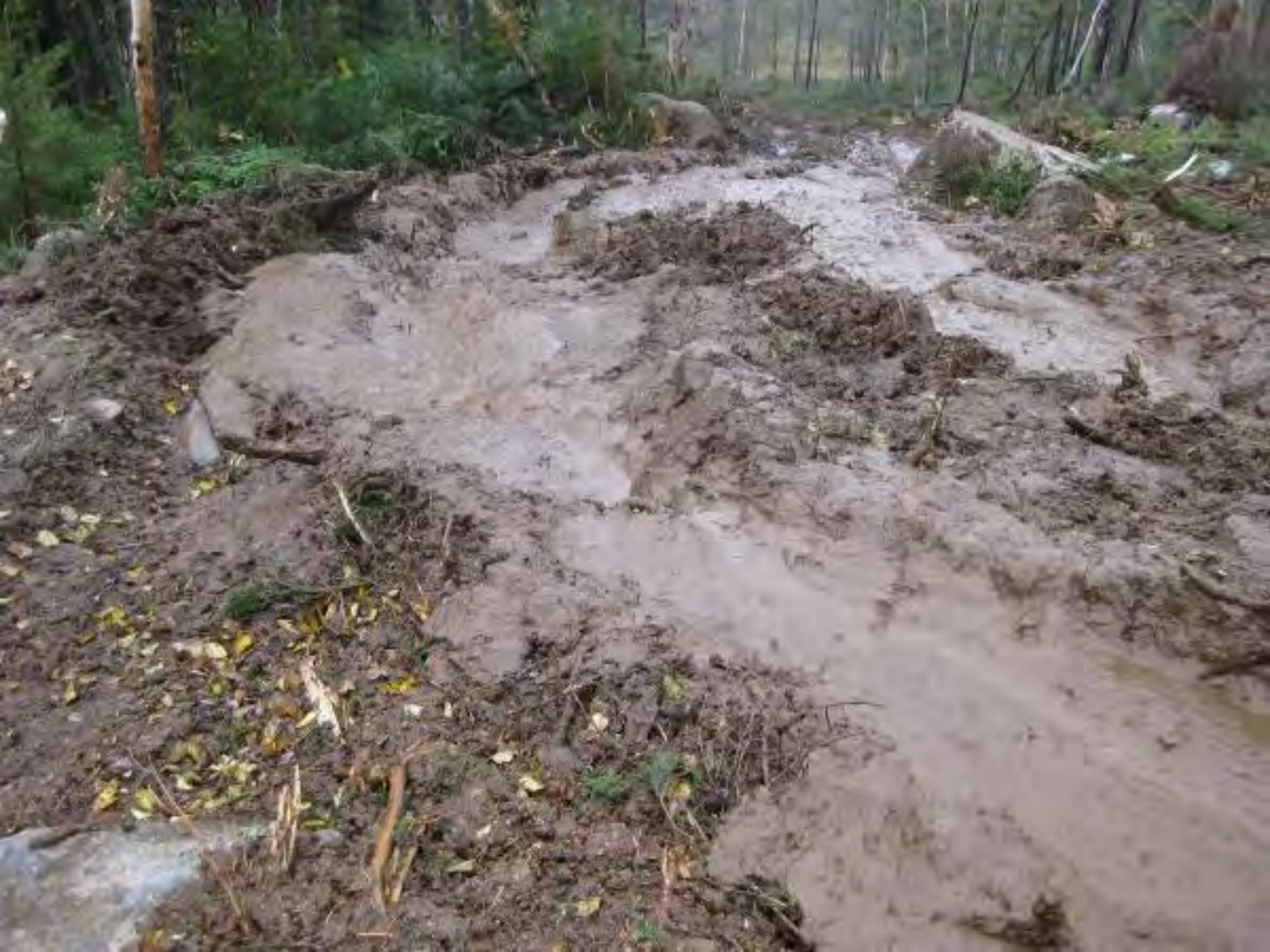


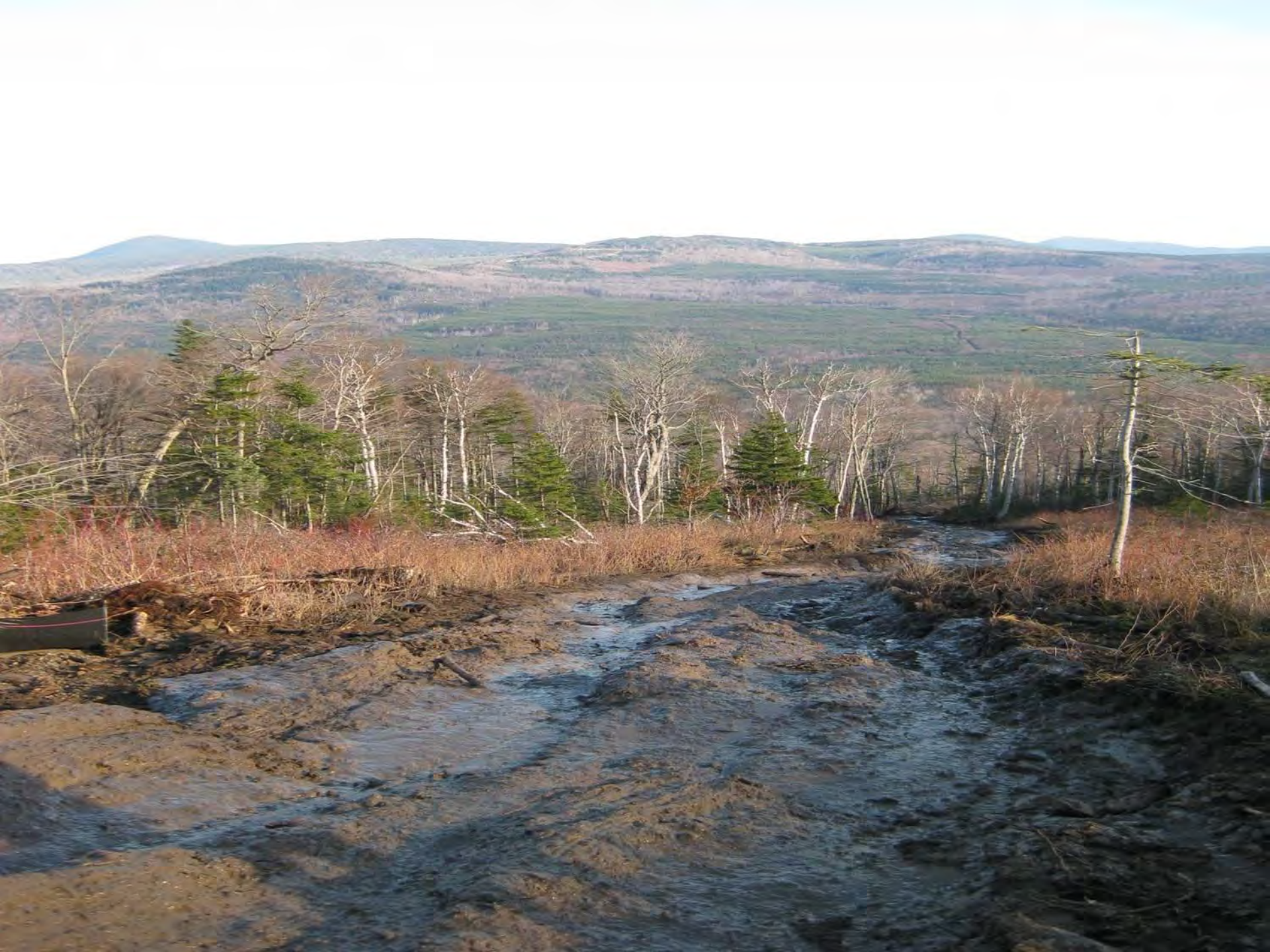












FORESTED OXYGENATED GROUNDWATER TABLE SOILS COMMONLY HAVE UNIQUE HYDROLOGY FEATURES

IF HYDROLOGY FEATURES ARE INTERRUPTED BY LOGGING ROADS

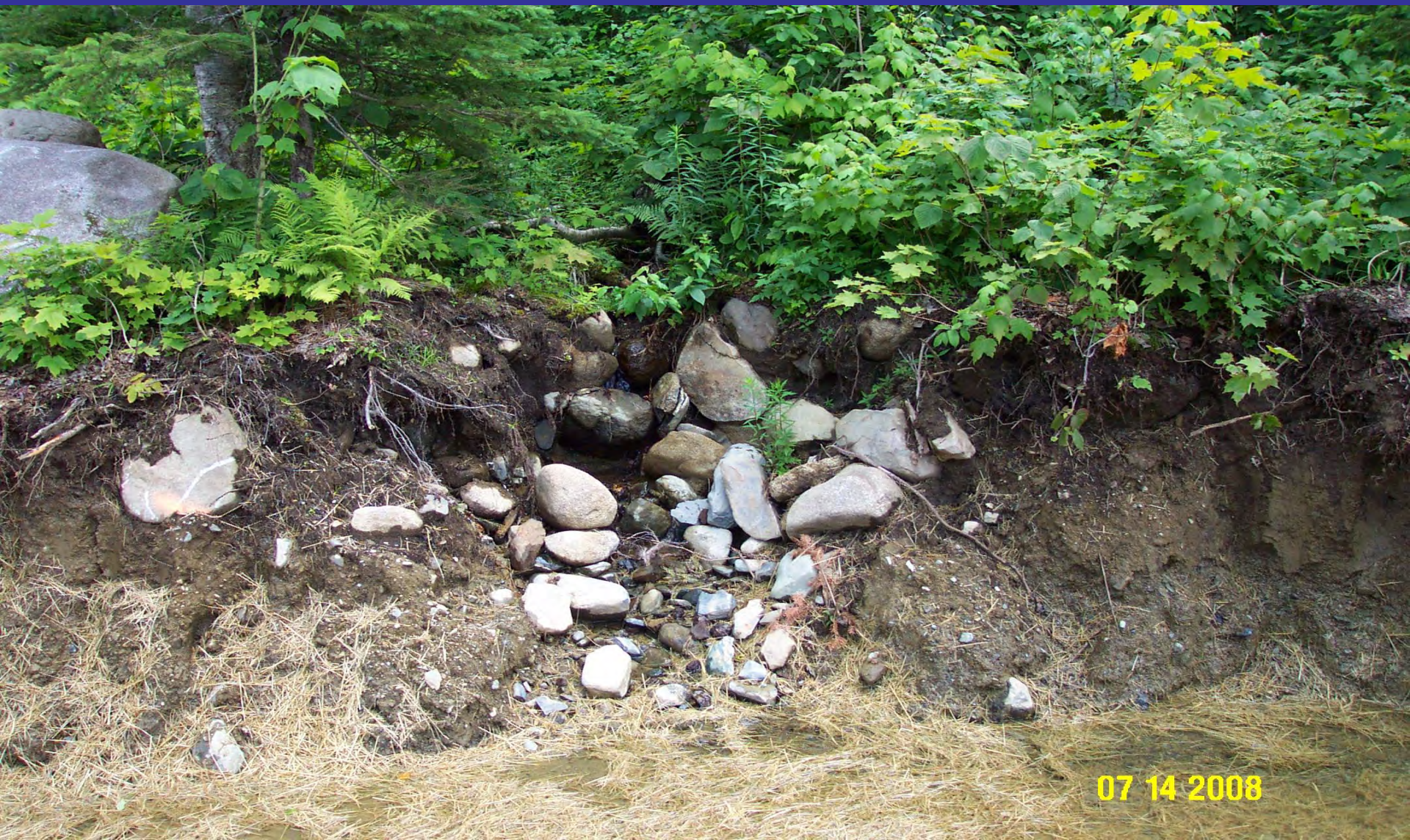
WATER ENTERS DITCHES AND CAN OVERWHELMING THEM

EXPOSED FLOWING GROUNDWATER

GROUNDWATER FLOWS BETWEEN STONES

GROUNDWATER FLOWS BETWEEN STONES

STONE LINED CHANNEL



STONE PAVED WET AREAS

BOULDER FIELD

BOULDER FIELD

EXAMPLES OF LOGGING ACTIVITIES ON OXYGENATED GROUNDWATER SOILS

LOGGING YARD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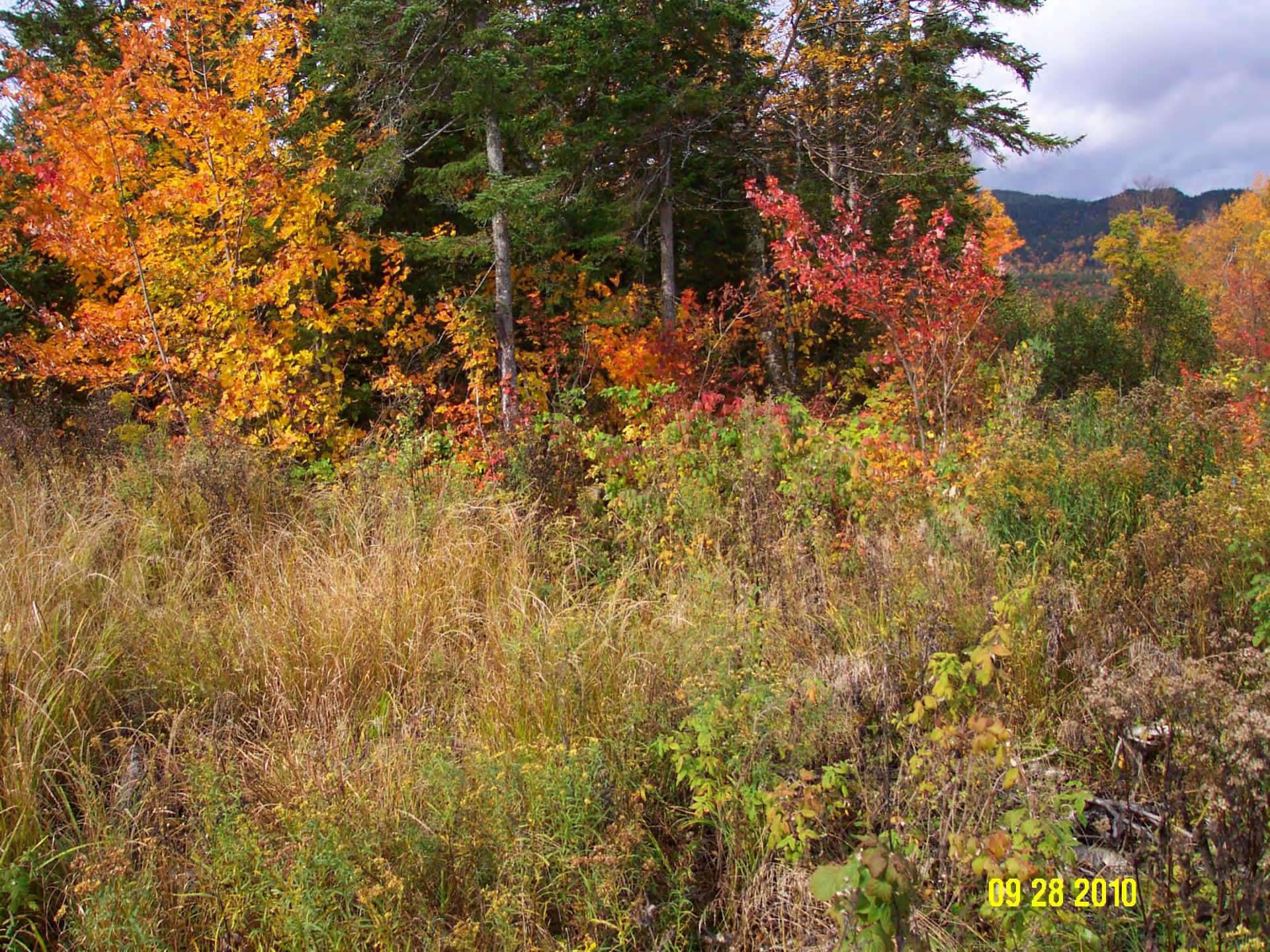
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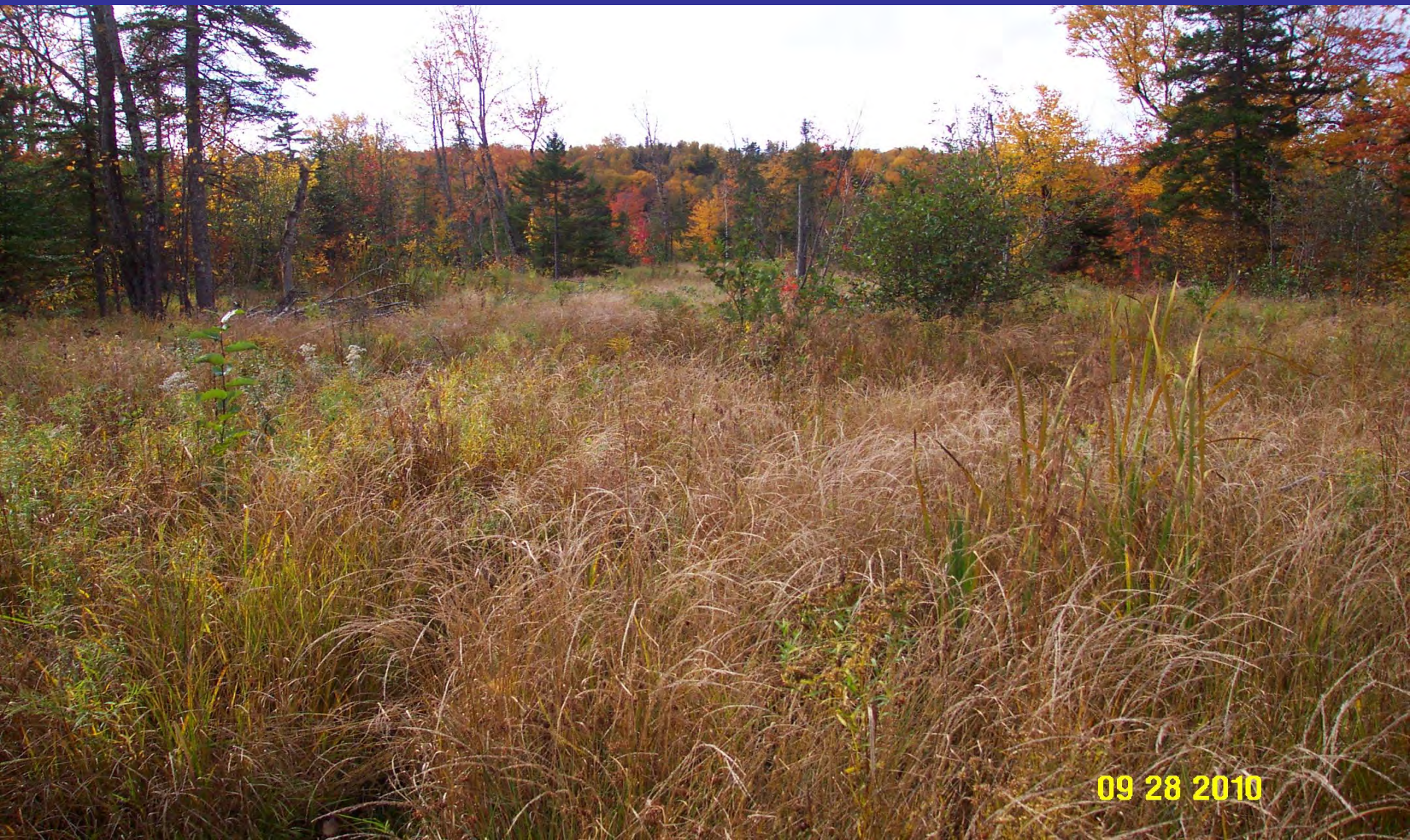
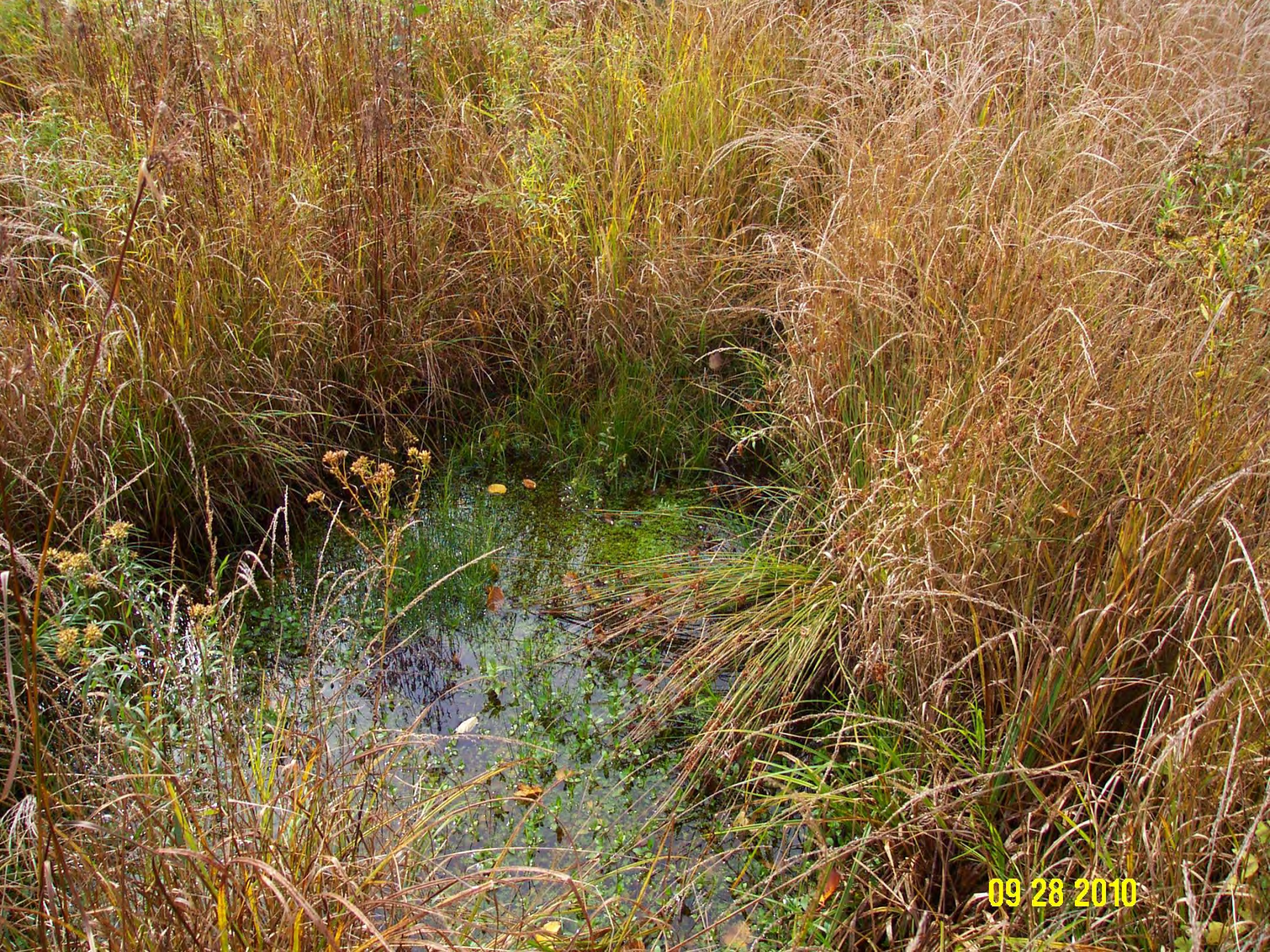
LOGGING YARD SITE BECOMES A WETLAND

