KANSAS CITY STREETCAR PROJECT
Streetcar Construction Methods Technical Memorandum
Final Draft: August 27, 2012

This technical memorandum describes the construction activities that are anticipated to occur during the course of the Kansas City, MO (KCMO) Downtown Streetcar Project. The purpose is to provide a general background of typical construction activities and durations of a streetcar project of similar scope and size to the one being considered for the starter project in KCMO. It should be noted the approach to construction staging and phasing described herein is general in nature and for the purpose of establishing a baseline to be used for the Environmental Assessment and to start discussions with businesses and public.

This is the final draft of this memo to support the EA

1. Introduction

The construction of the streetcar project will entail a number of elements including construction of guideway and trackwork, construction of streetcar platforms, a maintenance and storage facility, and roadway construction. It will also include installation of specialty system work such as traction power, communications, and train/traffic signaling. All work would need to conform to industry specifications and standards. The equipment used in construction would include graders, bulldozers, cranes, concrete trucks, flat bed trucks, dump trucks to haul dirt, and other equipment as described below. Any spoil materials would be hauled away from the work sites by trucks to approved disposal sites. Staging area(s) for construction will be established in the vicinity of the project and will be used for storage of equipment and materials. The staging areas will be located on vacant land and selected to minimize impacts on neighborhoods.

The various work activities to be performed over an estimated twenty-month construction/start-up/testing period will include the following facility and system items:

- Relocation, modification or protection in-place of utilities in conflict or impacted by excavations for street-level trackwork and streetcar platforms.
- Demolition and site clearing for the vehicle maintenance and storage facility (VMF).
- Construction of the vehicle maintenance and storage facility (VMF).
- Installation of temporary traffic control measures.
- Reconfiguration of the existing roadway network to accommodate streetcar and traffic movements.
- Construction of surface and subsurface drainage systems, if modifications to existing are needed.

- Installation of trackwork complete with preparation of track bed, track slab, rail, fasteners, communication ducts, and infill concrete.
- Construction of traction power substations with electrical power feeds.
- Installation of traffic signal and streetcar control improvements.
- Installation of overhead contact poles, wires, support brackets, feeder cables, and other components or alternative power distribution systems.
- Construction of streetcar stops using cast-in-place concrete.
- Construction of station stop finishes, such as canopies, benches, signage, trash receptacles, lighting, and all other amenities necessary for a functional streetcar stop.
- Testing of subsystems and systems.
- Simulated revenue operation test runs and final commissioning of the system.

It should be noted that there may be construction activity that will occur along the streetcar alignment that is not part of the streetcar project and will be completed by others. These improvements include:

- Grand Blvd Streetscape project – Grand Boulevard is currently being studied for possible streetscape improvements. These improvements could include widening sidewalks, adding bike facilities and modifying the existing traffic configuration. For the section of the streetcar alignment that uses Grand Blvd as a portion of its northern loop, close coordination and collaboration will be required between the two project teams.

Detailed information related to construction activities that will be completed as part of the streetcar project is provided below.

2. GENERAL CONSTRUCTION SCENARIO

The streetcar would be constructed over an approximately sixteen-month period and would include four construction stages. These construction stages are described in Table 1 below.

Table 1: Typical Sequence of Construction Activities*

Stage 1 - Utilities (2-8 weeks per 3 block section)

- Open trenches for underground utility relocations
- Temporary overhead lines for above-ground relocations
- Partial lane closures & temporary service interruptions
- Construction Period: Q1 2013 - Q1 2014

Stage 1 - Maintenance Facility (12-18 months)

- Site Clearing, Pad, Foundation
- Yard Track, Civil Site Work
- Shop Building
- Requires full closure and control of facility site, with construction ingress/egress
- Construction Period: Q3 2013 - Q4 2014

Stage 2 - Station Stops (3-4 weeks per station)

- Curb, gutter, sidewalk reconstruction
- Construct concrete platforms and canopy foundations
- Install platform finishes and amenities
- Construction Period: Q4 2013 - Q4 2014

Stage 2 - Trackwork (3-4 wks per 2 block section)

- Removal of existing pavement and sidewalks
- Construct sidewalk, curb, and gutter
- Install rail and track slab with track drains
- Install special trackwork
- Typical 20-25' wide work zone - requires multi-lane partial closure or temporary closure of entire street, depending on street width.
- Construction Period: Q4 2013 - Q4 2014

Stage 3 - Power Systems (3-4 weeks per 2 block segment)

- Install overhead contact system poles
- Install traffic signals and street lighting
- Connect overhead wiring
- Temporary lane closures at work zone at non-peak hours
- Install power substations (3 - 4 locs, not part of segmented work)
- Construction Period: Q4 2013 - Q4 2014

Stage 3 - Traffic Signals & Street Lighting (2 weeks per intersection)

- Install/modify traffic signals
- Install/modify street lighting
- Construction Period: Q2 2014 - Q4 2014

Stage 4 - Testing and Start-up (4-6 Months)

- Testing of communications, signaling, and ventilation systems
- Training of operators and maintenance personnel
- Testing Period: Q4 2014 - Q1 2015

*Some of these activities will be conducted simultaneously or overlapped through staging.

