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SPOKANE REGIONAL LIGHT RAIL PROJECT

Conceptual Design Cost Estimates Report

Two New "Low Cost" Alternatives ~
U-City Light Rail Minimum Operable Segment (MOS)
Bus Rapid Transit Alternative (BRT)

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Table of Contents

Tables

Appendices

Executive Summary

This phase of the Spokane Regional Light Rail Project has developed conceptual designs for two new low cost alternatives for high capacity transit service serving the South Valley Corridor. The purpose of this report is to present the conceptual cost estimates for these new alternatives and describe the cost estimation methodology used to develop them.

The two new alternatives are the University City (U-City) Light Rail Alternative and the Bus Rapid Transit (BRT) Alternative. The cost estimation methodology used to produce the estimates is comparable to that used on other similar projects in the conceptual and preliminary design phases. For instance the light rail system in Portland developed by the Tri-County Metropolitan Transportation District of Oregon (TriMet) has used a similar methodology for the successful estimation of costs for their projects during their formative stages. The methodology is flexible and can incorporate meaningful new data (such as local unit cost rates), current inflation rates and current transit pricing trends and will produce an estimate that is easily auditable and tracked through final design and construction.

The U-City Light Rail alternative is defined as a minimum operable segment (MOS) for light rail in this corridor. This alternative utilizes a shorter light rail alignment than studied in previous alternatives, extending from Downtown Spokane to an initial terminus at U-City. In order to provide high quality transit service out the remainder of the corridor from U-city to Liberty Lake this alternative incorporates a separate BRT system in the eastern segment interfacing with the initial light rail terminus at U-City. The LRT portion is 7.8 miles long and the BRT portion is 8.1 miles long. The transfer station at U-City will be designed to facilitate convenient rail to bus transfers and the schedule would be developed to minimize wait and transfer times. This alternative assumes a single-track application with passing tracks for two-way operations, and single-car diesel light rail vehicles (DMU) vehicles.

Conceptual design of this alternative takes a low-cost approach to the inclusion of both systems and facilities, providing only what is necessary to develop a safe and functional system with a minimum of amenities. There are seven rail stations (with eight rail platforms) and five BRT stations (with nine separate “platforms”). Two new 200-space park and rides at the Argonne and Fairgrounds LRT Stations, a 50 car park and ride at Appleway BRT Station and two shared (joint use) park and rides at Pines (50 spaces) and Sullivan (100 spaces) BRT stations are included. A total of five DMU vehicles and 5 BRT buses are included in this option. An alternative propulsion option for the LRT segment was also priced using electrically powered light rail vehicles with the traction electrification system required to support them.

The BRT alternative provides a high-capacity premium bus transit system that runs from downtown Spokane, through the City of Spokane Valley to Liberty Lake. Two options have been priced at the downtown Spokane end of the system. The “Sprague BRT Option” utilizes Sprague and Riverside Avenues for service to downtown Spokane. The “Trent BRT Option” turns off of Sprague at Helena, proceeds north to Trent, then west through the WSU Campus at Riverpoint, and circulating through downtown on a loop. The BRT alternative has a length of approximately 16 miles. BRT represents an enhanced bus transit application with design features that would offer many of the same improvements associated with rail transit technology. BRT operates with limited stop service to stations spaced approximately one-half to one mile apart. BRT also emphasizes a special identity, using premium buses to convey a special image and vehicle design that optimize faster passenger boarding and alighting. The BRT option includes frequent service primarily operating on the existing street system. However, BRT employs congestion avoidance techniques at selected intersections such as signal priority/preemption and queue jumps to maximize travel time efficiency and reduce the potential for delays. Other features included with

BRT technology are automated ticket machines to help speed passenger boarding, and advanced Intelligent Transportation System (ITS) technologies that enhance scheduling and passenger information. This alternative requires 14 BRT vehicles and 24 BRT station platforms. Two new park and rides are included with this alternative at the Argonne (200 spaces) and Appleway (50 spaces) BRT Stations. In addition two shared (joint-use) park and rides at Pines (50 spaces) and Sullivan (100 spaces) BRT stations are included.