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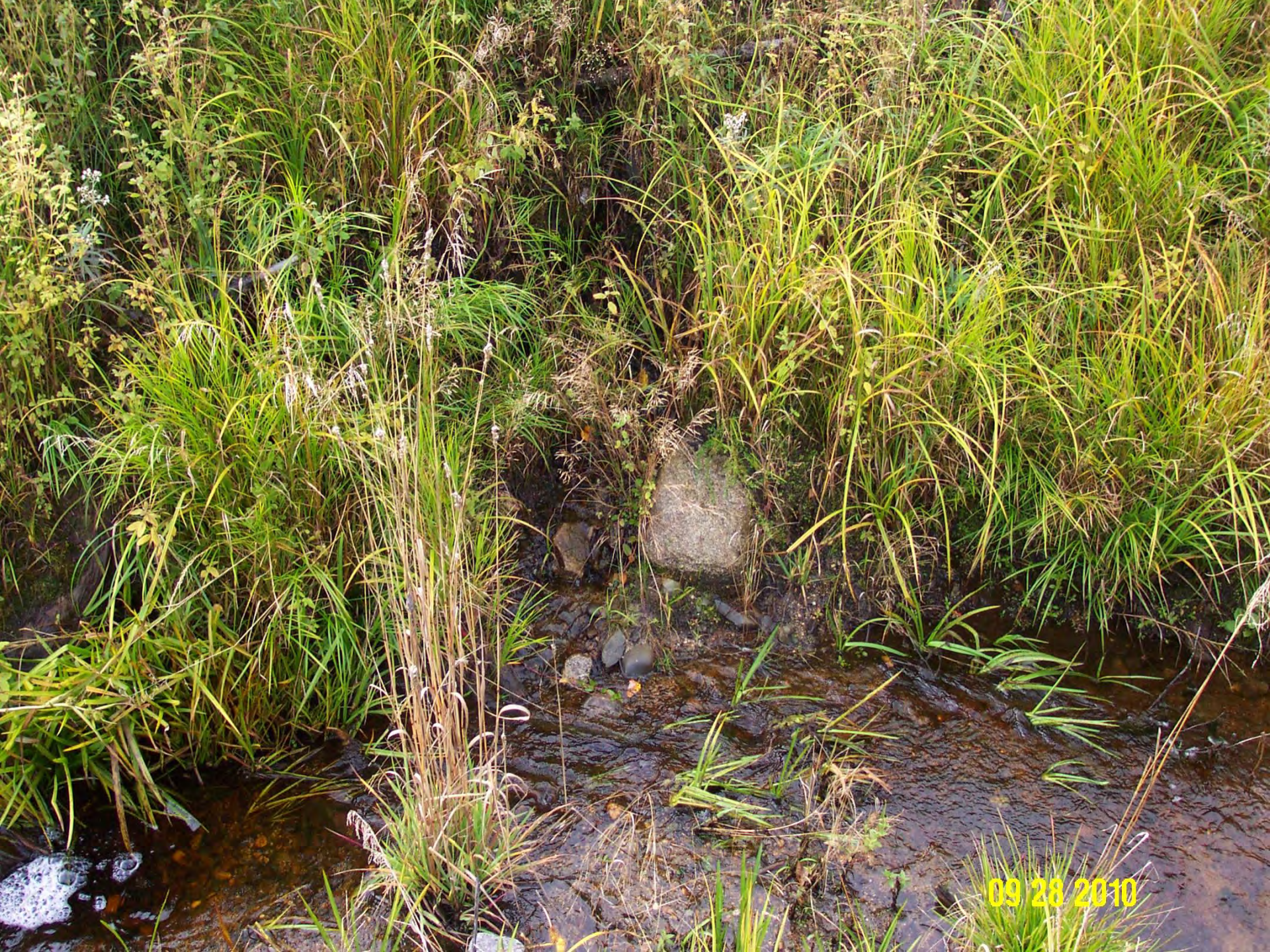
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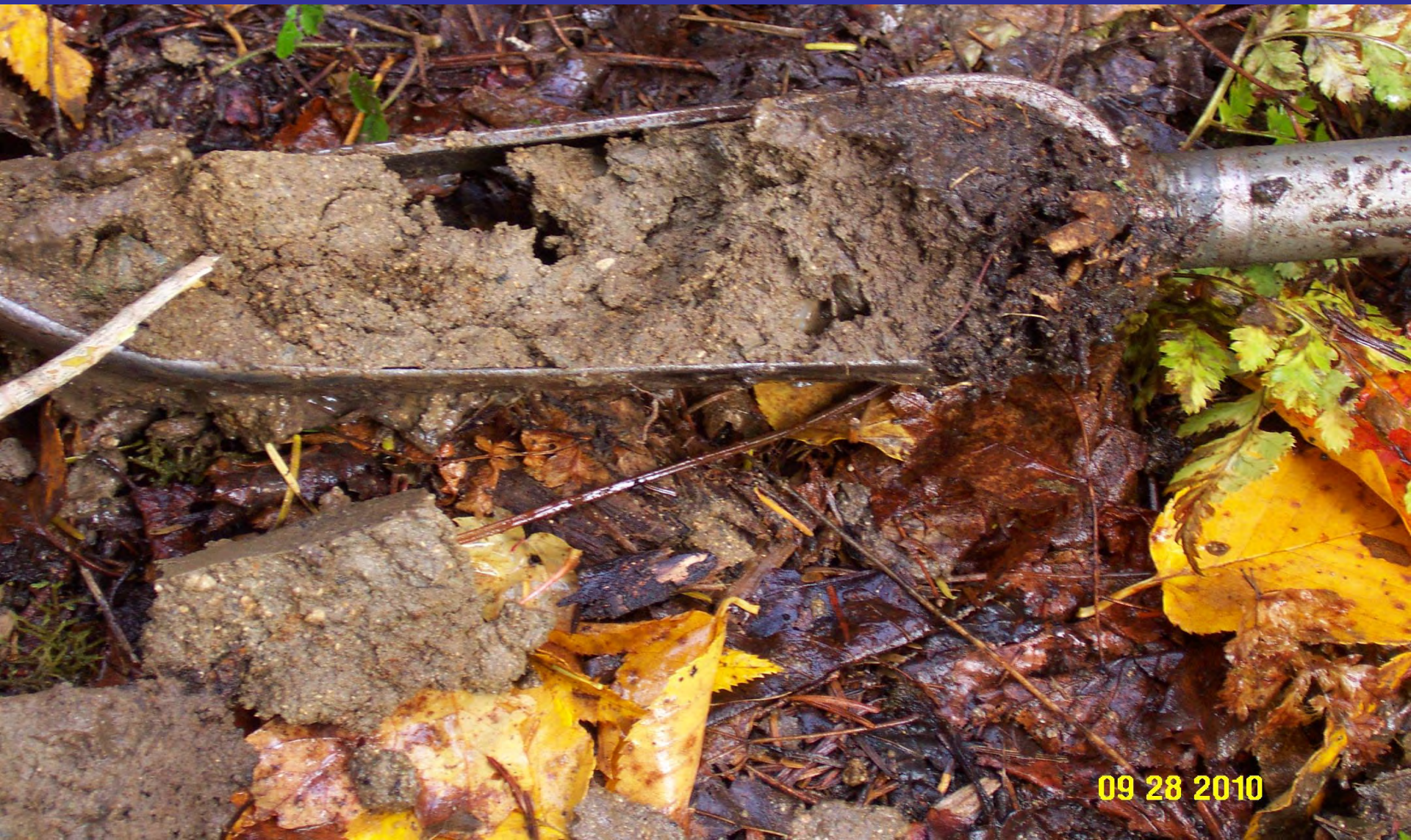
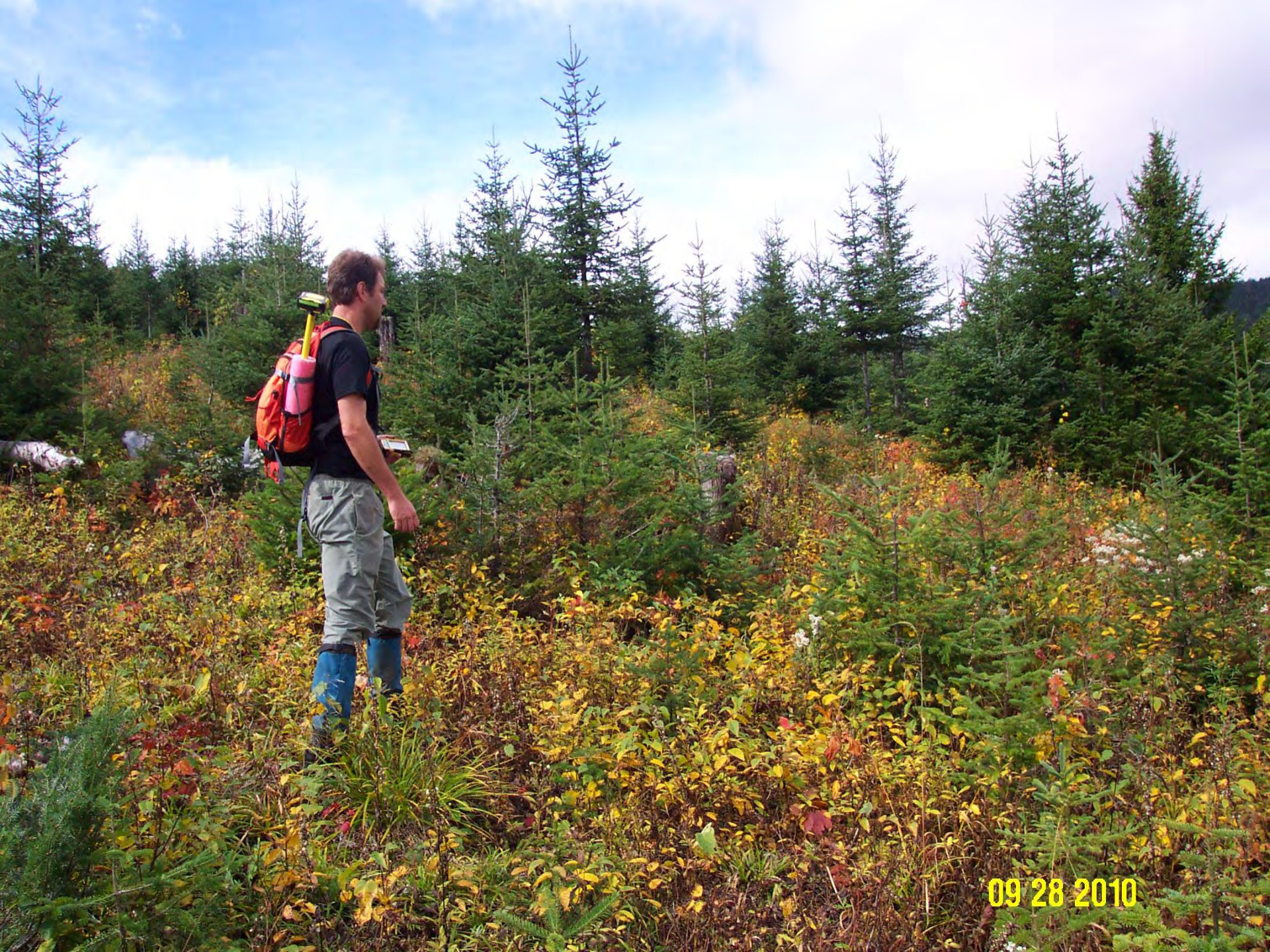
NOTE STANDING WATER IN LOWER RIGHT HAND CORNER

GROUNDWATER FLOW BETWEEN STONES/ROOTS

NOTE ORGANIC STREAKING TYPICAL OF OXYAQUIC SOIL



LOOKS LIKE A HIGH AND DRY SITE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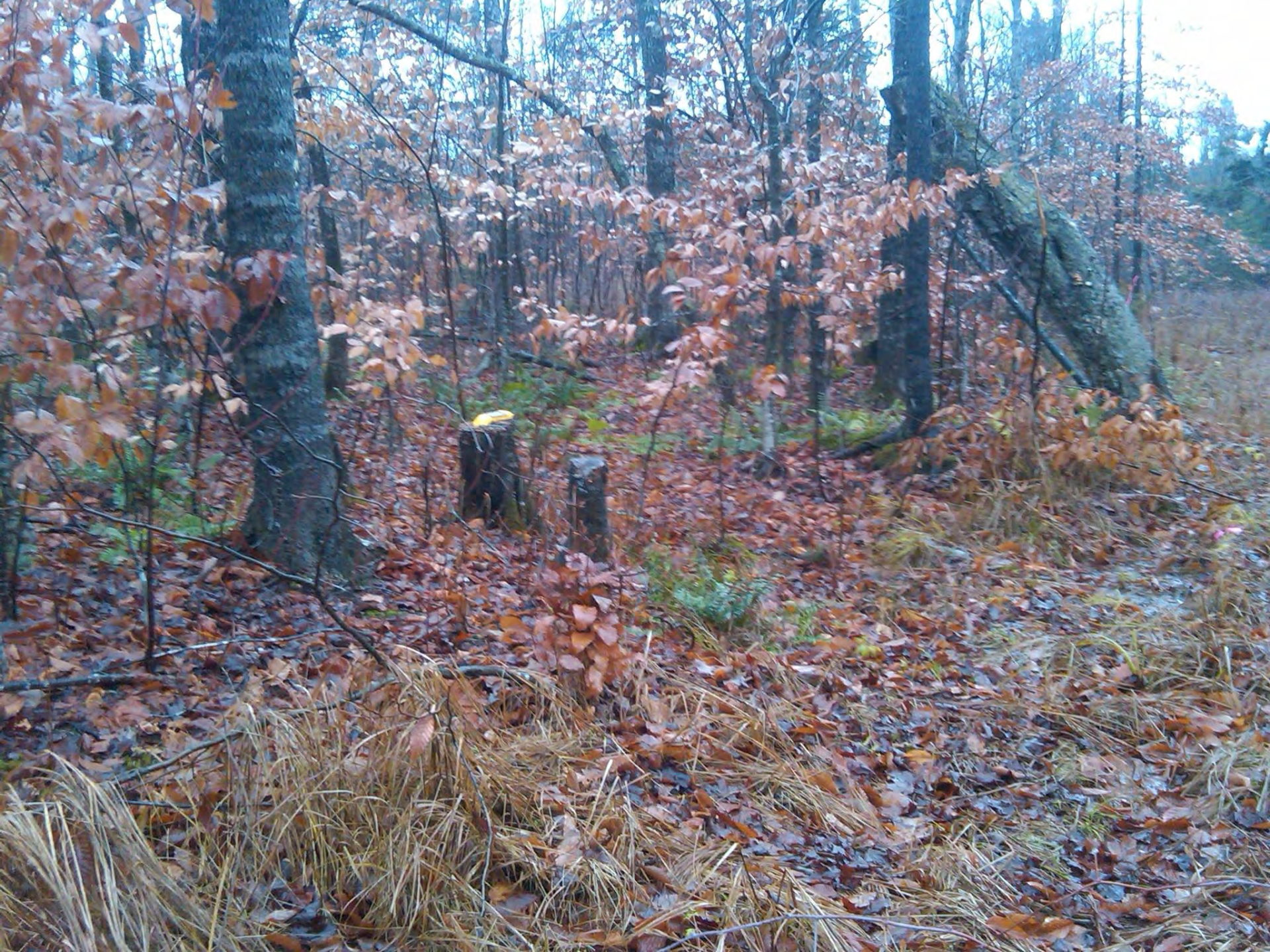
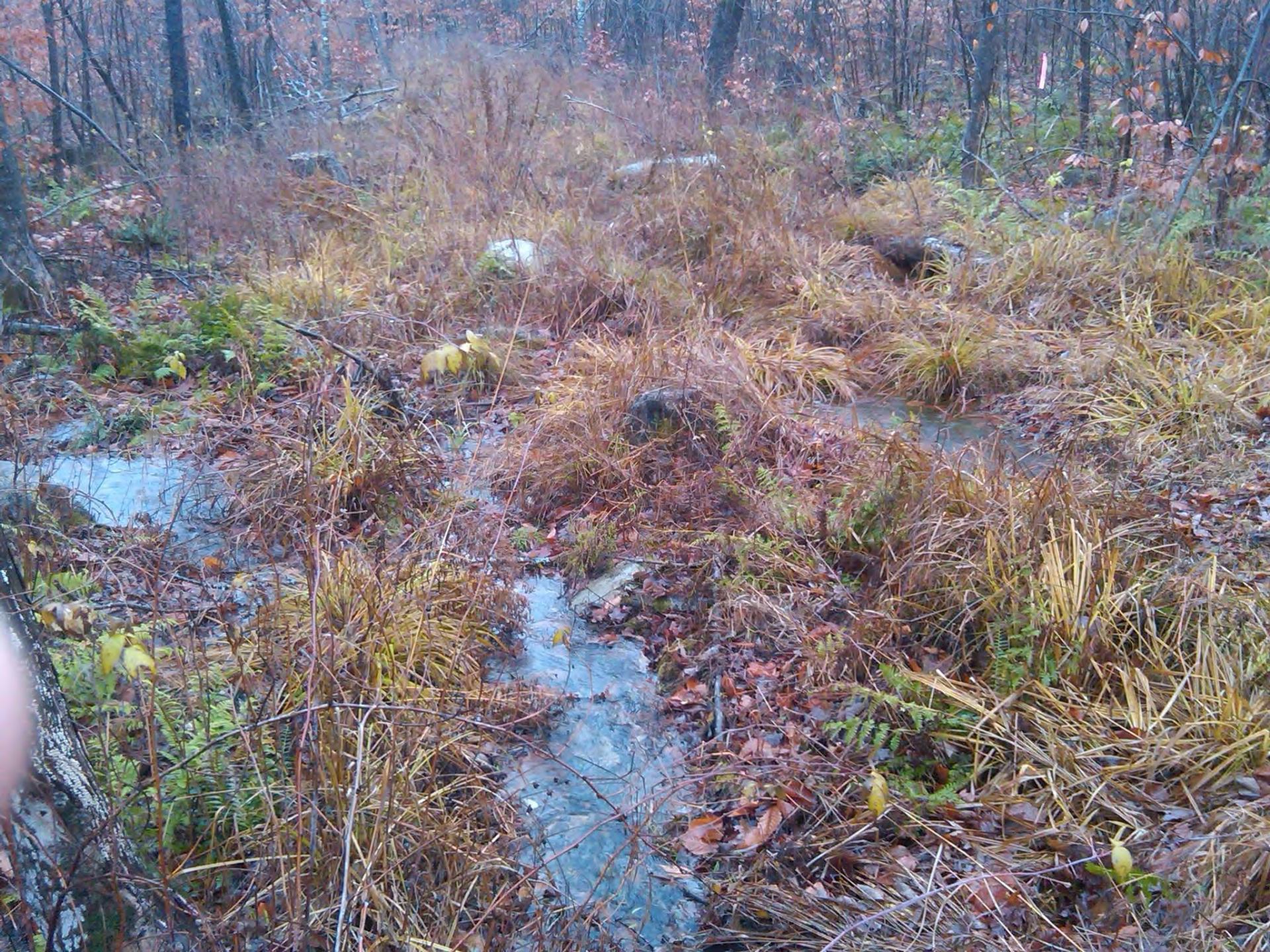
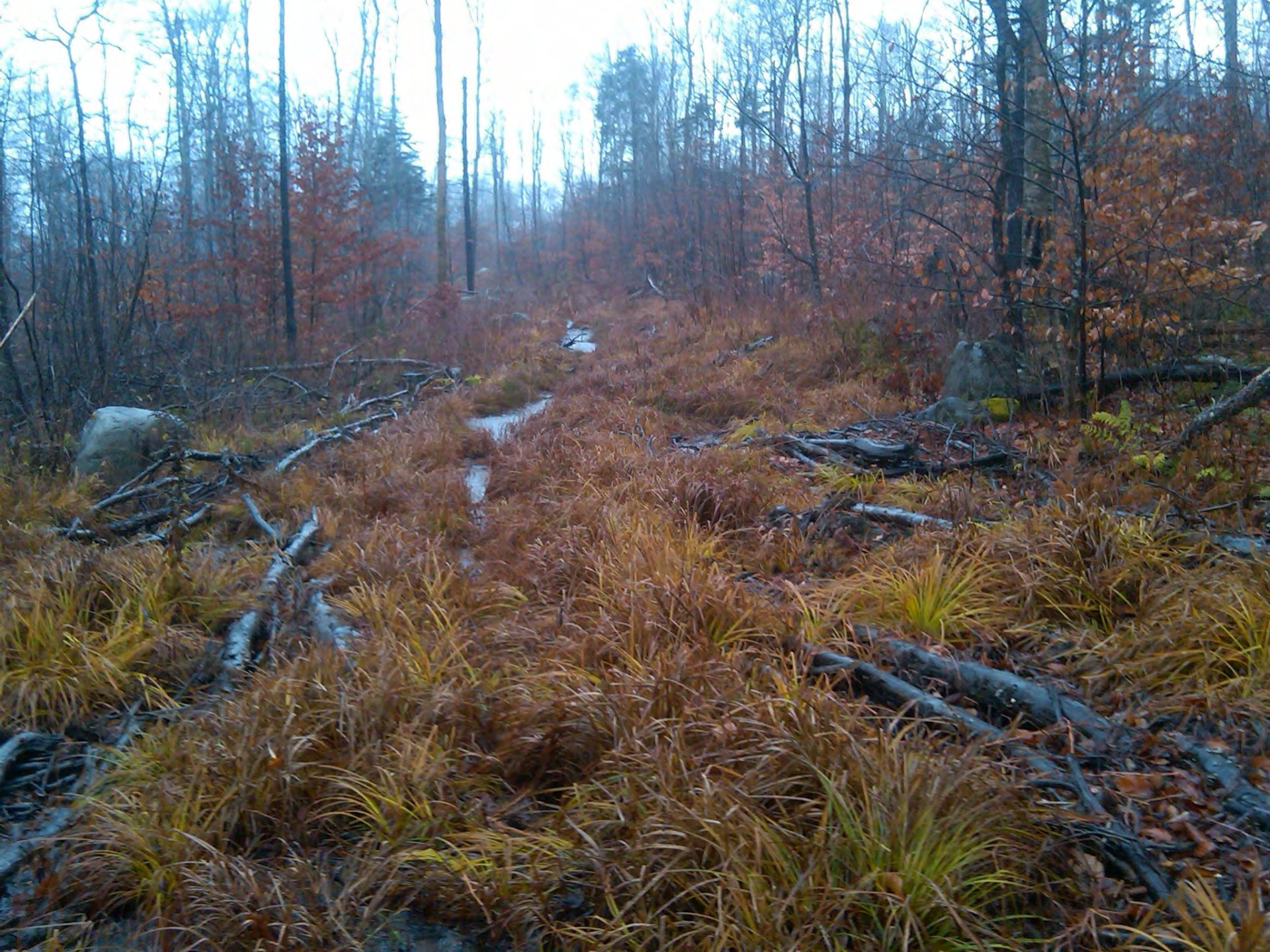
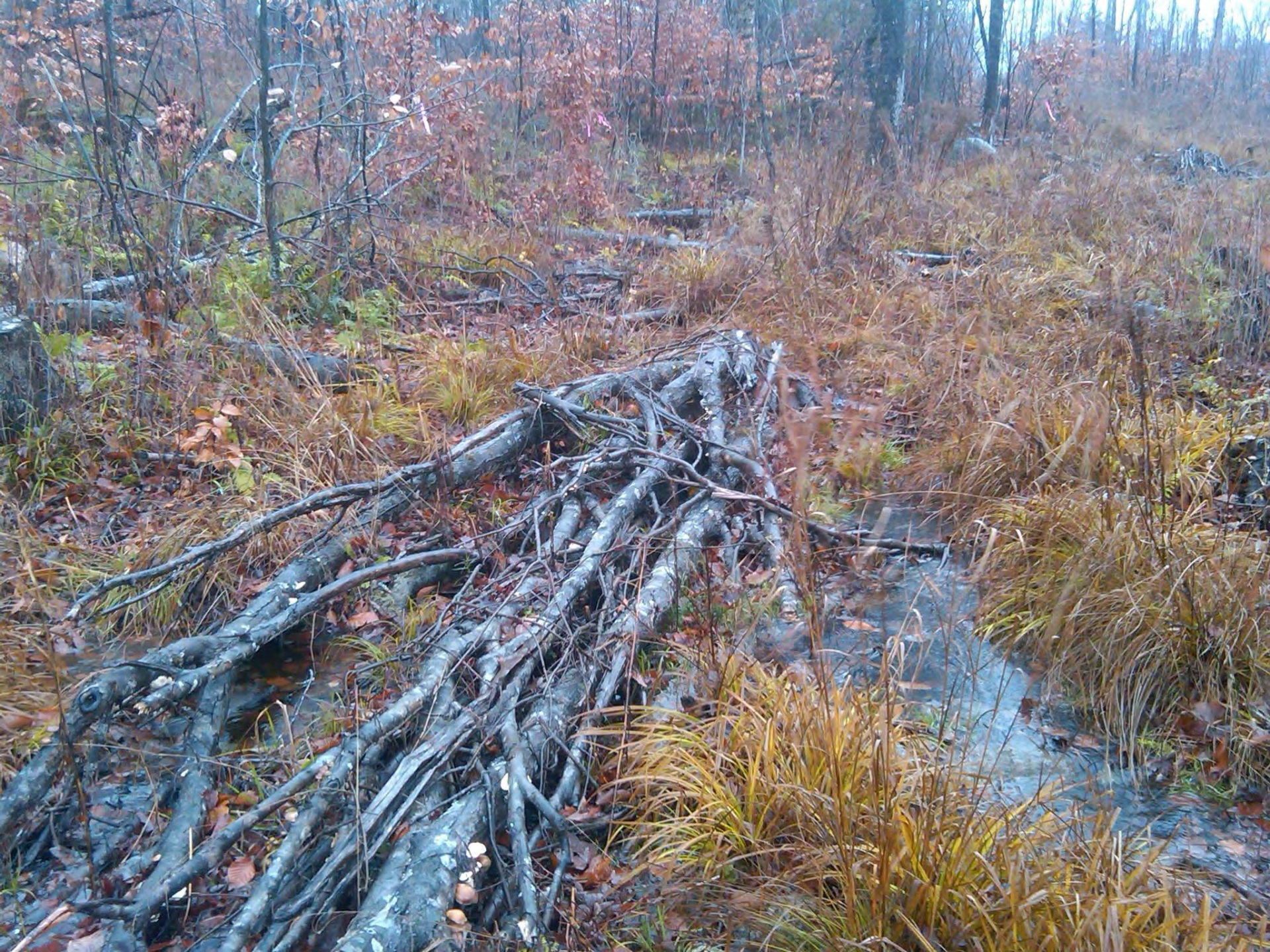
SKID TRAIL

