1 Tunnel Design
1.1 Cast in Place concrete or Precast concrete shall be provided. Corrugated metal pipe, poly or other prefabricated units are not permitted.
1.2 Precast tunnel systems shall consist of a three-sided, bottom and sides section with a removable top assembled to form a completely enclosed tunnel.
1.3 Precast concrete units shall be tested and conform to the current edition of the American Concrete Institute Standard ACI-711, Section 301.
1.4 Tunnel top should integrate the sidewalk surface where applicable.
1.5 Tunnel lifting hooks for precast tunnels shall be recessed and the joints shall be properly sealed and watertight.
1.6 Concrete mix designs for precast or cast in place tunnel tops, walls, vent shafts, etc. shall include a Crystalline waterproofing admixture (Xypex®) at the dosage specified by the manufacturer.
1.7 All tunnels shall be designed in accordance with AASHTO LRFD Bridge Design Specifications and for AASHTOHL-93 vehicle loading.

2 Soil Conditions & Backfill
2.1 Soil conditions shall be determined for each application by a Geotechnical Engineer registered in the state of Indiana.
2.2 All backfill to be placed under precast or cast in place tunnels or other underground structures for utility piping, sewer or water piping, conduit, duct banks, etc. shall be flowable fill.
2.3 All backfill to be placed adjacent to the sides and tops of precast or cast in place concrete trenches concrete utility tunnels, duct banks, pipe culverts, half-tiles, etc. and any other underground concrete structures subject to vehicular loading shall be flowable fill. This includes, but is not limited to, parking lots, roadways, alleys, streets, loading docks, pits, vaults, etc.. Provide a minimum flowable fill thickness of six inches (6") over the tops of the underground structure.
2.4 Compacted granular fill placed adjacent to, over top of or under precast or cast in place concrete trenches, culverts, utility tunnels, duct banks, pipe culverts, half-tile, etc. and other underground concrete structures subject to vehicular loading without prior approval by the Structural Engineer and/or Geotechnical will be removed by the installing Contractor at no additional expense to the Owner.

3 Tunnel Gaskets
3.1 Manufacturer shall flexible plastic gaskets for all joints in the installation.
3.2 Manufacturer shall also provide a sufficient quantity of primer to adequately prepare joints for installation under wet conditions.

4 Tunnel Manhole Frames, Hatches and Covers
4.1 Manhole frames and lids shall be designed in accordance for AASHTO HL-93 vehicle loading and selected for each application with Purdue approval.
4.2 Access hatches for tunnels, pits, and other accessible underground spaces, shall be aluminum, 60/40 opening size with Emergency Exit Release (panic hardware) from the interior. Hatches shall include a removable exterior turn/lift handle with a spring loaded ball detent to open the cover and the latch release shall be protected by a flush, gasketed, removable brass screw plug. A rim cylinder lock keyed outside, thumb knob inside, shall also be provided as an integral component of the Emergency Exit Release. Minimum dimensions 3’x6’ unless otherwise specified.
4.3 Grating for Vent shafts or other openings exposed to view shall be ADA compliant galvanized, grating with a minimum capacity of 500 psf uniform load and a 1,500 lb concentrated load.

5 Tunnel Top Waterproofing Standards
5.1 Underground/Buried Tunnel: 60 mil nominal thick Elvaloy KEE based thermoplastic membrane reinforced with a 5.0 oz. weft inserted knit polyester fabric integrally bonded to an Active Polymer Core (APC).
   5.1.1 Heat-welded seams
   5.1.2 Wrap membrane down sides of tunnel to the top of the footing.
5.1.3 Warranty: Special Manufacturer’s Warranty: A written non-prorated waterproofing warranty, covering both materials and labor, in which manufacturer agrees to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
   5.1.3.1 Warranty Period: 15 years from date of Substantial Completion.
   5.1.3.2 Warranty shall include removal cost, subsequent system repair, and replacement of the overburden, paving, etc. at manufacturer’s
expense for repairs resulting from the loss of water tightness due to failure of the waterproofing system, if necessary.

5.1.3.3 Warranty shall be a ‘no dollar limit’ warranty.

5.1.3.4 Contractor is responsible for installing the complete system as required to achieve the manufacturer’s warranty requirements.

5.1.3.5 Contractor is responsible to schedule and coordinate all inspections and leak detection testing as required to obtain the Manufacturer’s Warranty.

5.2 Drainage Panels

5.2.1 A three-dimensional polypropylene drainage core with a woven geotextile adhered to one side to allow water passage while restricting soil particles. Composite includes a thin polyethylene sheet on the back of the drainage core.

5.2.2 Minimum compressive strength of 18,000 psf (ASTM D1621)

5.2.3 Minimum flow of 1.34 gpm/ft width at 3600 psf sustained for 300 hours, and hydraulic gradient of 0.01 (ASTM D4716)

5.2.4 Filter fabric shall have a permeability coefficient of 0.015 cm/sec

5.3 Exposed Tunnel Top: Liquid applied traffic coatings complying with ASTM C 957.

5.3.1 Minimum dry film thickness of 55 mil

5.3.2 Color as selected by the Owner

5.3.3 Provide uniformly graded washed silica sand of particle size, shape and minimum hardness recommended by the manufacturer spread to refusal to achieve a slip-resistant finish

5.3.4 Acceptable manufactures include:

5.3.4.1 Autogard: Neogard
5.3.4.2 Sikalastic: Sika
5.3.4.3 Pecora Deck 800: Pecora