The details of the each of the options are provided in the conceptual plan sets and design reports under separate covers.

A summary of the capital cost estimates for the two new alternatives (U-City LRT and BRT) is shown below. Estimates for the "full corridor" light rail alternatives (Separate Track and Shared Track) that have been previously developed are also shown for a full range of comparative capital costs. All costs are shown in millions of dollars, escalated to the year 2008. 2008 is considered to be the approximate mid-point of expenditure in the program schedule at this time.

Table 1 - Capital Cost Summary

Alternative			Total in 2008$ (Millions)
Separate Track LRT - Double Track Electric to Liberty Lake			658
Shared Track LRT - Single Track Diesel to Liberty Lake			408
U-City LRT	LRT	139	166
	BRT	27	
BRT Alternative (Sprague / Riverside)			63
BRT Alternative (Trent)			68

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I. Capital Cost Estimation Methodology

This methodology has been developed for the conceptual engineering effort for the Spokane Regional Light Rail Project and used to develop a cost estimate associated with 10% level conceptual design. The conceptual cost estimate was prepared in three steps. In the first step, the defined project alignment was broken down into logical geographical limits or line segments for estimating purposes. The conceptual engineering drawings applicable to each line segment were used to define the nature of work and facilitate a "take-off" or measurement of the work to establish quantities. Where defined the actual quantities were measured and used, including for example linear feet of track, numbers of parking spaces etc. Units of measure are the US standard as appropriate (i.e. CY for Cubic Yard, FT for Feet, LS for Lump Sum etc.). Where insufficient detail currently exists to estimate quantities with certainty, a conceptual design or cross-section was developed as the basis for the estimation of quantities.

The second step was the selective application of initial cost data to the quantities established in step one and to develop unit cost and lump sum cost items in current year dollars (see below). In this estimate 60 to 65 individual cost items were used. These items have been organized into a “Bid Item Tabulation” format, which can be seen in the Appendixes.

The third step is to consolidate or gather these items into the 17 major project cost elements as defined below. Engineering and administration cost allocations as well as project contingencies are added on in this phase of the estimate. If a special contingency is required for any element, it was calculated in this category (i.e. a contingency of 50% has been applied to Utilities). The capital costs have been estimated in current year 2004 US dollars. Sub-totals have been inflated at 4.0% per year to get to the currently assumed midpoint of construction year, 2008. An allowance for the contractor’s margins (profit, overhead etc.) and insurance was incorporated into the unit prices used to prepare the cost estimates.

The 17 major project cost elements used to assemble the cost estimate are listed below:

1. Civil Construction
2. Insurance (Included in Civil Construction and Right-of-Way)
3. Utilities
4. Track Materials Procurement (Included in Civil Construction)
5. Structures
6. Stations
7. Park & Rides
8. Operations Facility
9. Traction Electrification System
10. Signal System
11. Communications
12. Fare Collection
13. Right-of-Way
14. Vehicles
15. Engineering & Administration
16. Contingency
17. Washington State Sales Tax

As noted, items 2 and 4 are incorporated into other cost elements at this stage of estimating. Each of these cost elements is briefly described below.

1. **Civil Construction**

   Site preparation, grade preparation, excavation, fencing, intersection crossings, street closures, queue bypass reconstruction, roadway improvements, new and modified traffic signals, concrete works, drainage, ductbank, traffic control, system-wide signage, and trackwork installation are all elements included in Civil Construction. Civil Construction is used as the "catch all" category to include any items of cost that are not included in any other cost element. Other examples of work included in this item are drainage, water quality treatment, track material procurement, temporary parking and traffic control during construction. Utility relocations, structures, stations and park and ride facilities are special cases for Civil Construction and are carried as separate items discussed below.