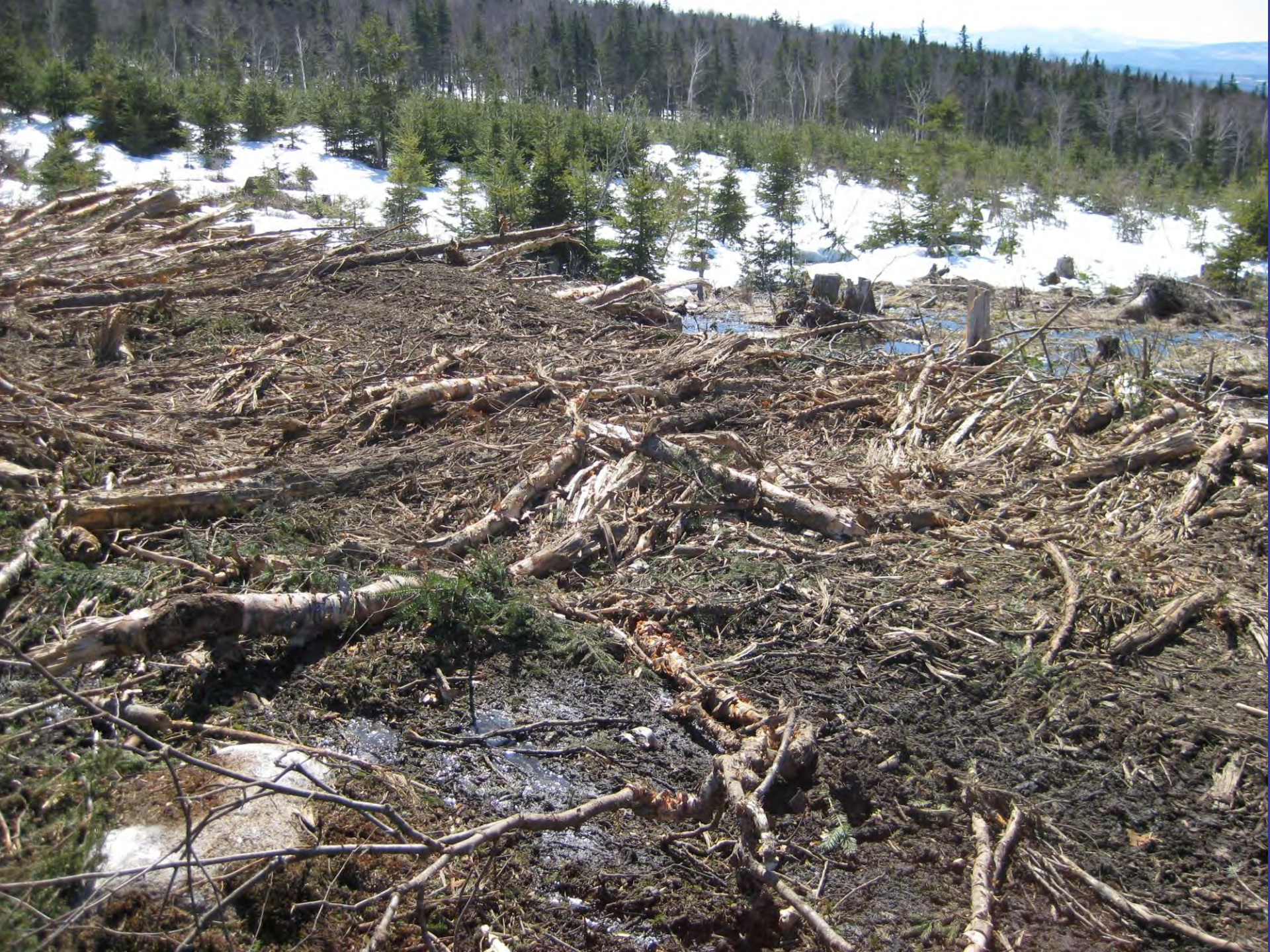






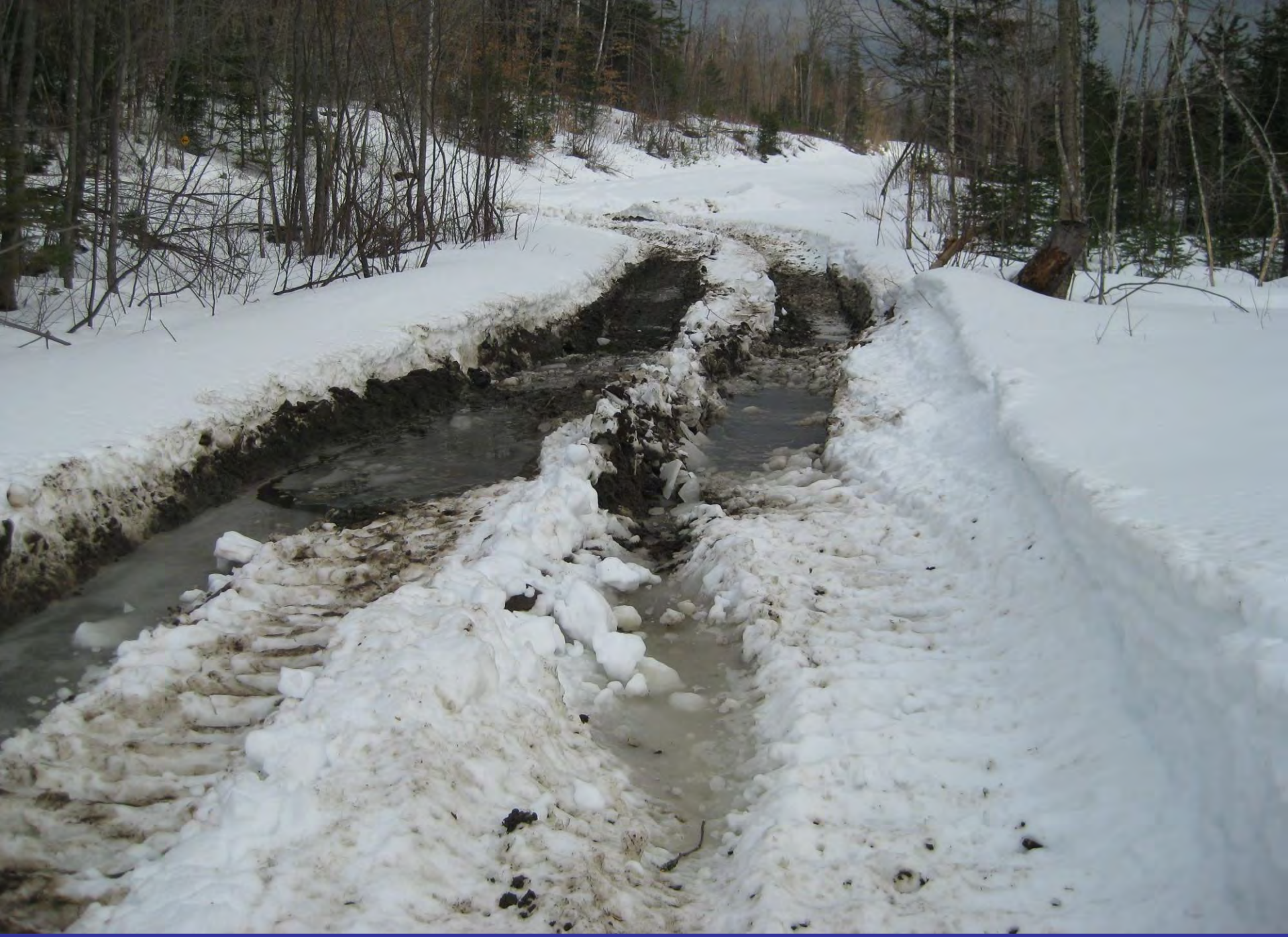


SLASH CAN HELP IF YOU FIND YOU ARE WORKING ON A WET SITE BY PROVIDING SUPPORT



YOY CAN ALSO WAIT UNTIL THE GROUND IS FROZEN BEFORE STARTING WORK

LATENT HEAT OF GROUNDWATER REQUIRES MORE COLD TO FREEZE THAN DRIER GROUND



RECOMMENDATION:

SCOUT SKID TRAIL/LOGGING ROAD LOCATIONS

USE SCREW AUGER

IDENTIFY HYDROLOGY/OXYGANATED GROUNDWATER SOIL FEATURES

AVOID UNIQUE HYDROLOGIC FEATURES OR BUILD OVER THEM

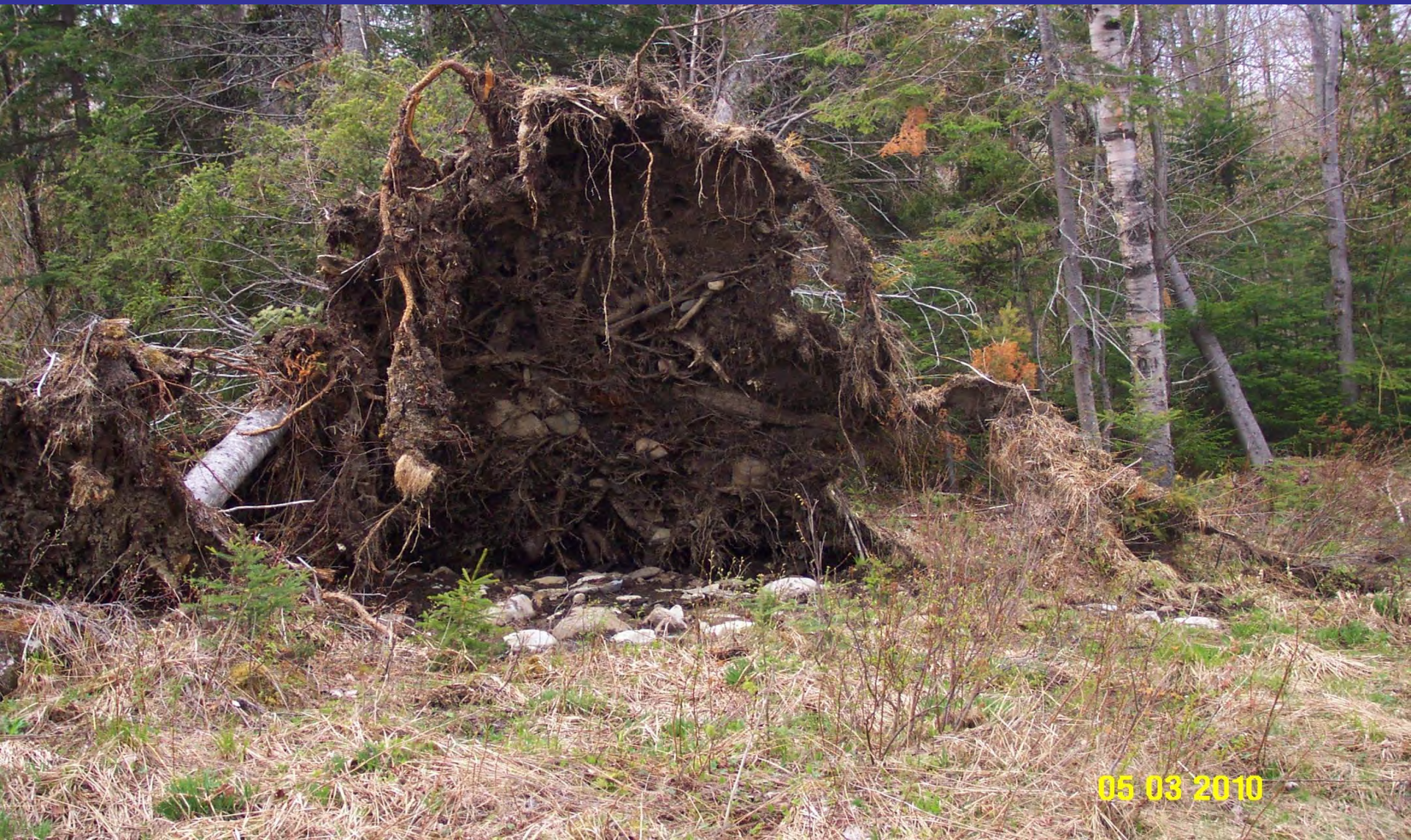
CONSTRUCT ROADS ON OXYGENATED GROUNDWATER TABLE SOILS ABOVE GRADE OR THAT ACCOMMODATE THE HYDROLOGY

