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EXTERIOR IMPROVEMENTS

*****EXTERIOR IMPROVEMENTS MUST ADHERE TO THE 2015 LANDSCAPE MASTER PLAN AS WELL AS THE DIVISION 32 TECHNICAL STANDARDS. THE LANDSCAPE MASTER PLAN CAN BE FOUND BY CLICKING ON THE LINK PROVIDED BELOW. NOTE THAT THE EXISTING DIVISION 32 TECHNICAL STANDARDS INCLUDED IN THIS DOCUMENT ARE STILL APPLICABLE DURING THE ROLL-OUT OF THE NEW MASTER PLAN. SOME OVERLAP & DISCREPANCIES MAY OCCUR BETWEEN THE TWO DOCUMENTS AND NOT ALL EXISTING STANDARDS ARE INCLUDED IN THE MASTER PLAN. AS A RESULT, BOTH DOCUMENTS ARE TO BE UTILIZED HOWEVER WORK MUST CONFORM TO THE LANDSCAPE MASTER PLAN UNLESS WRITTEN EXCEPTION IS MADE BY OWNER. IT IS THE CONTRACTOR'S AND DESIGN PROFESSIONAL'S RESPONSIBILITY TO IDENTIFY IN WRITING TO OWNER ANY DISCREPANCIES IDENTIFIED BETWEEN THESE TWO DOCUMENTS THAT MAY ALTER A PROPOSAL OR BID.**

2015 LANDSCAPE MASTER PLAN LINK:

<https://in.nau.edu/wp-content/uploads/sites/139/2018/07/2015-Landscape-Masterplan-Final-ek.pdf>

Part 1 – General

This section covers paving, site improvements and landscaping requirements for Owner.

Testing of materials will be by qualified materials testing laboratory hired by either the Contractor or the Owner.

Repaving and striping is required if staging or yard areas for construction are in an existing parking lot or an adjacent street. Any pavement damage or significant increased wear as a result of a construction project's laydown area(s) and/or site operations are the responsibility of the Contractor, and the Contractor shall restore the site back to its original condition. The Contractor may be required to repave the entire parking lot or roadway section. The Contractor may provide an alternate asphalt/concrete treatment to remediate the damaged condition back to a like new condition for review and approval. An alternate treatment would only be considered when recommended, designed, & stamped by a civil engineer registered in the state of Arizona. Any additional assessment, engineering, or other design and construction costs associated with these types of repairs are the responsibility of the Contractor and cannot be charged back to the project budget.

The most current version of the Flagstaff/Coconino County Pedestrian and Bicycle Design Guide (<http://www.flagstaff.az.gov/index.aspx?NID=3181>) shall be used

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for design and specification of paving and signage for bicycle routes and facilities.

Concrete surfaces shall be provided at motorcycle parking, ADA stalls, and in maintenance areas where oil or gas spillage could occur.

Access ramps shall be provided when the project is located at an intersection and at other intervals along a street if crosswalks are provided. Inclusion of these ramps must be evaluated by the DP with Owner’s involvement for ADA Compliance.

Part 2 – Products

In addition to testing required by the latest revisions of Maricopa Association of Governments for Public Works Construction (MAG), aggregates must be subjected to five cycles of the sodium sulfate soundness test in accordance with the requirements of AASHTO T-104. The total loss shall not exceed ten percent by weight of the aggregate as a result of the test.

Paint for exterior items, such as handrails, bike racks, etc., shall be Modern Masters ME209 Pewter.

Part 3 – Execution

During construction projects that affect the parking areas on campus, the Contractor shall be responsible for providing barricades and appropriate signage for all parking lot entrances.

Signs shall read:

"Parking Lot Closed From _____ to _____ Use Lot # _____"

32 10 00 BASES, BALLASTS, AND PAVING

32 11 00 Base Courses

Part 1 – General

Base course materials and preparation shall be determined by a geotechnical engineer after an investigation of the proposed project area and the existing surface (may be pavement) and subgrade conditions present.

Complete base course design includes subgrade soil preparation information and compaction standards, base course composition, depth and compaction standards. Base course placement will comply with MAG Section 310.

Part 2 – Products

Base course materials shall be tested in accordance with MAG Section 701 and shall be consistent with Section 702.

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Part 3 – Execution

The aggregate base course to be 6" minimum in depth, (more as defined on a project specific basis) 100% crushed rock conforming to MAG Specification 702, Type B, compacted per ASTM D1557-78;

32 12 00 Flexible Paving

Part 1 – General

Pavements are part of the site grading and storm drainage and will be designed in conformance with the storm water design guidelines. Use of permeable (also called porous or pervious) asphalt requires special permission by the Owner.

Asphalt and pervious or permeable pavements shall be designed by a geotechnical or civil engineer registered in the state of Arizona. A life cycle cost analysis (including proper maintenance procedures) shall be provided for the different types of proposed payment by the DP.

The Contractor shall furnish the Design Professional with a job-mix formula for the asphalt concrete not less than ten (10) days in advance of actual placement of the material. The job mix formula, upon approval of the DP, shall be used to establish the standards to which field test results will be compared, and to determine compliance of the materials furnished with all physical properties of the composite mix and its individual components as shown on the approved job-mix formula. The job-mix formula, with the allowable tolerances for a single test, shall be used for monitoring compliance with the specifications.

Part 2 – Products

Products will be consistent with Section 32 12 16 Asphalt Paving.

Part 3 – Execution

Execution of flexible pavements will be consistent with Section 32 12 16 Asphalt Paving or as specified in the plans and specifications by the DP.

32 12 16 Asphalt Paving

Part 1 - General

This section is written as design guidance for any paving project and is intended to give sufficient detail to provide Design Professional the information required to prepare design development documents (60 %) for asphalt and Modified Asphaltic Concrete (MAC) paving projects throughout campus including roadways, parking lots, driveways, bike paths, pedestrian ways and sidewalks. This section also

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applies to patching and repairing of the above listed pavements. Further refinement should not be made without specific input from the Owner.

All new and replacement full pavement sections shall include subgrade, base course, asphalt, and chip seal. Patches shall match existing pavement sections.

Throughout the design process (CD 30%, 60%, 90%) formal written approvals are required.

The DP shall follow the recommendations of the geotechnical engineer with regard to pavement design, including but not limited to asphalt cement type, subgrade thickness, and pavement thickness. If a geotechnical engineer has not been retained for the work, then the minimum standards contained in this section shall be used.

Damage to existing utilities shall be repaired and returned to original or better condition by the Contractor.

Cold patching may be used only as a temporary measure. Permanent patches must be hot mix.

If asphalt patch is less than 25 sq. ft., hand method of placement and screening can be used. Materials must be hot mix.

If asphalt patch is greater than 25 sq. ft. or a critical area, use lay down machine.

When working at curbs, widen excavation, form and pour curb, cut straight asphalt edge, and patch.

All asphalt cuts shall be saw cut.

Manholes and valves shall be adjusted to grade after paving. Final adjustment shall be provided with concrete paving patch to roadway grade.

No asphaltic concrete curbing or driveway aprons are allowable.

All utility trench patching shall follow the same requirements as street and parking lot asphalt design, installation, and testing. Utilize "T-Top" trench repair from MAG 200-1.

Testing Requirements:

Contractor will secure an independent testing lab for quality control purposes. The Owner shall employ an independent testing lab for quality assurance. All

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testing shall be documented and reports shall be provided to the Owner on an ongoing basis as soon as the results are obtained. The schedule for testing and results will be developed between the Owner and the lab but shall not be longer than 2 days from when the tests results are obtained. Failing tests are to be reported immediately to the Contractor and the Owner. Retesting required due to test failures are to be paid for by the Contractor. Testing is to be scheduled along with the work, and delays caused by testing will not be subject to change orders for more time.

Asphalt paving shall be tested according to the MAG criteria for asphalt and any additional testing required to confirm consistency to the mix design.

Geotechnical testing shall be provided during paving operations.

In general, paving shall conform to MAG Sections 321- 336 and materials Sections 709 - 717.

Due to the variation in costs between conventional asphalts and polymer modified mixes, Owner may require that alternative mix designs be developed for paving including a low initial cost material and a higher initial cost/longer life material. Designers may use the FHWA spreadsheet RealCost Life Cycle Cost Analysis for evaluating mix designs for life cycle cost. A link to this free software is: <http://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm>

Part 2 - Products

At a minimum asphalt shall be in conformance with AASHTO Designation MP-1, Table I and shall be PG 58-26 for 19 mm asphaltic concrete and PG 58-22 for modified asphaltic concrete (MAG).

MAG Table 710-3 Marshall Mix Design Criteria will be used for both 19 mm (3/4 in) and MAC. The aggregates and mix to be incorporated into the work shall also meet the following additional requirements.

Test	Acceptable	Test Results
AC TYPE Test	19 mm	MAC
Absorbed Asphalt Range (ASTM 1559)	0 - 1%	0 - 1%
Combined Water Absorption (AASHTO T-84)	0 - 2.25%	0 - 2.25%
Marshall Stability (ASTM D1559)	1800 min	1,000 min
Flow (ASTM D1559) Units of .01 inches	8 to 18	15 min
Air Voids Content (mix)	3% to 5%	3% to 5%

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Tensile Strength Ratio (TSR) (AASHTO T 283, with optional freeze cycle)	0.75 min	0.75 min
Sodium Sulfate Soundness (AASHTO T-104)	12 % max	12 % max
Percent Carbonates (Arizona test Method 238)	30 % max	30 % max
Binder Content	5.3% to 6.0%	8.0%to 9.0%

All asphaltic concrete and modified asphaltic concrete shall contain a minimum of 1% Portland cement or dry hydrated lime by weight of total aggregate added to the aggregate in a pug mill prior to addition of the binder. The moisture content of the aggregate immediately prior to the addition of the admixture shall be a minimum of 3.0 %.

See MAG for modified asphaltic concrete specifications.

REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT

(revise to include the following for CRS-2P)

CATIONIC RAPID-SETTING POLYMER-MODIFIED ASPHALTIC EMULSION, CRS-2P
MATERIAL SPECIFICATIONS FOR CHIP SEAL COATING

Test Description	Test Method	Min	Max
TEST OF EMULSION			
Viscosity, SFS @ 122 F	D244	125	400
Settlement, 5 days, %	D244		5
Storage Stability 1 Day, %	A244		1
Class, Un-coated Par	A502	60	
Particle Charge Test	D244		+
Sieve Test, %	D244		0.30
Oil Distillate, % V of Emulsion	D244		3
Residue by Distillation, %	D244	66	
Tests on Residue by VACUUM RECOVERY A512			
Viscosity, ABS, Poise @ 140 F	D2171	1800	2800
Pen @ 77F, 100g/5 sec, Dmm	D5	40	90
Ductility, 77F, 5 cm/min, Cm	D113	40	
Solubility in TCE, %	D2042	97.5	
Toughness, inch-pounds	(1)	150	

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Elastic Recovery by means of Ductilometer, %	T301	58	
Tenacity, inch-pounds	(1)	110	
Polymer Content (by wt. Of solids) %	CAL-401	2.5	
TEST ON RTFO RESIDUE			
Aging Ratio, ABS viscosities	D2171		2.5
POLYMER REQUIREMENTS			
Melt flow rate, dg/min 190 C	D1238		45

- 1) Benson method of toughness and tenacity: Scott tester, inch-pounds @ 77°F, 20 inches per minute pull. Tension head 7/8" diameter.
- 2) Upon standing undisturbed for a period of 24 hours, the emulsion shall show no white milky film upon the surface.
- 3) The base asphalt shall be modified prior to emulsification.
- 4) The emulsion shall be pre-certified prior to use. A one-quart sample each of the base asphalt and polymer shall be supplied to the agency 10 days in advance to the project start.

MODIFIED ASPHALTIC CONCRETE

Modified Asphalt Concrete (MAC) shall consist of a mixture of paving asphalt, modifiers and mineral aggregate which, with the addition of mineral filler and blending sand as may be required, shall be mixed at a central mixing plant in the proportions hereinafter specified to provide a homogeneous and workable mixture.

Modified Asphaltic Concrete (MAC) shall consist of furnishing asphaltic concrete with binder meeting the requirements of either:

- Rubberized Asphaltic Concrete (RAC)
- Polymer Modified Asphalt Concrete (PMA)
- Polymer Modified Rubberized Asphalt Concrete – Dry Process (PMRAC)
- SHRP graded PG64-28TR=(TR+)

At the locations shown on the plans in accordance with the following specifications. Within 10 calendar days of notice of award, the Contractor shall submit in letterform, the name of the supplier and a type of MAC to be supplied.

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Contractor shall submit test results from an independent testing company 1 week prior to construction. Application and testing will be in accordance with MAG 321.

MATERIAL

BINDER

The asphalt rubber binder in the mix shall comply with MAG 717 and 335 except the rubber shall be type II and the minimum rubber content for Rubberized Asphaltic Concrete (RAC) shall be 17% as a percentage of total binder. Asphalt cement for all MAC shall meet the requirements of PG 58-22 as per AASHTO MP-1 Table I. Polymer shall be Type SBS and shall be 5.5% to 7% of the total binder for PMA. Twenty percent of the modifier for PMA shall be ground tire rubber. The PMA shall be such that the materials conform to the specification requirements. Ground rubber shall be Type II with the following gradation:

Gradation - Ground Rubber (Type II)

Sieve No.	% Passing
#10	100
#16	70-100
#30	25-60
#50	0-20
#200	0-5

Binder for Rubberized Asphaltic Concrete (RAC) shall conform to the following specifications:

<u>Parameter</u>	<u>Requirement</u>
Apparent viscosity, centipoise, 350°F, Spindle 3, 20 RPM (ASTM D2196)	1500-6000 Centipoise
Penetration, 77°F, dmm, 100g, 5 sec (ASTM D-5)	25 minimum 90 maximum
Penetration, 39.2°F, dmm, 200 g, 60 sec (ASTM D-5)	15 minimum
Cone Penetration, 77°F, dmm,150g, 5 sec (ASTM D-5)	25 minimum
Resilience, 77°F, % (ASTM D-3407)	20 minimum
Softening Point, °F (ASTM D-36)	135 minimum
TFOT Residue (ASTM D1754)	75 minimum
Penetration Retention, 39.2°F, %" "	

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Haake type viscosity may be substituted for field control.

