

# **SUBSURFACE WASTEWATER DISPOSAL RULES**

**KEY FOR DETERMINING  
DEPTH TO THE  
SEASONAL  
GROUNDWATER TABLE**

**THE DRIVING FORCE BEHIND  
DEVELOPMENT OF THE KEY  
WAS 9" DEPTH TO  
GROUNDWATER TABLE FOR  
FIRST TIME SYSTEMS**

**I DECIDED TO DEVELOP A  
KEY THAT WOULD BE ALL  
INCLUSIVE INSTEAD OF FOR  
JUST ONE NARROW FOCUS**

**MAIN COMPONENTS ARE:  
REDOXIMORPHIC FEATURES  
AND  
ORGANIC MATTER  
ACCUMULATION**

**REDOXIMORPHIC FEATURES  
CAN BE FOUND IN SOILS  
THAT ARE ALTERNATELY  
AEROBIC AND ANAEROBIC  
BUT MAY BE MASKED IN THE  
“A” OR “Ap” HORIZON**

**ORGANIC MATTER  
ACCUMULATION OCURS IN  
THE “A” OR “Ap” HORIZON  
OF MOST POORLY DRAINED  
SOILS AND THE LOWER  
HORIZONS OF SOILS WITH  
AN OXYGEN RICH  
GROUNDWATER TABLE**

**ORGANIC MATTER  
ACCUMULATES IN OR ON A  
SOIL DUE TO REDUCED  
MICROBIAL ACTIVITY –  
USUALLY DUE TO LACK OF  
OXYGEN BUT CAN BE DUE  
TO COOL TEMPERATURES**

# **THE KEY IS DESIGNED TO:**

**IDENTIFY SEASONAL GROUNDWATER TABLE  
ON BASIS OF REDOXIMORPHIC FEATURES**

**IDENTIFY SEASONAL GROUNDWATER TABLE  
IN SOILS THAT DO NOT DEVELOP  
REDOXIMORPHIC FEATURES DUE TO  
OXYGENATED GROUNDWATER (OXYAQUIC  
CONDITIONS)**

# **THE KEY IS DESIGNED TO:**

**IDENTIFY THE SEASONAL  
GROUNDWATER TABLE IN SANDY  
SOILS AND SPODOSOLS**

**IDENTIFY THE SEASONAL  
GROUNDWATER TABLE IN SOILS  
WITH AN “A” OR “Ap” HORIZON THAT  
IS MORE THAN 9” THICK**

# **THE KEY IS DESIGNED TO:**

**CREATE GREATER CONSISTENCY  
AMONGST SITE EVALUATORS,  
PARTICULARLY FOR SOILS WITH  
SEASONAL GROUNDWATER TABLE  
AT OR NEAR THE SOIL SURFACE AND  
PROBLEM SOILS**

**REQUIRES THE  
UNDERSTANDING OF A FEW  
SOIL SCIENCE TERMS AND  
CONCEPTS**

# **MUNSELL COLOR BOOK**

**THE COLOR DESIGNATION SYSTEM  
USED BY SOIL SCIENTISTS THE  
WORLD OVER**

**ASSURES UNIFORMITY IN DESCRIBING  
SOILS**

# **MUNSELL COLOR BOOK**

**HUE – CHROMATIC GRADATION (HOW  
YELLOW OR RED IT IS)**

**CHROMA – PURITY OR STRENGTH OF  
THE COLOR**

**VALUE – DEGREE OF DARKNESS OR  
LIGHTNESS**

# REDOXIMORPHIC FEATURES

SOIL MORPHOLOGICAL FEATURES  
THAT DEVELOP AS A RESULT OF  
ALTERNATING ANAEROBIC AND  
AEROBIC CONDITIONS IN THE SOILS  
DUE TO PERIODIC SATURATION OR  
INUNDATION

FORMERLY CALLED “MOTTLES” OR  
“DRAINAGE MOTTLES”

# REDOXIMORPHIC FEATURES – FINE TEXTURED SOIL



# REDOXIMORPHIC FEATURES – SANDY SOIL



# REDOX DEPLETIONS

VALUE 4 OR MORE AND CHROMA 2 OR LESS  
ZONES, SPOTS OR SPLOTCHES

FORMERLY REFERRED TO AS “GRAY  
MOTTLES”