HYDROLOGY CAN BE ACCOMODATED BY

ROCK SANDWICHES
CULVERTS
DITCH TURNOUTS

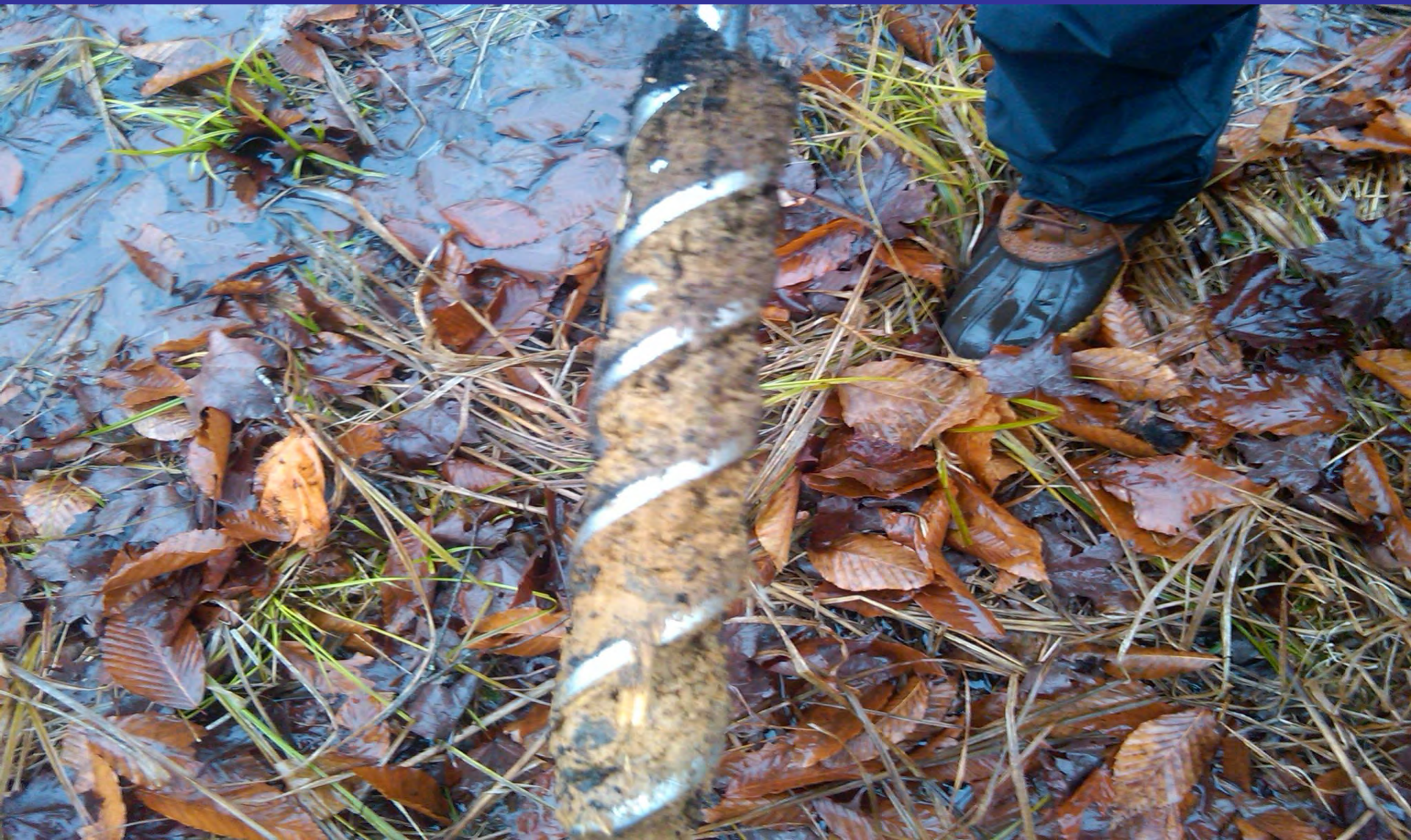
SOME WET AREAS ARE OBVIOUS

SOME ARE NOT AS OBVIOUS BUT THERE ARE STILL SIGNS

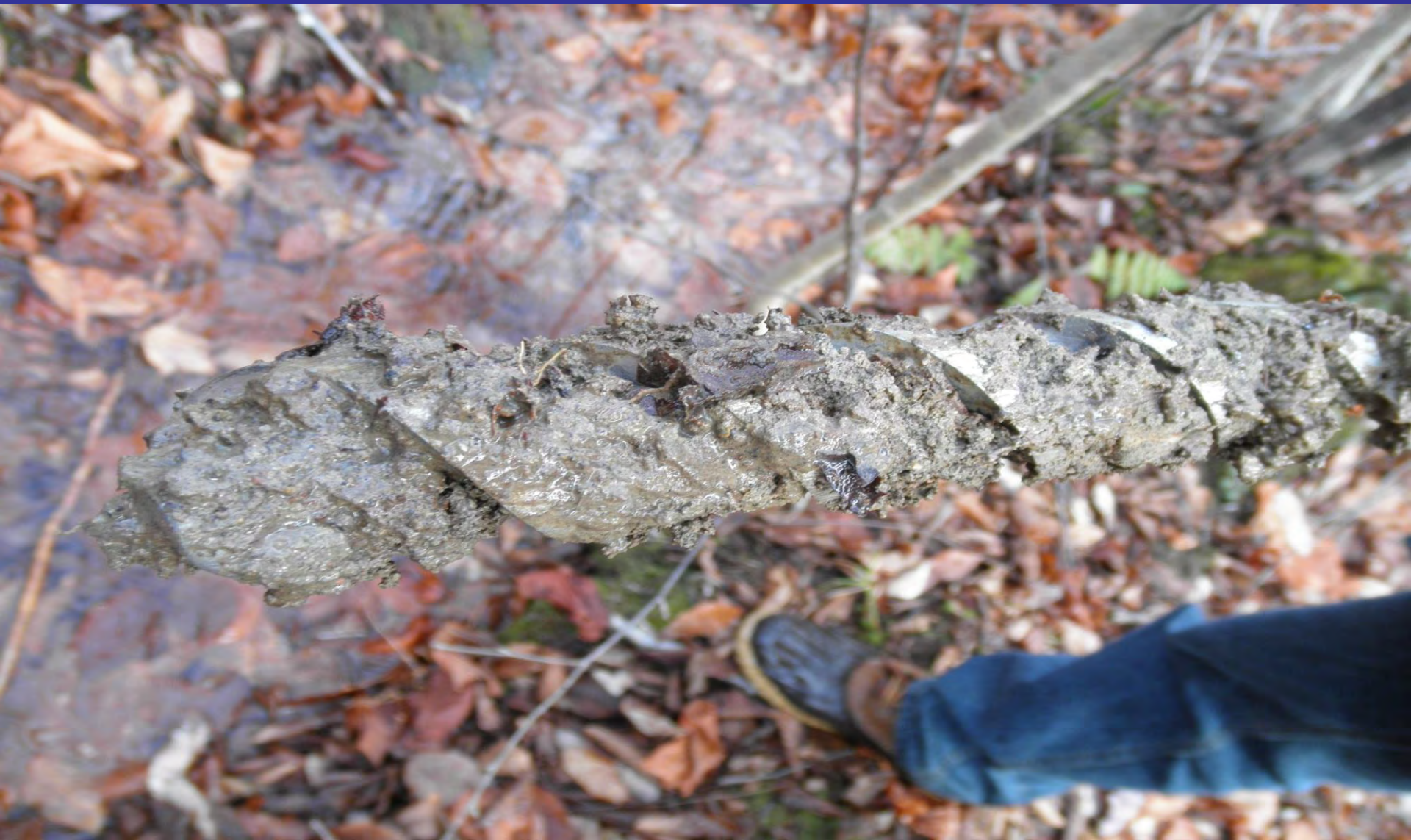


STONE FILLED CHANNEL

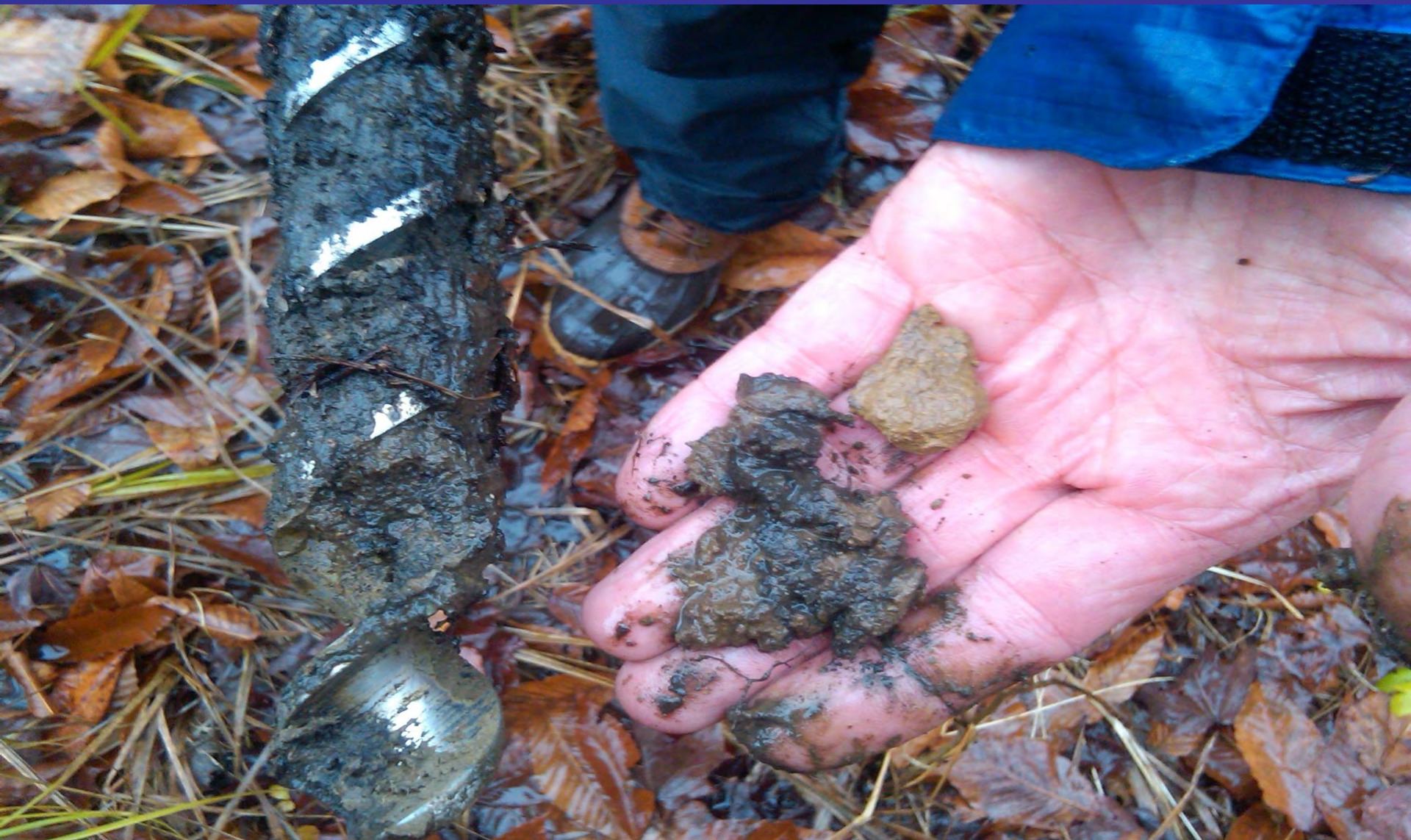
BRIGHT COLORED SOIL
GOOD DRAINAGE



GRAY COLOR
ANAEROBIC WET SOIL



DULL COLORS WITH OM ACCUM – AEROBIC & WET



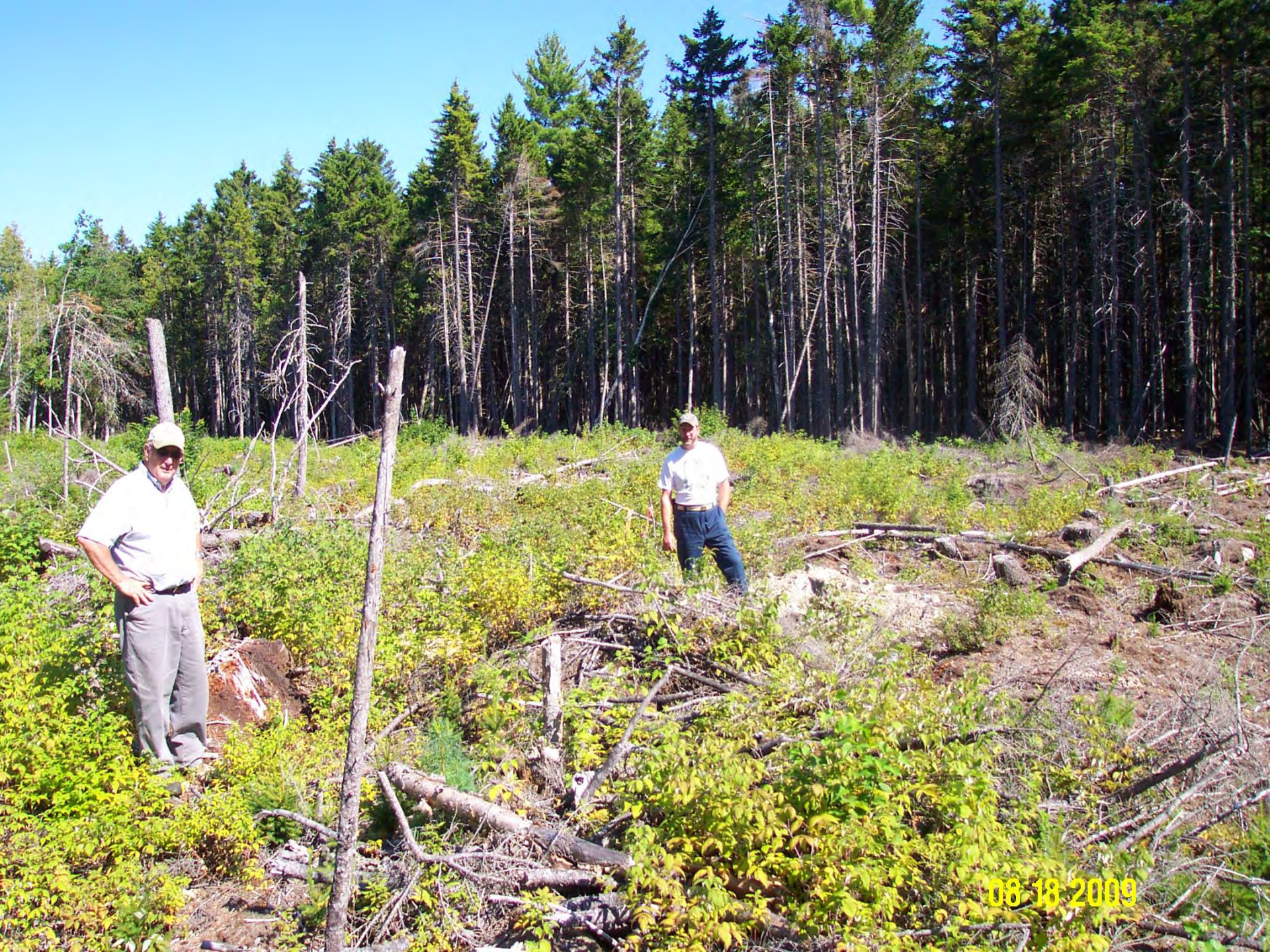
BOTTOM LINE

KNOW WHAT YOU ARE GETTING INT TO

BEFORE YOU GET INTO IT

PROJECTS I HAVE BEEN INVOLVED WITH THAT USE UNCONVENTIONAL TECHNIQUES

BOULDER FIELD WITH FLOWING WATER BETWEEN THE BOULDERS


08 18 2009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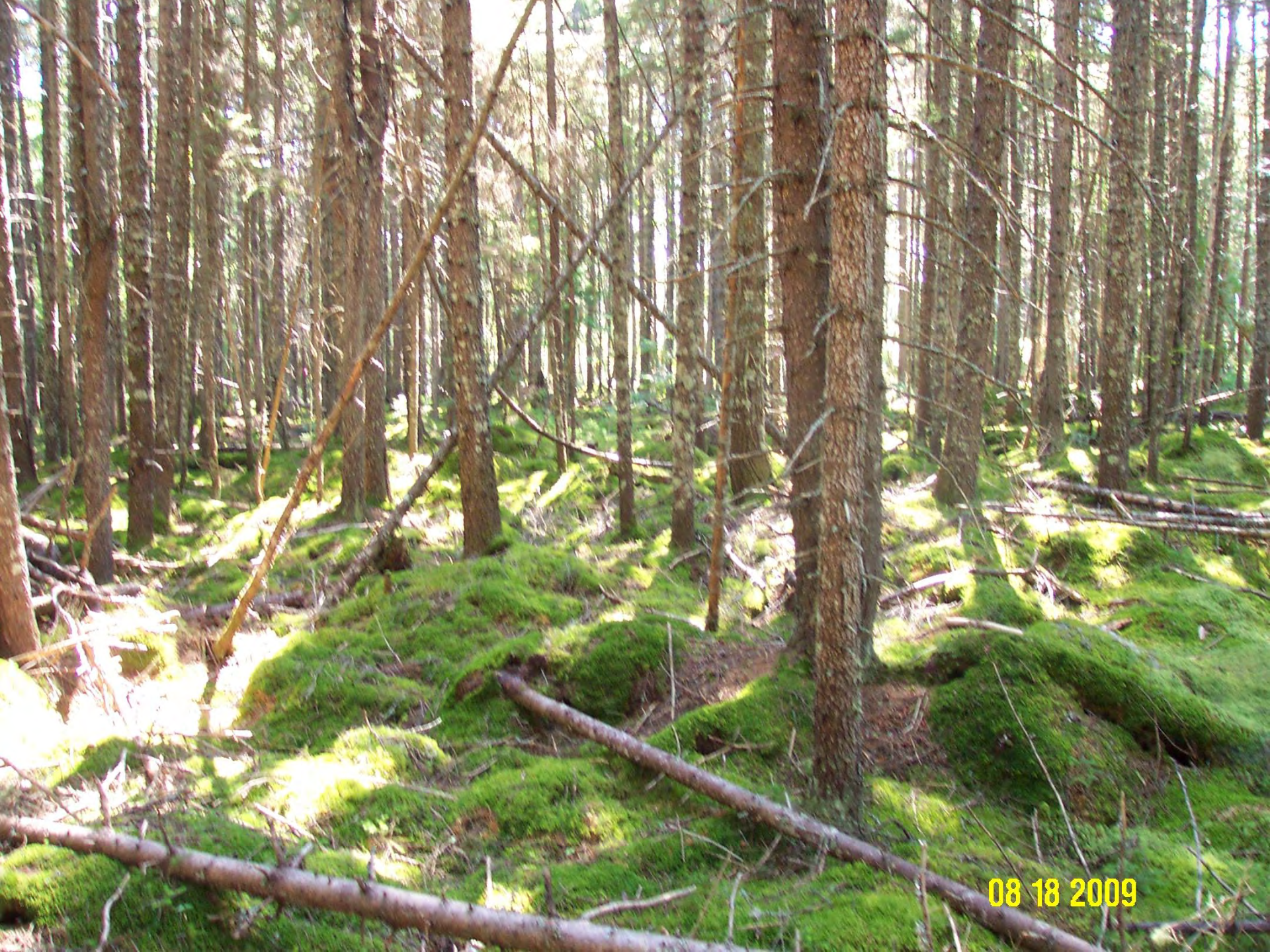
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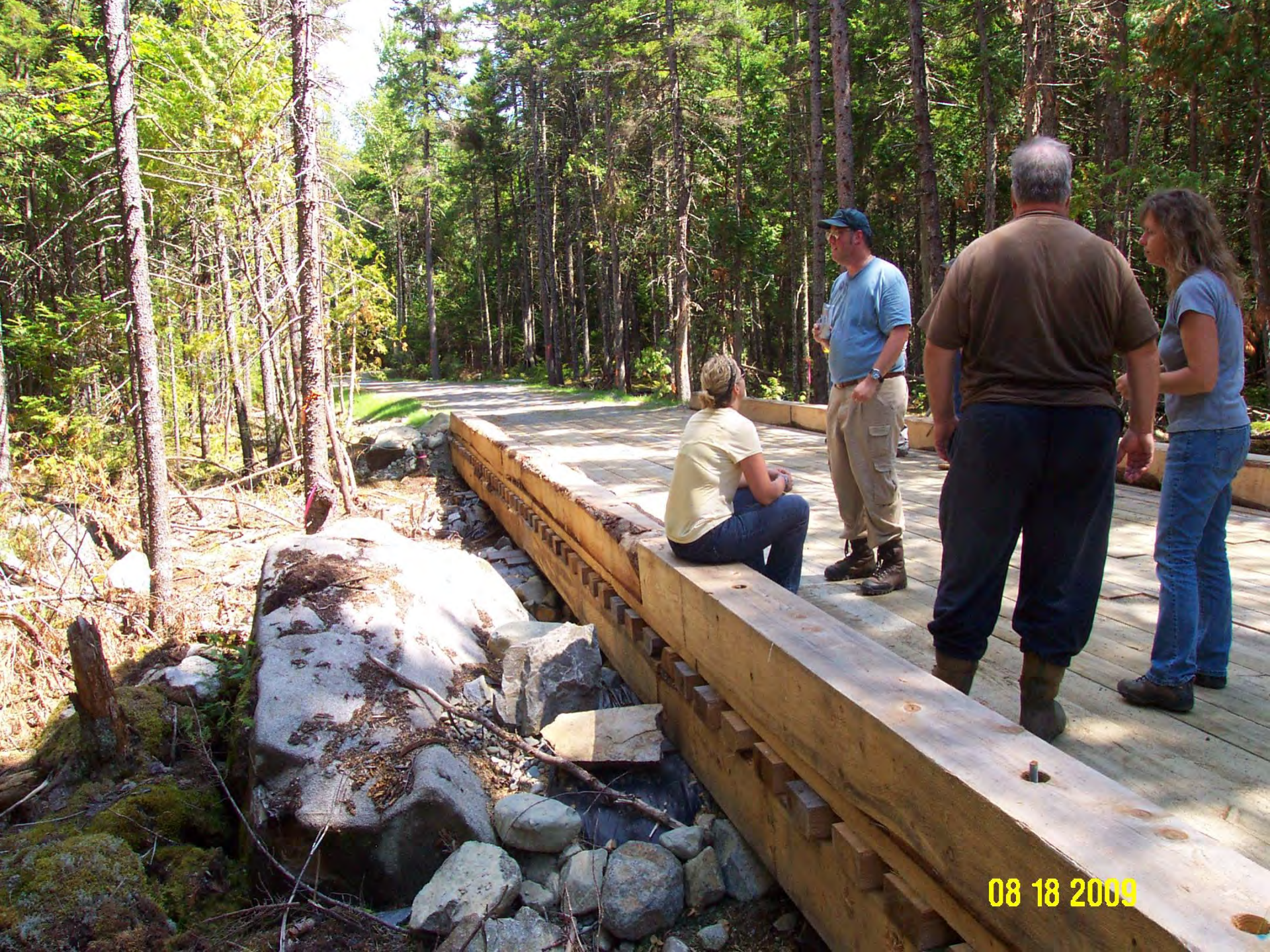
ROAD WAS BUILT ON TOP OF BOULDERS