Binder for Polymer Modified Asphaltic Concrete shall conform to the following specifications:

<u>Specification:</u>	<u>ASTM</u>	<u>SPEC. LIMITS</u>	
ORIGINAL ASPHALT	METHOD	MIN.	MAX.
Penetration, 39.2 F (200g/60 sec), dmm	D5	25	
Penetration, 77 F (100g/5 sec), dmm	D5	40	90
Softening point, F	D36	180	
Flash point, F	D92	450	
Ductility, 39.2, F (5 cm/min), cm	D113	30	
Ductility, 77 F (5 cm/min), cm	D113	100	
Viscosity, 275 F, cst	D2170	1000	
Recovery, 39.2 F, %	D113 MOD	60	
Solubility in Trichloroethylene %	D2042	99	
AGED ASPHALT (RTFO)	METHOD	MIN.	MAX.
Retained Penetration, 77 F, %	D5	60	
Viscosity Ratio, 275 F, %	D2170		15
Softening Point, F	D36	175	
Ductility, 39.2 F (5 cm/min), cm	D113	20	

The asphalt binder modifier for the PMA shall contain a minimum of 20% recycled material.

The Polymer Modified Rubberized Asphalt Concrete – Dry Process (PMRAC-DP) and SHRP graded PG64-28TR+ shall conform to requirements of Superpave Grade PG64-28 (AASHTO MP-1 and MAG Section 335) except as follows:

<u>Test Properties</u>	<u>Test Method</u>	<u>PMRAC-DP</u>	
		<u>Specification</u>	<u>Specification</u>
Scrap whole tire rubber (Type II) content, %, Minimum		17.0	8.0
Trans-polyoctenamer rubber polymer (TOR), %, Based on the weight of the tire rubber		4.5	

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	SBS Polymer content %, Minimum			2.0
	Original Testing			
	COC Flash Point, °C, Minimum	ASTM D92	232	232
	Softening Point, °C, Minimum	ASTM D36	50	50
	Elastic Recovery, 10°C, 10cm, % recovery/1hr, Minimum	ASTM D6084	55	55
	Solubility in Trichloroethylene, Minimum, %	ASTM D2042	97.5	97.5
	Dynamic Shear, 64°C, 10 rad/sec, G*/sin delta, kPa, Minimum	AASHTO TP5	1.00	1.00
	G*/sin delta, phase angle, degrees, Maximum		75	75
	RTFO Residue Testing	AASHTO TP5		
	Dynamic Shear, 64°C, 10 rad/sec, G*/sin delta, kPa, Minimum		2.20	2.20
	PAV Aging Residue Testing	AASHTO TP5		
	Dynamic Shear, 25°C, 10 rad/sec, G*/sin delta, kPa, Maximum		5000	5000
	Bending Beam Rheometer	AASHTO TP5		
	Creep stiffness, -18°C, MPa/60 sec, Maximum		300	300
	M-Value, -18°C, 60 sec, Minimum		0.300	

Aggregate shall conform to Section 710.2.2.

The aggregate gradation will be as follows:

Sieve No.	Percent Passing
5/8	100
1/2	98 +/- 2
3/8	85 +/- 7
4	35 +/- 7
8	20 +/- 5
30	10 +/- 5
200	5 +/- 2

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AGGREGATES CHARACTERISTICS

Combined aggregates shall conform to 710.2.2 except the minimum sand equivalent shall be 65 and at least 85% by weight of the aggregate retained on the #8 sieve shall consist of particles with at least one rough, angular surface produced by crushing.

MINERAL FILLER AND ANTI-STRIPPING AGENT

Mineral filler and anti-stripping agent shall be as per MAG Section 710.2.3.

MIX DESIGN REQUIREMENTS

The provisions of MAG Section 710.3 MIX DESIGN REQUIREMENTS shall apply to MAC except that:

References to asphalt, liquid asphalt, bituminous cement shall be changed to "binder conforming to 714.2.1."

For estimating purposes, the percentage of binder in the MAC shall be 8% for PMA and RAC. For estimating purposes, the percentage of binder in the MAC shall be 7% for TR+ and for PMRAC-DP. The exact amount of binder in the MAC shall be subject to the Design Professional's approval after review of the Contractor's job mix formula and materials submittals. Marshal mix design criteria will be used for MAC.

PRODUCTION TOLERANCES

The provisions of MAG Section 710.4 PRODUCTION TOLERANCES shall apply to MAC except that:

References to asphalt, liquid asphalt, bituminous cement shall be changed to "binder conforming to 714.2.1."

PRODUCTION REQUIREMENTS

The provisions of MAG Section 710.5 shall apply for MAC except that:

References to asphalt, liquid asphalt, bituminous cement shall be changed to "binder conforming to 714.2.1."

Bituminous binder course shall 2" thick, conforming to MAG Specifications Section 710;

Bituminous surface course shall be 2" thick, conforming to MAG Specifications Section 710.

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	<p>Sealer coat shall be applied after completion of laying of asphalt. DP to specify time frame and procedures. DP to include in asphalt section design.</p>
32 12 19	<p>Asphalt Paving Wearing Courses</p> <p><u>Part 1 – General</u> All new asphaltic pavements shall include a wearing course.</p> <p><u>Part 2 – Products</u> Quick setting and emulsified asphalt per MAG spec type CRS-2. Aggregate gradation shall conform to MAG spec table 716-1 for moderate traffic areas and MAG spec Table 716-2 for high traffic areas. ADOT specification CM 11 will be considered as an alternate subject to availability of MAG specification material and credit price.</p> <p>Submit chip sample for testing prior to application.</p> <p><u>Part 3 – Execution</u> Loose chips shall be swept and removed within a 24-hour period and again at a later date if chips still remain.</p> <p>Contractor is responsible for protection of all manholes and valve covers. All manholes and valve covers shall be marked with non-permanent orange paint and protected with cardboard (or equally effective material) prior to chip sealing.</p>
32 12 36	<p>Seal Coats</p> <p><u>Part 1 – General</u> Bituminous surfacing shall be used only in exceptional cases. Chipseal is the preferred preservation method.</p> <p><u>Part 2 – Products</u> <u>N/A</u></p> <p><u>Part 3 – Execution</u> <u>N/A</u></p>
32 12 73	<p>Asphalt Paving Joint Sealants</p> <p><u>Part 1 – General</u> Expansion joint filler material is used with asphalt pavements per MAG Sections 321-336.</p>

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Part 2 – Products

Joint materials shall be in conformance with MAG Section 729

Part 3 – Execution

N/A

32 13 00 Rigid Paving

This section includes concrete and pervious Portland cement based concrete pavements.

32 13 13 Concrete Paving
32 13 13.01 Concrete Paving –Vehicular Applications

Part 1 – General

Concrete ramps must meet the requirements outlined in the Design Guidelines.

Submittals

Shop Drawings: Submit sections and details where not fully dimensioned on the drawings.

Manufacturer's Data: Submit for all products.

Mix Design: Prior to pouring any concrete, submit concrete mixes for approval in accordance with Division 03. Separate mix designs shall be submitted for each type of concrete to be used in the project.

Record of Work: Provide record of time and date of placement, temperature, water additions to the mix, and weather conditions.

Quality Assurance

For placement restrictions see Division 03 Concrete.

All materials to conform to Division 03 Concrete

Prior to placement of concrete, independent testing lab must confirm subgrade compaction, Owner will confirm that the form placement conforms to the survey and is within the tolerances. Reinforcement shall be tied and supported in rebar chairs as approved by the DP. If welded wire mesh is used, support shall conform

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with plans and specs. Owner will confirm proper placement and spacing between the rebar or weld wire mesh and the forms.

Minimum Thicknesses:

1. Sidewalks not subject to Vehicle Traffic: 4".
2. Sidewalks and Drives subject to Vehicle Traffic: 6".
3. Structurally Supported Slabs (Such as Over Tunnels): As required to meet potential loading conditions.
4. Loading docks: 8"

Part 2 – Products

Reinforcement shall conformance with 03 21 00 Reinforcing Steel.

All loading docks shall be paved in concrete and reinforced per DP specifications.

Provide either welded wire fabric or fibrous reinforcement in concrete. One type is required for all on-grade slabs.

Curbs, gutter and cross pans finished with burlap drag or wood float. Do not plaster surfaces.

Immediately after float finishing sidewalks and ramps, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom except on inclined slab surfaces provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to the line of traffic.

Special Finishes: Do not use special finishes such as colored concrete, exposed aggregate, etc. unless specific approval from Owner is obtained. Evaluation will be made on a job-by-job basis. Do not use metal nosings on exterior concrete stairs.

Part 3 – Execution

Deposit concrete near final position on grade with minimum segregation and without damage of subgrade. Consolidate concrete so that concrete shall fill the forms and be free from rock pockets, bee holes, and honeycombing.

Finishing

Use equipment designed to spread, consolidate, screed and float freshly placed concrete in one pass, providing well consolidated, homogeneous mixture, requiring minimum of hand finishing to meet surface tolerances.

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Finished surface tolerances:

Tested with 10' straight edge parallel to center line immediately following first floating of surface.

Advance straight edge 5'; space under straight edge shall not exceed 3/16".

Joints

Control joints shall have a minimum depth of 1/4 of the thickness of the slab in the concrete or a minimum of 3/4 inch.

Space at even intervals perpendicular to the path of travel.

The jointing pattern shall be equal to the width of the walk or drive to a maximum of 6 feet o.c. on any side or 10 feet for curb and gutter.

For small concrete replacements, the jointing pattern shall match existing adjacent work.

Expansion joints with preformed joint filler in a vertical position, deviating not more than 1/4" from a straight line. Expansion joints shall be installed when abutting existing concrete or fixed structure. Expansion joint material shall be 1/2" thick and shall extend the full depth of contact surface and shall be at a maximum spacing of 60 foot o.c.

Saw Cutting and Patching

Joints shall be sawcut or added during placement with a jointing tool to eliminate random expansive cracking of slab surfaces. Sawcutting shall be performed within 24 hours of the slab

Curing

Required curing practices shall be specified by the Design Professional in the design documents. Contractor shall have curing equipment and accessories ready for use prior to placement of the concrete to ensure prompt curing once the exposed surfaces are finished.

Designers will provide for curing options for warm, dry and cold weather.

Concrete operations: Curing of the concrete should begin immediately upon finishing the surface. Finishing should not be completed until surface bleeding has stopped and the bleed water has dried immediately after finishing and water film has evaporated from surface. Do not use liquid membrane type on surfaces to receive mortar bed finishes.

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Field Quality Control / Testing

General: All testing, shall be performed by an approved testing laboratory. The following tests and procedures are subject to change during construction at the discretion of the Design Professional.

Control Tests: Control test of concrete work shall be made at such times and in such manner as recommended by the Design Professional, with Owner’s approval, at the expense of the Owner. Each test shall consist of 3 standard 6” test cylinders cast and cured in accordance with ASTM C31 and C172. One cylinder shall be broken at the end of 7 days after placing, one cylinder shall be broken at the end of 28 days after placing. The remaining cylinder will be broken only when the previous test reports indicate unsatisfactory results. Tests shall be made at the time test cylinders are taken, and recorded on the reports to determine the slump, air content, unit weights, and temperature of the concrete. All tests shall be made in accordance with ASTM C39, C138, or C231.

Protection

Protect fresh uncured surfaces from rain.

Cold Weather: Maintain temperature of concrete above 50 degrees F. for minimum five days from placement.

No vehicle loads exceeding design loading. No equipment permitted on new pavement until design strength is attained.

Design Professional to specify cure of 3 to 7 days minimum unless special use / mix.

32 13 13.02 Concrete Paving – Pedestrian Applications

Part 1 – General

This section includes all general concrete paving for pedestrian travel ways or entry features, that do not have special prominence dictating special design finishes.

Part 2 – Products

N/A

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Part 3 – Execution

Design Standard

- A. 8' minimum design width at all sidewalks, including collector walks at residence hall buildings. Major pedestrian paths of travel ,or major/significant building entries shall be of a width justified by traffic volume and aesthetic precedent. Standard gray, no color or pigment.
- C. Sidewalks should have 6 inches of concrete over 4 inches of base course.
- D. Magnesium floated, with a medium broom finish, perpendicular to the path of travel.
- E. Expansion joints 20' maximum in a single run of paving.
- F. Architectural scoring or joints to be at the same interval as the design width of the subject travel way. Designers option for widths greater than 8', or areas requiring special design consideration, maintaining patterns that are 3'x3' minimum and 12'x12' maximim, square or rectangular.
- G. An additional 3' of width is required for walks that are adjacent to surface parking lots, where the edge facing parking is used as a wheel stop or overhang area.
- H. Walk intersection corners shall be rounded and at all grade changes shall have appropriate curb cuts and transitions that allow full accessibility and safety.
- I. A minimum 12' radius turn-around area is required for any dead-end walk.

32 13 16 Decorative Concrete Paving

Part 1 – General

Special paving methods outlined in this section to be used as an accent in special areas, such as building entries or the Pedway, or areas of significance on campus, such as plazas and gathering spaces. Decorative pavement shall be a simple, unifying element that creates pedestrian scale, and provides ease of maintenance and repair. Colored or stamped concrete is not permitted unless approved by Owner, in instances where flexibility in design elements may be appropriate when the landscape is to be reflective of the architectural design. Generally, the landscape, including pavement, is intended to knit buildings and character zones together.

Submittals and Mock-ups

Prior to installation of decorative pavement, Contractor to provide an 8'x8' mock-up to ensure desired look is achieved and is in conformance with established campus standards. Approval by Owner (project manager and campus landscape architect) is required. Mock-up shall stay in place throughout project duration as a standard for judging completed work. Do not move or destroy mock-up.

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Part 2 – Products

Allowable Decorative Paving

Sand Finish Concrete Paving: to be used for the Pedway and special gathering areas such as plazas, courtyards, and building entries. Owner to provide Design Professional with standard design for Pedway at applicable projects. Concrete shall meet Owner standards and be 6" thick, fibermesh reinforced overlaying 4" of compacted aggregate base course. Concrete mix design must contain 60% fine aggregate and 40% large aggregate to achieve sand finish. Standard gray to be used, no color or pigment. Sand finish to be achieved using surface retarder as follows:

- A. 'Top Cast' by Grace Construction Products or approved equal
- B. Number code: grade 05
- C. Etch/aggregate size to expose: light sandblast finish
- D. Coverage: 250-350 square feet per gallon
- E. Retardant removal per manufacturer's standards, typically within 6-24 hours after application. Timing of removal dependent upon temperature to create desired finish.

Integral Color Concrete Paving: for use at Pedway only, at bike lane. Specify 'graphite' pigment, Davis Colors (mix 2 lbs of 8084 per 1 cu. ft. of cement). Owner to provide Pedway design at applicable projects.