The first two construction stages, during which utilities are relocated, the maintenance and storage facility is constructed, streetcar platforms and track are constructed, and the roadway is completed, will create the most traffic inconvenience. Construction may occur in alternating segments in a "leap-frog" fashion or proceed sequentially from one end to the other. The exact construction phasing will be determined during final design. With the exception of the construction of the maintenance facility, it is expected that the first two stages of construction will last approximately 14-15 months.

There are two basic types of approaches to construction phasing of Stage 2 that can be considered for this project:

- The first approach includes breaking the alignment into small manageable segments (approximately 2-3 blocks) and completing the Stage 2 work (primary disruption) in one segment at a time. This approach has been successful in Portland and Seattle and has been the preferred method of business owners for every extension (now 6 for Portland). Under this method, the Stage 2 work would last approximately 3 weeks for each segment before that crew would move ("leap-frog") to the next segment.

- The second approach would involve shutting down larger segments for longer periods of time to allow portions of other Stages to be constructed "back to back" in the same work area. The disruption that occurs would be longer in duration (it could extend to 1-2 months or more depending on the number of activities combined together), but it would minimize the number of times the contractor has to conduct work in any one area.

Both of these approaches have been used and can be considered for this project. The exact approach to construction phasing should be determined as the design advances, affected businesses and residents in the corridor are consulted, and the construction schedule is further detailed.

At times, one or more travel lanes may be closed temporarily during construction. A traffic control plan will be developed in conformance with local, state, and federal policies to minimize traffic and access impacts and will dictate the hours and extent of lane closures. Stage 2 of the construction phase, the track and civil construction phase, will likely result in the most inconvenience for businesses and residences. During this stage of construction, there will be times where temporary relocation of access drives, sidewalk closures/rerouting, and restrictions on turning vehicular movements occur. For short periods, such as when the track is constructed in front of a driveway, some access may be temporarily shut down until the contractor can "plate" (bridge) over the track construction. In such cases, the affected parties will be notified in advance, and measures will be taken to minimize the inconvenience as much as possible. Any temporary sidewalks and other access points will be designed to conform with Americans with Disabilities Act (ADA) accessibility guidelines.

Construction of the vehicle maintenance and storage facility may involve a greater level of disruption because of excavation, soil remediation if necessary, street closures, construction staging areas, traffic control, and utility issues that relate to building a permanent structure. The disruption will vary depending on the final site selection.

Multiple contractors specializing in various methods of construction would be working on the project throughout the construction period. The physical construction would involve the method that is most suitable for each segment. Many of the project elements would be constructed

simultaneously. Construction of the project would follow all applicable local, state and federal laws for building and safety. Standard construction methods would be used for traffic, noise, vibration and dust control, consistent with all applicable laws.

Construction Staging Area(s) will be provided where necessary to store materials and equipment used on the project. The type of use of these areas may vary but could include storage of equipment and materials as well as an area to prep items for installation.

One example of prep work would be rail welding. Rail typically arrives to the site in 40-80ft lengths. These short lengths of rail are often welded into "strings" which can be several hundred feet long using a mobile welding plant. This minimizes the effort and construction time in the field where the rail is being installed.

The photo on the right is an active staging area that was used for the Portland Streetcar Loop project and included mostly materials such as special trackwork, precast sewer structures and piping, conduit, rebar, rolls of rubber boot, etc.

A main staging area for the Kansas City Streetcar construction would be similar. It would likely be located near the alignment and could be located in a number of locations such as a parking lot or near by industrial parcel. These can be either public and/or privately owned so long as an agreement can be made between the contractor and property owner.

One of the most ideal locations for a possible staging area is the 2nd Street right-of-way as it has good vehicle access and is long enough to weld a Varity of length rail strings. The near by KCATA owned park and ride lot could also partially be used if an agreement between the City and KCATA could be reached as well as many other potential sites along the alignment.

For day to day activities, the contractor may also use the on street work zone for temporary staging. For example, if the contractor is working from 16th to 18th street they may have a portion of that work zone where they temporarily store material such as rebar, forms, pipes, etc. that are actively being used for construction. This may also include some of the cross streets, from time to time. The intent, however, would be for the majority of the staging and storage of material to be accomplished at the main staging area and to restrict the on-site/work zone staging to only materials and equipment actively being installed or used.

