DESIGN INTENT

THIS PLAN HAS BEEN CREATED TO SERVE AS A GENERAL GUIDE THAT MAY BE APPLIED TO MULTIPLE STREAM LOCATIONS ON THE OAK RIDGE RESERVATION (0RR). ALTHOUGH THIS PLAN WAS PREPARED FOR ORNL TO USE IN PROTECTION AND ENHANCEMENT OF RIPARIAN BUFFER AREAS, THE CONCEPT IS APPROPRIATE TO EXPAND TO THE ORR. ORNL GUIDELINES CALL FOR A VEGETATED RIPARIAN BUFFER OF 59' IN WIDTH (SEE ORNL RIPARIAN BUFFER REQUIREMENTS). BEST MANAGEMENT PRACTICES CALL FOR A VEGETATED RIPARIAN BUFFER OF 100' OUTSIDE OF FACILITY AREAS.

THESE VEGETATED RIPARIAN BUFFERS ARE INTENDED TO INCREASE BOTH THE ENVIRONMENTAL QUALITY AND THE AESTHETIC APPEAL OF STREAM CORRIDORS OF ORR. THE PRIMARY GOALS ARE TO **PROTECT AND IMPROVE WATER QUALITY** AND **INCREASE BIODIVERSITY** BY:

- SHADING THE STREAM CHANNELS
- FILTERING AND SLOWING SURFACE AND SUBSURFACE WATER FLOW
- MANAGING TO REDUCE FLOOD IMPACT
- PROVIDING HABITAT AND FOOD SOURCES FOR WILDLIFE BY ENCOURAGING DIVERSE NATIVE PLANT COMMUNITIES
- REDUCING EROSION BY ANCHORING SOIL WITH STRONGER/DEEPER ROOT SYSTEMS THAN TURF
- REDUCING ENERGY USE BY CREATING 'NO MOW' AREAS AND ZONES THAT ONLY REQUIRE MOWING 1-2 TIMES PER YEAR
- REDUCE WATER/FERTILIZER USE BY DEVELOPING NATIVE PLANT COMMUNITIES THAT ARE WELL-ADAPTED TO EXISTING CONDITIONS (SOIL ACIDITY/MOISTURE/DRAINAGE, SUN ASPECT, ETC.) ONCE ESTABLISHED, THESE PLANTS WILL THRIVE WITH CONSISTENT BUT MINIMAL MANAGEMENT.

DESIGN GUIDELINES

THE CONCEPTS AND RECOMMENDATIONS INCLUDED IN THIS PLAN ARE MEANT TO SERVE AS A GENERAL GUIDE FOR STREAMS ON THE ORR; HOWEVER. EACH SITE IS UNIQUE AND WILL PRESENT VARIOUS CHALLENGES AND OPPORTUNITIES. THESE BASIC GUIDELINES CAN BE FOLLOWED TO TAILOR THE GENERAL PLAN TO BEST SUIT A PARTICULAR SITE:

- **SITE INVENTORY & ANALYSIS**

  STREAM CONDITIONS: ANALYZING THE OVERALL CONDITION OF A STREAM AND ITS BANKS IS AN IMPORTANT FIRST STEP IN THE RIPARIAN BUFFER DESIGN PROCESS. SEVERELY ERODING AREAS MAY REQUIRE BIOENGINEERING TECHNIQUES FOR STABILIZATION. BURIED STEAM PIPES MAY RAISE SOIL TEMPERATURES TO A POINT WHERE NO PLANTS WILL GROW. TAKING EXISTING CONDITIONS INTO ACCOUNT AND PLANNING FOR AND AROUND THEM CAN SAVE TIME, ENERGY, AND MONEY.
  VEGETATION: TAKING NOTE OF EXISTING VEGETATION IS A HELPFUL STARTING POINT FOR DEVELOPING A NATIVE PLANT PALETTE. THIS INDICATES SOIL ACIDITY, MOISTURE, DRAINAGE, ETC.
  SOILS: PERFORMING SIMPLE SOIL TESTS FOR ACIDITY CAN ALSO HELP IN DEVELOPING THE BEST PLANT PALETTE FOR A PARTICULAR SITE THAT WILL NOT REQUIRE SOIL AMENDMENTS OR FERTILIZERS. PROBING THE SOIL WITH A HAND AUGER IN VARIOUS REPRESENTATIVE LOCATIONS IS ALSO RECOMMENDED, AS THIS WILL REVEAL SOIL TYPE, QUALITY, DEPTH, AND DRAINAGE CAPACITY.
  ASPECT: PAYING ATTENTION TO WHAT AREAS ARE IN SUN OR SHADE WILL INFLUENCE PLANT CHOICES, AS WELL AS UPLAND VERSUS LOWLAND ZONES. AREAS IMMEDIATELY ADJACENT TO A STREAM CAN HAVE UPLAND CHARACTERISTICS (DRY, WELL-DRAINED) IF EROSION HAS CAUSED EXTREME SLOPES.
  VIEWS: ANALYZING WHAT VIEWS TO PRESERVE OR SCREEN IS IMPORTANT AND USEFUL IN GUIDING EACH RIPARIAN BUFFER DESIGN. FOR EXAMPLE, A BEAUTIFUL CASCADE IN THE STREAM CAN BE FRAMED BUT NOT HIDDEN WITH SHRUB MASSES AND LOW-GROWING GRASSES OR SEDGES; WHILE A RUSTY STEAM PIPE CAN BE SCREENED WITH DENSELY PLANTED SHRUBS AND TREES.
  STRUCTURES/UTILITIES/ETC.: TAKING INTO CONSIDERATION ANY ACCESS NEEDS, EXISTING STRUCTURES, UTILITIES, SAMPLE POINTS, AND FUTURE PROJECTS, IS RECOMMENDED TO AVOID POTENTIAL CONFLICTS.