Sealer to be applied to decorative concrete paving after 14 day curing period unless otherwise directed by Owner. Owner has pre-approved the following product to be in compliance with these standards: MasterProtect H 400 Sealer (water-based 40% silane penetrating sealer).

Part 3 – Execution

Medium broom finish, perpendicular to path of travel.

Expansion joints 20' maximum in a single run of paving, except to be 37.5' at Pedway.

Architectural scoring or joints to be at the same interval as the design width of sidewalks. Design Professional's option for widths greater than 8', or areas requiring special design consideration, utilizing patterns that are 3'x3' minimum and 12'x12' maximum, square or rectangular.

At Pedway, use 2' long, ½" diameter rebar dowels at 2'-6" o.c. to tie pedestrian and bicycle lane sections together.

Section Number	Title
32 14 00	Unit Paving
32 14 13	Precast Concrete Unit Paving

Part 1 - General

Pavers should be a simple, unifying element to create a pedestrian scale and provide ease of maintenance and repair. Pavers can be used as an accent material in outdoor gathering spaces with no vehicular traffic. Use in vehicular areas shall be limited and as approved by Owner.

Submittals and Mock-ups

Prior to construction of the sample pavement, Contractor to submit one set of six units each for each type and color of paver required, showing full range of colors and textures. Pavers shall be consistent with the materials palette in the Landscape Master Plan and per Part 2 - Products, below.

Materials included in the palette are the only materials allowed for use at the exterior of all new buildings and renovations.

For all new and infill concrete unit pavers adjacent to existing pavement, a 36 square foot sample pavement (mock-up) shall be constructed on site near the proposed work area to evaluate the selected paver for matching. Contractor shall allow for sufficient time for the Owner and the DP to evaluate and approve the proposed pavement.

On new construction, a minimum 36 square foot sample pavement (mock up) shall be constructed to establish the standard of acceptance for all elements of the work, including but not limited to: curbing and expansion, bond pattern, tie-in with other materials and finishes, accessories, etc. The sample panel shall be approved by the Owner and the Design Professional prior to ordering materials and commencement of paver work.

Retain sample pavement (mock-up) during construction as a standard for judging completed unit paver work. Do not move or destroy mock-up until work is completed.

For roadway applications, pavement section should include a concrete subbase for pavers. Consult with geotechnical engineer if the area will have vehicular traffic.

Section
Number

Title

Part 2 – Products

Paver units shall be whole and undamaged prior to installation. Units that are chipped, cracked, broken or stained are not allowed

Provide materials obtained from only one source for each type and color of pavers.

Bedding and joint sand shall be clean, non-plastic, and free from deleterious or foreign matter. The sand shall be natural or manufactured from crushed rock. The sands shall be as hard as practically available.

Sound durable particles free from organics, clays, deleterious and foreign matter. Use an aggregate base course material per MAG Section 702.

Bed Sand shall conform to ASTM C33 and joint sand shall conform to ASTM C144 not more than 1% passing No. 200 sieve.

Pavers must be 4" x 8" x 3 1/8" (80 mm) or 4" x 18" x 3 1/8" (80 mm).

Paver Materials

Owner has pre-approved the following manufacturers to be in compliance with these standards:

- Belgard Holland Pavers, 4" x 8" x 3 1/8" (80 mm), 'Sedona Blend,' or approved equal. Sand-set, concrete subbase required.
- Belgard Plankstone, 4" x 18" x 3 1/8" (80 mm), 'Rio' (blend of charcoal and gray), or approved equal. Sand-set, concrete sub-base required.

ACCESSORIES

Upon recommendation by the geotechnical engineer, a geotextile fabric may be specified for paver installation. Use of fabric is reserved for areas with clay soil or damp conditions.

Part 3 – Execution

Contact Bluestake before conducting any excavations. See procedures in Division 1.

Excavate the pavement area to allow for the pavers and the bedding sand layer.

Prepare subgrade soil per the recommendations of the soils report. In all cases, this will include even grading of the area and compaction. The subgrade shall be free from water, clay and rocks. If recommended, provide a geotextile fabric.

Section Number	Title
	<p>Verify location, type, installation and elevations of edge restraints around the perimeter area to be paved.</p> <p>Place an approximately 1-1 ¼ inch deep sand bed. Use polymeric sand in joints where sand washing out of joints will be an issue.</p> <p>Lay out work in pattern provided in the plans and specs to minimize cutting. Cut pavers as necessary to fit within the edge restraints.</p> <p>Lay the pavers with consistent spacing for joints and provide an even flat surface with no elevation deviation between pavers of greater than 1/16" will be unacceptable. Pavement tolerance of 3/16" is allowed over a distance of ten feet.</p> <p>Install per MAG detail 225 with modifications per manufacturer's recommendation.</p>
32 14 30	<p>Concrete Stepping-stone Pavers</p> <p>Generally, for limited use along seat walls as a skateboard deterrent. This design requires high level of maintenance and should be limited to special design areas.</p> <p>Preferred size: 2' square. Standard gray concrete (no color or imprint). Must be surrounded by bluegrass turf or low ground cover. Surrounding with unplanted mulch or gravel is not acceptable.</p>
32 14 45	<p>Grass Pavers</p> <p>To be used where contiguous lawn areas are desired to provide subgrade support for pedestrian or vehicular fire truck traffic. Install per manufacturer's specifications. Owner has pre-approved the following manufacturers to be in compliance with these standards: Grasspave.</p>
32 15 00	Aggregate Surfacing
32 15 13	Cinder Surfacing
32 15 40	Crushed Stone Surfacing

Section Number Title

Part 1 – General

Gravel roads shall be constructed with the proper cross section to allow for drainage and maintenance. Use the Coconino county lot split standard for sloping of roadway bed and shoulders for emergency and maintenance access driveways.

Part 2 – Products

If no geotechnical recommendations are available surfacing and subgrade for gravel roadways, use the recommended gradation from the EPA gravel roadway guidelines: <http://www.epa.gov/nps/gravelroads/>.

Requirement	Aggregate Base Course	Gravel Surfacing
Sieve	Percent Passing	Percent Passing
1"	100	
3/4"	80-100	100
1/2"	68-91	
No. 4	46-70	50-78
No. 8	34-54	37-67
No. 40	13-35	13-35
No. 200	3-12	4-15
Plasticity Index	0-6	4-12

Part 3 – Execution

Contractor to call Bluestake before grading the roadway area.

Excavate within the area to allow for driveway material, shoulders, and drainage areas.

Scarify and compact the subgrade per MAG Section 301

Install the subgrade ABC per MAG Section 310.

Install the crushed stone (gravel surfacing) wearing course per MAG Section 310.

32 15 40.01 Crusher Fines Surfacing

Part 1 – General

May be used at seating areas or as secondary, informal path in forested area or through lawn or native grass areas. Use concrete border at paths. Not to be used at building entries, areas with high velocity stormwater runoff, areas that require snow plowing, or primary circulation routes.

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Part 2 – Products

¼” minus ‘Madison Gold’ decomposed granite with fines.

Use CE-Structural Soil or approved equal as subbase material where new trees are planted in crusher fines. Planting pit to be 10’ diameter minimum.

Tackifier may be used when trees (new and existing) are not planted in crusher fines area.

Part 3 – Execution

Install 4” thick without weed fabric. Proper subgrade preparation, an underdrain system, or a minimum slope should be utilized to assist drainage.

32 16 00 Curbs and Gutters

Curbs are used to define the roadway areas and for drainage control.

Part 1 – General

For concrete curbs see Division 03 Concrete.

Part 2 – Products

N/A

Part 3 – Execution

Refer to division 33 for utility marker requirements in curblines .

32 17 00 Paving Specialties

32 17 13 Parking Bumpers

Parking bumpers shall only be specified for pavement installations within 2’ of existing structures or fences.

32 17 23 Pavement Markings

All roadway pavement markings other than lane striping are to be thermoplastic . They may not be painted.

Painted traffic markings to be 4" wide and contain glass beads.

All bike lane assemblies, turn arrows, stop bars, crosswalks, or similar roadway pavement markings are to be thermoplastic.

Section Number Title

Typical right angle parking stalls are to be installed at a minimum stall size of 9’x18’ and are to be striped on-center of these dimensions. Refer to the Design Guidelines for additional detail on ADA parking stalls.

Parking lot striping color schemes:

White – Used for vehicle stall lines & motorcycle parking hatched areas

Yellow – Hatches used for no parking of any type. Stenciled inside “no parking”.

Blue – Hatched Accessible aisles, ADA Stall Lines & Accessible Icons. Stenciled “no parking” inside of hatched areas.

Red – Curbs, Fire Lanes, & Hatched Areas anywhere we do not want there to be parking. Typically associated with fire truck access areas. Stenciled “no parking” inside of hatched areas.

32 17 23.33 Plastic Pavement Markings

Preformed Thermoplastic Pavement Markings

1. **USE:** A durable, high skid resistant, retroreflective pavement marking material suitable for use as interstate shields, route shields, bike path, roadway, intersection, airport, commercial or private pavement delineation and markings.
 - 1.1. The markings must be a resilient white, yellow or other color thermoplastic product, the surface of which must contain glass beads and abrasives in an alternating pattern. The markings must be resistant to the detrimental effects of motor fuels, lubricants, hydraulic fluids etc. Lines, legends and symbols are capable of being affixed to bituminous and/or Portland cement concrete pavements by the use of the normal heat of a propane torch.
 - 1.2. The markings must be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic when heated with the torch.
 - 1.3. The markings shall not have minimum ambient and road temperature requirements for application, storage, or handling.
2. **MANUFACTURING CONTROL AND ISO CERTIFICATION:** The manufacturer must be ISO 9001:2008 certified and provide proof of current certification. The scope of the certification shall include manufacture of reflective highway markings.
3. **MATERIAL:** Must be composed of an ester modified rosin resistant to degradation by motor fuels, lubricants etc. in conjunction with aggregates, pigments, binders, abrasives, and glass beads which have been factory produced as a finished product, and meets the requirements of the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The thermoplastic material conforms to AASHTO designation M249-79 (98), with the

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exception of the relevant differences due to the material being supplied in a preformed state.

3.1. Graded Glass Beads:

3.1.1. The material must contain a minimum of thirty percent (30%) intermixed graded glass beads by weight.

The intermixed beads shall be clear and transparent. Not more than twenty percent (20%) consists of irregular fused spheroids, or silica. The index of refraction shall not be less than 1.50.

3.1.2. The material must have factory applied coated surface beads and abrasives in addition to the intermixed beads at a rate of 1/2 lb. (± 20%) per 11 sq. ft. The surface beads and abrasives must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a “checkerboard” pattern of glass beads and abrasive materials. The abrasive material must have a minimum hardness of 8 (Mohs scale). These factory applied coated surface beads shall have the following specifications:

- 1) Minimum 80% rounds
- 2) Minimum SiO₂ Content of 70%;
- 3) Minimum refractive index of 1.5
- 4) Maximum iron content of 0.1%

Size Gradation		Retained, %	Passing, %
US Mesh	Um		
12	1700	0 - 2%	98 - 100%
14	1400	0 - 6%	94 - 100%
16	1180	1 - 21%	79 - 99%
18	1000	28 - 62%	38 - 72%
20	850	62 - 71%	29 - 38%
30	600	67 - 77%	23 - 33%
50	300	86 - 95%	5 - 14%
80	200	97-100%	0 - 3%

3.2. Pigments:

3.2.1. White: The material shall be manufactured with sufficient titanium dioxide pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected.

3.2.2. Red, Blue, and Yellow: The material shall be manufactured with sufficient pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected. The yellow pigments must be organic and must be heavy-metal free.

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- 3.2.3. Other Colors: The pigments must be heavy-metal free.
- 3.3. Heating indicators: The top surface of the material (same side as the factory applied surface beads) shall have regularly spaced indents. These indents shall act as a visual cue during application that the material has reached a molten state so satisfactory adhesion and proper bead embedment has been achieved and a post-application visual cue that the installation procedures have been followed.
- 3.4. Skid Resistance: The surface of the preformed retroreflective marking materials, wherein every other shaped portion contains glass beads, or abrasives with a minimum hardness of 8 (Mohs scale), shall upon application provide a minimum skid resistance value of 60 BPN when tested according to ASTM: E 303.
- 3.5. Thickness: The material must be supplied at a minimum thickness of 90 mils (2.29 mm) or 125 mils (3.15 mm).
- 3.6. Retroreflectivity: The preformed retroreflective marking materials upon application shall exhibit adequate and uniform nighttime retroreflectivity. The marking materials shall have the following retroreflectivity as measured using a Delta LTL 2000 or LTL-X Retroreflectometer:
- White preformed reflective marking materials—minimum of $275 \text{ mcd}\cdot\text{m}^{-2}\cdot\text{lx}^{-1}$
- Note: Initial retroreflection and skid resistance are affected by the amount of heat applied during installation. When ambient temperatures are such that greater amounts of heat are required for proper installation, initial retroreflection and skid resistance levels may be affected.
- 3.7. Environmental Resistance: The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.
- 3.8. Abrasives: The abrasives and surface beads must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a “checkerboard” pattern of glass beads and abrasive materials. The abrasive material must have a minimum hardness of 8 (Mohs scale).
4. **APPLICATION:**
- 4.1. Asphalt: The materials shall be applied using the propane torch method recommended by the manufacturer. The material must be able to be applied without minimum requirements for ambient and road temperatures and without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of

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a thermometer. The pavement shall be clean, dry and free of debris. Supplier must enclose application instructions with each box/package.

4.2. Portland Concrete: The same application procedure shall be used as described under Section 4.1. However, a compatible primer sealer may be applied before application to assure proper adhesion.

5. **PACKAGING**: The preformed thermoplastic markings shall be placed in protective plastic film with cardboard stiffeners where necessary to prevent damage in transit. Linear material must be cut to a maximum of 3' long pieces. Legends and symbols must also be supplied in flat pieces. The cartons in which packed shall be non-returnable and shall not exceed 40" in length and 25" in width, and be labeled for ease of identification. The weight of the individual carton must not exceed seventy (70) pounds. A protective film around the box must be applied in order to protect the material from rain or premature aging.

6. **TECHNICAL SERVICES**: The Contractor shall provide technical services as required.

32 17 26 Tactile Warning Surfacing

Wherever curb ramps are installed they shall comply with the Design Guidelines for universal accessibility. These ramps shall also include a tactile warning area paved using detectable warning/cast iron truncated domes in an area determined by the ADA Design guideline requirements. Use Neenah Foundry cast iron truncated dome, or approved equal.

