NedPeds Major Design Options and Recommendations

The following are the recommended outstanding design options that have been approved by the DDA for consideration by the various town boards through the NPP process. These options bring the status of the design to 60% complete and will be the last significant opportunity to incorporate comments. They are the result of in depth analysis and research by the sustainability consultant and the design team and represent what is felt to be the most sustainable options for the project. Due to their complexity and/or unique design, and the fact that the cost analysis is ongoing, there is the possibility that some aspect of the design may not make it into the final project. An eye has been kept towards most cost-effective improvements, but there is no guarantee that the final project will be able to incorporate all of the below design strategies.

There are two additional major remaining schedule/design hurdles that are being addressed concurrently. The first is the matter of historical clearance for the project which ultimately depends on CDOT and the State Historical Preservation Office; if the project receives a go-ahead it will proceed as scheduled, if not the delay would likely send the project into construction next year. The team does expect to get the clearances. The second item is the results of the infiltration test, which must be conducted once the ground thaws. If there is minimal natural soil infiltration, then more conventional options must be looked at for drainage.

All of the options below are presented with the recommended options and potential alternates (where appropriate). There is also a sustainability summary beneath each that details the case for their individual sustainability.

- Surface Materials: Pathway

  Discussion: The highest prioritized option is a concrete pathway. While concrete is a material that contains a high amount of embodied energy and typically may seem out of place in parts of Nederland, the benefits it offers are substantial and the options below can address both of these issues to some extent. Alternatives such as crusher fines, cobblestones, hempcrete, pervious concrete, and stone (and otherwise) pavers have been investigated, but don't work as well as concrete for a number of reasons. These range from high cost (pavers, cobblestones),

maintenance concerns (all to various degrees, but especially crusher fines per the path by the fire station), and ADA issues (most of them, which is a requirement for the grant). The pervious concrete is a possibility, but the jury is still very much out on its durability, and the degree of technical rigor it takes to do it right seems overly ambitious for this project. Other alternatives suggested that are still under consideration are some sort of rubberized walkway, compacted dirt, and wooden boardwalks, but based on initial research none of these are expected to compete with concrete.

Depending on cost and prioritizations, the following strategies should be applied to the concrete: Exposed aggregate: This will make the concrete have more grip, look a bit more “rural”, and as long as it’s not overdone, still be ADA compliant. Coloration: Pigment can be added to the concrete mix that will serve a dual purpose, snow melt and distinctive character. Research is ongoing, but there may be an opportunity for a local firm to supply the pigment or a natural material to be used. Recycled content: Use to extent possible, at least 25% fly ash for the portland cement, 100% recycled aggregate, recycled sub-base, and wherever else possible. Stamping: a low cost option to put in a distinctive pattern, this could be animal tracks, a boardwalk pattern, or some creative variation contracted out locally or as part of the total bid.

Recommended Option: A concrete walkway with through cuts at the typical cut lines. This method, termed hydracrete by one supplier, allows for infiltration at the joints. This has the advantage of being fairly cheap, effective, and easy to do from a constructability standpoint. While the joints may have to be slightly wider than typical, this method will allow for the infiltration, safety, and ease of maintenance requested along with being relatively resilient in the future. This method has been applied in Lakewood and appears to be resistant to freeze/thaw.

Alternate Option: Using a higher strength concrete mix would allow the concrete sections to be removed with a forklift and replaced for future maintenance needs of piping etc. that runs underneath. While more expensive in the initial costs, it would save the town from the other option of having the sections likely break and then have to be re-poured with virgin materials.

Sustainability Summary: The best way to reduce the energy content of concrete is to reduce the amount of virgin materials used, particularly portland cement.

Substituting fly ash, an industrial by-product of coal plants, is a beneficial practice that CDOT has approved for up to 25% of the cement. The aggregate for the project is inherently low-energy as it typically has to be extracted, crushed, sorted, and transported, but not created at high temperature like cement. If we can find a local source or rock that was previously used for some other purpose, we can further reduce the embodied energy. To meet the goal of a 50% energy reduction from phase 1, we will have to include all of these options. Concrete is a durable, low maintenance, resilient, and low life cycle cost material. While not the greenest option in terms of environmental footprint, this concrete will be as green as possible and hopefully functional and beautiful as well.