   Civil Construction costs were estimated in several ways. If design estimates were available they were used. If local production or cost information was available it was given consideration. If not, then comparable rates were retrieved from various applicable databases. David Evans and Associates, Inc. (DEA) maintains an extensive transit cost database that monitors construction costs in cities throughout the US. As projects are bid, cost data are incorporated into DEA's database with projects indexed based on location and year of bid. Cost information from this database can be adjusted from city to city and to different years of construction. Cities used in the database include, but aren't limited to Portland, St. Louis, Salt Lake City, San Diego, Denver and San Jose. In addition standard public databases are also used, such as Engineering New Record's Cost Data and R. S. Means. Otherwise, unit cost rates are calculated by qualified construction cost estimators using standard production and estimating methods.

2. **Insurance (Included in Civil Construction and Right-of-Way)**

   Railroad insurance will be required for this project. Definition of these insurance costs will be forthcoming during the Preliminary Engineering portion of the design however; a general estimate for this insurance has been included in the railroad real estate estimate provided in the Real Estate category until actual railroad insurance costs are known. In addition the risk associated with the hazards of construction (general liability and property damage, builder's risk and workman's compensation) will be covered by insurance. The cost for all construction insurance is currently included in the individual prices for each item. The cost for the administration of the insurance work is included in the Engineering and Administration costs below.

3. **Utilities**

   The Utilities item includes the cost to the Project for the relocation or adjustment of public or private utilities that may become the responsibility of the Project during construction. The Project will impact utilities that are located in or near the right-of-way as well as utilities located in private or railroad easements. In order to prepare a more likely estimate of the utility costs a detailed study of utilities in the corridor was undertaken. The location of existing utilities in the corridor was researched by examining several of the utility company records. The corridor was then reviewed to determine the accuracy of the data collected from the utility owners. While a visual "survey" was conducted no "pot-holing" was done. Once the data were collected several drawings were developed for selected locations that show the typical existing utilities in plan as well as in cross-section. These drawings are appended to the U-City LRT Alternative Utilities Report. The drawings were also used to estimate the typical extent of utility relocations that should be expected in several areas. This led to the development of the three unit prices used in the development of this estimate for "low", "medium" or "high" abundance or complexity of utility relocation. These costs will be further detailed during Preliminary Engineering. The utility costs have been kept separate from the basic civil costs. Based on this

study, a contingency of 50% for utility work has been added in the contingency category to accommodate expected unknowns regarding utility relocation. This has been reduced from the 100% contingency that was used in the development of utility cost estimates for the Separate and Shared Track Alternatives. This reduced contingency allowance for utility relocation also assumes that the public jurisdictions in the Project corridor will collaborate with the Project sponsor to minimize costs for utilities including an avoidance of all unnecessary betterments.

4. Track Materials Procurement (Included in Civil Construction)

Trackwork has two major elements, namely, "Track Installation" and "Track Materials Procurement". Track installation consists primarily of the labor and equipment costs necessary to assemble and install the trackworks (rail, ties, rail specials, special work etc.). This cost is included in the Civil Construction portion of the estimate.

Track Materials Procurement represents the cost of acquiring long lead-time materials for the Track Installation. Included are rail, ties, fasteners, crossovers, turnouts, switches, crossing panels and any other specials. The cost for track materials procurements was derived from the actual cost of recent procurements and engineer's estimates. In the supporting documentation, this element is separately identified from the Civil Construction portion of the estimate in anticipation of an early procurement contract(s). However for purposes of this early conceptual cost estimate it is not shown separately, but combined with track installation costs and included in the Civil Construction line item.

5. Structures

At this time there are no major bridge structures included in the conceptual design of either or the two new low cost alternatives. A few minor structures have been included. For example in the U-City Light Rail (MOS) alternative it is anticipated that all intersections with roadways will be at grade and that no structures for grade separation will be required. It is anticipated that on Madelia Street, where the LRT system crosses under the BNSF Railroad, the existing underpass will be used, but crash walls will be required as a minor structural item. In addition a pedestrian bridge over Sprague is anticipated at Argonne Station in the BRT alternative. Also in the MOS rail alternative a sound mitigation allowance has been included as a minor structural item for the segment along Appleway just east of Argonne Road. These costs have been estimated using typical unit costs for the respective types of structure and are shown in the attached estimate.