****END OF SECTION****

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32 30 00 SITE IMPROVEMENTS

Part 1 – General

All site improvements shall be designed with sustainability in mind and shall conform to the Design Guidelines for Sustainability. Consider Low Impact Development (LID) stormwater management, snow plowing and storage, maximum accessibility, and other innovative practices for design of site improvements.

NAU’s Landscape Master Plan, Principles, Standards and Concept Designs section to be referenced for supplemental information. Site improvements shall conform to the Landscape Master Plan. Proposed design and construction drawings to be reviewed by Owner’s campus landscape architect for approval. Requirements set forth in the Technical Standards, Landscape Master Plan and Owner’s campus landscape architect’s review shall be incorporated into the construction documents prepared by the DP. Where discrepancies exist, Owner (campus landscape architect) shall be consulted and Owner shall have ultimate authority on final decisions.

Part 2 – Products

Products used for site improvements are covered in Sections 31 00 00 and 32 00 00.

Part 3 – Execution

If no direction is given in the plans and specs follow manufacturer’s recommendations or MAG applicable sections.

32 31 00 Fences and Gates

Part 1 – General

Refer to NAU Landscape Master Plan, Principles and Design Standards, Railing section, for specific information regarding allowable locations on campus, including appropriate character zone (Historic North, Central Innovation, or Mountain South) and site placement. Also refer to concept plans in Landscape Master Plan for guidance regarding preferred type and placement.

Generally, fencing, railing and handrails to be treated as a unifying campus element with consistent use of specified materials while allowing some variability in design.

Part 2 – Products

Allowable materials and locations as per below. Variations to be approved by Owner.

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Paint used on fences, handrails, and gates shall be Modern Masters ME209 Pewter unless otherwise specified by Owner.

Temporary, non-structural barrier: may be used to discourage pedestrian access or to protect newly installed landscaping during establishment period. Standard is plastic black post and chain.

Ornamental black iron fencing design with brick masonry pillars: May be used at north and central campus to define campus edges. Replicate existing style, including cap, brick, and metal detailing. Not for use at interior campus areas.

Rustic steel: Can be used at south campus when separation rail is needed for pedestrian safety. Use Corten or weathering steel, pre-treated to induce rusting and then sealed to reduce staining. Use concrete cap and stone base/pillars (natural sandstone or limestone), sealed.

Stainless steel or steel handrail/fall protection railing painted color as noted in Part 2-Products of this section: To be used throughout campus in all character zones, at stairs or ramps, or areas requiring fall protection. Specify stainless steel or steel painted with new NAU standard silver color paint, rounded top rail with round or square vertical supports welded to top rail. With Owner approval, black or green painted railing may be specified at certain locations where existing context dictates. Fall protection railing to have 4” maximum vertical or horizontal spacing.

Weathering steel handrail/fall protection railing or fencing: May be used with Owner approval at south campus at stairs or ramps, or areas requiring fall protection or fencing. At pedestrian gathering areas, treat with muriatic acid and peroxide to induce rusting, followed by sealant to prevent staining of concrete/rubbing off of rust. If unsealed, offset from concrete to prevent staining. When used as handrail/fall protection railing, specify rounded top rail with round or square vertical supports welded to top rail. Fall protection railing to have 4” maximum vertical or horizontal spacing. Existing railing in good condition may be painted to match weathering steel. When used as fencing, match FUTS (Flagstaff Urban Trail System) design.

Part 3 – Execution

No unique requirements. Install per manufacturers’ requirements.

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32 32 00 Site Walls

Mock-up shall be constructed by Contractor to establish the standard of acceptance for all elements of the work. The sample wall shall be approved by the Owner and the Design Professional prior to installation. Retain mock-up during construction as a standard for judging completed. Do not move or destroy mock-up until work is completed.

Refer to NAU Landscape Master Plan, Principles and Design Standards, Walls section, for specific information regarding allowable locations on campus, including appropriate character zone (Historic North, Central Innovation, or Mountain South) and site placement. Also refer to concept plans in Landscape Master Plan for guidance regarding preferred wall type and placement.

Stucco, CMU and basalt stone not to be used for site walls. Pre-cast block to be only as specified in Section 32 32 23.

Construction and plans for all site walls shall be approved by Owner to ensure appropriateness of materials, design, and placement.

Skateboard deterrent: Exterior planters, seat walls, and retaining walls shall be designed to deter skateboard use. Metal skatestops are not permitted. Acceptable methods to be used:

Breaks or interruptions every three feet minimum along top of wall/at wall cap, using 1" deep x 2" wide sawcuts. Cuts shall be designed to be integral to site element.

Chamfered or rough edges which are less likely to be ground down.

Strategically placed landscape beds or lawn/native grass areas.

32 32 13 Cast-in-Place Concrete Retaining Walls

Part 1 – General

Concrete work to conform to Technical Standards Division 3: Concrete.

Part 2 – Products

Exposed surfaces of cast-in-place concrete low-height (approximately three feet) freestanding and retaining walls to be sand finish, in North zone along North-South Pedway only, and throughout central and south campus. Sand finish must match Owner’s established standard for appearance and quality, to be standard gray, without color or pigment, beveled/chamfered edge preferred.

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Wall cap options as follows:

North zone (along Pedway only) and Central zone: no cap, to provide clean lines and modern detailing, or utilize sand finish concrete cap (standard gray) for more classic appearance.

South zone: sand finish concrete cap (natural gray) for classic appearance, or Belgard Hardscapes ‘Tandem’ cap, ‘Danville Beige,’ to mimic look of natural limestone.

Part 3 – Execution

Contractor to construct wall mock-up for Owner approval; mock-up is to remain throughout project duration.

32 32 23 Segmental Retaining Walls

Part 1 – General

Contractor to submit product sample to Owner (Project Manager and campus Landscape Architect) and DP prior to purchase.

Part 2 - Products

Owner has pre-approved the following products to be in compliance with these standards:

- Low height freestanding or retaining walls to be Belgard ‘Tandem’ wall and cap, color: ‘Danville Beige,’ all three solid unit sizes: 13”, 15” and 18”; ashlar pattern units not allowed. Free-standing wall up to 30” high, gravity wall up to 36” high, maximum height with engineering is 8’ high. To be used in North and South campus character zones. May be used in Central zone with campus landscape architect approval only. Appropriate application as a seat, edge or planter wall, with strategic location required to deter skateboarding.
- Mass segmental retaining walls to be used where higher retaining walls are required. Product to be Belgard ‘Mega-Tandem Wall,’ ‘Danville Beige’ with ‘Mega-Tandem’ cap. Can be used for free-standing seat walls up to 36” high, gravity retaining walls up to 10’ high without surcharge, and reinforced walls up to 15’ high. Wall terracing is preferred, with plantings, to soften visual impact. To be used in North and South character zones, or Central zone with campus landscape architect approval only.

Part 3 – Execution

Install per manufacturer’s direction.

Section Number	Title
32 32 53	Stone Retaining Walls

Part 1 – General

In Central campus, clean lines and modern detailing shall be used. Sandstone and limestone in natural form to have tight coursing with long rectangular blocks and smooth face. In North campus, pitched, chiseled faces are desired to mimic the stonework at the campus historic buildings. In south campus, drystack limestone is preferred. Use of natural stone may be able to be coordinated with Owner (Landscaping & Outdoor Services) in some instances, using Owner’s stockpiles.

Stone sample(s) to ensure desired visual appearance, including coloration and facing, along with testing data, to be submitted to Owner for approval. Required testing for sandstone, to be performed by a registered geologist, is ASTM C-170 Standard Test Method for Compressive Strength of Dimension Stone, including parallel and perpendicular loads. Provide test results to Owner for review and approval prior to selection of stone source. Limestone shall be hard enough to avoid cracking and fracturing. Testing for limestone to be at Owner’s request.

Anti-graffiti product to be applied following completion of stonework. Apply silane/siloxane sealer before application of anti-graffiti product to provide protection against water absorption and penetration, prolonging life of the stone. A silane/siloxane sealer is preferred above a sealer containing only one of these ingredients. Owner has pre-approved the following product to be in compliance with these standards: Vandlguard.

Part 2 – ProductsLimestone Walls

Classic Limestone Wall

- A. Character zone: North
- B. Placement: high visibility accent areas and seat walls.
- C. Wall cap: natural limestone.
- D. Rectangular blocks 6”-12” high and 12”-18” long with pitched, chiseled face.
- E. Rock and mortar color to match existing campus limestone.
- F. Source to be within 500 miles of campus

Modern Limestone Wall

- A. Character zone: Central
- B. Placement: high visibility accent areas and seat walls.
- C. Wall cap: none
- D. Drystack large cut blocks, 2’-3’ in length and 12”-18” high maximum.

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- E. Rock color to match existing campus limestone
- F. Source to be within 500 miles of campus

Drystack Limestone Wall

- A. Character zone: South
- B. Placement: seat walls, edge wall, and retaining walls under 3 feet high.
- C. Wall cap: none
- D. Drystack large blocks in natural form, 2'-3' in length and 12"-18" high maximum.
- E. Rock color to match existing campus limestone
- F. Source to be within 500 miles of campus

Sandstone Walls

Classic Sandstone Wall

- A. Character zone: North
- B. Placement: high visibility accent areas and seat/edge walls.
- C. Wall cap: natural limestone/beige sandstone, manufactured concrete (Belgard 'Tandem'), or sand finish concrete cap
- D. CMU with sandstone veneer
- E. Rectangular blocks 6"-12" high and 12"-18" long with pitched, chiseled face
- F. Raked mortar joints with color pigment to match natural stone
- G. Source within 500 miles of project location
- H. Minimum 4" thick veneer with rock bedding planes parallel to ground to discourage spalling.

Modern Sandstone Wall

- A. Character zone: Central
- B. Placement: high visibility accent areas and seat/edge walls.
- C. Wall cap: none, or sand finish concrete cap
- D. CMU with sandstone veneer in ashlar pattern
- E. Rock color should match existing red sandstone on campus
- F. Raked mortar joints with color pigment to match natural stone.
- G. Source within 500 miles of campus
- H. Recommended veneer to be 4" thick with rock bedding planes parallel to ground to discourage spalling.

Part 3 – Execution

Contractor to construct wall mock-up for Owner approval, and mock-up shall remain throughout project duration.

Cast-in-place retaining walls with a stone veneer shall be sealed on the side which contacts soil to prevent efflorescence from appearing on the outside of the wall.

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All stone veneer walls shall not have stonework extend below grade or surface of adjacent pavements and walks. At least two inches of the foundation shall be exposed above adjacent grade level.

32 33 00 Site Furnishings

Refer to NAU Landscape Master Plan, Principles and Design Standards, Furnishings section, for specific information regarding allowable locations on campus, including character zone (Historic North, Central Innovation, or Mountain South) and site placement. Also refer to concept plans in Landscape Master Plan for guidance regarding preferred furnishing type and placement.

Furnishings appropriate for each site/building shall be included in the project. Furnishings should be durable, either placed or designed to deter skateboarding, and composed of sustainable materials. Central campus furnishings, at certain areas, are encouraged to be expressive in design.

32 33 13 Bicycle Racks and Skateboard Racks

Part 1 – General

Existing bike racks of the same model may be re-used on projects with the Owner’s (Project Manager and campus landscape Architect) approval. Existing bike racks that are re-used shall all match in color and finish within the same location. Per Owner direction, existing bike racks to be painted in Modern Masters ME209 Pewter.

Part 2 – Products

Bike Rack

- A. Character zone: campus-wide
- B. Placement: near building entrances, between buildings, or at social gathering spaces.

Owner has pre-approved the following manufacturer to be in compliance with these standards: Madrix Model UT160, powdercoat finish ‘Storm Metallic.’

Skateboard Rack

- A. Character zone: campus-wide
- B. Placement: near building entrances, between buildings or at social spaces.
- C. Owner has pre-approved the following products to be in compliance with these standards: Board Loch brand products ‘Genesis 7,’ ‘Spartan 7,’ or ‘Spartan 14,’ Zinc plated finish.

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Part 3 – Execution

Install per manufacturer’s direction, on a separate concrete pad from the sidewalk/path of travel.

32 33 23 Site Trash and Litter Receptacles

Part 1 – General

As approved by Owner (Campus Landscape Architect and Project Manager): Big Belly trash/recycling receptacle, Landscape Forms ‘POE’ waste and recycling receptacles, Anova ‘Exposition’ double receptacle/recycler.

Part 2 – Products

Owner has pre-approved the following manufacturers to be in compliance with these standards:

1. Big Belly solar-powered trash and recycling stations
 - A. Character zone: campus-wide
 - B. Placement: areas requiring receptacles, including near building entries, social spaces, and along pedestrian circulation routes.
 - C. BB5 HUB (Big Belly 5) compactor with SB5 (Smart Belly 5) companion recycler (COMPANION RECYCLER-L; left side companion, never right side), Big Belly hopper to be standard black, Smart Belly faceplate, icon in blue (never ‘flap’) faceplate. Visual Order Tools (VOTs) to be sent to Owner for sign-off/approval; without the foot controlled opener, as it will assuredly become stuck/damaged in snow clearing efforts
2. Landscape Forms ‘POE’
 - A. Character zone: campus-wide
 - B. Placement: areas requiring receptacles as an alternate to Big Belly.
 - C. Powder-coated metal, color: ‘Titanium,’ side opening without lock to permit access in winter conditions.
 - D. Waste receptacle: ‘Landfill’ label sign, clear vinyl, white text. Titanium color.
 - E. Recycling receptacle: ‘Recyclable Material Only’ label sign, clear vinyl, white text. Lid and body color: Titanium. Diverter/shield/door top plate color: Ocean. 5” dia. Holes.
3. Anova ‘Exposition’ double receptacle/recycler with side doors
 - A. Character zone: campus-wide
 - B. Placement: areas requiring receptacles, as an alternate to Big Belly.
 - C. White decal labels with no background color: “Mixed Recycling” and “Landfill.”
 - D. SLEX70, low-profile fusion advantage finish ‘Textured Charcoal’

Section Number	Title
	<p><u>Part 3 – Execution</u> Place on a concrete pad or other paved surface.</p>
32 33 33	<p>Site Manufactured Planters</p> <p><u>Part 1 – General</u> Planter below is a pre-approved planter to be used. Alternate planters may be considered on a case-by-case basis if approved by Owner.</p> <p><u>Part 2 – Products</u> Quick Crete Products Corp. precast concrete ‘Cascade Round’ series planter</p> <ul style="list-style-type: none"> A. Character zone: campus-wide B. Placement: Pedestrian gathering areas, building entries C. Color: ‘Latte’, texture: ‘Craftsman’s Etch,’ standard gloss sealer, drain hole D. 36” outside diameter x 18” height (or other size variation as approved) E. Watering saucer preferred to limit staining of concrete from soil organics <p><u>Part 3 - Execution</u> No unique requirements</p>
32 33 43	<p>Site Seating and Tables</p> <p><u>Part 1 – General</u> Some existing benches may be replaced with tables and chairs to deter skateboarding and increase social activity. Benches should be placed to capitalize on mountain views and in more intimate quiet spaces.</p> <p>Custom furnishings may be included with approval from Owner. In Central Campus Character zone, expressive furnishings design may be encouraged significant campus gathering areas.</p> <p><u>Part 2 – Products</u></p> <p>Benches: Owner has pre-approved the following manufacturers to be in compliance with these standards:</p>

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Metal Bench

- A. Character zone: campus-wide
- B. Placement: Gathering areas with crusher fines or pavement
- C. Landscape Forms ‘Parc Vue,’ powder-coated metal, color: “Titanium,’ backed bench with arms
- D. Custom skateboard deterrent required (provided by manufacturer)

Thermory (heat modified ash) Bench

- A. Character zone: campus-wide
- B. Placement: intimate seating areas
- C. Anova ‘Allure’ Thermory 6’ Contour Bench without armrests: Owner approved alternative material. Recycled plastic not preferred. Tropical hardwood not permitted
- D. Custom skateboard deterrent desired (provided by manufacturer) unless strategically located
- E. Concrete pad or footings required for supports

Resysta Bench

- A. Character zone: campus-wide
- B. Placement: intimate seating areas and social spaces
- C. mmcite ‘Intervera’ bench with backrest and armrest, 6’ long, Resysta boards with CO2 lacquer finish, RAL 9007 powdercoated steel supports.
- D. Custom skateboard deterrent required (provided by manufacturer) unless strategically located.
- E. Concrete footings required for support.

