# City of Flagstaff Engineering

**Materials Approval Requirements**
**2019 Construction Season**

For all Materials Approvals, the City of Flagstaff is requesting the following items be provided as a complete submittal for approval consideration. The following are items that must be received in order to obtain approval. Review and Approvals can take up to 7 working days once a complete submittal is received. Incomplete submittals will not be reviewed. Submit sealed cover letter and the appropriate attachments to: jdegeyter@flagstaffaz.gov (include product name in subject line).

If you have any questions, please contact Jeremy DeGeyter, Engineering Project Manager at (928) 213-2706, jdegeyter@flagstaffaz.gov.

**The requirements listed below should not be considered exhaustive and are presented for general reference.**

## General Requirements for all Submittals

1. **Cover letter (typically from testing firm), sealed/stamped by a registered professional,** indicating the material submitted meets all testing requirements (MAG with City of Flagstaff revisions) and is suitable for the specified use.
    a. Letter should include material description, material identification (label, lot, number) and any other important reference information.
    b. Letter should address any deficiencies identified during testing and why the material should be approved.
2. **Testing Results** (requirements depend on type of approval, see below)
    a. **Existing materials*** seeking re-approval (e.g. previously approved in prior year) should submit laboratory test results, with all appropriate testing performed, for a minimum of one (1) sample.
    b. **For New approvals*** (e.g. not approved for use in the prior year or short-run/on site crushing operations) laboratory test results should be supplied for a minimum of three (3) samples, with all appropriate testing performed on each sample.

***Recycled Asphalt (RAP) or Recycled Concrete (RCM) products are considered short run materials due to varying source materials and will require testing results from three (3) samples, regardless of prior approval.**
*** Pipe bedding and shading materials are not required to be MAG ABC, however must meet MAG 601.4.8 requirements for Granular Materials. Submit one (1) set of test results, along with sealed cover letter for approval.**

## Concrete Mix Design Requirements

1. Mix design should meet MAG 725 requirements and any City of Flagstaff Revisions.
2. Important City of Flagstaff Revisions (Should not be considered exhaustive):
    a. All Concrete Classes: Maximum Slump of 4 inches
    b. Concrete Classes AA, A, and B: 5% to 7% entrained air for exposed structures
    c. 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.

## Non-Shrink Slurry Backfill Mix (City of Flagstaff)

1. Mix proportions shall be as follows:
    a. 2,600 lbs 3/8" minus aggregate
    b. 800 lbs sand
    c. 94 lbs Portland cement
    d. 11 gallons of water

## CLSM/Slurry Backfill

1. Mix design should meet MAG 728 requirements.
    a. Aggregates should pass all testing required per MAG 701 or 702.
2. Flow requirements:

**TABLE 728-1**

**CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS**

| Portland Cement Content, Sack/cu yd | Flow, inches |
|---|---|
| 1/2 Sack | 9±2 |
| 1 Sack | 9±2 |
| 1 1/2 Sack | 9±2 |

## Asphalt Mix Design Requirements

1. Mix design should meet MAG 710 requirements and any City of Flagstaff Revisions.
2. Important City of Flagstaff Revisions (Should not be considered exhaustive):
    a. The asphalt to be mixed with the mineral aggregate shall be paving grade asphalt conforming to AASHTO Designation MP1, Standard Specification for Performance Grade Asphalt Binder and shall be 58-28 unless otherwise specified in the special provisions. AC 20 conforming to Section 711 may be used if PG 58-28 is not available.
    **b. Up to 15% Recycled Asphalt Products (RAP) allowable in mix design. Conditions will apply.**
    c. Aggregate-Volcanic cinders or materials containing clay balls, coated rock or other deleterious materials shall not be used.
    d. The aggregate and mix to be incorporated into the work shall also meet the following requirements:

| Test | Acceptable Test Results |
|---|---|
| Loss on Abrasion (ASTM C 131 and/or AASHTO T-96) after 500 revolutions | 40 Maximum |
| Absorbed Asphalt Range (AASHTO T-245) | 0-1% |
| Combined Water Absorption (AASHTO T-84) | 0-2.25% |