WHERE IRON AND MANGANESE OXIDES  
HAVE BEEN REDUCED AND THE IRON AND  
MANGANESE HAVE LEACHED AWAY

# **LOAMY FINE SAND TEXTURE**

**IMPORTANT DETERMINATION FOR  
APPLYING SOIL DRAINAGE CLASS  
KEYS**

**SANDY SOILS DEVELOP DIFFERENT  
MORPHOLOGIES THAN FINER  
TEXTURED SOILS**

# **SUBSOIL HORIZON WITH 2 OR MORE COLORS**

**MUST BE DUE TO SOIL DEVELOPMENT PROCESSES NOT DISTURBANCE BY MAN, ANIMALS OR PLANTS**

**IS COMMONLY FOUND IN SOILS WITH OXYAQUIC (OXYGENATED GROUNDWATER) CONDITIONS – ASSOCIATED WITH ORGANIC MATTER ACCUMULATION**

**THE DARKER THAT ONE OR MORE OF THE COLORS IS THE WETTER THE SOIL**

# **ORGANIC MATTER STREAKING DIFFERENTIAL ACCUMULATION**

**MOST OF THE TIME, SOILS WITH 2 OR  
MORE COLORS EXHIBIT ORGANIC  
MATTER ACCUMULATION IN A  
STREAKED PATTERN OR ONE THAT  
HAS LARGE BLACK MOTTLES OR  
SPLOTCHES**

**TRANSLOCATED FROM HIGHER IN THE  
WATERSHED**

# OXYGENATED GROUNDWATER SEEPING FROM SOIL



# OXYAQUIC SOIL WITH LARGE ROOT IN “PIPING” PATH



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# OXYGEN AND ORGANIC RICH GROUNDWATER