Tables and Chairs:

Attached

- A. Character zone: campus-wide
- B. Placement: Pedestrian gathering areas
- C. Landscape Forms ‘Carousel,’ powder-coated metal color: ‘Titanium,’ chairs with or without backs, perforated seats and table
- D. Anova ‘Beacon Hill,’ Thermory Owner approved alternative material, fusion advantage finish color: ‘pewter,’ flat or contour seats. Recycled Plastic not preferred. Tropical hardwood not permitted.

Moveable

- A. Character zone: campus-wide
- B. Placement: Pedestrian gathering areas with increased security, so that furniture cannot be removed, i.e. fenced area

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- C. Landscape Forms ‘Catena’ tabletop steelhead perforated without umbrella hole, ‘Parc Vue’ 24” single backed bench seat, powder-coated metal color ‘titanium’

Umbrellas

- A. Character zone: campus-wide
- B. Placement: optional with Landscape Forms tables and chairs
- C. Landscape Forms ‘Solstice Cygnus,’ powder-coated metal custom colors: NAU blue or gold
- D. Canvas umbrellas not allowed

Chairs

- A. Character zone: central and south campus
- B. Placement: Pedestrian gathering areas
- C. Adirondack chairs: Loll Designs Adirondack Collection 4 slat, flat, (standard or rocking), colors: charcoal, evergreen, leaf, custom NAU blue
- D. Chaise Lounge: Maglin MCL720 Series-M, powder-coated steel, south campus colors: ‘Bronze 14’ or ‘Silver 14,’ central campus colors: ‘Graphite,’ ‘Silver 14,’ or custom NAU blue

Other/Custom Furnishings:

Picnic Table

- A. Character zone: campus-wide
- B. Placement: Pedestrian gathering areas with crusher fines or concrete pad (not in grass). Strategic placement required to deter skateboarding.
- C. 6’ or 12’ length, supports to be smooth standard gray concrete, weathering steel or Corten, seats and table top to be sustainable wood product approved by Owner, tropical hardwood not permitted. If weathering steel is used, it must be treated with muriatic acid and peroxide to induce rusting and then sealed to prevent staining of concrete.

Picnic Table with Benches

- A. Character zone: campus-wide
- B. Placement: Intimate seating areas with crusher fines or concrete pad. Strategic placement required to deter skateboarding.
- C. mmcite ‘Tably’ table, 6’ long park table with ‘Vera Solo’ 6’ long park benches on solo leg, without backrest or arms.
- D. Resysta boards with CO2 lacquer finish

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- E. RAL 9007 powdercoated steel supports.

Harvest Table

- A. Character zone: Central and South campus
- B. Placement: Pedestrian gathering areas with crusher fines or concrete pad (not in grass). Strategic placement required to deter skateboarding.
- C. 24' length, supports to be smooth standard gray concrete, weathering steel or Corten, seats and tabletop to be sustainable wood product approved by Owner. Rainforest sourced wood not permitted. If weathering steel is used, it must be treated with muriatic acid and peroxide to induce rusting and then sealed to prevent staining of concrete.

Solar Charging Station

- A. Character zone: campus-wide
- B. Placement: Pedestrian gathering areas with crusher fines or concrete pad (not in grass).
- C. 'Soofa Core' in custom NAU blue, or other as approved by Owner.

Bar Style Seating

- A. Character zone: Central campus
- B. Placement: Only where specified in Landscape Master Plan Concept Designs. Strategic placement required to deter skateboarding.
- C. Swivel seating design encouraged

Skateboard Bench

- A. Character zone: Central and South campus
- B. Placement: Areas where skateboarding can be encouraged. Place adjacent to skateable surface. Not to be used in high traffic areas.
- C. Stainless steel edge required, standard gray concrete (no color or pigment).

Double-sided Wood Deck Lounge Chair

- A. Character zone: Central and South campus
- B. Placement: Only where specified in Landscape Master Plan Concept Designs. Strategic placement required to deter skateboarding.
- C. Sustainable wood product approved by Owner i.e. Kebony, Black Locust. Rainforest sourced wood not permitted.

Hammock

- A. Character zone: Central campus

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- B. Placement: Only where specified in Landscape Master Plan on concept design plans.
- C. All weather fabric that is water and mildew resistant, stainless steel or galvanized steel supports, colors: NAU custom blue or gold.

Hammock

- A. Character zone: South campus
- B. Placement: Only where specified in Landscape Master Plan on concept design plans.
- C. Provide hammock hooks and tree protection.
- D. All weather fabric that is water and mildew resistant, stainless steel or galvanized steel supports, colors: NAU custom blue or gold.

Part 3 – Execution

Generally, items should be anchored in concrete so as to not be removed.

32 39 00 Manufactured Site Specialties

32 39 13 Manufactured Metal Bollards

Part 1 – General

Manufactured metal bollards shall be collapsible when placed in fire access routes.

Part 2 – Products

As approved by Owner: is MaxiForce™ Traffic Control Bollards, manufactured by Blue Ember Technologies or equivalent. Part ID is MCSW-SS3-S, Description: MaxiForce Collapsible (MC) Bollard, Standard Style (S) Rectangular Body, Wrench (W) Operated, Standard Style 3 (SS3) Head, Simple (S) Base, One Wrench Included Per Every 10 Units. Color is Bengal Silver Drylac 049/99999 powder coat. Standard Duty Aluminum Release Insert (breakaway insert) is recommended.

Part 3 – Execution

Installation shall be per manufacturer’s recommendations.

****END OF SECTION****

Section Number	Title
32 80 00	IRRIGATION
32 84 00	Planting Irrigation

Part 1 – General

All irrigation systems for new construction shall be designed as part of the landscaping plans and shall be considered in the grading, and storm water management of the site and the surrounding areas. The Design Professional shall include adequate irrigation for planting and use reclaimed water for irrigation where it is available. Planning shall work towards plant and designs that allow for irrigation to be phased out as landscaping becomes established. At maturity irrigation will be limited to climate stresses only.

The Contractor is responsible for all blue staking before and during the project.

Warning Tape: Each 2” line shall have warning tape provided directly above line, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs. **All main lines shall have tracer wires for efficient locating.** Provide detectable warning tape (“water” blue for domestic and potable water and “reclaimed” purple for reclaimed water) with metallic core encased in a protective jacket for corrosion protection for irrigation mains, conduit or other underground services outside of building line.

Reduced pressure backflow preventers shall be installed at all connections to water distribution mains. Immediately downstream of the back-flow preventer shall be a master valve and Calsense flow sensor of appropriate size.

Drawings

Prior to construction, preliminary design plans must be submitted to Owner (Landscaping and Outdoor Services) for approval. At the completion of each project, accurate, reproduceable, as-built drawings shall be provided to Owner. AutoCad compatible files (*.dwg, *.dxf) shall be provided so the sprinkler system may be entered into the campus infrastructure data.

Part 2 – Products

Pipe and Fittings

All pipe used for main lines and auxiliary lines shall be schedule 40 PVC pipe with ratings printed on pipe.

All fittings shall be schedule 40, pressure rated, PVC fittings.

Fittings between the auxiliary (lateral) line and any sprinkler head or hose bib shall consist of rigid PVC full circle swing joint.

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Specifications for piping shall include standards that all piping shall be free from cracks, holes, and foreign materials, blisters, inside bubbles, wrinkles, and dents.

If pipe is stored outside it shall be protected from direct sunlight.

No galvanized nipples, elbows, or other fittings shall be used with PVC pipe installations.

Standard specifications for the piping materials shall include that the pipe shall be free from cracks, sunburn, discoloration, holes, foreign materials, blisters inside, bubbles, wrinkles and dents.

Controllers

The controller shall be Calsense ET3000 Irrigation Controller.

Flow Sensors shall be Calsense FM Flow Sensors.

The master valve (EFB-CP) will be located in the control box.

Controller Wires

Electronic controller cable to be solid copper wire, UL approved for direct burial, minimum gauge 14 UV for runs under 1000 L.F., 12 UF for runs over 1000 L.F. Control wires must be buried at least 18" below finish grade.

Electric control wires shall be color coded so that neutrals are white, grass areas are red, shrub areas are blue, flower beds are green, and drip irrigated areas are brown.

All connections to valves and all splices shall be made with "SNAP-TITE" connectors and PT-55 sealer, or approved equal.

Valves

Valves shall have a minimum size of 1". EFB-CP Series Rainbird. Ball valves to be installed before all control valves for isolation.

Sprinkler Heads

Heads for lawn or native grass areas less than 25 feet wide shall be Hunter I 20 or approved equal.

Heads for 15'-25' wide areas, use Hunter PGJ rotaries.

Heads for strips and shrubs shall be Rainbird 1800 series with strip nozzles.

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Heads for open areas 25 feet or wider shall be Hunter I 40 or approved equal.

Heads for large areas with few trees shall be Hunter I40 or approved equal.

Drip Irrigation

Rainbird multi-port emitters without box and cover.

Provide drip irrigation boxes at end of lineflush tubes or isolation valves. Do not use boxes at multi-emitters.

Backflow Prevention

Backflow preventers shall be reduced pressure type and shall be installed at all connections to domestic water distribution mains. Owner has pre-approved the following manufacturers to be in compliance with these standards: FEBCO and WATTS. Reclaimed water mains will require pressure reducing valves (PRV).

Part 3 – Execution

Trenching: Cover Requirements:

All pipe and wire under pavement	24"
Pressurized Lines	18"
Non-pressurized lines	12"
Non-pressurized drip laterals	8"
Control Wire	18"

Lines bordering curbs and sidewalks shall be held 12" away to allow for maintenance and access to the lines.

Backfill around and over pipes shall be with sandy soil free from rocks over 1/8" in diameter. Where existing soil does not meet this requirement, sandy soil shall be imported for backfilling.

Pipe and control wiring and tubing under walks, roads and other hard surfaces shall be installed in schedule 40 sleeves that are two times the size of the pipe. Sleeves shall extend a minimum of 12" beyond the hard surface.

Heads, bubblers, and drip lines shall maintain a minimum of 2' 0" setback from walks, drives or building faces. Special care shall be utilized in design to avoid the possibility of wind driven mist from wetting paving and building surfaces.

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Pipe and Fittings

All main lines shall be looped whenever possible so as to improve pressure and flow.

Glued joints shall set for 24 hours before pressure is applied to lines.

If pipe is stored outside, it shall be protected from direct sunlight.

PVC joints shall be glued according to manufacturer’s recommendations.

Control Wires

Lawn, shrub, flower beds, xeriscape and drip areas shall be valved separately and have separate stations on the time clock.

All splices shall be made in valve boxes.

All wire runs shall have expansion loops at all corners.

Valves

All valves shall be EFB-CP Series Rainbird valves. Avoid locating valves in areas where curbs and walks come together.

Main valves should be located, when possible, in a grassed area, five feet from sidewalks curbs, or other traffic areas. Ball type isolation valves installed vertically before all control valves.

Valve boxes shall be set at finished grade, before sod, with valve stems 4" below top of the box. Each valve box or group of valves shall have a quick connect on the pressure side of the valve.

Valves to be separated where possible.

All valves shall be placed in valve boxes so to allow access for servicing. 3" of gravel shall be placed under all valves (electric, gate and sectional).

Controllers

Controllers shall be mounted on the exterior of buildings or any other proximate built structures.

Heads

Placement of heads shall be influenced by prevailing wind direction, location of mounds and placement and location of trees.

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Heads shall be installed so that the top of the head is flush with the finish grade **BEFORE** sod.

Provide diagrams for all head installation.

All lines shall be flushed before the heads are installed.

A non-fading, weather resistant copy of the irrigation diagram and controller name-label shall be affixed to the inside of the controller cabinet door. The irrigation diagram shall show all valves operated by the controller, valve sizes and type of plantings irrigated.

Drip Irrigation

Bury emitter tubing 2" below soil (below mulch or gravel is not sufficient bury depth).

Locate emitters equidistantly around plant at edge of rootball. Do not locate at plant trunk or main stem.

Backflow Prevention

All backflow preventers shall be assembled with pipe fittings and risers of galvanized steel, or copper.

Valves and drains shall be placed so the entire system may be winterized.

Trenching

Immediately downstream of the back-flow preventer shall be a water meter or flow sensor of appropriate size. Flow sensors shall be installed at least 2 feet upstream and at least two feet downstream of any joints to ensure accurate readings.