NO DITCHES WERE EXCAVATED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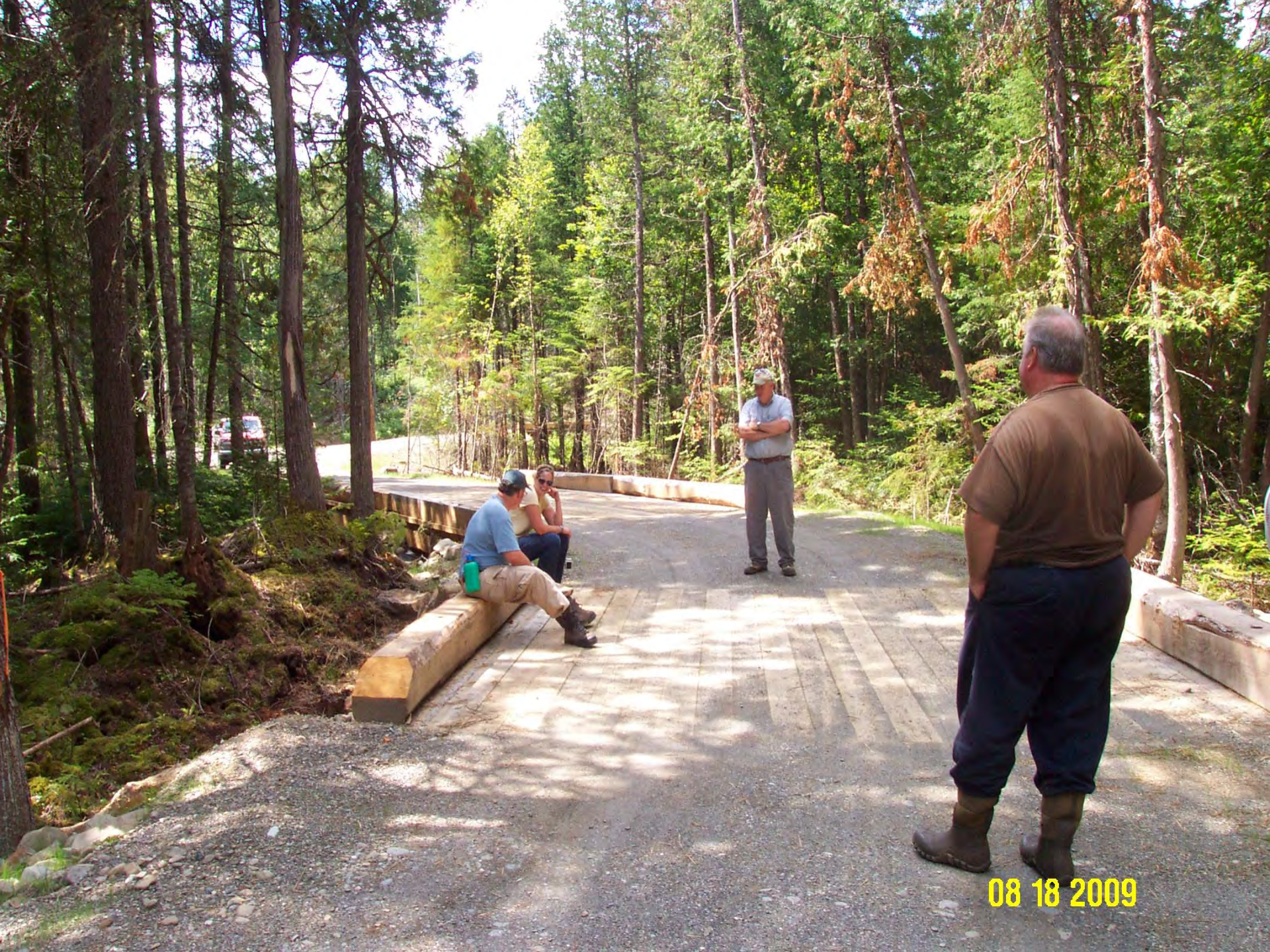
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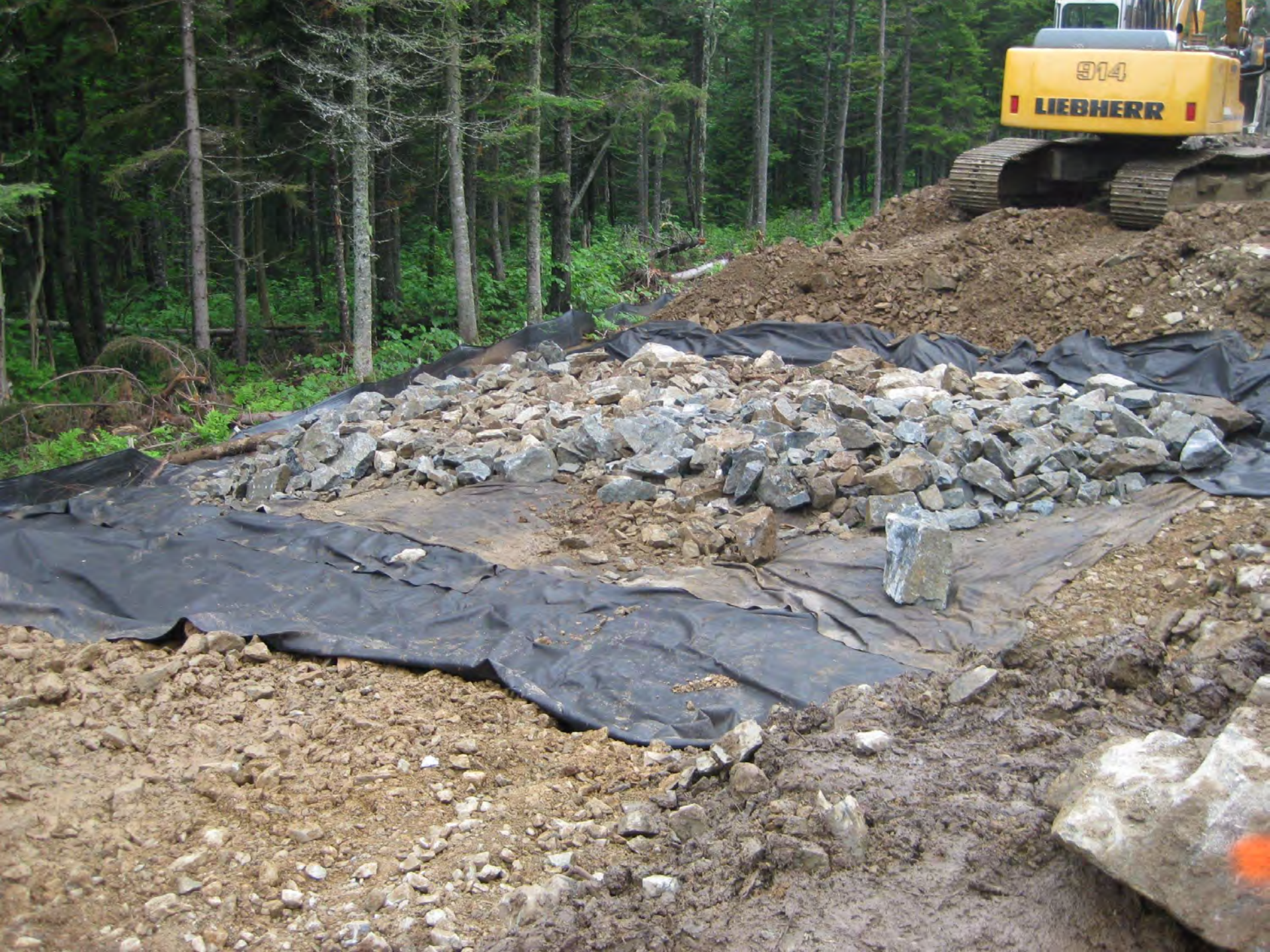
ROCK SANDWICHES

USED TO RECONNECT THE NATURAL HYDROLOGY

DO NOT FREEZE, CRUSH, HEAVE OR COLLAPSE

WILL BECOME TEMPORARY LOW AREA WHEN FROST IS LEAVING THE GROUND

BECAUSE THEY DO NOT HAVE FROST IN THEM TO EXPAND LIKE SOIL ON EITHER SIDE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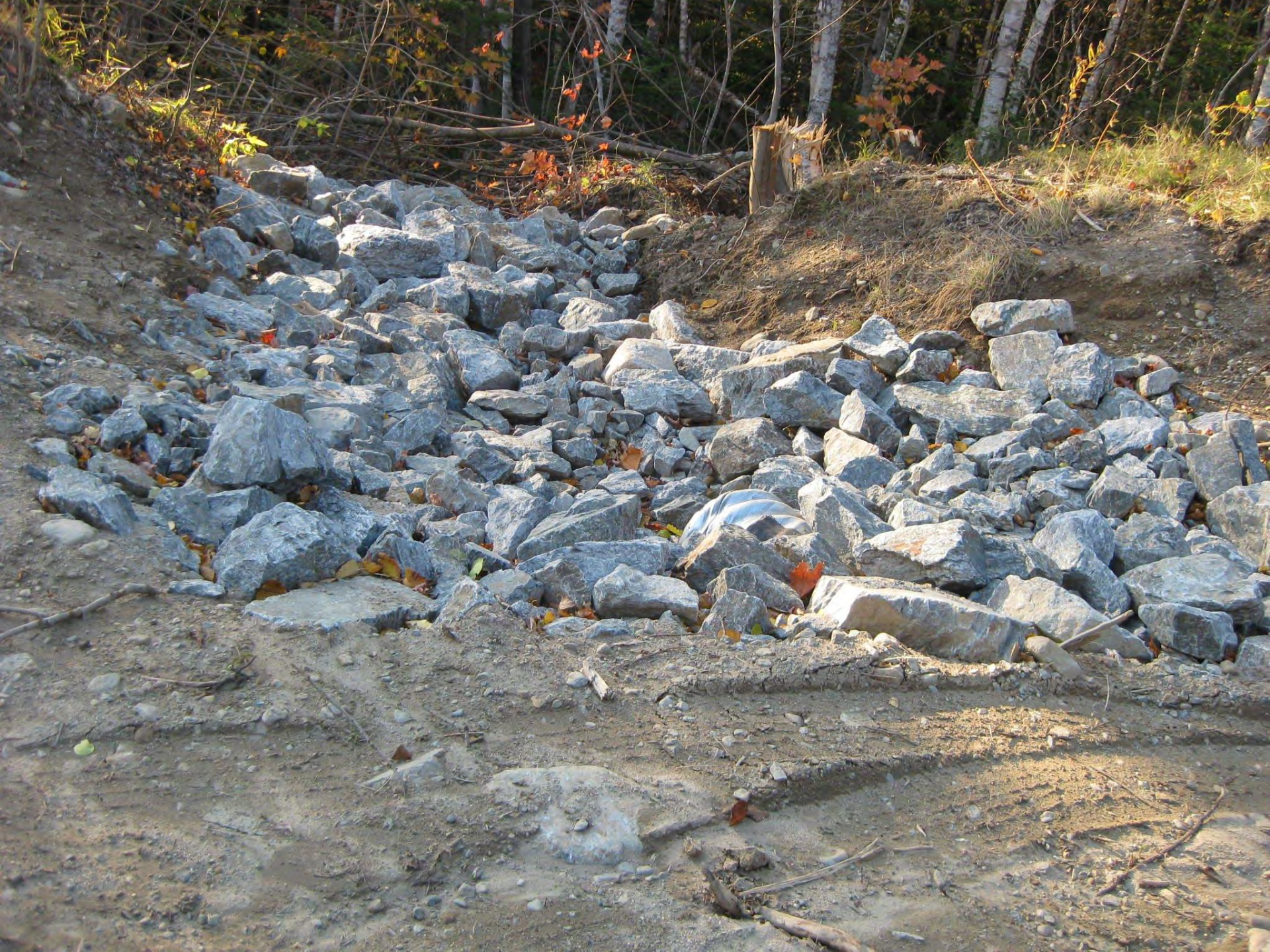
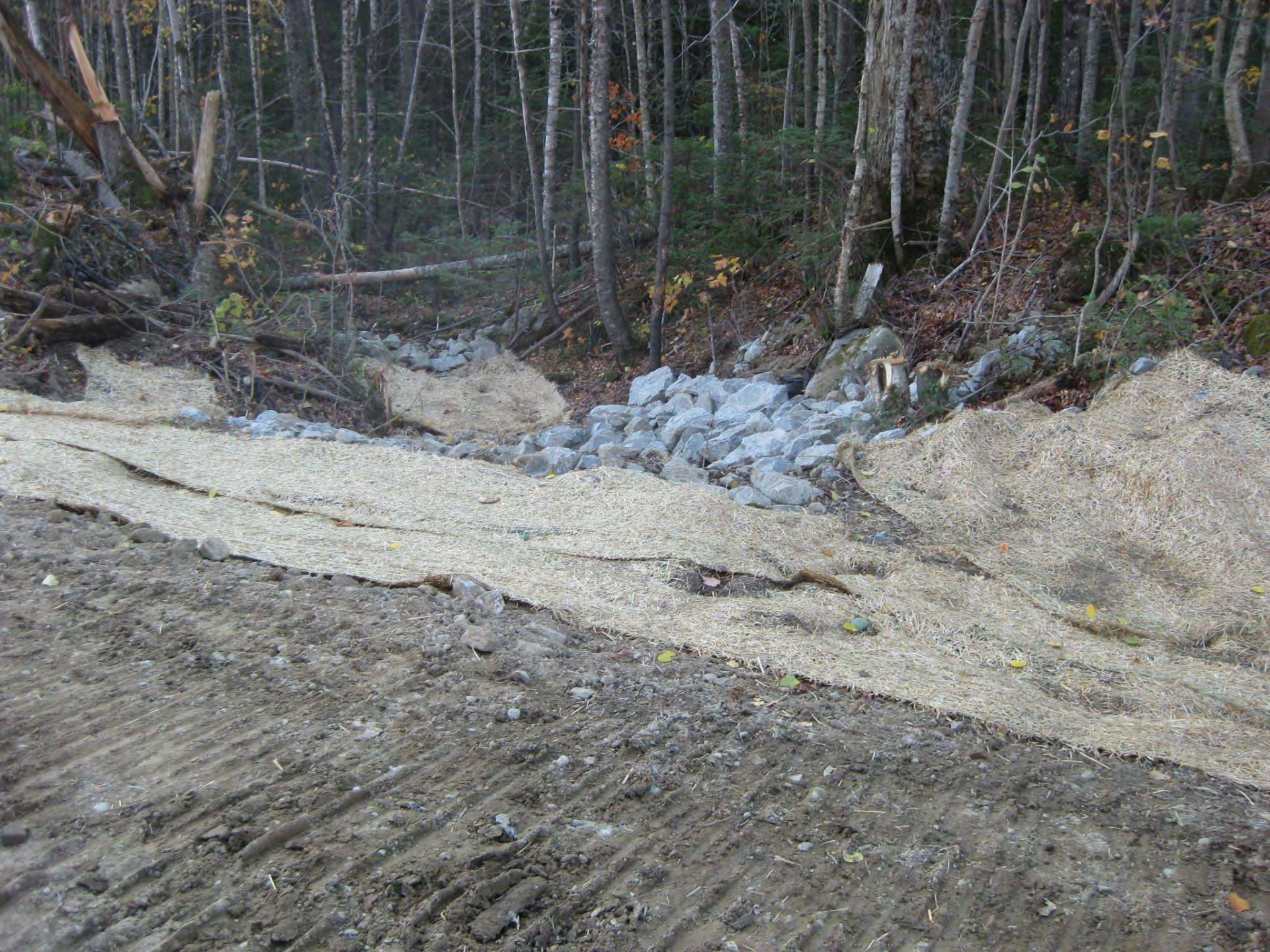
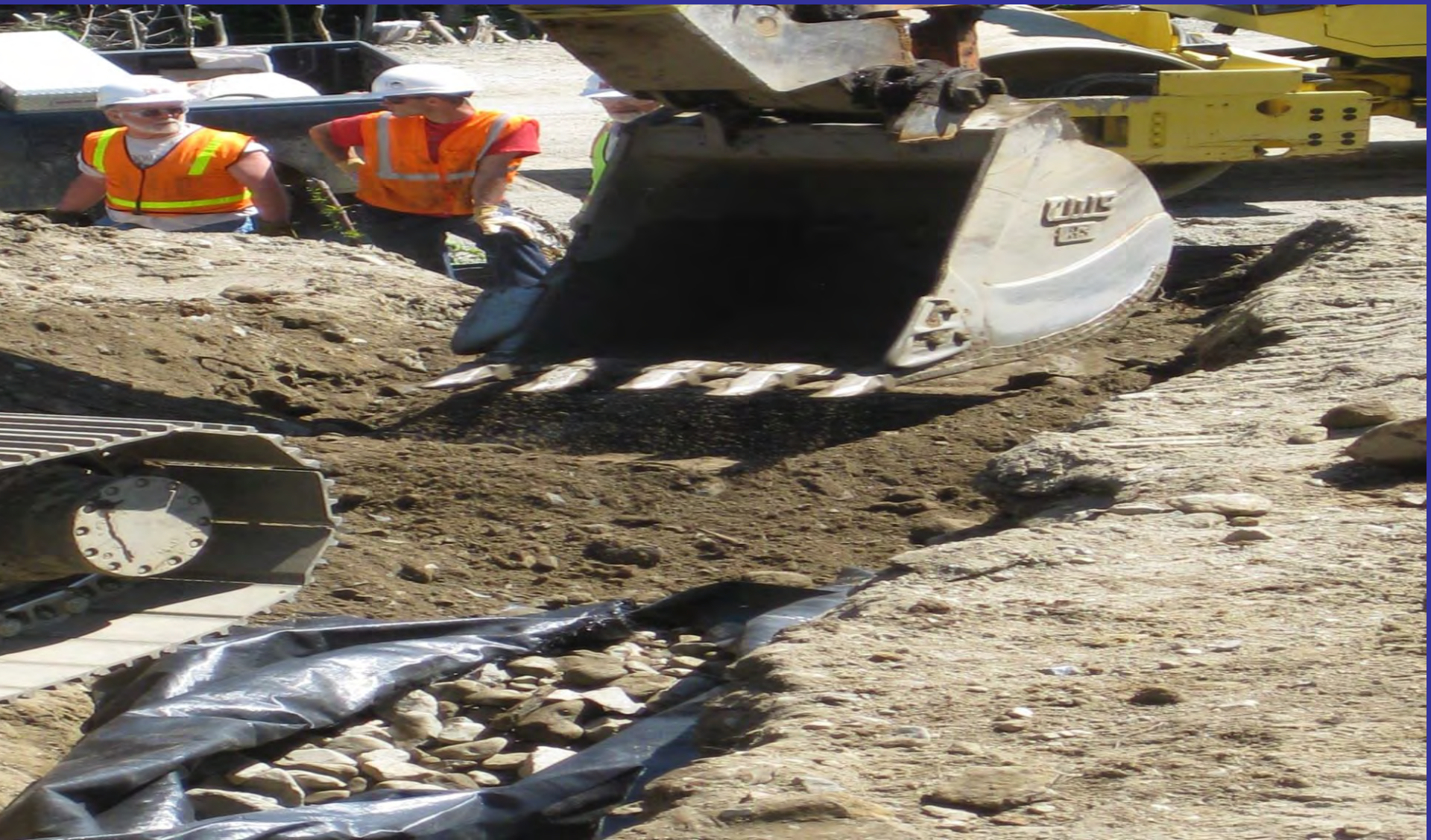
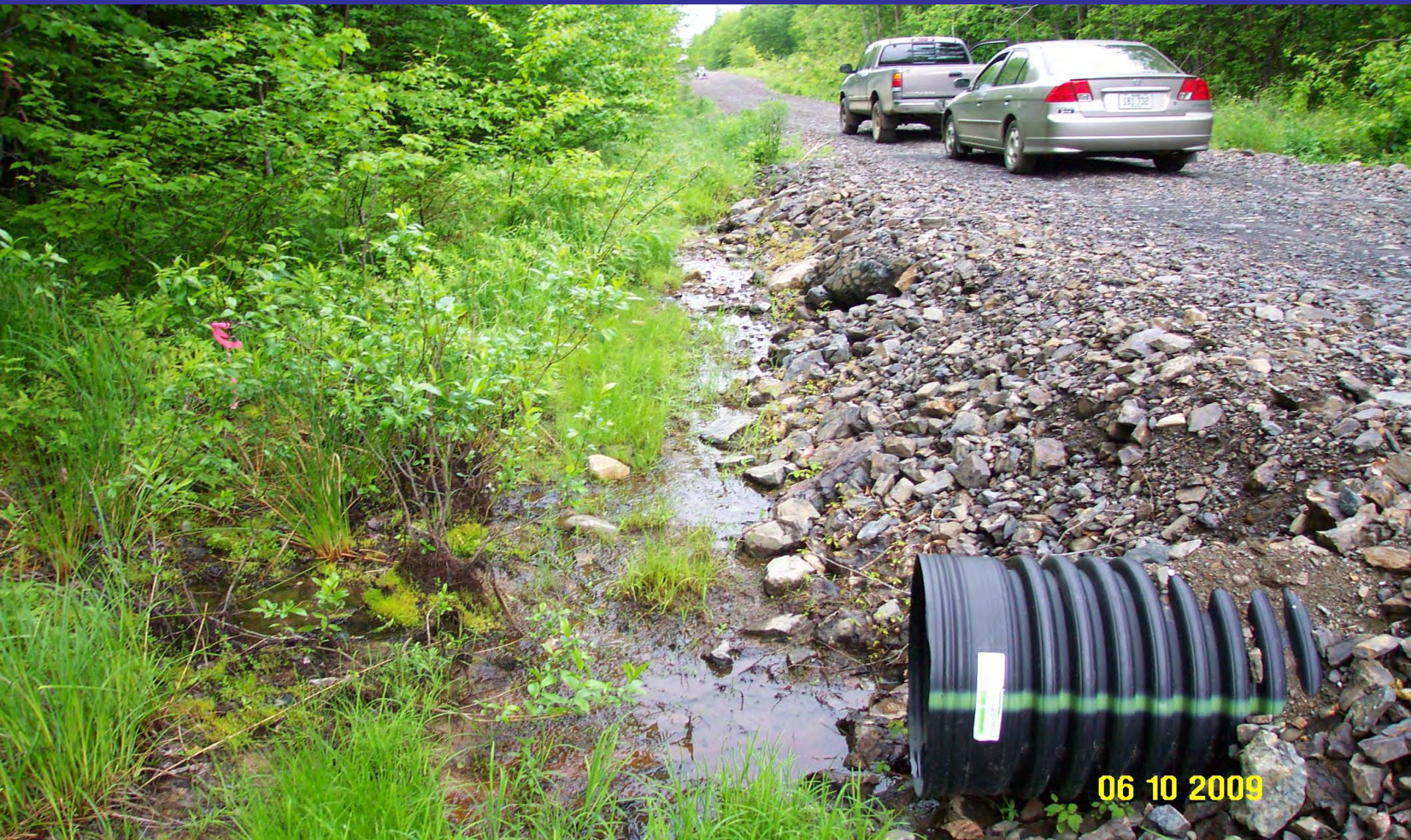