    e. All asphaltic concrete shall contain a minimum of 1% Portland Cement or dry hydrated lime by weight of total mixture.
    f. For MAG 710.3.2.1: Revise the percent of asphalt range for B-1 and three-quarter (3/4) inch asphaltic concrete from five percent (5%) to six percent (6%) to five and three-tenths percent (5.3%) to six percent (6%).
    g. Revise MAG Table 710-3 as follows:
        i. Dry Tensile Strength: psi, Min. from 100 to 65 for all mixes
        ii. Stability: pounds, Min. 1/2" and 3/4" mixes, from 2,500 to 2,000
3. Aggregate Testing Requirements from MAG Table 710-2:

| TABLE 710-2<br>COARSE/FINE AGGREGATE REQUIREMENTS | | | |
|---|---|---|---|
| Characteristics | Test Method | Low Traffic | High Traffic |
| Fractured Faces, %<br>(Coarse Aggregate Only) | Arizona 212 | 75, 1 or more | 85, 1 or more<br>80, 2 or more |
| Uncompacted Voids, % Min. | AASHTO T-304, Method A | 42 | 45 |
| Flat & Elongated Pieces, % 5:1 Ratio | ASTM D4791 | 10.0 Max. | 10.0 Max. |
| Sand Equivalent, % | AASHTO T-176 | 50 Min. | 50 Min. |
| Plasticity Index | AASHTO T-90 | Non-plastic | Non-plastic |
| L.A. Abrasion, %Loss | AASHTO T-96 | 9 max. @ 100 Rev.<br>40 max. @ 500 Rev. | 9 max. @ 100 Rev.<br>40 max. @ 500 Rev. |
| Combined Bulk Specific Gravity | AI MS-2/SP-2 | 2.35 – 2.85 | 2.35 – 2.85 |
| Combined Water Absorption | AI MS-2/SP-2 | 0 – 2.5% | 0 – 2.5% |

## Aggregate Base Requirements

1. Aggregate Base should meet MAG 702 requirements and any City of Flagstaff Revisions.
    a. Per MAG 702: Recycled Concrete Materials (RCM) meeting the requirements of Section 701.4 can be utilized in base material at a **maximum quantity of 50%** and may be used in roadway applications or where otherwise specified by project plans or special provisions.
    b. Per MAG 702: Recycled Asphalt Products (RAP) meeting the requirements of Section 701.5 can be utilized in base material up to 100% and may be used in roadway applications or where otherwise specified by Project plans or special provisions.
2. Important City of Flagstaff Revisions (Should not be considered exhaustive):
    a. Volcanic Cinders are not acceptable
    b. Amend Table 702-1: For aggregate base, the percentage by weight passing the No. 200 sieve shall be limited to no more than 10 percent.
3. Testing Requirements from MAG Table 702-1:

| Table 702-1 | | | |
|---|---|---|---|
| Sieve Analysis<br>Test Methods AASHTO T-27, T-11 | | | |
| Sieve Size | Accumulative Percentage Passing Sieve, by Weight | | |
| | Select Material | | Aggregate Base Course |
| | Type A | Type B | |
| 3 in. | 100 | - - | - - |
| 1-1/2 in. | - - | 100 | 100 |
| 1 in. | - - | - - | 90 – 100 |
| No. 4 | 30 - 75 | 30 - 70 | 38 - 65 |
| No. 8 | 20 - 60 | 20 - 60 | 25 – 60 |
| No. 30 | 10 - 40 | 10 - 40 | 10 – 40 |
| No. 200 | 0 - 12 | 0 - 12 | 3 – 12 |
| Plasticity Index<br>Test Methods AASHTO T-89 Method A, T-90, T146 Method A | | | |
| Maximum allowable value | 5 | 5 | 5 |
| Fractured Face, One Face<br>Test Method ARIZ 212, Percent by Weight of the Material Retained on a #4 Sieve | | | |
| Minimum required value | 50 | 50 | 50 |
| Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine<br>Test Method AASHTO T-96, Percent Loss by Weight | | | |
| Maximum allowable value at 100 revolutions | 10 | 10 | 10 |
| Maximum allowable value at 500 revolutions | 40 | 40 | 40 |

## Reclaimed Asphalt Pavement/Recycled Asphalt Products (RAP)

1. Per MAG 701.5: Reclaimed asphalt pavement (RAP) is defined as all recovered, salvaged or recycled asphalt road waste, large particles or milled material that has been size-reduced, crushed and or screened appropriately, making it reusable. This material shall be of a consistent and relatively clean manner as to not adversely affect the final material usage. RAP may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RAP shall not be used in Portland Cement Concrete without the prior approval of the Engineer.