- **DEVELOPING A PLANT PALETTE**

  ONCE THE SITE INVENTORY & ANALYSIS IS COMPLETE, A GENERAL PLANT PALETTE FOR THE RIPARIAN BUFFER SHOULD BE DEVELOPED. EACH RIPARIAN BUFFER WILL LIKELY HAVE LOWLAND AND UPLAND AREAS, SO IT IS RECOMMENDED THAT A COMBINATION OF PLANT COMMUNITIES BE USED CONSISTING OF:

  - CANOPY TREES
  - SUB-CANOPY/ACCENT TREES
  - SHRUBS
  - GRASSES/SEDGES
  - HERBACEOUS FLOWERING PLANTS
  - FERNS

  SOME SPECIES ARE MORE ADAPTABLE THAN OTHERS, AND MAY BE FOUND IN BOTH **LOWLAND** (LOW LYING, MOIST/MODERATE, OCCASIONAL FLOODING) AND **UPLAND** (GENERALLY HIGH AND DRY) ZONES. PLEASE REFER TO THE LISTS ON SHEET 5. THESE ARE LISTS OF NATIVE SPECIES THAT HAVE BEEN APPROVED FOR USE ON THE ORR, AND ARE GENERALLY AVAILABLE IN THE NURSERY INDUSTRY. MANY OF THESE SPECIES CAN BE CONTRACT GROWN IN LARGE QUANTITIES.

- **SELECTIVE THINNING AND EXOTICS MANAGEMENT (S.T.E.M. ZONE CONCEPT)**

  THIS CONCEPT INVOLVES INITIAL AND ANNUAL REVIEW OF THE RIPARIAN BUFFER. IF VEGETATION IS PRESENT, IT IS LIKELY TO CONSIST OF A COMBINATION OF DESIRABLE NATIVE SPECIES AND INVASIVE EXOTICS. THE OBJECTIVE IS TO IRRADICATE THE INVASIVE EXOTIC SPECIES AND TO THIN/REMOVE SOME OVERLY AGGRESSIVE OR UNDESIRABLE NATIVE SPECIES. BLACKBERRY, FOR EXAMPLE, IS A NATIVE PLANT WITH HIGH WILDLIFE VALUE. HOWEVER, IT CAN BE SO AGGRESSIVE THAT IT BECOMES A MONOCULTURE, WHICH DECREASES OVERALL BIODIVERSITY. DESIRABLE NATIVE SPECIES CAN BE IDENTIFIED AND LEFT IN PLACE TO FORM THE FRAMEWORK FOR EACH UNIQUE RIPARIAN BUFFER PLANT COMMUNITY. GO TO www.tneppc.org FOR THE LATEST INFORMATION ON IDENTIFYING, REMOVING, AND MANAGING INVASIVE EXOTIC SPECIES.

RECOMMENDED PLANT SPECIFICATIONS

WHEN IMPLEMENTING A RIPARIAN BUFFER LANDSCAPE PLAN, IT IS IMPORTANT TO CHOOSE THE MOST VIABLE PLANT MATERIAL AVAILABLE WITHIN BUDGET. PLANT MATERIAL SHOULD BE PURCHASED FROM LOCAL GROWERS IF POSSIBLE AND SHOULD BE PROPAGATED/GROWN IN A STATE CERTIFIED NURSERY (NOT WILD-COLLECTED).