6. Stations

The LRT Stations for the project will consist of platforms, shelters and furnishings. All costs associated with the LRT Stations were placed into one of the three categories (stations, electrical and artwork) based upon the prototypical station designs developed as part of the conceptual engineering plan set. Each station has been identified by a name (i.e. Plaza Station) with the costs summarized into the three categories for each station. The work at the stations will include shelters, lighting, signage, landscaping, and furnishings (benches, trash receptacles, etc.) with minimum amount of fixed facilities and amenities. A detailed estimate was prepared for a typical light rail station and a typical BRT station platform. Station cost allowances are therefore applied per LRT station or BRT platform, reflecting the anticipated typical designs shown in the conceptual design plans.

7. Park & Rides /Transit Centers

The cost estimates for the Park & Ride Lots and Transit Centers include curb/gutter work, sidewalks, paving, grading, drainage, site utilities (fire hydrants, water supply etc.), lighting, striping, landscaping and a minimum amount of associated amenities. Each facility was estimated based upon takeoff of quantities from

the conceptual site plans and includes allowances for features not shown. Additional roadway construction required to serve park and ride lots has also been estimated and included in the civil category. The right-of-way costs are included in the ROW category as described below.

8. Operations Facility

The costs for the operations facility required by each alternative have been kept separate from the basic civil construction portion of the estimate so that other alternatives and design can be accommodated if it becomes necessary. The operations facility category includes building, equipment and yard/site preparation. Yard/site preparation that includes site grading, drainage, roadway access, parking, landscaping, and utility relocation required for the operations and maintenance facility site. Equipment includes maintenance equipment and maintenance of way vehicles. Costs for spare parts for all vehicles are included in the respective vehicle cost allowances.

For the U-City LRT alternative, cost estimates were developed for two alternative sites. One option is near the Fairgrounds Station in vicinity of the existing UPRR Railroad yard; the other being east of the U-City LRT Station at the Fleck Service Center, a site currently owned by STA and used to maintain and store buses. While use of the Fleck site would incorporate the use of an existing building, it would also require the construction of additional track (a yard lead) to access the site east of U-City. Estimates indicate that the Fairgrounds site may be somewhat less expensive to develop and this site has been used in all of the U-City LRT (MOS Rail) alternatives. Costs for the Fleck site option are shown as a separate line item in the summary. The rail yard work associated with the operations and maintenance facility (storage trackwork, TES, signals, grading, buildings, non-revenue equipment & maintenance support vehicles, etc.) is included in this element. It is intended that the operations and maintenance facility will be a stand alone cost element.

For the LRT alternative, equipment costs include specialized shop equipment that is required to maintain the LRT vehicle fleet. The maintenance of way vehicle is anticipated to be one hi-rail vehicle with multiple attachments as may be necessary to perform routine maintenance on the track and wayside. It was assumed that outside contractors would perform specialized or infrequent maintenance. Typical contracted items may include rail grinding and rail integrity tests.

The BRT buses are longer than the typical STA bus, although STA does have some longer articulated buses. For the BRT Alternative, an allowance for an operations and maintenance facility similar in layout to the Fleck Service Center, but sized for the assumed BRT vehicle fleet, was developed. It is not yet determined where this operations and maintenance function would occur. During preliminary engineering, assessment of the use of current STA facilities or development of a new facility would be given. For the BRT component of the U-City Light Rail Alternative, the bus maintenance facility was assumed to be an expansion of an existing STA facility or in proximity to the rail maintenance facility. The cost estimates for the rail and bus facilities are documented separately.