- Surface Materials: Roadway from Snyder to East

Discussion: The rest of second street has existing asphalt that it doesn't make sense to tear up at this time; a deep sustainability retrofit could include a centerline infiltration strip being cut in, but we would recommend seeing how well the first functions (assuming that option) first. The highest prioritized option is a hybrid roadway, with a primary surface material of either asphalt or concrete. A concrete hybrid is not included at this time due to the cost and road maintenance issues (not as easy to patch, otherwise very durable). Due to the steepness of the road and the desire for stormwater mitigation, a hybrid design should utilize a centerline longitudinal infiltration strip and a reverse crown on the roadway. There are other options presented below that may also be viable, and final design will need to account for the right balance of management and practicality in terms of stormwater and constructability.

Explore the use of recycled asphalt shingles for the asphalt content. There is a program out of Boulder that connects roofers with batch plants to create new asphalt paving out of used shingles. Pricing and approval may be issues(CDOT currently allows only 5% shingle use), but if they can be resolved it would be a good statement to make and much less embodied energy.

Recommended Option: Asphalt with a longitudinal centerline infiltration strip. This may be difficult from a constructability standpoint, but would give a distinctive look, provide a good amount of infiltration, and possibly allow for a one-pipe (or no-pipe) system as opposed to two-pipes, creating system benefits from a life-cycle cost standpoint. The strips would still need to be plowable, but the centerline

design is more forgiving than lateral stripes and since it will be in a natural low point (reverse crown) it will be even more so.

Alternate Option #1: Porous Asphalt. This could be a good option since the design has been shown to work and there are local contractors with experience. That being said, most of the applications have been on flat areas such as parking lots and not graded roadways. If it competes economically, it will look typical to an asphalt roadway and serve the basic functions of dust (and sedimentation) control, consistent roadway (no more changes in depth), and traffic conveyance with the added benefit of infiltrating water.

Alternate Option #2: Asphalt. While not an ideal material, asphalt is easy to maintain, durable, and the hard surface would mitigate the erosion and dust issues. The surface water would still need to be managed, but if cost becomes a driving factor this option may have to be explored.

Sustainability Summary: While many options were vetted, and a cobblestone road or something similar would be more fitting with the town as well as less energy intensive, the cost is prohibitive. If the town and DDA really wants to focus on this aspect of the project, it would be possible to keep it out of the project scope and address later or find the funds and do something different now. The trick is making sure that the drainage system is protected and designed to function with the roadway surface in the meantime. Asphalt gets applied across the country with regularity because it is the most effective material to make roads from. Once applied it is relatively non-toxic, easy to repair, and can take a pounding. It is petro-chemical based and can be a high energy material, using the recycled shingles would mitigate that to a certain extent.

- Surface Materials: Infiltration Strip for the Roadway

Discussion: Having strips of a material that allows for infiltration on the surface serves multiple purposes. In addition to infiltration, the strips would provide a distinctive look, and help define the roadway. Strips should be at or just below grade and consist of a highly permeable, regulation load bearing material such as pavers. The recommendation here ultimately is that the design team find the most cost effective solution that fits the bill, but a couple of options are described below.

Option #1(Recommended if cost effective): Closed concrete pavers. While these are less open (no plantings) and appear more like typical plaza pavers from above, they are stable, perform well in cold climates, bear a load well, are easy to maintain, and are typically ADA compliant. These would work in the roadway and the team is currently looking at a system like the PaveDrain system(see attachments).

Alternate Option #1: Crushed gravel. Crushed gravel down the centerline would be more cost effective, but would also present some technical challenges and maintenance issues.

Sustainability Summary: The incorporation of some type of porous paving materials would give the project a distinctive look and provide drainage opportunities that it might not have otherwise. It would allow for impervious surfaces and could even potentially be installed by a local contractor. The choice of materials is dependent on a number of factors, but the energy to make them and maintain them along with their look and infiltration characteristics will be some of the key ones in making a final decision, along with cost.