2. Per MAG 702: RAP meeting the requirements of Section 701.5 can be utilized in base material up to 100% and may be used in roadway applications or where otherwise specified by Project plans or special provisions.
3. RAP should meet or exceed testing requirements per applicable sections of MAG 701 or 702.

**Reclaimed Concrete Material (RCM)**

1. Per MAG 701.4: Reclaimed concrete material (RCM) is defined as an aggregate material that is derived from the crushing, processing and classification of Portland cement concrete construction materials recovered, salvaged, or recycled from roadways, sidewalks, buildings, bridges, and other sources. In accordance with Section 7 of AASHTO M319, RCM shall not contain more than five percent by mass of brick or concrete block and shall be substantially free of wood, metal, plaster, and gypsum board, RCM shall be free of all materials that fall under the category of solid waste or hazardous materials as defined by the state or local jurisdiction. With the approval of the Engineer, these respective quantities may be adjusted if the performance of the RCM is not adversely impacted. RCM may be used alone or uniformly blended with other approved aggregate materials to obtain the applicable performance criteria. RCM shall not be used in Portland Cement Concrete without the prior approval of the Engineer.
2. Per MAG 702: RCM meeting the requirements of Section 701.4 can be utilized in base material at a **maximum quantity of 50%** and may be used in roadway applications or where otherwise specified by project plans or special provisions.
3. RCM should meet or exceed testing requirements per applicable sections of MAG 701 or 702.

## Flagstaff Urban Trail System (FUTS) Materials

1. FUTS Aggregate Base should meet MAG 702 requirements, except that the gradation shall be as follows:

| SIEVE SIZE (SQUARE OPENINGS) | PERCENT BY WEIGHT PASSING SIEVE |
|---|---|
| 1" | 100 |
| 3/4" | 96-100 |
| 1/2" | 85-99 |
| 3/8" | 79-98 |
| No. 4 | 68-87 |
| No. 8 | 52-74 |
| No. 30 | 27-50 |
| No. 100 | 16-33 |
| No. 200 | 13-27 |

2. Aggregate surface material shall be a color compatible with natural surroundings and acceptable to the City. White, light grey, or other visually incompatible colored aggregates will not be accepted.
3. FUTS Dirty Cinder base materials must meet the following gradation specification:

DIRTY CINDER GRADATION SPECIFICATION

| SIEVE SIZE (SQUARE OPENINGS) | PERCENT BY WEIGHT PASSING SIEVE |
|---|---|
| ¾" | 90-100 |
| No. 4 | 58-78 |
| No. 8 | 37-67 |
| No. 30 | 13-35 |
| No. 100 | 4-15 |
| No. 200 | 0-12 |

**LID Materials (Two submittals required; one for Development Engineering and one for Stormwater)**

1. Per the figure on page 3-47 of the LID manual the approved sand soil mixture for the sand/peat layer in a Bio Retention (BR) basin is 85% ASTMC-33 Sand and 15% Peat mix.
2. This is not necessarily the only allowable gradation and material. Alternatives that have been allowed:
    a. 80% ASTM C-33 sand, 5% topsoil, and 15% composted steer manure.
        i. This sand has also been specified as "all-purpose sand, washed and dried (ASTM C-33)"

    b. 80% sand, 10% topsoil, and 10% composted steer manure.

    c. 80% dirty cinder – (unscreened ¾" minus dirty cinders), 5% topsoil, and 15% composted steer manure mix

    d. 80% all-purpose sand, washed and dried (ASTM C-33), 10% Steer Manure, and 10% garden soil.
        i. Please note:
            1. Steer Manure must be "composted"
            2. Top soil and Garden soil are wide range terms; therefore, a specification must be provided by the Designer or Landscape Architect. This would include organic percentages, gradation, clay content etc.
3. Also note that an extended detention basin (EDB) has a sand/soil bed as discussed in section 3.8 and shown in the figure on page 3-52 with no additional clarification so to-date the same mixes have been allowed.
4. Per the LID manual, planting media shall be delivered fully mixed in a drum mixer. On-site mixing of piles shall not be allowed.