9. Traction Electrification System (only applicable to the electrified LRT option)

The Traction Electrification System (TES) costs include the Overhead Contact System (OCS) and the Traction Power Substations (TPSS) required to provide electric power to the light rail system if this option is selected. TES costs were developed from bid tabulation information on similar systems and at this stage of conceptual design have been based on tentative operating plans, nominal field information, and single line diagrams. They include spare parts and other appropriate allowances. The related costs of the civil site work (site development, landscaping etc. for TPSS) and the foundation structures for the OCS system are included in the Civil Construction category where applicable.

10. Signal System

The Light Rail Signal System includes such items as collision prevention, grade-crossing gates, signal equipment enclosures, track circuitry, wayside signal equipment, inter-lockings, switch machines, intrusion detection, VTAG loops, and over-speed protection. Systems estimates of cost at this early stage of the project have been based upon single line diagrams and nominal field information so that the estimates have been priced based upon work of a similar nature from other similar projects. Spare parts and other appropriate allowances are included.

11. Communications

The communication systems for both Light Rail and BRT alternatives will be basic and consist of a radio communication system with a base station for central control and dispatching. It will be designed to allow train operators to communicate with a "home base" and make it possible to alert supervision, maintenance, and/or law enforcement personnel of problems. The cost for the home base portion of the project is included in this item (equipment cabinets, hardware, software, etc.). Systems estimates of cost at this stage of the project have been based upon single line diagrams and nominal field information so that the estimates have been priced based upon work of a similar nature from other similar projects. Spare parts and other appropriate allowances are included.

12. Fare Collection

Fare collection equipment largely consists of ticket vending machines and ticket validators. Fare vending and validation equipment for both light rail and BRT alternatives are assumed to be located on the station platforms. The allowance for pricing fare vending machines assumes the machines will accept cash only, and therefore are not be connected to telephone services. For the BRT alternative, estimates of the cost of fare collection have been based on equipment of a similar nature recently used on other similar projects and include spare parts and appropriate allowances.

13. Right-of-Way

Right-of-Way (ROW) includes the cost of securing and providing all of the real property rights required for the implementation of the Project. In addition, the direct costs for title, appraisal, appraisal review, acquisition and relocation costs, the estimate the cost of services involved in these processes (consultant costs) as well agency costs to administer the program are included in the right-of-way estimate.

An appraiser viewed each property and estimated the impact of the acquisition on the property. As is typical at this stage, property owners were not verified nor contacted. For partial acquisitions and where appropriate, the impact included damages to real estate not acquired and possible changes in highest and best use. Some improvements that are not within the acquisition area might have been impacted. Appraisers researched the assessed values of affected properties along with recent sales of similar properties in and near the project area. This data was then used to develop a relationship between assessed values and sales prices that assisted in developing the real estate cost estimate.

Compensation for easements allowing shared (joint use) park and rides in the BRT areas is also included in this estimate. Shared park and rides were assessed at these locations because of lower expected cost in this application. Cost for legal fees, appraisals and residential and business relocations have been included. Costs for required demolition, for contaminated site analysis and clean up, for potential condemnation expenses and other forms of mitigation have also been included to the extent they are defined. For example, impacts to the value of selected properties where curb-cuts for driveways are closed for the benefit of the project are

estimated to the extent they are thought to be likely to result in a determination of value. Right of way specialists have estimated the right of way requirements for this conceptual engineering estimate. The cost for environmental assessments of properties of the "Type I" or "Type II" category have been included. The costs for securing occupancy of railroad owned property and railroad insurance have also been included in this element. In addition, the value of selected publicly owned properties are also estimated. These are thought to be a source of potential local match revenue (See Funding Options Report for further discussion).