THIS PLAN PROVIDES GUIDELINES FOR PLANT QUANTITIES PER 300 LINEAR FEET. CREATING SHADE AND DENSE MASSES OF PLANTS IN LESS TIME WILL HELP TO MINIMIZE WEED COMPETITION, THEREFORE IT IS NOT RECOMMENDED TO USE BARE ROOT SAPLINGS FOR INITIAL INSTALLATION. ONE EXCEPTION WOULD BE IN STREAM BANK SITUATIONS WHERE BIOENGINEERING OR EROSION FABRIC/MASS BARE ROOT PLANTINGS ARE REQUIRED FOR SOIL STABILIZATION. BELOW ARE PREFERRED SIZES/FORMS OF PLANT MATERIAL IF AVAILABLE AND THE BUDGET ALLOWS:

- CANOPY/EVERGREEN TREES: 6-8', 8-10' BALLED & BURLAPPED (B&B)
- SUB-CANOPY/ACCENT TREES: 5-6' B&B OR CONTAINER
- SHRUBS (>4'): 3-4', 4-5' B&B OR CONTAINER
- SHRUBS (<4'): 2-3', 3-4' B&B OR CONTAINER
- GRASSES/SEDGES: FOR ACCENT - LG 2 GAL, SM 1 GAL OR 1 QT
  FOR LARGE AREAS - PLUGS (LOW GRASS ZONE MAY BE PLUGS, SEEDS, OR COMBINATION
- HERBACEOUS FLOWERING PLANTS: FOR ACCENT - 1 GAL OR 1 QT
  FOR LARGE AREAS - PLUGS
- FERNS: 1 GAL OR 1 QT

IF THE SIZES ABOVE ARE NOT AVAILABLE OR AFFORDABLE, SCALING DOWN IS AN OPTION, BUT IT IS RECOMMENDED TO MAINTAIN A VISUAL LAYERING EFFECT. FOR EXAMPLE, PLANTING SUB-CANOPY TREES THAT ARE TALLER THAN CANOPY TREES MAY NOT APPEAR AS A NATURALISTIC WOODLAND PLANT COMMUNITY FOR SEVERAL YEARS.

REGARDING THE LOW GRASS ZONES ON SHEETS 2,3,& 4, IT IS QUITE CHALLENGING TO MANAGE A WEED-FREE WILDFLOWER MEADOW IN THIS REGION (DUE TO RICHER SOILS AND MORE RAINFALL THAN MID-WESTERN PRAIRIES). ATTEMPTING TO ESTABLISH A SOLID STAND OF WARM-SEASON GRASSES FIRST MAY PROVE TO BE MORE ATTAINABLE. MOWING/BURNING PRACTICES MEANT TO ENCOURAGE NATIVE GRASSES OFTEN CONFLICT WITH THOSE SUGGESTED FOR WILDFLOWERS, SEASONALLY SPEAKING. THUS, TO SIMPLIFY MANAGEMENT OF THE LOW GRASS ZONE, HERBACEOUS PLANTS SHOULD BE LIMITED TO HIGHLY VISIBLE AREAS (SUCH AS ALONG WALKWAYS OR AROUND INTERPRETIVE SIGNS), AND PLANTED IN MASSES. OVER TIME, THEY MAY NATURALIZE BY SEED OR BE INTRODUCED INTO BY SEED OR PLUGS INTO THE LOW GRASS ZONES.

SHEETS 2 & 3 DEPICT TALL GRASSES AS ACCENTS WITHIN THE WOODED AREAS BEHIND THE LOW GRASS ZONES. THIS IS SIMPLY AN ATTEMPT TO ORGANIZE THE ZONES AESTHETICALLY, AS SOME OF THE TALLER GRASSES MY BLOCK VIEWS OF THE BUFFER AND STREAM. SHEET 4 ILLUSTRATES ANOTHER WAY OF ACHIEVING A SIMILAR EFFECT, BUT FEATURES A CONTINUOUS STRIP OF TALL GRASSES INSTEAD OF ACCENT PLANTINGS.

ALTHOUGH THIS PLAN FEATURES NATIVE PLANT COMMUNITIES WELL ADAPTED TO ORR, INITIAL AND CONSISTENT WATERING IS CRUCIAL FOR PLANT SURVIVAL UNTIL ESTABLISHED.

RECOMMENDATIONS FOR SLOPED/ERODING AREAS

THERE WILL LIKELY BE A VARIETY OF EROSION ISSUES ALONG STREAMS THAT SHOULD BE ADDRESSED BEFORE AND DURING RIPARIAN BUFFER RESTORATION/ENHANCEMENT PROJECTS. SOME AREAS MY REQUIRE BIOENGINEERING TECHNIQUES OR EVEN STRUCTURAL SOLUTIONS TO STABILIZE THE SOIL BEFORE PLANTING. OTHERS MAY CALL FOR OTHER MEANS OF CREATING STABLE PLANTING AREAS.