1. Main lines shall be a minimum of 24 inches deep; auxiliary lines shall be 4 inches deeper than the bottom of the head being used.
2. Lines bordering curbs, sidewalks or other hard surfaces shall be held 12 inches away to allow for maintenance and access to the lines.
3. Sand shall be used in all trenches as bedding material for all PVC piping and also used as a covering for all piping. There shall be a minimum depth of 2 inches over the top of all piping.
4. Pipe, drip tubing and control wire being routed under walks, roads or other hard surfaces shall be installed in schedule 40 sleeves.

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Warning Tape

Provide warning tape in the trench with irrigation lines 12 inches above the line and provide detectable warning tape with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector for irrigation mains, conduit or other underground services outside of building line.

32 90 00 PLANTING

Part 1 – General

Design Professional shall coordinate hardscape design with size of plant pits and planting areas so as to provide adequate root growth area, including planning for mature trunk flares and proper subgrade material in pavement areas (i.e. CU Structural Soil), and eliminate conflicts with hardscape and utilities. Refer to Section 32 93 00 Execution regarding offset distances between trees and utilities.

The Contractor shall maintain all plantings until Owner’s acceptance at Substantial Completion of landscaping. Maintenance operations shall include: watering, mulching, tightening or adjusting of tree stakes, resetting plants to proper grade, fertilization and weeding. Contractor shall commission the irrigation system prior to acceptance. Replacement materials shall meet all specifications of original materials.

All plant materials shall look vibrant and healthy. Plants that look weak, sickly, or unhealthy will be refused and shall be replaced by Contractor at Contractor’s expense. Owner shall have option of inspecting plants prior to purchase. Plant material to conform to the standards set forth in the *American Standard for Nursery Stock*.

Installers shall loosen or break up root balls on all plants, trees, shrubs, etc. prior to inserting into planting holes. All root ball binding materials shall be removed before planting, including all twine, all wire, and top 2/3 of burlap minimum. Remaining burlap to be cut and not left intact, subject to inspection by NAU LOS or Landscape Architect. No soil is to cover the top of the rootball. Contractor will be required to reset plants if too low.

Tree pits may be subject to percolation test as determined by NAU LOS or Landscape Architect.

Trees shall be guaranteed for 2 full years following Substantial Completion. During the warranty period, the Contractor is recommended to hand water evergreen material after irrigation system is winterized. In order to maintain healthy trees, it is recommended the Contractor check evergreens biweekly during the winter, to

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determine water needs, unless there is snow accumulation or ground is frozen. All other plant materials, including sod and native grass areas, shall be guaranteed for 1 full year following substantial completion. Replacement material to be subject to original warranty period starting on the day the replacement planting is approved by Owner. The warranty period resets with replacement material planting(s). Replacement material shall be replaced at Contractors' expense.

Part 2 - Products

Planting pits: Provide 1/3 organic amendment and 2/3 native soil (2/3 imported topsoil if needed as determined by NAU LOS and Landscape Architect) in all planting pits to improve soil structure and improve nutrient content. Pits to be two times wider and 6" deeper than root ball.

Perennial and groundcover beds: 18" depth planters mix (imported topsoil with 3cy/1000 s.f. organic amendment thoroughly tilled in.

Sod: 12" depth, consisting of lower 6" tilled native soil with 3 cy/1000 s.f. organic amendment, and upper 6" imported topsoil with 3 cy/1000 s.f. organic amendment. Use existing native soil at 9" depth, if soil lab test determines existing material is suitable, including any amendments as may be needed, and if existing material is approved by NAU LOS and Landscape Architect as suitable.

Native grass areas: if no depth/amendment is specified, conduct nutrient and soils analysis to determine required imported soils and amendments.

Provide organic amendment and topsoil data, including source, material composition, and pH, to Owner (landscape architect) for approval. Material shall be composted, well-rotted, free of refuse and containing not more than 25% straw or other bedding material.

A routine nutrient and texture soils analysis, with recommendations for amendments from a soils lab, is required to determine additional additives, including fertilizers and organic soil amendments, that may be required for turf, native grass and plant establishment. Soil-Testing Laboratory Qualifications: An independent laboratory with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed. Submit to landscape architect for approval.

Tree stakes shall be three (3) inch diameter by eight (8) feet long Lodgepole Pine, free of any weakening knots or other defect, driven 3' into undisturbed soil. Stake deciduous trees 3" caliper and larger and evergreen trees 6' tall and larger with 2-

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3 stakes equidistantly spaced in direction of prevailing wind. Allow 6” play in wire for staking. NAU representative to remove stakes after 1 year.

Guy wire shall be new, 2 strands 12 gauge, annealed, galvanized.

Chafing guards shall be new, 16” x 3” canvas strap with brass grommets and heat finished edges. Do not use rubber hose.

Sod shall be cut, delivered and installed (remove plastic mesh from sod rolls) within a 24-hour period. Cultivate subgrade to a depth of 6" prior to placing clean topsoil and remove all construction material, stones and debris 1" and greater in diameter. Place topsoil to a depth of 6" over cultivated subgrade.

Planting Bed Mulch and Mulch at Tree Basins in Lawn Areas: Shredded Western Red Cedar. Bulk sources only; bagged material not permitted. Submit sample and source to campus landscape architect for approval prior to delivery to site. Place to a depth of 4” thick at all planting beds. Adjust thickness of mulch at perennials to 2” to avoid burying foliage. Top of mulch to be flush with adjacent finish grades. Do not install with weed fabric or plastic. Do not use at retention or detention basins, areas with high velocity runoff, high wind areas, or slopes greater than 3:1.

Gravel: ½” or 1” screened ‘Rock Springs Chocolate’ or ‘Table Mesa Brown’ crushed rock. Place 4” thick, without weed fabric or plastic. Limited use on campus; only to be used at planting beds where flammability or high-wind is an issue, or at unplanted locations only as approved by campus landscape architect. Do not use at retention or detention basins, areas with high velocity runoff, or slopes greater than 3:1.

Rip-Rap: 3”-6” diameter ‘Rock Springs Chocolate’ or ‘Table Mesa Brown’ crushed rock. Visually screen rip-rap areas with high density planting. Limit use to areas where erosion will occur if rock is not used and stormwater cannot be slowed using other methods.

Soil Rip-Rap: 3”-6” diameter ‘Rock Springs Chocolate’ or ‘Table Mesa Brown’ crushed rock mixed with topsoil installed 12” thick. Use 65% rip-rap and 35% topsoil by volume, uniform mixture without voids. To be used in conjunction with shortgrass and tallgrass meadow blends at drainage swales and steep slopes.

Boulders: limestone, approximately 3’ diameter or of ledgestone shape and size. Rock color to match existing limestone on campus. Basalt only as approved by NAU LOS and Landscape Architect. Coordinate use of campus limestone stockpiles with Landscaping & Outdoor Services and campus landscape architect. To be

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buried 1/3 for natural effect and placing naturalistically to appear as outcroppings. Use only in select locations as approved by Owner (landscape architect).

Part 3 - Execution

Where plant material will be placed in soil beneath existing pavement, especially asphalt pavement, or other condition where soil sterilant or other treatment potentially harmful to plant material may have been applied, area shall be tested for the presence of any such chemicals or condition. Affected soils shall be treated and/or excavated and disposed of in accordance with local codes.

Areas to receive groundcover or perennial plants shall be excavated in their entirety to 18" below finish grade and filled with clean topsoil mix described above.

Planting pit percolation rates to be determined prior to planting in the presence of Owner (Landscaping and Outdoor Services) representative. Where applicable, percolation tests may be required to prove drainage. If pit (filled with water) does not drain in 30 minutes, inform landscape architect to determine adjusted location or correction of drainage condition.

After water settling backfill, top of trees and shrub rootballs to be flush with adjacent finish soil grade, with no rootball exposed before installation of mulch or gravel. Top of root ball for perennials, groundcover and grass plugs to be flush with finish grade. Scarify planting pit sides.

Construction debris and rocks larger than 1" shall be completely removed from site and shall not be buried in mulch beds.

Where existing lawns have been damaged by construction they shall be repaired by the Contractor, via resodding or refurbishment per the Owner's discretion/direction. Resodding shall include loosening and tilling compacted soil to a min. 9" depth, and removal of contaminated soil, and debris and rock larger than 1". Rototill organic amendment (3 cy/1000 s.f.) into top 6" layer of native soil. Refurbishment shall include aerating, topdressing with ½" organic amendment, and overseeding with bluegrass/rye blend approved by NAU Landscaping and Outdoor Services. Contractor is required to provide a seed bag tag submittal for review and approval prior to installation which includes at a minimum the Purity %, Test Date, Germination Rate, and Weed Seed Content. Repaired/resodded areas must be fenced for protection from trampling at installation.

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Maintenance for new or reestablished turf areas shall be as follows:

- Maintenance period shall be for 2 mowings or an agreed upon time frame depending on season of the year. New sod shall be mowed in ½” increments.
- Spray heads shall be initially set at finish grade of soil **BEFORE** sod installation. During the warranty period additional height adjustments by the Contractor at no additional cost may be required once turf is established. Irrigation shall not result in wilting, puddles or runoff.
- After 3 weeks, fertilize with a fertilizer that provides one-pound available Nitrogen per 1000 sf.
- Final acceptance will occur with a satisfactory stand of grass (solid, healthy growth, without bare spots) at the end of the maintenance period.
- Berms and swales shall be formed as continuous, smooth landforms with no obvious top or bottom to slopes or grade change from berm to swale.
- Provide positive drainage away from buildings and structures. Direct runoff water to planting areas.

32 91 00 Planting Preparation

32 91 13 Soil Preparation

Part 1 – General

Submit sands soil analysis (for pH levels) for material to be used at LID basins for Owner’s (Landscaping and Outdoor Service’s and landscape architect’s) review and approval.

Part 2 – Products

Topsoil

Topsoil shall be friable, loam topsoil, free from construction materials, sticks, stones over 1" in diameter, roots, refuse, noxious weeds or any other material toxic to plant growth. Topsoil is subject to inspection and acceptance by Owner (landscape architect and Landscaping & Outdoor Services), accompanied by required soils analysis.

Shall have:

- Loam and soil texture (USDA classification)
 - 30% to 50% sand
 - 10% to 25% clay
 - 30% to 50% silt
- pH. - 6.0 - 7.5

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All in-place soil and topsoil shall be free from nut grass, refuse, roots, noxious weeds, or any material toxic or a hindrance to plant growth.

Unless otherwise specified, all in-place and/or imported soil will be prepared and conditioned as topsoil to meet the following minimum specifications:

- pH shall not exceed 7.5 or be lower than 6.0
- Manure as a soil conditioner/amendment must be fully aged a minimum of two years.

Organic amendment

Organic soil conditioner product shall be certified as fully composted and contain no solid particle greater than ½” in length or diameter, and be free from uncomposted and non-stabilized wood bulking agents. Provide soil conditioner analysis to Owner (landscape architect and Landscaping & Outdoor Services) three (3) weeks prior to delivery to site.

Part 3 – Execution

The Contractor is required to furnish the Owner at no additional cost, a routine soils texture and nutrient analysis, with recommendations from the soils laboratory for the type of landscape to be installed (sod, native grass, perennials, trees and shrubs) for native soil, imported topsoil, and organic amendment (composted soil conditioner) which will include at a minimum:

- Nitrogen
- Phosphorus
- Potassium
- Sodium absorption
- pH
- Percentage of sand, silt, clay, organic matter, water holding capacity

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods.

If imported soil is specified, the existing soil shall be roto-tilled to a minimum depth of 6 inches prior to placing topsoil. All clods and rocks over 1 inch in diameter, within 6 inches of the surface, shall be removed and disposed of offsite. The thickness of the topsoil shall be at least 6 inches.

****END OF SECTION****

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TURFS AND GRASSES

32 92 00

Part 1 – General

Lawns may only be specified where maintainable with full normal access (no inner courtyards not directly accessible from outside) for irrigation, mowing, fertilizing, and pest control operations.

Lawn areas shall be designed open and clutter free to maximize usability and simplicity, absent of boulders or other items.

Planting beds shall be separated from lawns and native grass areas by concrete edger, MAG Type 'B' curb, 6" wide x 12" depth, modified to be flush with finish grade, standard gray (no color or pigment).

Bluegrass blend turf shall not be used in any planting strip less than 36" wide.

Lawn soil surfaces shall be constructed 1" below walks, curbs, mow strips or other adjacent paving to allow for sod root base.

Any valve boxes installed in turf areas shall be made flush with the finish grade, not turf blade height.

32 92 16 Native Grass Plugging

Part 1 - General

At high visibility areas, native grass plugs to be specified in conjunction with hydroseeding to reduce establishment period of short and tall grass meadows.

Submit seeding operations and grass plug planting schedule to Owner (campus landscape architect and Landscaping & Outdoor Services) for approval. If seeding/planting operations do not occur during July when natural monsoon moisture and warm temperatures are present, hand watering and/or a turf-type annual rye nurse crop may be required. Hand watering frequency required would be three (3) times per week for one (1) month to root in plugs and germinate seed if monsoons are not active with sufficient moisture.

Weed control in all native grass meadow areas shall be addressed by the Contractor before project acceptance at Substantial Completion. Weed control shall be accomplished by hand-pulling. Herbicide may only be used in cases of a weedy infestation, and only if approved by Owner (Landscaping & Outdoor Services and landscape architect).

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Part 2 – Products

Tall Meadow Mix – grass plugs

Botanical Name

Festuca arizonica

Common Name

Arizona Fescue

Short Meadow Grass – grass plugs

Botanical Name

Bouteloua gracillas

Common Name

Blue Grama

Part 3 – Execution

Plant plugs 12” on center, triangular spacing, throughout area, in addition to hydroseed mix. Hydroseed to be applied prior to plugging.

32 92 21 Turf Lawn Seeding

Part 1 – General

At Owner’s discretion, turf lawn seeding may be specified in lieu of sodding. Submit seeding operations and grass plug planting schedule to Owner (Campus Landscape Architect and Landscaping & Outdoor Services) for approval.

Part 2 – Products

Blend of Kentucky Bluegrass (3 cultivars minimum) and Perennial Ryegrass. Submit to Owner for approval prior to seeding.