# OXYGEN RICH GROUNDWATER SEEP



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION



# WELL DRAINED VS OXYGEN RICH WET SOIL PROFILE



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION IN E



# ORGANIC MATTER STREAKING IN "E"



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION IN E



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# DIFFERENTIAL ORGANIC MATTER ACCUMULATION



**REDOX ON RIGHT  
OXYAQUIC ON LEFT**



# DIFFERENTIAL OM ACCUMUL. OVER REDUCED MATRIX



# FILL OVER “O” HORIZON



# SOIL HORIZONS

# FORESTED SPODOSOL PROFILE



**“O” HORIZON  
<5% MINERAL BY WEIGHT**

**O<sub>i</sub> HORIZON – LEAF LITTER**

**O<sub>e</sub> HORIZON- INTERMEDIATE DECOMP**

**O<sub>a</sub> HORIZON – HIGHLY DECOMPOSED**

# Oa HORIZON OXYAQUIC SOIL



# Oa HORIZON

## NOTE LACK OF STRUCTURE



# **“A” OR “Ap” HORIZON**

**TOP MOST MINERAL SOIL HORIZON**

**DARKENED BY ORGANIC MATTER**

**DO NOT TYPICALLY FORM IN FORESTS  
UNLESS SOIL IS POORLY DRAINED**

**MAY BE FOUND IN UPLAND FORESTS THAT  
WERE ONCE PASTURE OR FARMLAND**

**DARK - VALUE 3 OR LESS AND  
CHROMA 2 OR LESS**

**THIS IS A VERY IMPORTANT INDICATOR  
OF ORGANIC MATTER  
ACCUMULATION**

**ASSOCIATED WITH REDUCED  
MICROBIAL ACTIVITY DUE TO  
PROLONGED WETNESS**

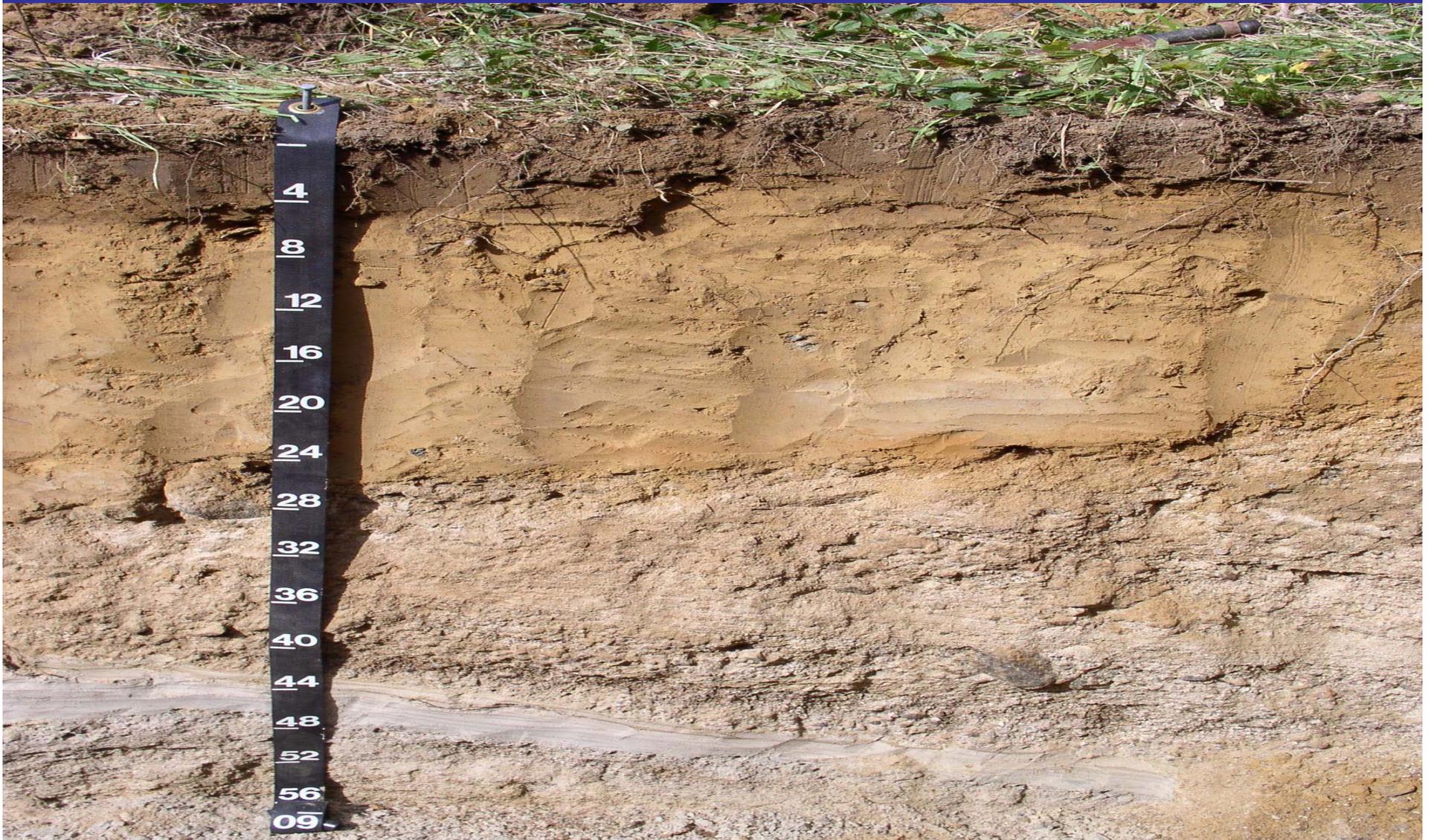
**DARK - VALUE 3 OR LESS AND  
CHROMA 2 OR LESS**