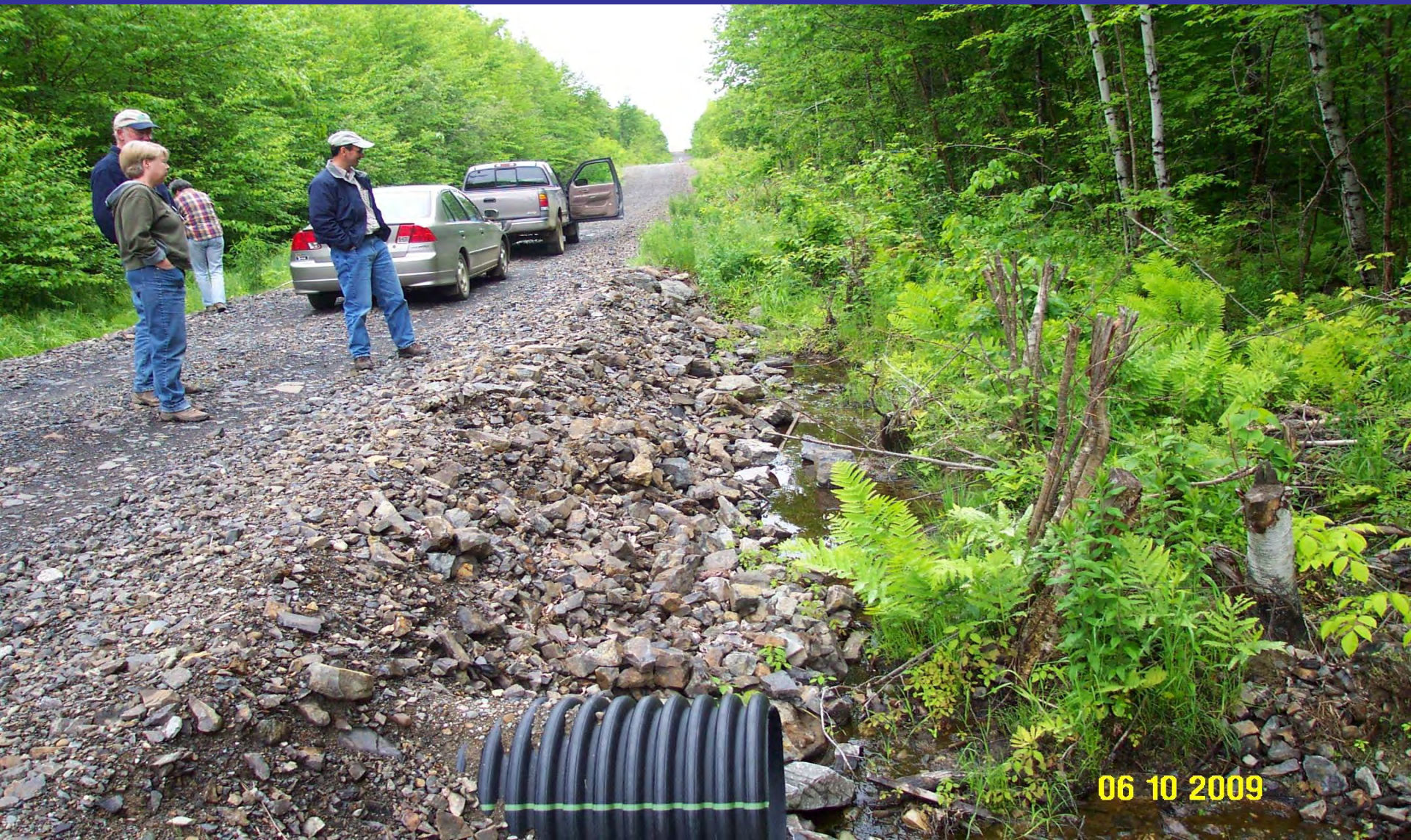
MAKING A ROCK CANOLE



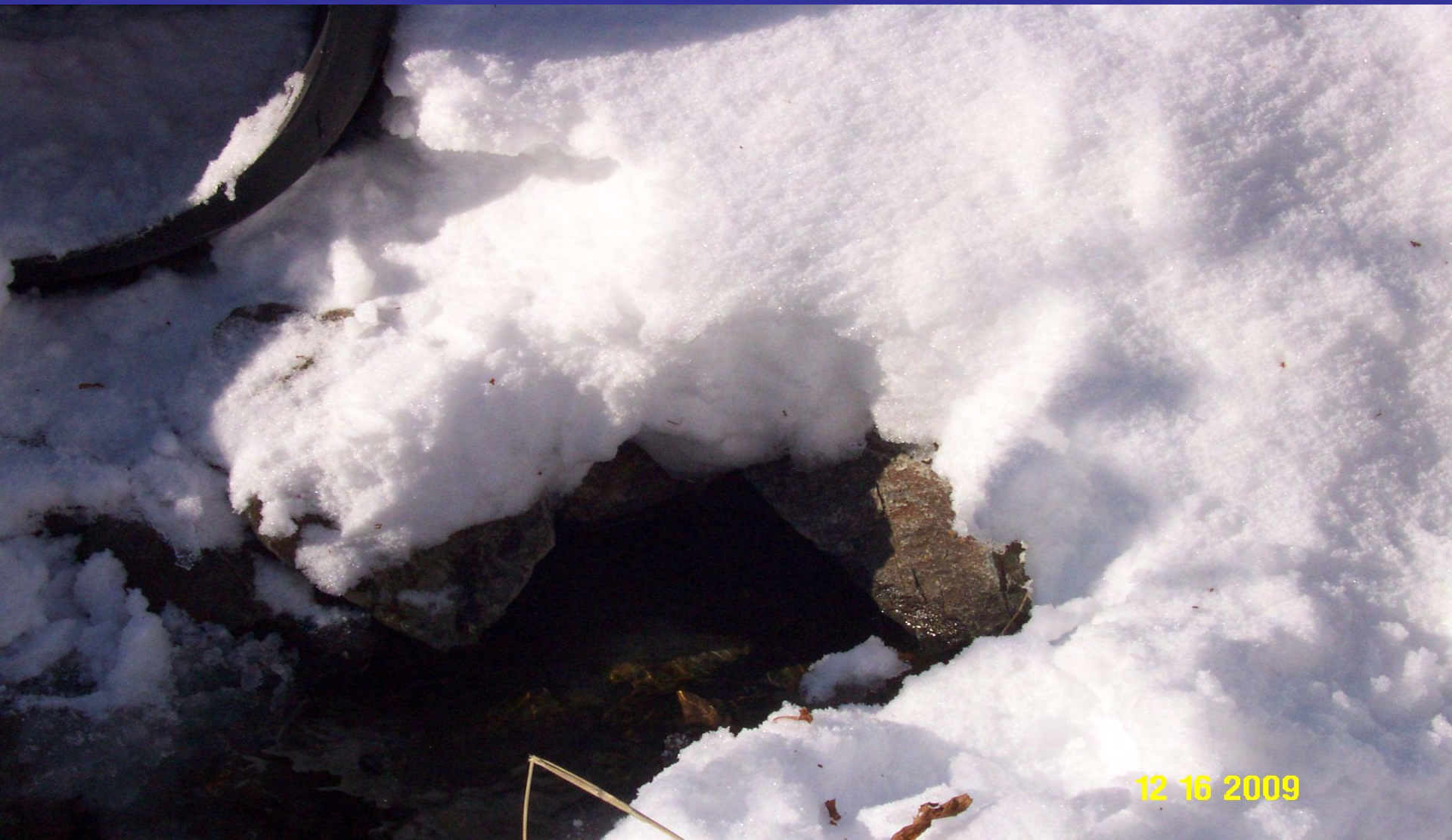
UPSLOPE

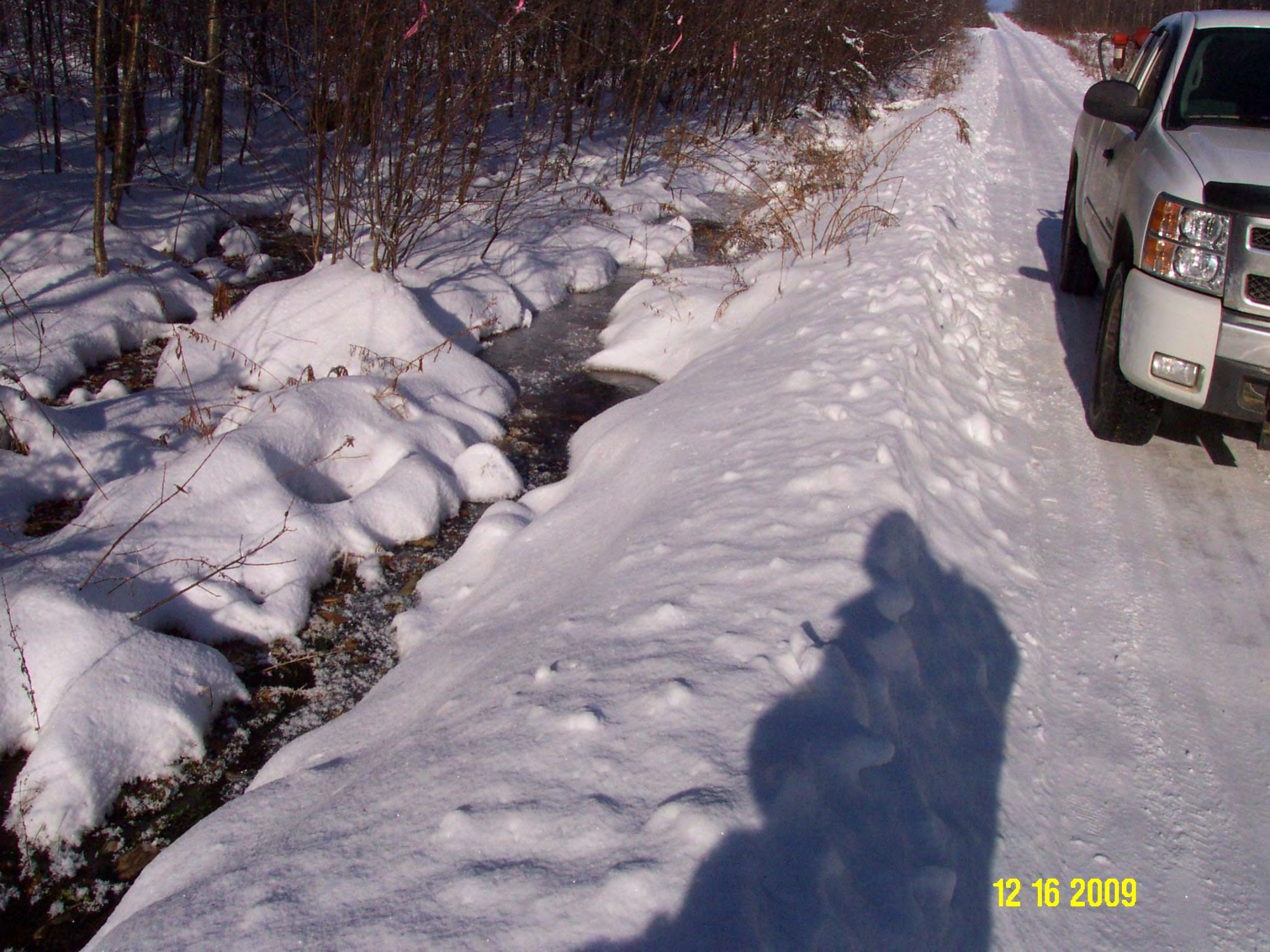


DOWNSLOPE



DO NOT FREEZE IN WINTER

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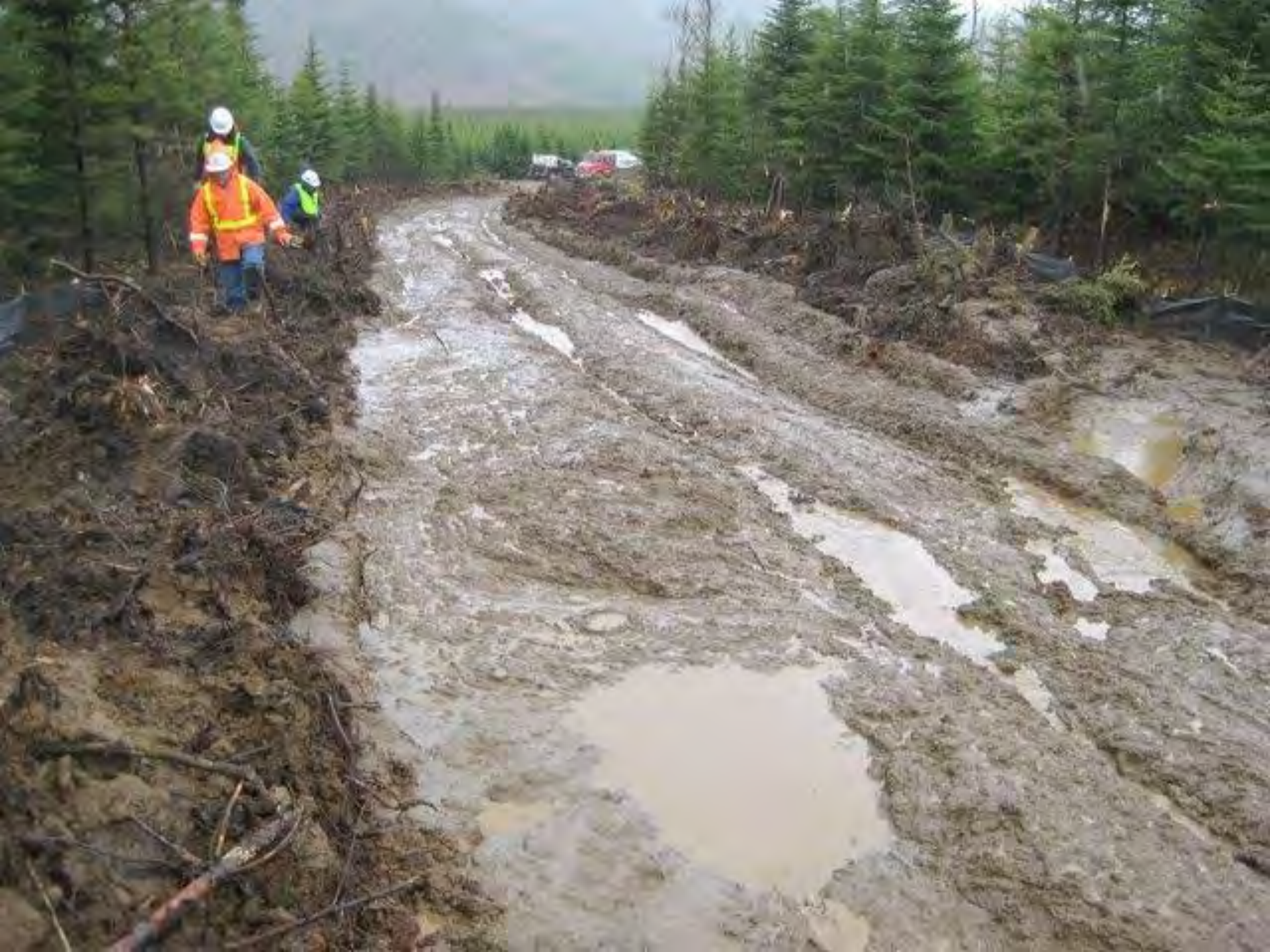
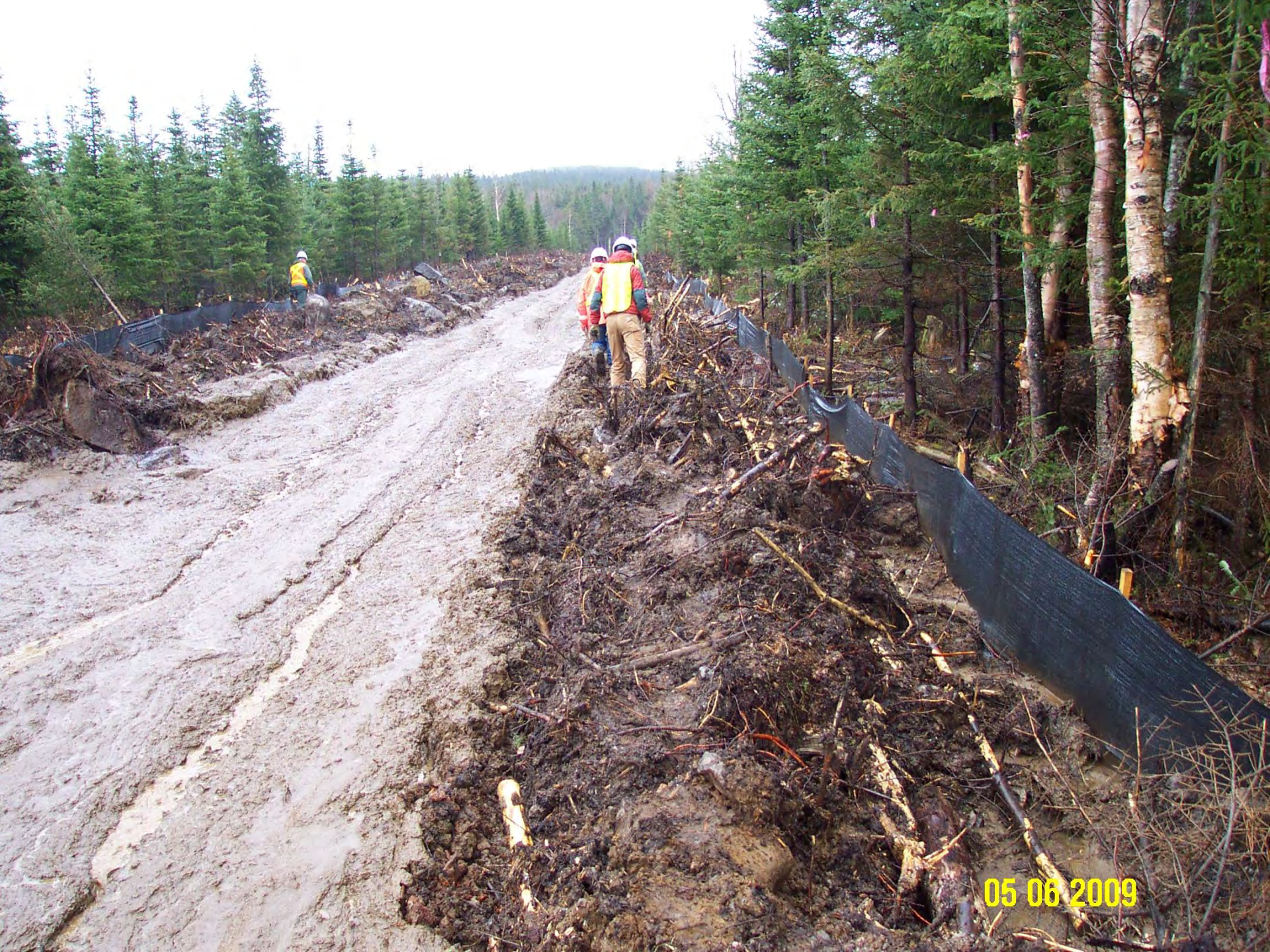
WINDFARM ROAD BUILT ON AN OXYGENATED GROUNDWATER TABLE SOIL USING ROCK SANDWICHES