ONE EFFECTIVE METHOD OF STABILIZING SLOPES OR AREAS VULNERABLE TO EROSION IS TO PIN DOWN AN APPROVED BIODEGRADABLE EROSION FABRIC AND PLANT PLUGS OF SEDGES OR GRASSES DIRECTLY THROUGH IT USING A SPECIAL TOOL CALLED A 'DIBBLE.' **IF** THE CORRECT STRENGTH/WEAVE OF THE FABRIC IS SELECTED FOR A PARTICULAR SITUATION (% SLOPE, VELOCITY, ETC.), IT IS INSTALLED PROPERLY, AND PLUGS ARE PLANTED AND SPACED ADEQUATELY, A DENSE ROOT SYSTEM CAN DEVELOP BEFORE THE FABRIC BREAKS DOWN. IF INSTALLING THE FABRIC IN AREAS WITH TURF GRASS, THE GRASS SHOULD BE SPRAYED WITH AN APPROVED HERBICIDE FIRST TO MINIMIZE WEED COMPETITION. AN ALTERNATIVE TO HERBICIDE IS TO SPREAD A THICK LAYER (10-12")OF LEAVES (FALLEN AND COLLECTED) ON THE GROUND AND IMMEDIATELY PIN THE FABRIC DOWN TIGHTLY.

ANOTHER METHOD OF CREATING STABLE PLANTING AREAS ON STEEP SLOPES IS TO CREATE LEDGES. THIS INVOLVES DIGGING A SHELF OR PIT IN A SLOPE, SETTING IN ONE OR SEVERAL LEDGE ROCKS, AND BACKFILLING SO AS TO SECURE THE ROCK IN PLACE. THIS CREATES A POCKET OF SOIL FOR PLANTING A TREE OR SHRUB, AND APPEARS MORE NATURAL THAN A ROCK OR STONE WALL. IT IS RECOMMENDED TO USE ROCK THAT IS INDIGENOUS TO THE ORR (LIMESTONE), AND THAT IT BE SALVAGED FROM CONSTRUCTION/DEVELOPMENT SITES IF POSSIBLE. SLABS OF CONCRETE COULD ALSO BE BROKEN AND RECYCLED TO FORM LEDGE PLANTING POCKETS.

ORNL RIPARIAN BUFFER REQUIREMENTS

THE ENGINEERING DATABASE SHOWS RIPARIAN ZONES, APPROXIMATELY 59 FEET ON EACH SIDE OF THE STREAM AND REFERENCES ORNL NPDES WATER QUALITY PROTECTION PLAN, OCT. 2008, VOL.1 BEST MANAGEMENT PRACTICES (ENGINEERING DRAWING NUMBER C3E02003A129). THE DRAWING SHOWS BETHEL VALLEY AREA AS AN EXAMPLE, BUT APPLIES TO ORNL FACILITIES, INCLUDING MELTON VALLEY. THE PROCEDURES NOTES ON RIAPRIAN ZONES STATE:

1. LOCATIONS OF ZONES ARE APPROXIMATEDEPENDING ON ACTUAL PHYSICAL CONSTRAINTS.
2. PREVIOUSLY UNIMPACTED RIPARIAN ZONES AND INTACT PORTIONS OF IMPACTED ZONES ARE PROTECTED.
3. WHERE IMPROVEMENTS ARE REQUIRED TO FACILITIES OR INFRASTRUCTURE NOW WITHIN THE RIPARIAN ZONE, THE DESIGN SHOULD INCORPORATE RESTORATION OF THE ZONE, AND WHERE NOT FEASIBLE RECOMMEND A REPLACEMENT EXCHANGE ELSEWHERE WITHIN THE SAME RIPARIAN ZONE. PROPOSED DESIGNS OF FACILITY OR INFRASTRUCTURE WITHIN THE RIPARIAN ZONE REQUIRE ORNL LANDSCAPING REVIEW COMMITTEE CONCURRENCE.
4. IF NEW CONTRUCTION OR INFRASTRUCTURE IMPROVEMENTS REQUIRE ENCROACHMENT INTO THE RIPARIAN ZONE, THEN IT MAY BE PERMISSIBLE PROVIDED A PROPOSAL IS MADE TO THE ORNL LANDSCAPING REVIEW COMMITTEE FOR CONCURRENCE. MITIGATIONS COULD INCLUDE IMPROVEMENTS TO THE ENCROACHED UPON ZONE OR CONTIGUOUS PORTIONS OF THE RIPARIAN ZONE, OR ENHANCEMENT OR RESTORATION OF A SIMILARLY SIZED RIPARIAN AREA AT A DIFFERENT LOCATION (PREFERABLY ON THE SAME STREAM).

Environmental Landscape Design - ORR

Generic Plan - Riparian Buffer

Design Guidelines

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