**MUST BE BASED ON MOIST SOIL  
COLORS**

**SOILS HIGH IN ORGANIC MATTER THAT  
ARE BLACK WHEN MOIST BECOME  
QUITE LIGHT IN COLOR WHEN DRY**

**OTHER SOIL HORIZONS ARE LOWER  
CHROMA DRY THAN MOIST**

**“Ap” NOT DARK**



# “Ap” NOT DARK



# “Ap” DARK



# DARK AND NOT DARK Ap

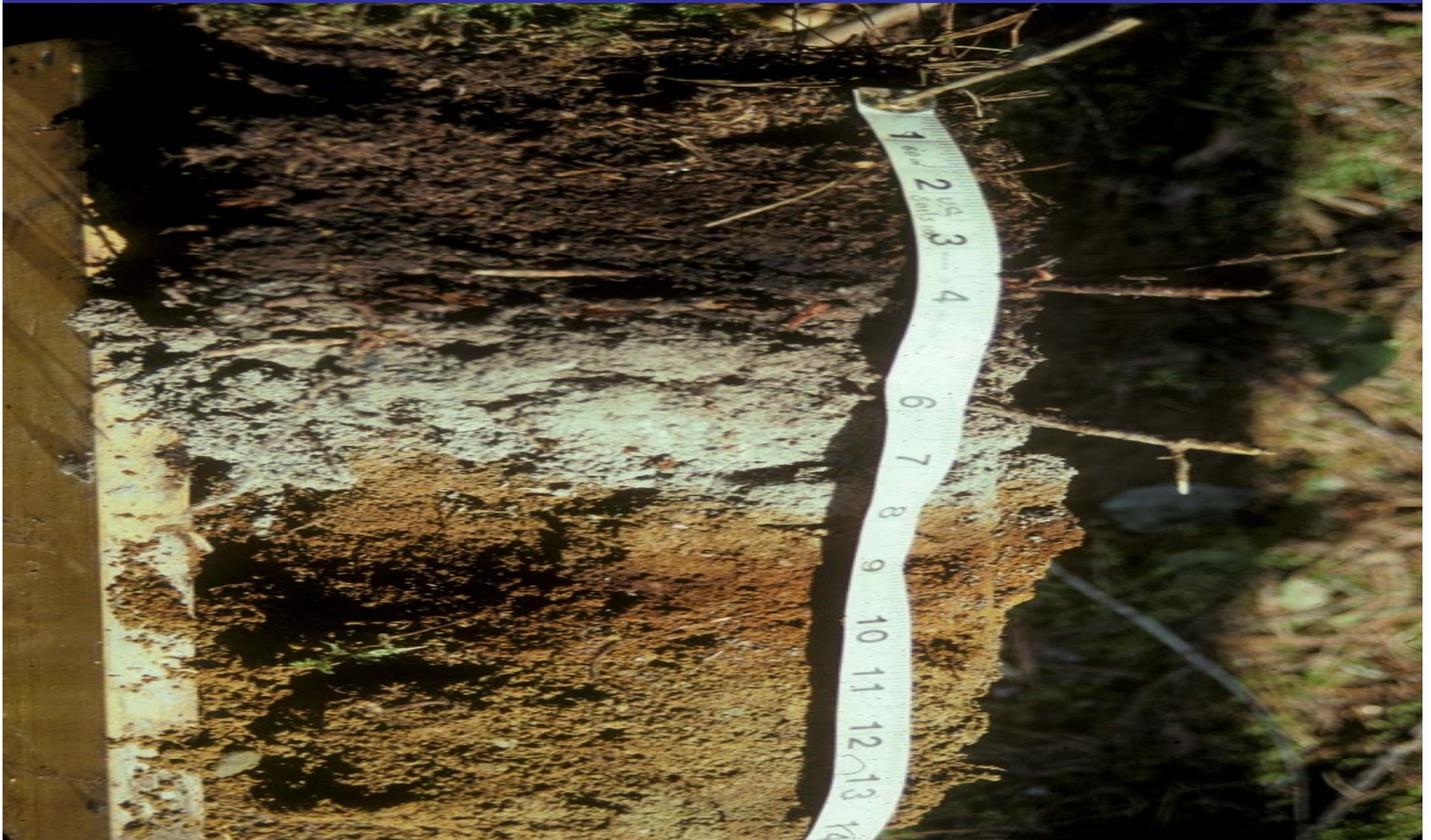


# **“E” HORIZON**

**HORIZON THAT DEVELOPS AS A  
RESULT OF INTENSE LEACHING -  
INFILTRATING WATER BECOMES  
ACIDIC**

**FORMS UNDER THE “O” HORIZON  
USUALLY GRAY IN COLOR BUT NOT  
DUE TO REDUCING CONDITIONS**

# “E” IN WELL DRAINED SOIL ALMOST “WHITE” IN COLOR



**“E” HORIZON IN WET SOIL  
NOT AS WHITE**



# **OXIDIZED RHIZOSPHERES**

**THE RHIZOSPHERE IS THE ZONE  
IMMEDIATELY SURROUNDING LIVING  
PLANT ROOTS**

**IN WET SOILS WITH GRAY COLORS,  
OXYGEN RELEASED FROM PLANT  
ROOTS OXIDIZES THE IRON IN THIS  
ZONE**

# OXIDIZED RHIZOSPHERES





# **“Bh” OR “Bhs” HORIZONS**

**HORIZONS THAT DEVELOP UNDER AN “E”  
HORIZON (WHICH MAY NO LONGER BE  
PRESENT)**

**ACCUMULATION OF ORGANIC MATTER  
AND/OR SESQUIOXIDES (IRON, ALUMINUM  
ETC.) FROM “E” HORIZON ABOVE**

**COLOR RELATED TO ORGANIC DUFF  
THICKNESS**

# **COOL TEMPERATURES AND 2" THICK "Bh" OR "Bhs" HORIZON**

**THICKNESS AND COLOR OF THE "Bh" OR  
"Bhs" HORIZONS DIRECTLY RELATED TO  
THE "O" HORIZON**

**THE THICKER THE "O" THE THICKER AND  
DARKER THE "Bh" OR "Bhs"**

**"O" HORIZON THICKNESS RELATED TO  
MICROBIAL ACTIVITY (TEMP. AND  
WETNESS)**

# **“Bh” OR “Bhs” HORIZON CONTINUOUS**

**CONTINUOUS MEANS CONSISTENT  
ACROSS THE AREA WHERE FOUND  
REPRESENTING THE AVERAGE  
CONDITION**

**CAN BE FOUND IN POCKETS OF  
BETTER DRAINED SOILS UNDER A  
ROCK OR IN A PIT WHERE ORGANIC  
MATTER ACCUMULATES**