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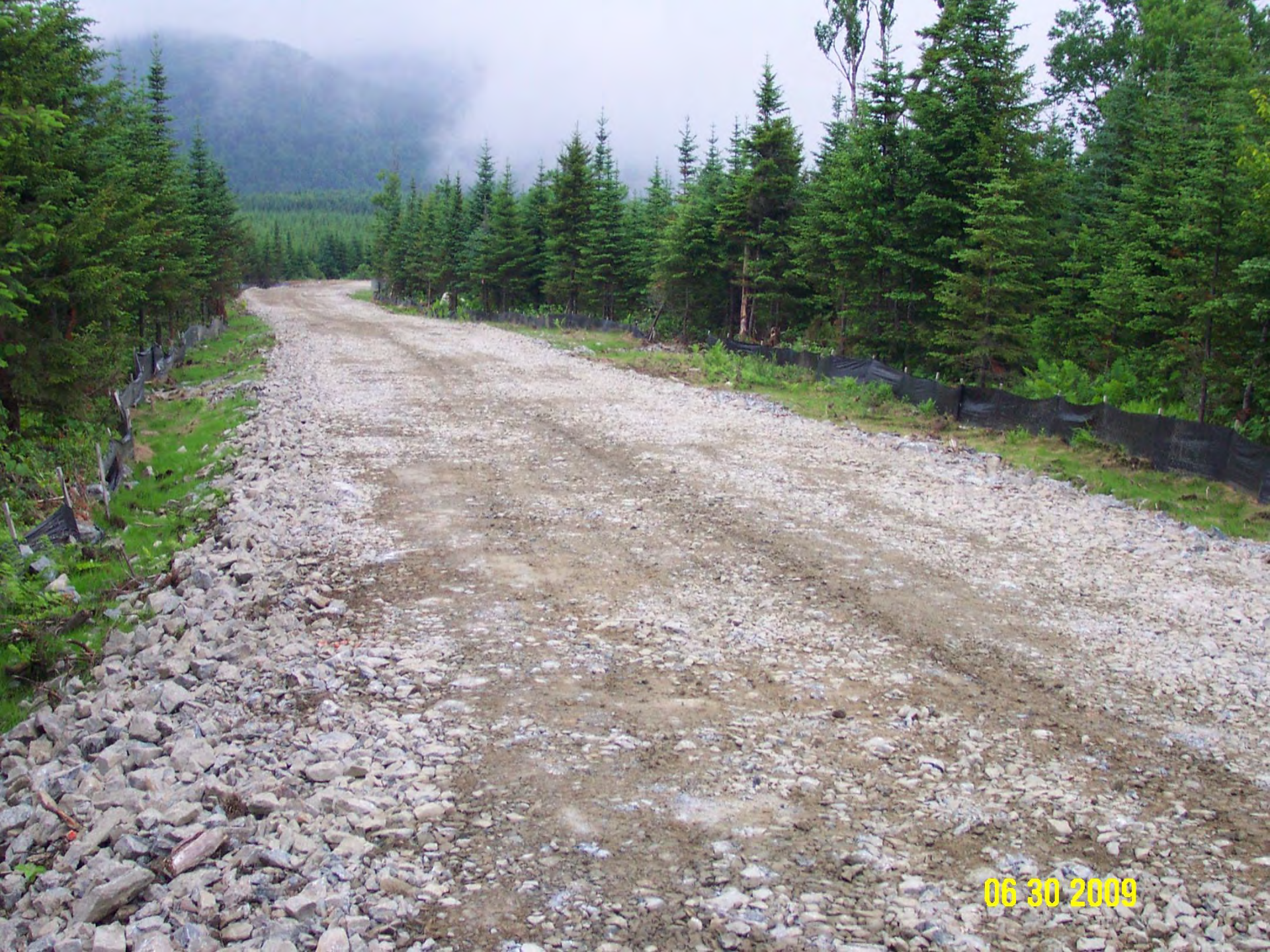
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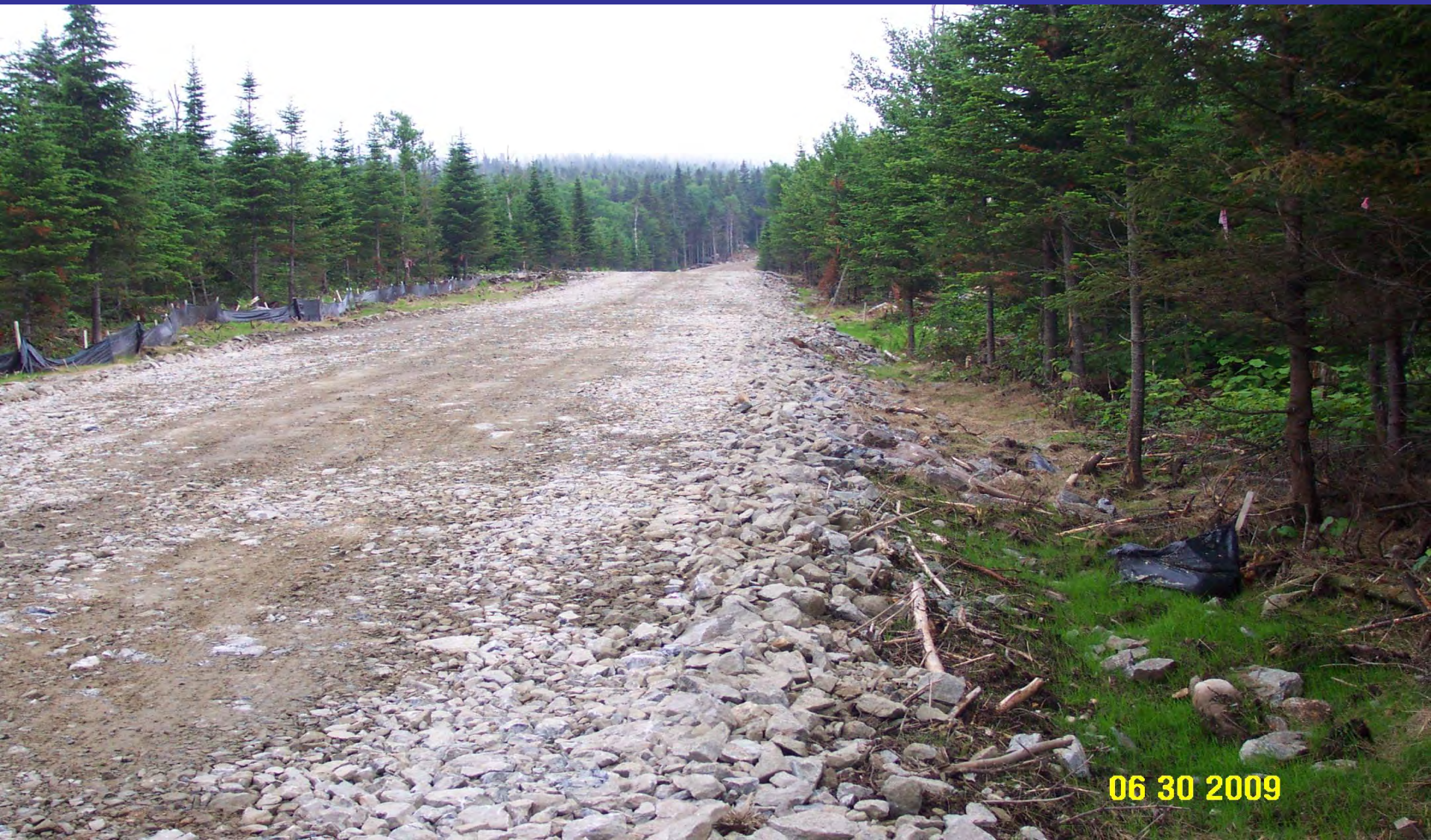
NOTE LACK OF ROAD DITCHES