Part 3 – Execution

1. Turf Renovation

- a. Renovate existing turf where indicated and where turf is damaged by Contractor’s operations, such as storage of materials or equipment and movement of vehicles.
 - i. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - ii. Install new planting soil as required.
- b. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- c. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel and other construction materials resulting from Contractor’s operations, and replace with new planting soil.
- d. Mow, dethatch, core aerate, and rake existing turf.
- e. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

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- f. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner’s property.
- g. Till stripped, bare, and compacted areas 30”x48” or larger thoroughly to a soil depth of 6 inches.
- h. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 6 inches of existing soil. Mix at tilled areas only. Aerated, non-tilled areas to receive topdressing application for amendments and fertilizers. Install new planting soil to fill low spots and meet finish grades.
 - i. Soil Amendment(s): Per soils analysis lab recommendations.
 - ii. Initial Fertilizer: Per soils analysis lab recommendations.
- i. Apply seed and protect with fiber mulch as required for new turf.
- j. Water newly planted areas and keep moist until new turf is established.

2. Turf Maintenance

- a. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - i. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - ii. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - iii. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- b. Watering: If irrigation for the renovated area is precluded from watering schedule coordination with NAU LOS Department is required. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - i. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - ii. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

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- c. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - i. Mow to a height of 2.5 to 3.5 inches.
 - d. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.
 - i. Use fertilizer that provides actual nitrogen of at least 1 lb./1000 sq. ft. to turf area.
- 3. Satisfactory Turf
 - a. Turf installations shall meet with following criteria as determined by Architect:
 - i. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5”x5”. Areas beneath the dripline of evergreen trees are excluded.
 - b. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.
- 4. Cleanup and Protection
 - a. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other paved areas.
 - b. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner’s property.
 - c. Erect temporary fencing (4’ high green colored “cyclone” or “snow” fencing) and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout entire maintenance period and remove after satisfactory turf is accepted by Owner.
 - d. Remove nondegradable erosion-control measures after grass establishment period.
- 5. Maintenance Service
 - a. Turf Maintenance Service: provide full maintenance by skilled employees of landscape installer. Begin maintenance immediately

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after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

- i. Lawn Seeding: 60 days from date of seeding application or until satisfactory turf is established, whichever is greater.
 - 1. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

32 92 22 Hydroseeding

Part 1 - General

Submit seeding operations schedule to Owner (campus landscape architect and Landscaping & Outdoor Services) for approval. Preferred dates are June-July during monsoons, or October-November as dormant seeding application. If seeding operations do not occur during July when natural monsoon moisture and warm temperatures are present, hand watering and/or a turf-type annual rye nurse crop may be required. Hand watering frequency required would be three (3) times per week for one (1) month to root in plugs and germinate seed if monsoons are not active with sufficient moisture.

Weed control in all native grass meadow areas shall be addressed by the Contractor before project acceptance at Substantial Completion. Weed control shall be accomplished by hand-pulling. Broadleaf herbicide may only be used in cases of a weedy infestation, following first application of seeding, and only if approved by Owner (Landscaping & Outdoor Services and campus landscape architect).

Native grass areas should be full stands, 98% weed free. Bare areas to be overseeded prior to project acceptance at Substantial Completion.

Part 2 – Products

Tall Meadow Blend

Botanical Name	Common Name	% of Blend
<i>Bouteloua gracillas</i>	Blue Grama	40
<i>Blepharonuron trichloepis</i>	Pine Dropseed	10
<i>Bouteloua curtipendula</i>	Side Oats Grama	15
<i>Festuca arizonica</i>	Arizona Fescue	10
<i>Koeleria macrantha</i>	Prairie Junegrass	10
<i>Muhlenbergia rigens</i>	Deer Grass	10
<i>Panicum virgatum</i>	Switch Grass	5

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Short Meadow Blend

Botanical Name	Common Name	% of Blend
<i>Bouteloua gracillas</i>	Blue Grama	50
<i>Festuca idahoensis</i>	Idaho Blue Fescue	10
<i>Festuca ovina</i>	Sheep’s Fescue	10
<i>Muhlenbergia montana</i>	Mountain Muhly	10
<i>Poa fendleriana</i>	Mutton Grass	10
<i>Sporobolus crytandrus</i>	Sand Dropseed	10
<i>Bouteloua dactyloides</i>	Buffalo Grass	

Add Buffalograss (*Bouchloe dactyloides*) to short meadow blend for high traffic areas. When adding Buffalograss, use 30% Buffalograss at 6 lbs./acre, 30% Blue Grama and evenly distribute remaining varieties in the mix.

Riparian Grass Blend for PLD (LID) Basins (seasonal moisture)

Botanical Name	Common Name	% of Blend
<i>Bouteloua gracillas</i>	Blue Grama	40
<i>Festuca arizonica</i>	Arizona Fescue	20
<i>Muhlenbergia rigens</i>	Deer Grass	20
<i>Muhlenbergia wrightii</i>	Spiked Muhly	20
For areas with year-round moisture, add:		
<i>Carex aquatillis</i>	Water Sedge	10
<i>Carex microptera</i>	Smallwinged Sedge	10

For areas with year-round moisture, reduce Blue Grama to 30% with even proportions of remaining species.

Sow meadow mixes at 8-10 lb./acre; obtain seeding rates from seed supplier based on percentage of mix listed. Seed tag germination testing dates to be 12 months or less from date of sowing.

Refer to Landscape Master Plan, Principles and Design Standards, for perennials that can be added to short and tall grass blends, and riparian blend in high visibility areas. Use equal proportions of perennials added.

Part 3 – Execution

Where soil amendments are incorporated or imported topsoil is required, soil shall be thoroughly rototilled and incorporated with native soil, and fine graded prior to seeding operations. Applying imported soil without thorough mixing with native soil is not acceptable practice. Where native soil is an acceptable growing medium, hand rake native seed areas to disturb soil prior to seeding operations.

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Hydroseed mix to include native seed mix as specified, wood fiber mulch, plant, cellulose-based trackifier (plantago or equal), and 3-2-1 organic fertilizer at a rate of 1.5 LB nitrogen/1000 s.f. In small areas where hydroseeding is not practical, treat with ½” layer of organic matter raked into to 2” of disturbed soil, cover with 1” layer of organic mulch after seeding. Apply 3-2-1 fertilizer watered in.

A second seeding application may be necessary to ensure adequate control of weedy species between seeding applications.

Maintenance

Contractor is responsible for maintenance of seeded areas, including watering during dry periods, weed removal, monitoring of germination, and reseeding to ensure full stand of grass without bare spots not exceeding 18” x 18”. Provide full maintenance for 60 days from date of seeding application or until satisfactory stand is established, whichever is greater. When initial maintenance period has not elapsed before end of planting season, or if grass stand is not fully established, continue maintenance during next planting season.

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Sodding

Part 1 - General

Sod is required at new turf areas; seeding bluegrass areas is not acceptable to establish new lawns.

Warranty sod for a period of one (1) year from date of acceptance. During warranty period, replace sod that has died or is in unsatisfactory condition.

Contractor is to notify Owner of any new sod plantings.

Part 2 – Products

Sod shall be Arizona-grown bluegrass rye mix blend having a healthy, vigorous root system. Blend shall contain a minimum of two (2) improved bluegrass varieties and no more than 25% of rye. Sod shall be tolerant of drought, sun to shade and foot traffic is preferred. Sod soil base to be similar to NAU campus soil types. Sod grown on a sandy loam soil will not be accepted. Owner has pre-approved the following source to be in compliance with these standards (due to similar soil base): Northland Sod in Chino Valley. Alternative sources are to be submitted to Owner (landscape architect) for approval. Sod with excessive weed content will be rejected.

Sod is subject to inspections and acceptance. Owner reserves the right to reject at any time prior to acceptance, any work and sod which in the Owner’s opinion fails

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to meet the requirements herein. Rejected sod shall be promptly removed and replaced at Contractor’s expense.

Sod shall be healthy, thick turf having undergone a program of regular fertilization, mowing and weed control; free of objectionable weeds; uniform in green color, leaf texture and density; healthy, vigorous root system; inspected and found free of disease, nematodes, pests and pest larvae.

Each piece of sod shall have a soil base that will not break, crumble, or tear during installation. Root base shall be 1” thick. Thatch not to exceed ½” compressed. Sod shall be cut in strips or slabs no more than twenty-four (24) hours prior to delivery.

Deliver inorganic or chemical fertilizer(s) to site in original unopened container bearing manufacturer’s guaranteed chemical analysis, name, trade name, trademark, warranty and conformance to state law.

New imported topsoil shall be fertile natural loam and subject to inspection and acceptance by Owner (landscape architect), accompanied by required soils analysis.

Organic soil amendment product shall be certified as fully composted and contain no solid particle greater than ½” in length or diameter, and be free from uncomposted and non-stabilized wood bulking agents. Provide soil conditioner analysis to Owner (landscape architect and Landscaping & Outdoor Services) three (3) weeks prior to delivery to site.

Use selective herbicides, insecticides and fungicides as approved by Owner and adhere to local environmental laws.

Part 3 – Execution

Landscape contractor to verify site conditions are specified prior to beginning sodding work. Report unsatisfactory conditions in writing to General Contractor and Owner. Beginning of installation means acceptance of conditions.

The soil shall be thoroughly rototilled to a depth of 6” minimum and fine graded to receive the grass. Contractor shall request a DP inspection on the grading, to be submitted to Owner. Contractor to request grade inspection from NAU LOS or Landscape Architect. Till imported soil with native soil to eliminate stratification between different soil types.

All sod must be in place prior to September 15th and warranty must be provided for one (1) year from the date of Substantial Completion.

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Sod shall be delivered on pallets with root systems protected from exposure to sun, wind, and heat in accordance with standard practice and labeled with botanical and common name of each grass species in accordance with federal seed act.

Sod to be protected from dehydration, contamination and heating at all times. Store sod moist and under shade or covered with moistened burlap. Do not drop sod rolls or slabs from carts, trucks, or pallets. Do not stack more than 24" deep. Install sod within twenty-four (24) hours of delivery. Remove soil base netting/mesh from rolls.

Import and place any fill material required to adjust the fine grade to meet drainage requirements or to match adjustment surface fine grades. Soil levels shall be 1" down from adjacent grades. Remove weeds, debris, and rocks larger than ½" which may hinder sodding. Dispose of debris off-site. Provide smooth, well-countered surface prior to sod installation.

Adjust irrigation heads and valve boxes to be flush with finish grade (not turf blade height).

Install sod between spring and fall: April 15th – September 15th. Do not install on frozen or saturated soil.

Sod which is laid shall be slightly moist. Lay sod with longest dimension parallel to contours and in continuous rows. Tightly butt ends and sides of sods together. Stagger rows by 2' minimum and compact vertical joints between strips or slabs so sod will be incorporated into ground surface, ensuring tight joints between pieces. Sod shrinkage is grounds for rejection.

When soil and sod are moist, hand-roll sod lightly as soon as possible after laying. Ensure positive drainage of storm and irrigation water will occur without ponding after sod installation.

Protect sodded areas against damage from pedestrian and vehicular until acceptance by Owner.

Evenly distribute soil conditioner at a rate of 3 c.y. per 1,000 S.F.

First application of fertilizer to sodded areas shall be starter fertilizer applied per manufacturer's recommendations. Water turf thoroughly following applications.

Remove annual weeds by tilling and perennial weeds by applying herbicide one (1) week before soil preparation and as needed, but no sooner than three (3) after

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emergence. Contractor to provide seventy-two (72) hour notice prior to application.

Rip to a minimum 6" depth after rough grading has been established. In area where extremely stiff material or rock is encountered, re-adjust depth to avoid bringing up chunks of untillable material.

Compact grade at sod areas to 80% SPD with 2% optimum moisture.

Maintenance period shall begin immediately after each area is sodded and continue for 60 days or until satisfactory turf is established, whichever is greater. When initial maintenance period has elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season. During this time, be responsible for watering, mowing, fertilizing, spraying, weeding, aerating and all related work as necessary to ensure that sodded area is in a vigorous growing condition. Furnishing all supervision, labor, material and equipment to maintain turf areas.

Initially water sod upon completion until the irrigation system can be operated under full control. Water sod sufficiently to moisten subsoil at least 4" deep.

Mow to maintain turf at 2 ½" height. Do not remove more than 33% of grass leaf in single mowing. Remove clippings from pavement areas.

Resod spots larger than 1 s.f. not having healthy, uniform stand of grass and resod or overseed (using like for like soil) joints which separate ½" or more.

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Plants

Part 1 – General

Unless otherwise approved by Owner, minimum sizes for material as follows:

- Deciduous trees: 2" caliper
 - Aspen shall be single stem, no multiples
- Evergreen trees 6'-8' height
- Shrubs and ornamental grasses: 5 gallon
- Perennials 1 gallon

Refer to Landscape Master Plan for complete list and description of plant materials for each character zone. Design Professionals shall not specify or permit the substitution of materials that do not appear on the approved lists, unless approved by campus landscape architect.

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Plant Non-Availability: In order to request a substitution of plant material the Contractor must submit in writing a request for plant substitution including a list of a minimum of (3) major nurseries which indicated they could not supply the specific plant material at the specified size. The Contractor shall suggest a substitution for a different size of the specified plant or different variety of species, including its size and root condition. Requests for substitution will be reviewed and a written response provided by the Design Professional and/or campus landscape architect. The Contractor shall not proceed with ordering or installing any requested substitutions until receipt of written approval is received.

Owner reserves the right to inspect and choose trees, shrubs, and other plantings in the nursery field or some other site prior to planting. Provide at least five (5) working days written request for inspection prior to the proposed date.

Owner has the option of acceptance or rejection of any plant materials deemed unacceptable upon delivery to the site.

Plant installation processes and maintenance after planting shall be reviewed by Owner. Any plants not installed according to campus standards must be removed and re-installed. Follow Owner standard planting details.

Warranty

Trees shall be guaranteed by Contractor for minimum two years after substantial completion. All other plant materials to be guaranteed for one year. At any time during the warranty period, the Contractor shall remove or replace, without cost to the Owner, all plants not in a healthy and flourishing condition as determined by the Owner or Design Professional.

Replacement plants shall be subject to the same specified requirements, including adherence to original duration of the warranty.

Include the following remedial actions as a minimum:

- Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
- Replace plants that are more than 25% dead or in an unhealthy condition at end of warranty period.

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Planting Plans

Planting plans shall graphically depict tree sizes canopies at 75% maturity, with no more than 30% overlap between canopies to allow sufficient space for growth and uptake of water and nutrients. Represent shrub, perennial, and ornamental grass plantings at 90% maturity (within approximately three years of planting).

Planting design shall achieve minimum 80% coverage on the ground plane after three-four year establishment period. Use staggered or triangular plant spacing (avoid linear patterns). Evergreens and winter interest plants shall comprise 30-50% of the planting palette. Seasonal interest to include year-round color and structure, with particular emphasis on fall, winter and spring seasons.