- Drainage System

Discussion: The drainage system should include as many water quality features as possible , be as “natural” as possible, and encourage infiltration whenever possible. As opposed to a typical drainage system with pipes leading directly to the river, this type of drainage system should allow for intermediate filtration by gravel and if at all possible continue to allow for infiltration into the ground. The worries are that ponding and freezing could happen, so the conditions must be thoroughly evaluated before proceeding in that direction. The design team has geotechnical engineers doing test along the roadway to see what may be possible; more will be known as that is completed. It is important to note that the roadway will still be the major channel for conveyance of large storms; while much of the water will infiltrate, there will be enough volume that there will still be flooding (albeit significantly reduced) on the main road.

Recommended Option: A “pipeless” system with a channel filled with large pore gravel/rock and some sort of liner on the sides, preferably permeable (i.e. rip-wrap) This will allow for the best water treatment and infiltration and could be cost-effective as well.

Alternate Option #1: A single main pipe with a perforated bottom spread out infiltration and gravel layers surrounding it. If designed and installed properly, this will allow some overflow water from larger storms to get put in the pipe and conveyed while water from smaller events will mostly percolate into the ground.

Alternate Option #2: Two pipe system with BMPs for water quality. If a two-pipe system is deemed more cost-effective, then focusing on ways to slow the water down and filter it as much as possible would allow for better water quality and more infiltration.

Sustainability Summary: Finding precedents for non-piped and alternatively piped systems in the US, and on sloped mountain town roads especially, is no easy task. While infiltration is the goal, if the soil is impervious, there may be no point in trying to force it as it will just pond and cause issues. At a minimum, some type of rocks and gravel as a pre-treatment may be able to slow the water and catch some of the pollutants/silt, and the incorporation of additional Best Management Practices (BMPs) such as baffle boxes, bioswales, and small ponds might be necessary. It is important to remember however, that this project is part of a system, and that if the water does ultimately flow at a greater velocity to the stream, the real opportunity to treat this water from a water quality perspective is at the new Gateway Park. The proposed wetlands there will be enough to handle much more water than comes down and will be big enough to both treat the pollutants and provide natural habitat for native species. If this project needs to save money with a less expensive system, it is ultimately still a call for better overall watershed management. Upstream and downstream improvements are what is really needed overall, if this project can even move the flooding of small storms off the street it will be baseline successful.

- Pervious landscaped areas

Discussion: These areas that are currently shown as unprogrammed and parking will allow for such uses as parking, snow storage, habitat, infiltration, and public art. With a meandering road design, these areas will also need to be carefully designed so as to minimize traffic impacts. Putting some sort of higher profile feature such as artifacts from the mining museum at key junctures will help guide traffic (and snow plows) when there's snow on the ground. The areas that are too

small for parking or for bioswales will need to be designed to be low maintenance and durable.

Recommended Option: 3/4” crushed gravel for parking areas and resilient natives for smaller areas, with plans to include durable art at strategic points. The gravel, while not beautiful, is in keeping with town character, low energy, affordable, and allows for infiltration. Resilient natives would require some attention from the city/adjacent residents, but ideally would only require water for establishment and provide a good opportunity to be a steward. The art spaces would serve a purpose, be in keeping with town character, and provide a distinctive element to the project.

Alternate Option #1: Pavers for parking(or parking on particular parts of the project), all other the same. A more expensive but possibly more durable and attractive option. Certainly more expensive, but if the desire is a more walkable urban feel it could be an option. Also, this could be included if there is money available for just a portion of the project such as the Central Business District (CBD).

Sustainability Summary: Incorporating native species in the areas too small for parking will serve to create habitat, enliven the street, provide a reason for residents and businesses to maintain the project, and infiltrate more water. While these plantings would not necessarily be as “beautiful” as flower displays since they would need to be resilient to being alongside a road, there would be room to experiment within the right of way. Since the Right of Way will be public forever, maintenance of the plantings would in no way infer ownership, but in practical terms, resident and business owner support may be necessary to maintain the plantings once the town installs them.

The gravel for parking would be of a type that would not rut or spread easily, and would be in keeping with the town’s character while allowing infiltration. It could be from recycled rocks, possibly even some of the rocks from the wastewater treatment plan effort, and would be effective for parking and walking.

Allowing public art and planning ahead for spaces provides local employment opportunities, helps make the project more loved, and may be a good opportunity to recycle some materials that will otherwise have to be disposed of in the landfill (or recycled) such as some of the artifacts currently residing behind the mining museum.