3. CONSTRUCTION ACTIVITIES

Utility Relocations

Prior to beginning construction of the guideway it will be necessary to relocate, modify or protect in place some utilities and underground structures, which are in conflict with excavations for street level trackwork and station structures or limit future access. Shallow utilities, such as maintenance holes or pull boxes, which would interfere with guideway excavation work, will require relocation. The utilities would be modified and moved away from the proposed facilities. Temporary interruptions in services (several hours) could be experienced during re-location or re-routing of utilities. Streets will be open, with partial lane closures as necessary. Equipment used would include backhoes, small cranes, dump trucks, concrete trucks, paving equipment, and various hand and power tools. In some cases, as shown in the photo above, utilities may remain in place if the utility is generally in good condition and all parties agree to future access limitations.

Vehicle Maintenance and Storage Facility

The vehicle maintenance and storage facility would be constructed in the first construction stage, given the need to test and store the streetcar vehicles prior to operation. The maintenance and storage facility would be constructed from standard building materials that are

durable and resistant to vandalism. Its design would be such that it would complement the surrounding neighborhood; and so the design may vary depending on the final site selection.

Surface Trackwork

For the majority of the alignment, tracks and platforms will be located within the existing roadway right-of-way and share operation with vehicles. The exception is at the south terminus, where the streetcar will operate in an exclusive trackway in the middle of Main Street just north of Pershing Road in order for the operator to stop the vehicle and switch directions safely. In all cases, platforms will either be located in the center of the roadway or along the curb.

Trackwork construction involves work to demolish the roadway sections being displaced by the guideway, preparation of the track bed, construction of the supporting track slab, and laying of rails. Work zones for trackwork construction require a narrowed roadway and restricted right- and/or left-turn access in the vicinity of the work zone. In most cases, a minimum of one lane of traffic in each direction will be able to be maintained at all times. The exception is areas with narrow right-of-way such as Main Street between 14th Street and 9th Street (48 feet curb-to-curb) and along 5th Street in the River Market area, where traffic may be reduced to one lane in one direction during certain construction activities (i.e. during concrete pours of the track slab). Full

closures of the roadway and/or intersections would be limited to areas where the streetcar alignment is crossing multiple lanes of traffic. This work could be accomplished at night or during weekends to minimize impacts to traffic and businesses.

Rail will be welded into strings at several locations along the alignments, using diesel-powered, trailer-mounted machines. The machinery will clean, straighten, prepare, weld, and grind short sections of rail into approximately one-quarter mile strings. Rails would be brought to the sites by truck, and local rail storage areas along the alignment will be necessary for short-term storage and to facilitate placement of rails. Periodic lane closures, predominantly on one side or the other of the work zone, would be required for delivery of materials and during concrete pours. Construction of station platform slabs would be coordinated with trackwork installation within each construction segment.

Equipment used for construction of the tracks, platforms, and the maintenance and storage facility would be similar to what is required for relocation of the utilities with the addition of track-laying equipment, paving machines, concrete mixers, and concrete finishers.

Streetcar Platforms

Platforms could be constructed simultaneously with the various segments of the system using the “leap-frog” construction technique, or the contractor may elect to construct them sequentially. These platforms would be constructed from standard building materials which are durable and resistant to vandalism.

Operating Systems Installation

The operating systems include traction power, an overhead contact system (OCS), communications, and streetcar control (including traffic signals). Overhead contact systems consist of poles connected to drilled shaft foundations with overhead wires to supply power to the streetcar. Poles would be about 27 feet tall and typically installed at intervals from 80 to 100 feet. Traction power includes approximately 4 substations, spaced almost evenly along the alignment, to provide Direct Current power for the streetcar. These include grounding systems and pre-fabricated units that are placed on foundation slabs by crane and connected to the system. The substations would be enclosed structures about 15 by 30 feet (25 by 40 feet including the grounding mat around the substation). If existing structures must be demolished to accommodate the substation, demolition work will be completed prior to construction of the substation. Construction equipment will include equipment for installation of the wires from the guideway area. While wires are strung at cross streets, temporary night time street closures of a few hours would be anticipated.

Systems installation contracts are generally bid as a system-wide contract and follow the completion of track construction. Finishing contracts for platforms and landscaping would be planned to overlap with systems work and be completed prior to final testing and pre-revenue operations. Systems installation work is significantly less disruptive to communities as compared to track construction work. Since the work zone is confined within the track area, minimal partial lane closures would occur and could be limited to non-peak hours.