# **“Bh” OR “Bhs” HORIZON CONTINUOUS**

**IN PIT AND MOUND TOPOGRAPHY  
SHOULD BE AT MORE OR LESS THE  
SAME RELATIVE ELEVATION IF  
INDICATIVE OF A SEASONAL GROUND  
WATER TABLE**

# “B” HORIZON NOT THICK AND DARK



# SOIL IN MIDDLE AND RIGHT HAVE THICK DARK “Bhs”



# THICK AND DARK “Bhs”



# THICK AND DARK “Bhs”



# THICK AND DARK “Bhs” MOUNTAIN SOIL



**THE KEY**

**IN A FIELD OR FOREST WITH AN  
“A” OR “Ap”**

**IF “A” OR “Ap” OF ANY THICKNESS IS  
NOT DARK**

**MEASURE TO THE DEPTH WHERE 2%  
OR MORE REDOXIMORPHIC  
FEATURES ARE FIRST FOUND OR TO  
TOP OF FIRST HORIZON WHERE 2 OR  
MORE COLORS IN A STREAKED  
PATTERN OR WITH DIFFERENTIAL  
ORGANIC MATTER ACCUMULATION**

# IN A FIELD OR FOREST WITH AN “A” OR “Ap”

IF “A” OR “Ap” OF ANY THICKNESS IS DARK

MEASURE TO THE DEPTH YOU FIRST  
ENCOUNTER REDOXIMORPHIC FEATURES  
OR OXIDIZED RHIZOSPHERES IN “A” OR  
“Ap” FOR DEPTH TO SEASONAL  
GROUNDWATER TABLE

IF NO REDOXIMORPHIC FEATURES OR  
OXIDIZED RHIZOSPHERES FOUND IN “A”  
OR “Ap”, LOOK AT HORIZON IMMEDIATELY  
BENEATH

# IMPORTANT NOTE

WHEN YOU HAVE A DARK “A” OR “Ap” AND  
THERE ARE MORPHOLOGICAL INDICATORS  
OF WETNESS IN THE HORIZON  
IMMEDIATELY BELOW THE “A” OR “Ap”  
THE GROUNDWATER TABLE IS IN THE “A”  
OR “Ap”

REDOX FEATURES ARE MASKED BY  
ORGANIC MATTER STAINING EXCEPT  
SOMETIMES FOR OXIDIZED RHIZOSPHERES  
IN A FIELD

**FIELD OR FOREST WITH DARK  
“A” OR “Ap” ANY THICKNESS**

**THE SOIL IS POORLY DRAINED IF HORIZON  
IMMEDIATELY BELOW “A” OR “Ap” HAS:**

- a. **2% OF ANY KIND OF REDOXIMORPHIC  
FEATURES IF LOAMY FINE SAND OR  
COARSER OR REDOX DEPLETIONS IF  
FINER THAN LOAMY FINE SAND**
- b. **2 OR MORE COLORS IN A STREAKED  
PATTERN OR WITH DIFFERENTIAL OM  
ACCUMULATION WHERE ONE IS DARK**