Concrete header to be used for planting bed borders where they abut turf or native grass meadow areas. In instances where concrete header is not practical (i.e. installation would damage existing tree roots), planting beds shall have a 45 degree, 6 inch deep shovel-cut edge. Do not use metal or plastic edging.

Refer to Landscape Master Plan Principles and Design Standards for special areas, i.e. parking screening, accent areas, and for North, Central, and South campus character zone principles.

Part 2 – Products

Quality Assurance

All plants shall be healthy, true to species and variety/hybrid/cultivar specified, and nursery-grown in accordance with good horticultural practices and under climatic conditions similar to those of campus. Material to meet full size of specifications (no recent shifts to larger container), and shall conform to American Standard for Nursery Stock and standard specifications for height, width, caliper and grade specified.

Trees and shrubs shall be trained in development and appearance as to be superior in form, compactness and symmetry. Trees with multiple leaders, unless specified otherwise, and shrubs with damaged or cut main stem(s), will be rejected.

Trees and shrubs with a damaged, cut or crooked leader, abrasion of bark, sunscald, frost crack, disfiguring knots, insects (including eggs and larvae) or insect damage, cankers/cankerosus lesions or fungal mats, mold, prematurely-opened buds, or cuts of limbs over 3/4" (1.9 cm) diameter that are not completely callused will be rejected.

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Trees and shrubs shall have healthy, well-developed root systems, and be free from physical damage or other hindrances to healthy growth.

Balled and burlapped plants shall be dug with solid balls of a diameter not less than that recommended by the American Standards for Nursery Stock, and of sufficient depth to include both fibrous and feeding roots. Balls shall be securely wrapped with burlap, and tightly bound with rope or twine. No plant shall be bound with rope or wire in such manner as to damage bark or break branches. The root flare should be within the top 2” (5.1 cm) of the soil ball.

Balled and burlapped plants will not be accepted if the ball is dry, cracked, or broken before or during planting.

Containerized plants are to be well-established within the container, with a root system sufficiently developed to retain its shape and hold together when removed from the container. Soil within the container should be held together by the roots, in form and whole. Plants shall not be pot-bound, nor have kinked, circling, or bent roots.

Bare root plants are to have a healthy, well-branched, and adequately spreading root system characteristic of the species.

Measurement

Plants shall conform to the measurements specified within the contract documents. Specified height and spread dimensions will refer to the main body of the plant, and not from branch tip to branch tip. Plants meeting a specified measurement, but judged to lack the balance between height and spread characteristic of the species will be rejected.

Plants shall be measured when branches are in their normal position.

No plant shall be less than the minimum size specified, and no less than fifty (50) percent of the plants shall be as large as the maximum size specified.

Measure the trees and shrubs with their branches, canes, and trunks in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

Containerized shrubs shall be measured by height and width for conformity with the plant list.

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Perennials shall be measured by pot size, not by top growth.

All other measurements, such as number of canes, ball sizes, and quality designations, shall conform to *American Standards for Nursery Stock*.

Plant List

Refer to Landscape Master Plan for complete list (species and varieties) of plant materials for each campus character zone. Genuses are listed below for perennials, ornamental grasses, shrubs, and trees.

Deciduous Trees

Botanical Name	Common Name
<i>Acer</i>	Maple
<i>Amelanchier</i>	Serviceberry
<i>Celtis</i>	Hackberry
<i>Crataegus</i>	Hawthorn
<i>Fraxinus</i>	Ash
<i>Gleditsia</i>	Honeylocust
<i>Gymnocladus</i>	Kentucky Coffee Tree
<i>Populus</i>	Aspen
<i>Prunus</i>	Cherry
<i>Quercus</i>	Oak
<i>Robinia</i>	Locust
<i>Sorbus</i>	Ash
<i>Ulmus</i>	Elm
<i>Populus</i>	Cottonwood

Evergreen Trees

Botanical Name	Common Name
<i>Abies</i>	White Fir
<i>Picea</i>	Spruce
<i>Pinus</i>	Pine
<i>Pseudotsuga</i>	Douglas Fir
<i>Sequoiadendron</i>	Sequoia
<i>Juniperus</i>	Juniper

Deciduous Shrubs

Botanical Name	Common Name
<i>Amelanchier</i>	Serviceberry
<i>Aronia</i>	Chokeberry
<i>Caryopteris</i>	Spirea

Section Number	Title	
	<i>Cornus</i>	Dogwood
	<i>Cotoneaster</i>	Cotoneaster
	<i>Ligustrum</i>	Privet
	<i>Lonicera</i>	Honeysuckle
	<i>Philadelphus</i>	Mockorange
	<i>Potentilla</i>	Cinquefoil
	<i>Prunus</i>	Sand Cherry
	<i>Prunus</i>	Almond
	<i>Prunus</i>	Cherry
	<i>Rhus</i>	Sumac
	<i>Ribes</i>	Currant
	<i>Rosa</i>	Rose
	<i>Spiraea</i>	Spirea
	<i>Symphoricarpos</i>	Coralberry
	<i>Syringa</i>	Lilac
	<i>Viburnum</i>	Viburnum
	<i>Amorpha</i>	Leadplant
	<i>Holodiscus</i>	Mountain Spray
	<u>Evergreen Shrubs</u>	
	Botanical Name	Common Name
	<i>Juniperus</i>	Juniper
	<i>Mahonia</i>	Oregon Grape Holly
	<i>Pachystima</i>	Mountain Lover
	<i>Picea</i>	Spruce
	<i>Pinus</i>	Mugo Pine
	<i>Chamaebatiaria</i>	Fernbush
	<u>Ornamental Grasses</u>	
	Botanical Name	Common Name
	<i>Andropogon</i>	Big Bluestem
	<i>Calamagrostis</i>	Feather Reed Grass
	<i>Carex</i>	Sedge
	<i>Festuca</i>	Fescue
	<i>Helictotrichon</i>	Blue Avena Grass
	<i>Miscanthus</i>	Maiden Grass
	<i>Panicum</i>	Switch Grass
	<i>Bouteloua</i>	Blue Grama
	<i>Muhlenbergia</i>	Deergrass
	<i>Muhlenbergia</i>	Muhly
	<i>Blepharoneuron</i>	Dropseed
	<i>Poa</i>	Muttongrass
	<i>Schizachyrum</i>	Little Bluestem

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Sorghastrum
Sporobolus

Indian Grass
Alkali Sacaton

Perennials

Botanical Name

Common Name

Achillea
Agastache
Aquilegia
Aster
Callirhoe
Calylophus
Centranthus
Cerastium
Ceratostigma
Clematis
Coreopsis
Delphinium
Echinacea
Erigeron
Gaillardia
Galium
Geranium
Hemerocallis
Heuchera
Iris
Lavandula
Leoucanthemum
Lupinus
Monarda
Nepeta
Oenothera
Papaver
Parthenocissus
Penstemon
Phlox
Potentilla
Ratibida
Rubbeckia
Salvia
Saponarai
Stachys
Tanacetum
Thalictrum

Yarrow
Hyssop
Columbine
Aster
Winecups
Sundrops
Red Valerina
Snow in Summer
Plumbago
Westen Virgin’s Bower
Coreopsis
Delphinium
Coneflower
Fleabane
Blanket Flower
Sweet Woodruff
Geranium
Daylily
Coral Bells
Iris
Lavender
Shasta Daisy
Lupine
Bee-Balm
Catmint
Primrose
Poppy
Virginia Creeper
Beardtongue
Phlox
Cinquefoil
Coneflower
Blacked-Eyed Susan
Salvia
Rock Soapwort
Lamb’s Ear
Partridge Feather
Meadow Rue

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section Number	Title	
	<i>Thymus</i>	Thyme
	<i>Veronica</i>	Speedwell
	<i>Vitis</i>	Canyon Grape
	<i>Zaushneria</i>	Hummingbird Flower
	<i>Arctostaphylos</i>	Kinnikinnick
	<i>Hedera</i>	English Ivy
	<i>Geum</i>	Prairie Smoke
	<i>Heuchera</i>	Coral Bells
	<i>Iberis</i>	Candy Tuft
	<i>Lonicera</i>	Honeysuckle
	<i>Mahonia</i>	Mahonia
	<i>Paxistima</i>	Mountain Lover
	<i>Penstemon</i>	Penstemon
	<i>Teucreum</i>	Germander
	<i>Thymus</i>	Thyme
	<i>Veronica</i>	Speedwell
	<i>Vinca</i>	Periwinkle
	<i>Akebia</i>	Akebia
	<i>Akebia</i>	Chocolate Vine
	<i>Clematis</i>	Western Virgin's Bower
	<i>Hedera</i>	English Ivy
	<i>Lonicera</i>	Honeysuckle
	<i>Parthenocissus</i>	Virginia Creeper
	<i>Vitis</i>	Canyon Grape
	<i>Asclepias</i>	Butterfly Weed
	<i>Castilleja</i>	Paintbrush
	<i>Eriogonum</i>	Buckwheat
	<i>Erysimum</i>	Wallflower
	<i>Fragaria</i>	Wild Strawberry
	<i>Gaura</i>	Whirling Butterflies
	<i>Helianthus</i>	Maximillian's Sunflower
	<i>Ipomopsis</i>	Scarlet Gilia
	<i>Litras</i>	Gayfeather
	<i>Linanthastrum</i>	Mountain Phlox
	<i>Linum</i>	Blue Flax
	<i>Lithospermum</i>	Stoneseed
	<i>Machaeranthera</i>	Aster
	<i>Monardella</i>	Mint
	<i>Oxytropis</i>	Locoweed
	<i>Pseudocymopterus</i>	Mountain Parsley
	<i>Saponaria</i>	Rock Soapwort
	<i>Senecio</i>	Groundsel
	<i>Solidago</i>	Goldenrod

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	<i>Thermopsis</i> Golden Banner
	<i>Veronica</i> Speedwell
	<i>Viola</i> Violet
	<i>Prairie Zinnia</i> Paper Flower
	<i>Antennaria</i> Pussytoes
	<i>Polygonum</i> Silver Lace Vine
	<i>Aurinia</i> Allysum
	<i>Origanum</i> Oregano
	<i>Santolina</i> Lavender Cotton
	<i>Scabiosa</i> Pincushion Flower

Refer to Section 32 92 16 (Plugging) and 32 92 22 (Hydroseeding) for Tall and Short Meadow Grasses.

Part 3 – Execution

All plants and trees shall be identifiable to Owner to verify species with the plant tag. All plant tags, pricing, identifiers, and care labels to be removed by Contractor at Substantial Completion.

All trees must be installed prior to September 15 to allow one month of irrigation prior to winterization.

An on-site mockup stake layout of planting bed areas and trees shall be approved by Owner and Design Professional prior to installation.

Trees located in turf lawns (existing and proposed) shall be provided with four foot diameter mulch rings, with sod free soil beyond and around the full circle of the tree, excluding large existing trees, upon approval from Owner. Tree groupings (existing and proposed) within lawn areas may have one large mulch planting bed around them.

Preferred distance for deciduous trees from paved surfaces (walks and mowing edges) is six feet (3' minimum with approval by campus landscape architect). Evergreen trees to be planted no closer than two feet greater than the anticipated mature radius of branching from paved surfaces.

Maintain access to manholes for equipment and/or safety gear when locating new trees and other plantings. Location of new trees from the centerline of sanitary and storm sewer utilities to be as follows:

- Deciduous ornamental trees: 6' minimum
- Deciduous shade trees: 8' minimum
- Evergreen trees (full size): 10' minimum
- Dwarf variety evergreen trees: 6' minimum

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Aspen trees should not be planted in lawn areas and should be five feet minimum from paved surfaces. Clump or multi-stem form aspen not permitted unless approved by NAU LOS or Landscape Architect.

Plant material planted in rows shall be uniform in size and shape.

Trees and shrubs shall not be planted until all construction working the area has been completed, final grades established, the planting areas properly graded and prepared as specified.

Existing Plant Material

To minimize disruption and protect existing tree roots, the guidelines below shall be followed:

- Locate poles, conduit, boxes 10' min. from tree trunk for large mature trees such as Elm.
- Locate poles, conduit, boxes 6' min. from tree trunk for smaller mature trees such as Crabapple.
- Never cut roots within 2' of tree trunk. Cutting of just one buttress root within 2' of tree reduces stability strength by 25%, making tree a liability even if it survives.
- Ideal tree protection is the entire dripline (full canopy diameter). Majority of roots (80%) are in the top 2' of soil.

Temporary Protection

Contractor to provide temporary fencing, barricades or guards during construction to protect from damage existing trees, lawn, and other plants which are designated to remain on site with green colored "cyclone" or "snow" fencing.

Protect root systems by not storing construction materials, debris, or excavated material within five (5) feet of the drip line of the tree (outer perimeter of the branches). Do not permit vehicle traffic within outer perimeter of the branches and restrict foot traffic to prevent excessive compaction of the soil over root systems.

Repair and Replacement of Existing Trees, Shrubs and Lawn

Repair trees, shrubs and lawns damaged by construction in a manner acceptable to the Owner. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees, shrubs, and lawns.

Remove and replace dead and damaged trees, lawns, and shrubs, which are determined by the Owner to be incapable of restoration to normal growth

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patterns. Damaged plants, lawns or grass areas shall be replaced and treated as required to conform with specifications herein for fresh stock.

Replace existing damaged and dead plant material with same size and species. Plant, maintain, and warranty as specified under landscaping section of the specifications. Use campus standard planting details. Cover disturbed planting bed area with 4" of mulch and restore back to preconstruction conditions.

For any trees requiring replacement due to neglect by the Contractor that have a caliper greater than 4", a penalty per tree will be assessed. Penalty will be assessed at the value identified by Owner's tree software, or, if not identified in the software, at fair market value. The penalty shall be in addition to the required replacement planting.

32 96 00 Transplanting

Part 1 – General

Salvage of existing trees from a project shall be performed by a firm approved by Owner with at least four years of experience with this type of work. The work shall be guaranteed and conducted in a manner consistent with local practice. Owner shall designate a holding area and source of irrigation for containerized or otherwise temporarily stored trees. Owner has first right of refusal for all plantings or materials removed or transplanted from the site. Contractor is required to provide the Owner (Landscape and Outdoor Services and Project Manager) a minimum 72 hours' notice prior to any site removals or anticipated transplants and salvages.

Part 2 – Products

No specific products included.

Part 3 – Execution

Transplanting of plant materials shall be consistent with Section 32 90 00 (Planting) and the execution section of Section 32 91 00 (Planting Preparation).

****END OF SECTION****