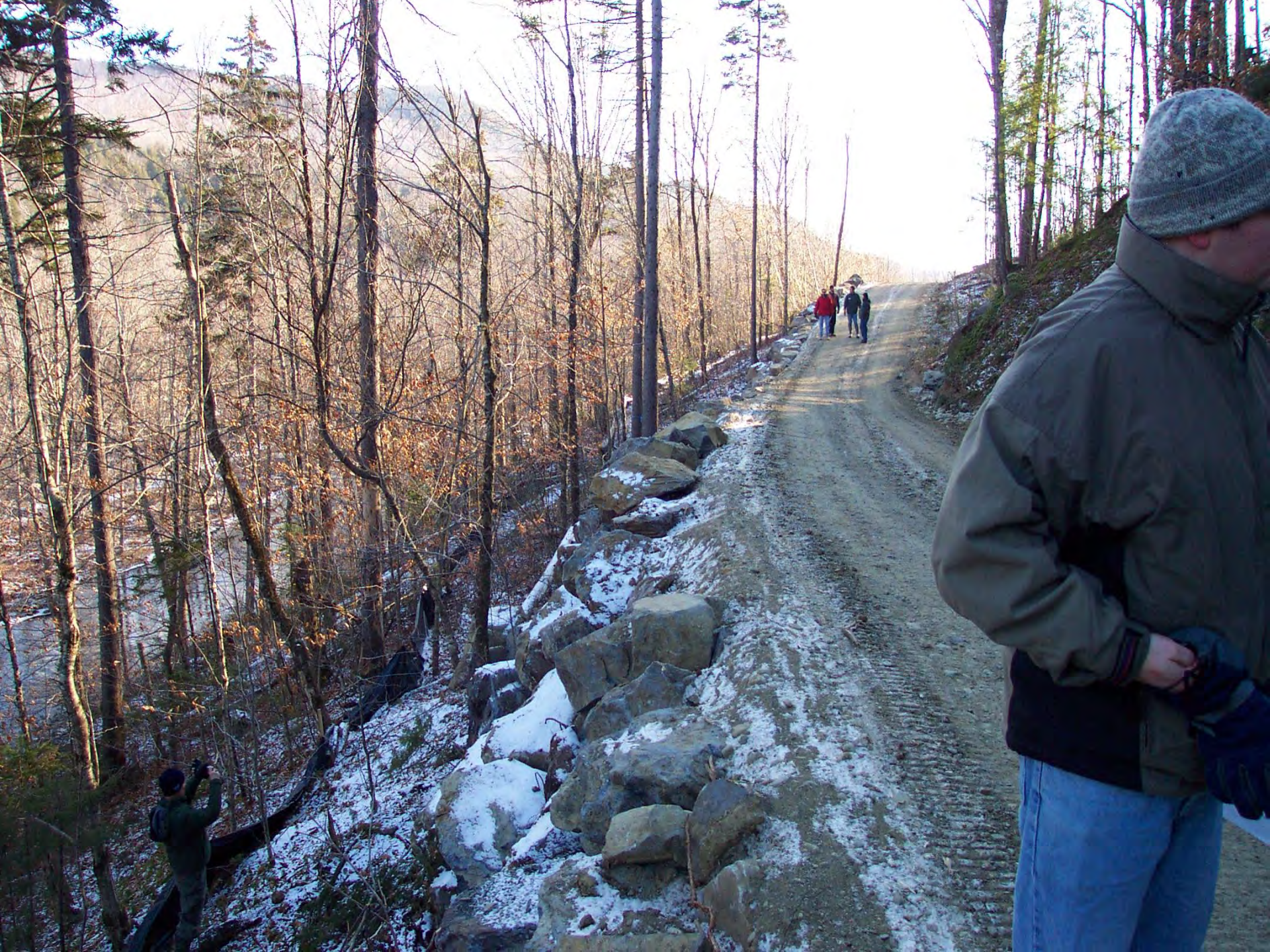
SUBDIVISION ROAD
ROCK SANDWICH UPSLOPE

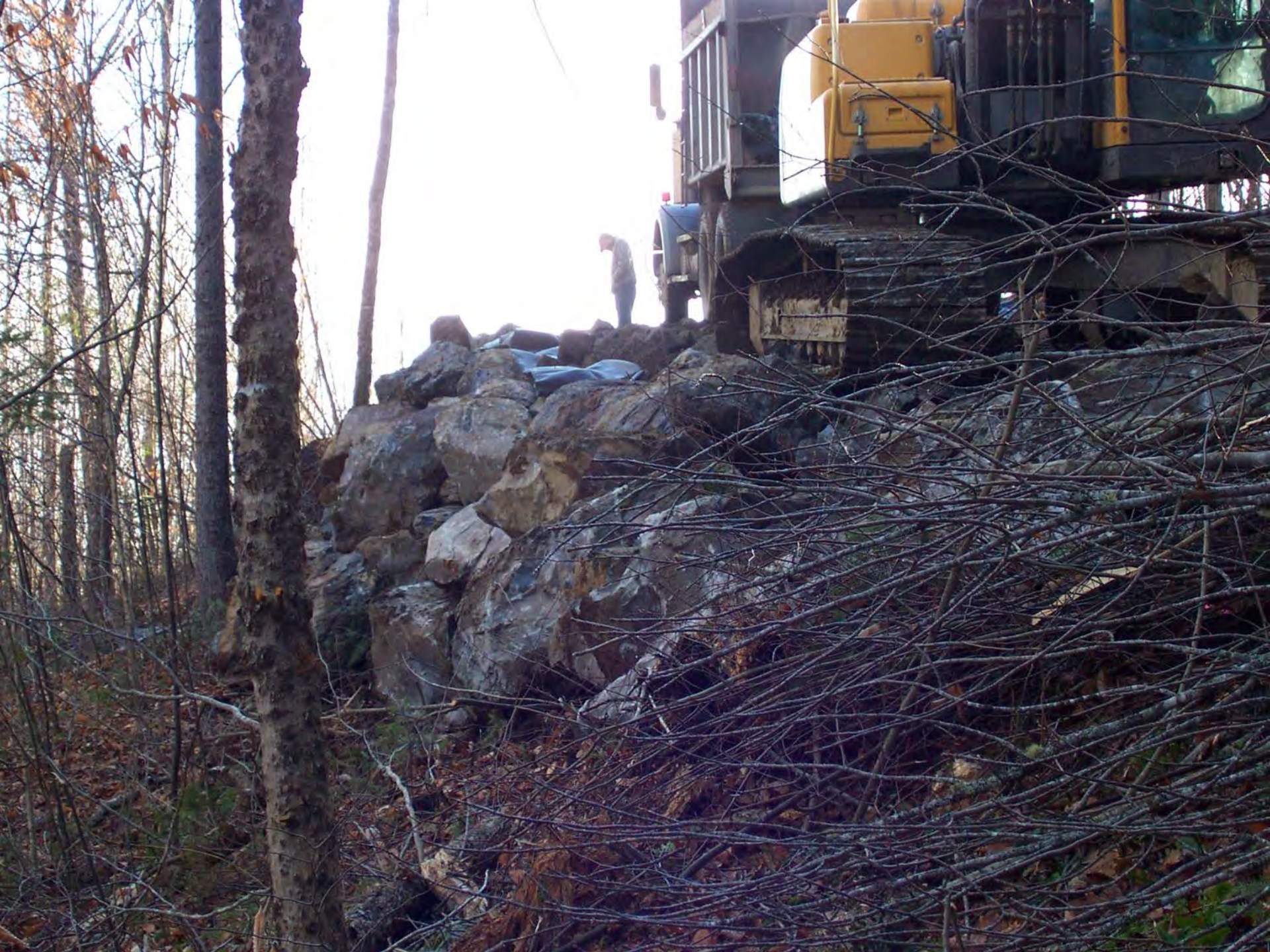
ROCK SANDWICH DOWNSLOPE

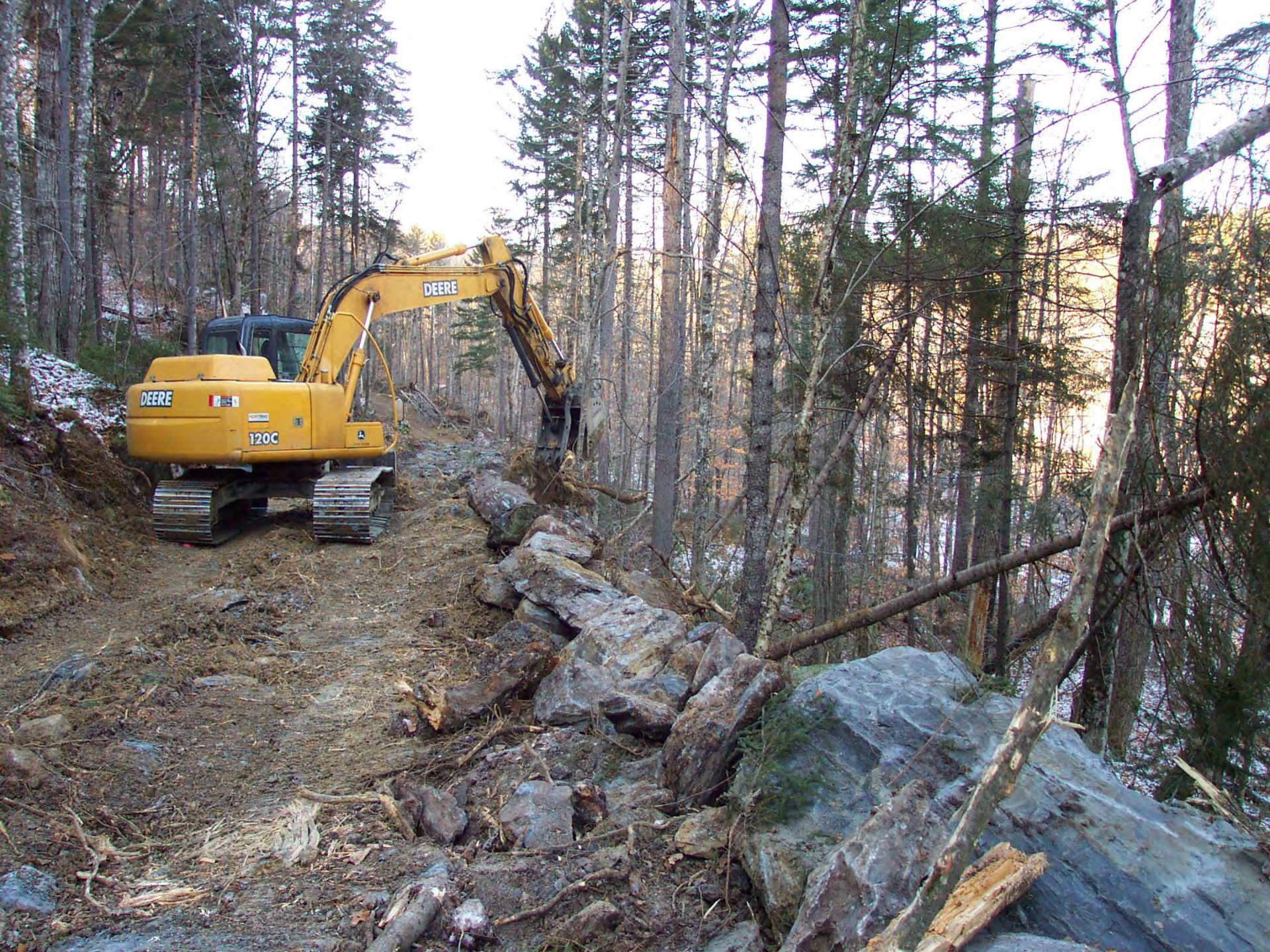
ROCK SANDWICH DOWNSLOPE

ELLIOTSVILLT TOWNSHIP

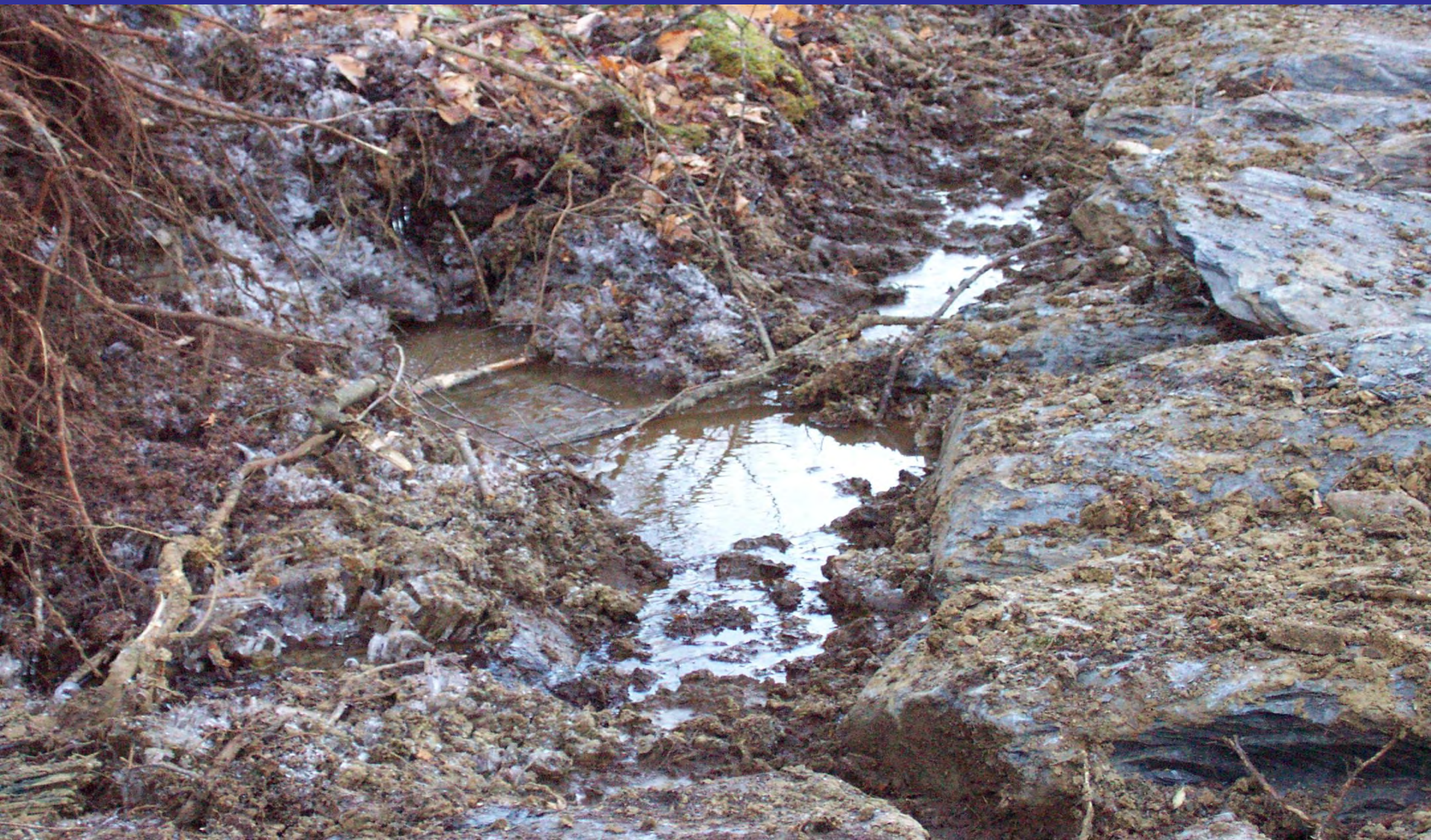
LOGGING ROAD BUILT ON VERY STEEP SLOPE NEAR WILSON STREAM






DEERE
DEERE
120C

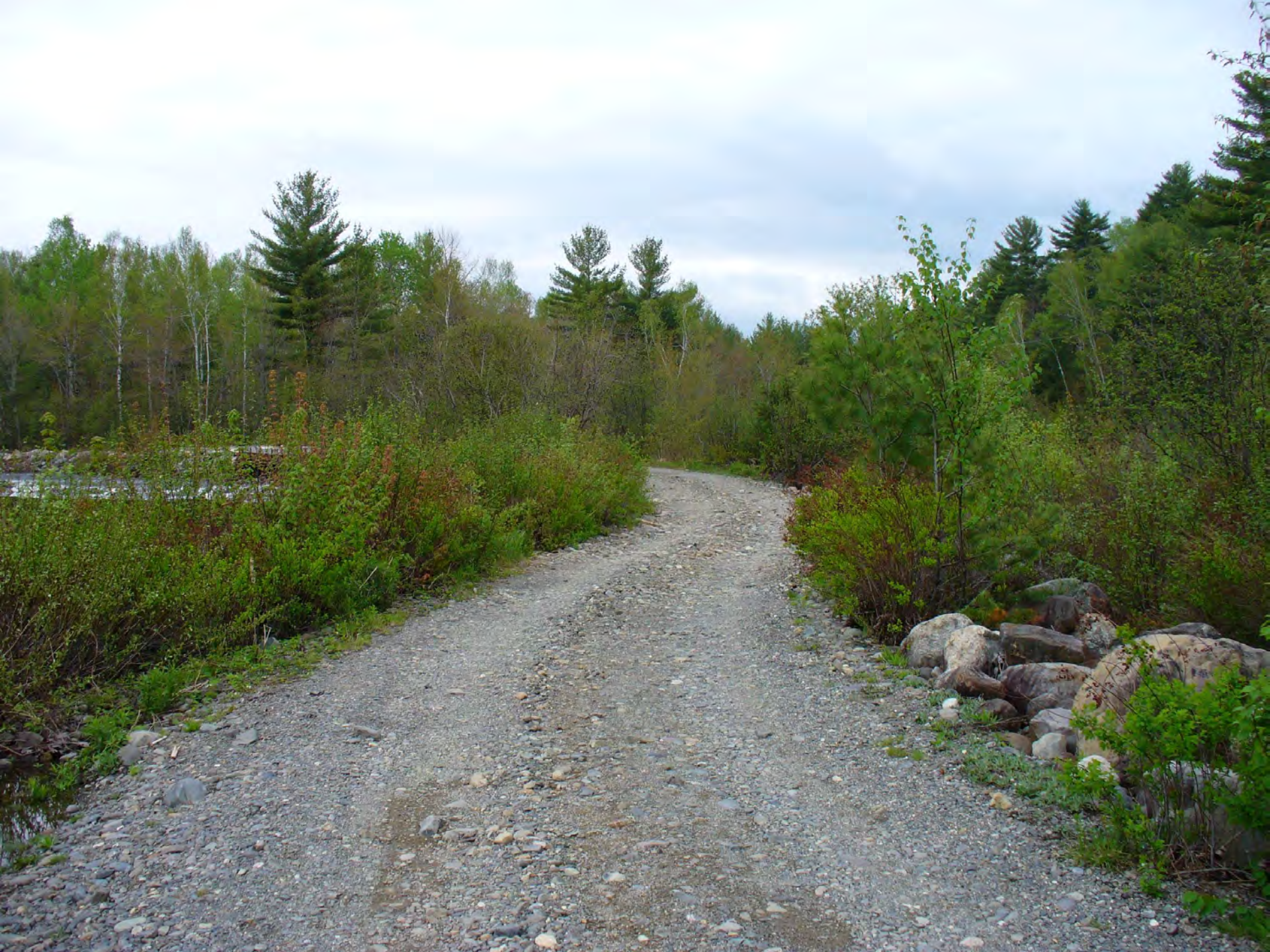
BOULDERS TRANSMIT WATER

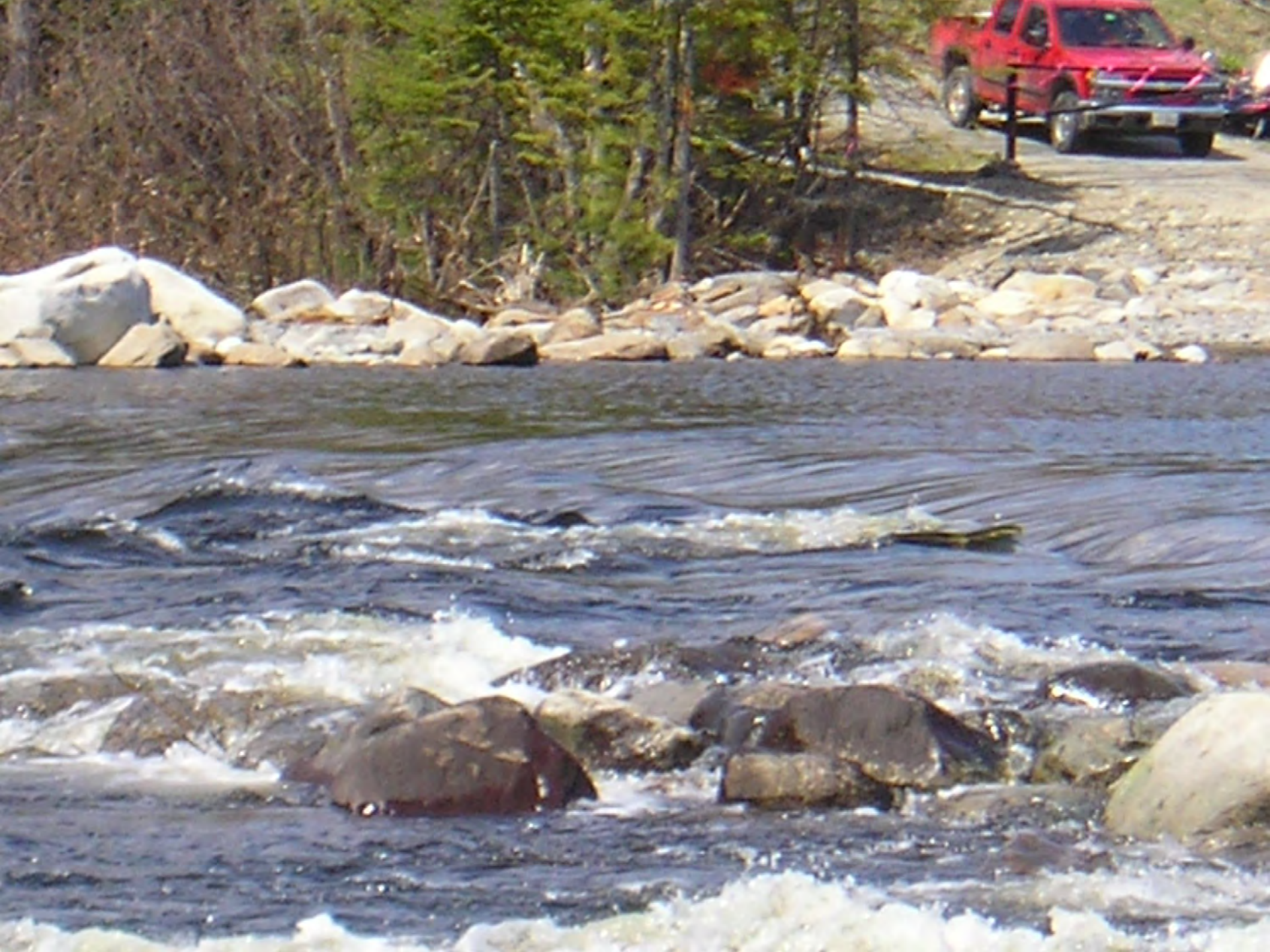


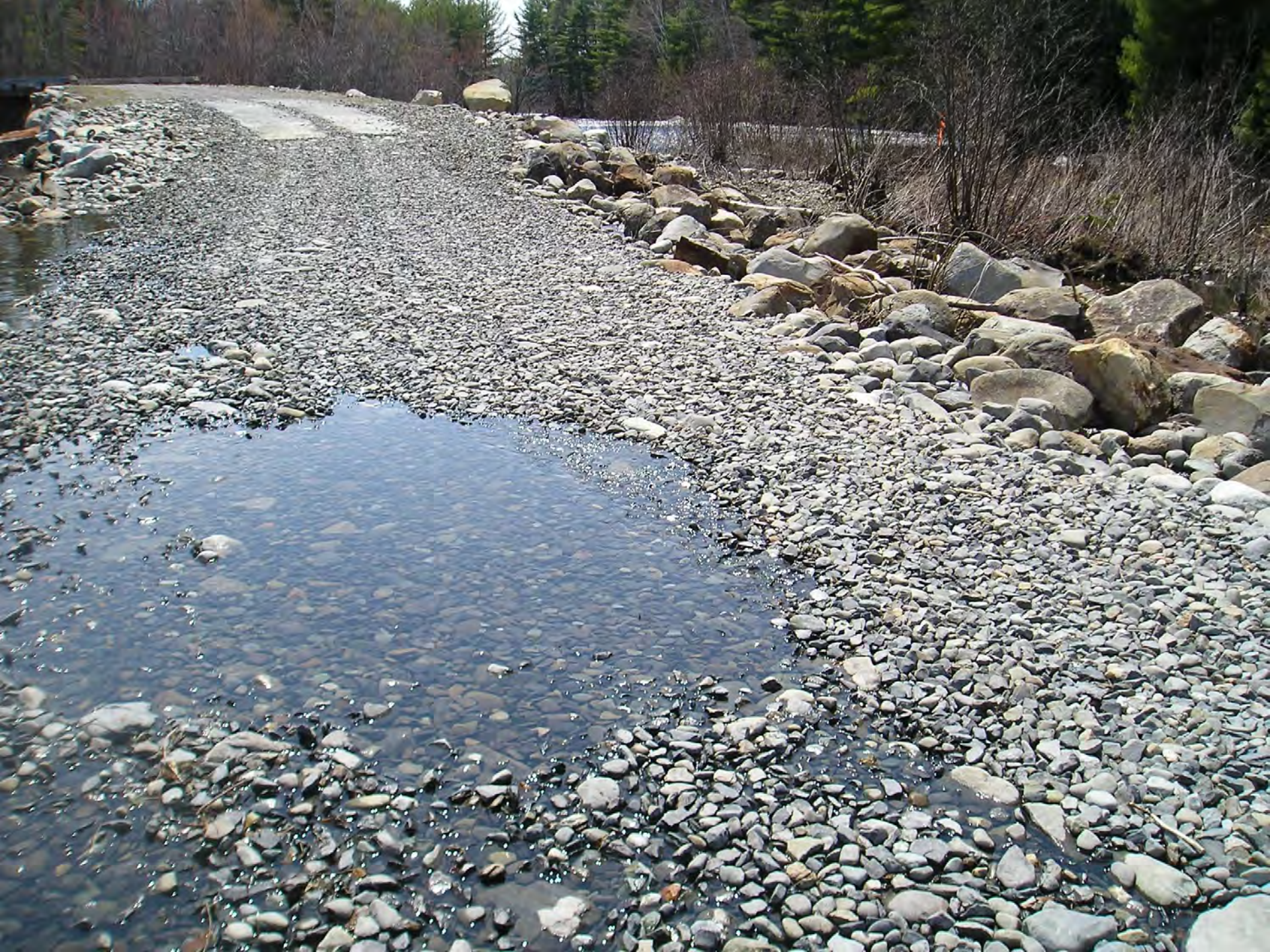
NO CULVERT NEEDED

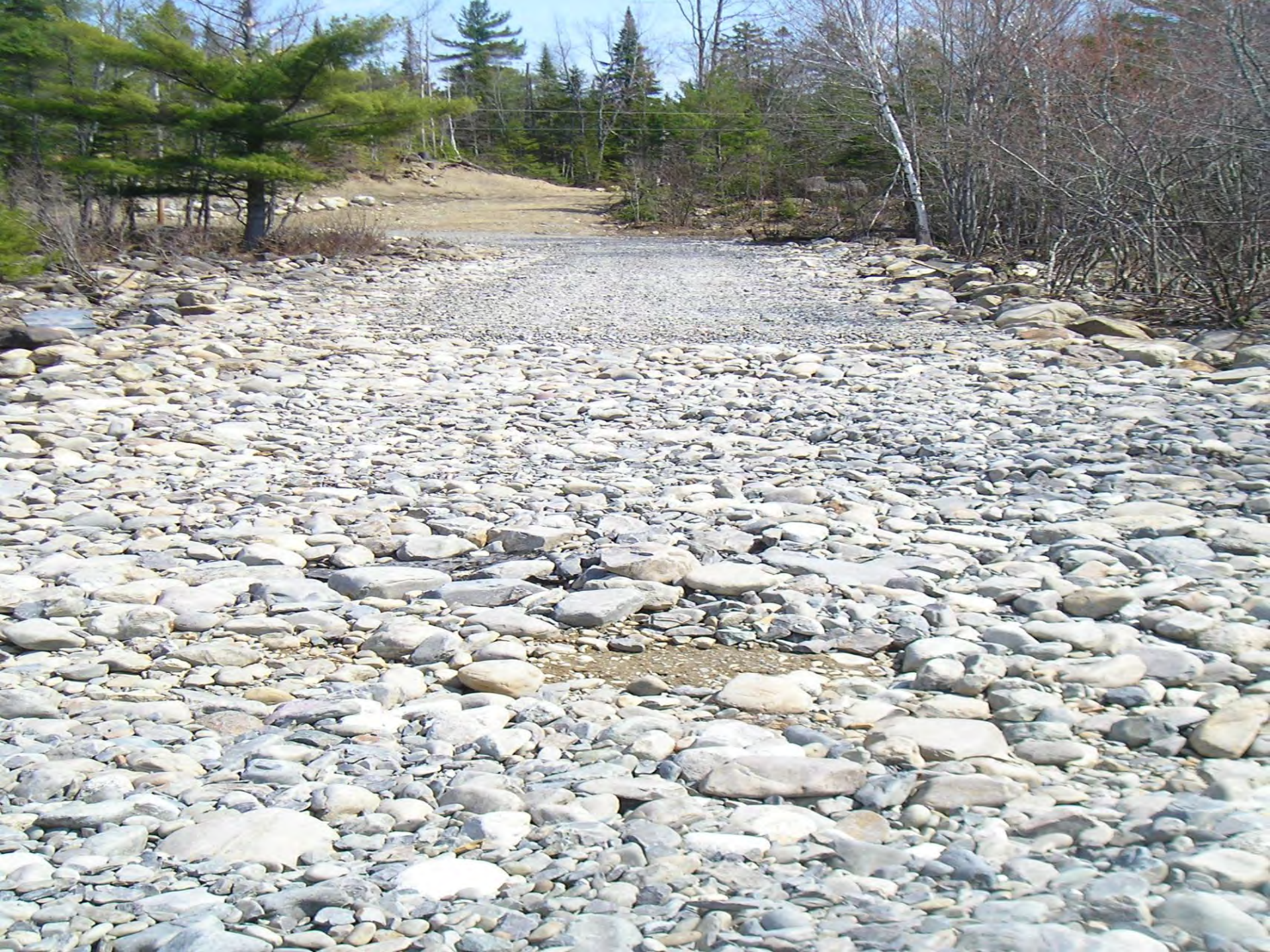
EBEEMEE

CAMP ACCESS AND LOGGING ROAD BUILT OVER FLOODWAY





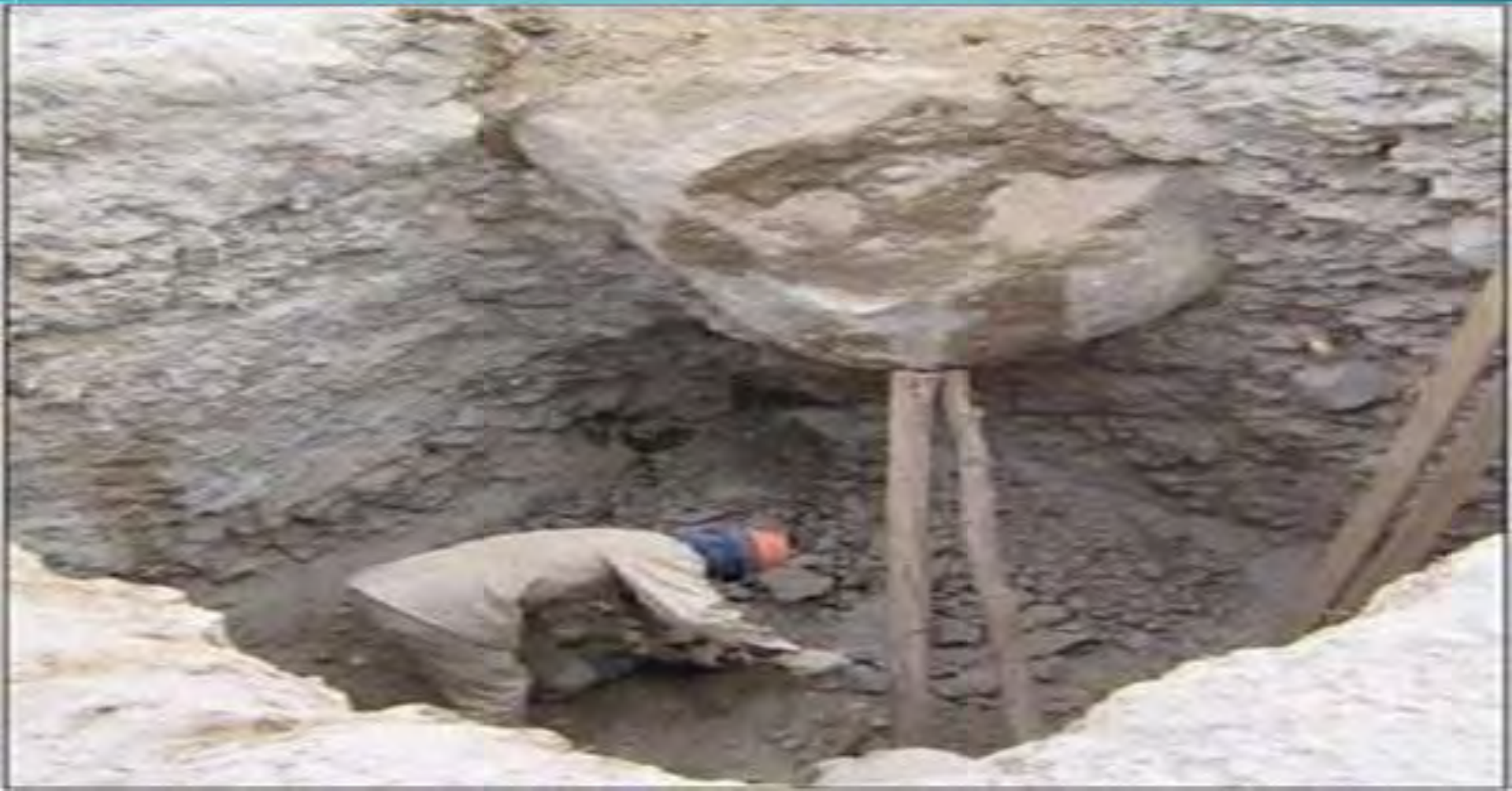




FINALLY

SAFETY SHOULD ALWAYS BE CONCERN

FOLLOW PROPER OSHA SAFETY REQUIREMENTS



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QUESTIONS