**FIELD OR FOREST WITH DARK  
“A” OR “Ap” ANY THICKNESS**

**THE SOIL IS POORLY DRAINED IF THE  
HORIZON IMMEDIATELY BELOW THE  
“A” OR “Ap” HAS:**

**C. AN “E” WITH 2% OR MORE  
REDOXIMORPHIC FEATURES OR OM  
STREAKING OVER A 2” THICK OR  
MORE DARK “Bh” OR “Bhs” THAT IS  
CONTINUOUS**

**FIELD OR FOREST WITH DARK  
“A” OR “Ap” ANY THICKNESS**

**THE SOIL IS POORLY DRAINED IF THE  
HORIZON IMMEDIATELY BELOW THE  
“A” OR “Ap” HAS”:**

**D. A 2” OR MORE THICK DARK “Bh” OR  
“Bhs” THAT IS CONTINUOUS**

**THE “Bh” OR “Bhs” MAY BE CEMENTED  
(ORTSTIEN)**

**FIELD OR FOREST WITH DARK  
“A” OR “Ap” ANY THICKNESS**

**IF THE HORIZON IMMEDIATELY BELOW THE  
“A” OR “Ap” DOES NOT MEET a-d ABOVE:**

**MEASURE THE DEPTH TO WHERE YOU FIRST  
FIND 2% OR MORE REDOXIMORPHIC  
FEATURES OR 2 OR MORE COLORS IN A  
STREAKED PATTERN OR WITH  
DIFFERENTIAL ORGANIC MATTER  
ACCUMULATION**

**(SOME SEPERATION BETWEEN DARK “A” OR  
“Ap” AND HORIZON WITH WET  
MORPHOLOGY)**

**SOIL IS POORLY DRAINED IN  
FOREST WITHOUT “A” OR “Ap”**

**IF THE FIRST MINERAL SOIL HORIZON  
IMMEDIATELY BELOW THE ORGANIC DUFF  
LAYER HAS:**

**A. 2% OR MORE REDOXIMORPHIC FEATURES  
OR ORGANIC STREAKING IN THE “E”  
WHICH IS IMMEDIATELY UNDERLAIN BY A  
2” OR MORE THICK “Bh” OR “Bhs” THAT IS  
DARK AND CONTINUOUS**

**SOIL IS POORLY DRAINED IN  
FOREST WITHOUT “A” OR “Ap”**

**IF THE FIRST MINERAL SOIL HORIZON  
IMMEDIATELY BELOW THE ORGANIC  
DUFF LAYER HAS:**

- b. 2 OR MORE COLORS IN A STREAKED  
PATTERN OR WITH DIFFERENTIAL  
ORGANIC MATTER ACCUMULATION  
WHERE ONE OF THE COLORS IS  
DARK**

**IN A FOREST WITHOUT AN “A”  
OR “Ap”**

**IF THE SOIL DOES NOT MEET a OR b  
ABOVE, MEASURE THE DEPTH TO  
WHERE YOU FIRST FIND 2% OR MORE  
REDOXIMORPHIC FEATURES OR TO  
THE TOP OF A HORIZON WHERE  
THERE ARE 2 OR MORE COLORS IN A  
STREAKED PATTERN OR WITH  
DIFFERENTIAL ORGANIC MATTER  
ACCUMULATION**

**IRIS TUBES  
IN SUSPECTED OXYAQUIC  
SOIL AT REID STATE PARK**

# SOIL PROFILE FROM REID PARK OXYAQUIC PIT





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# NOTE ORGANIC STREAKING TYPICAL OF OXYAQUIC SOIL



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# **SKID TRAIL IN NORTHERN MAINE**



# DIFFERENTIAL ORGANIC MATTER ACCUMULATION









# **SKID ROAD IN WESTERN MAINE**









**PROPER METHOD FOR  
PREPARING A SOIL PIT FOR  
DESCRIBING**



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