14. Vehicles

The costs of the transit vehicles have been estimated based on recent procurements of similar vehicles for other US projects. This includes the diesel powered light rail vehicles (light DMUs); the optional electrically powered low-floor light rail vehicles, and the BRT busses. The costs include an allowance for spare parts. It is noted that relatively few US Transit properties have yet procured light DMUs. The costs estimated for light DMUs are therefore higher than estimated for electric light rail vehicles in part because of market characteristics. It is believed that if the use of light DMUs become more prevalent in the US their procurement cost will become more competitive with electric light rail vehicles. A similar trend is anticipated with BRT buses as they become more widely used.

15. Engineering and Administration

Engineering and Administration encompasses six distinct cost elements. Initial estimates for this item have been assumed based on comparative experience on similar projects as a percentage of the total cost of all estimated direct construction cost elements. The six elements are as follows:

a. *Grantee Support.* The Federal Transit Administration as "Grantee" also refers to the Project Sponsor. Grantees direct and indirect administrative and overhead staffing costs associated with the management, design oversight, in-house project control, support, implementation, and start-up of the system are included in this element.

b. *Civil Design Services.* This includes the contracted cost of professional consultant services (including engineers, architects, and related services) for design of facilities including earthwork and drainage, structures, stations, park and ride lots, utility relocation and mitigation measures. It also includes surveying, geo-technical investigations, design review, inspection and independent testing services for civil elements.

c. *Systems Engineering Services.* The cost of contracted professional consultant services for Grantee-managed engineering of Systems related components are included in the project. Also included is the design review, inspection, independent testing services, training and startup; including Operations Facility, Signals, Communications, Central Control, and Fare Collection. Construction Management (CM) services for the systems work is included in this item.

d. *Project Control Services.* Project Control and Construction Management consultants for development and maintenance of procedures, overall schedule, budget, cost estimating and cost tracking, change order status, and provision of management advice and assistance in construction management and claims support make up this element.

e. *Other Services.* Other Services under this contract unit include outside agency materials testing, legal assistance, financial advisory services, audits, computer consulting services, partial environmental planning and permit development services, safety/quality assurance assistance, public and community relations, and insurance brokerage services.

f. *Interim financing*. To assure cost effective use of public funds an allowance for interim financing will be covered under this item.

g. *Intergovernmental and Joint Use Agreements – Public, Private and Railroad*. Cost of all permits and agreed local jurisdiction involvement in design and construction in accordance with any formal railroad or interagency agreements.

The element descriptions noted above are expected to be refined as project implementation strategies evolve. An Engineering and Administration percentage of 35% on infrastructure and utilities and 5% on the vehicle costs has been used in this Conceptual Engineering Estimate.

16. Contingency

A contingency has been added to the project costs applied as a factor applied to the total estimate of direct cost items. This is to cover the uncertainty due to the incomplete status of design (costs being estimated rather than firm, and changes anticipated during the design and construction process). Assignment of contingencies is a blend of engineering judgement and management philosophy. Contingencies have been assigned and risk has been assessed by category as appropriate. For this conceptual design cost estimate the following contingencies have been used:

- 20% for infrastructure costs
- 5% for transit vehicle costs
- 50 % for utilities

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As the project progresses through Preliminary Engineering and into Final Design the contingencies should be reduced as design details are determined.

17. Washington State Sales Tax

The State of Washington charges a sales tax of 8.4% on all materials that are used in construction. For cost estimate purposes, the sales tax was applied to 2/3 of infrastructure & contingency (reduced to eliminate tax on labor) and 100% of the vehicle's estimated total.

II. Assumptions

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The development of the MOS Rail and BRT alternatives was focused on finding a reasonable operating alternative for initial system start-up with a low capital cost. As such these are bare bones, no frills alternatives that form the basis for a component of the solution for the regional transportation needs. However it should be noted that many "nice to have" items are not included in these estimates. The following section describes some of the planning assumptions that were made in the preparation of these estimates.

1. U-City Light Rail (MOS) Assumptions

The MOS Rail Alternative is intended to be a low-cost start up rail system that can be upgraded and expanded in the future. The design is based on the Conceptual Design Drawings submitted in January 2004 and the Conceptual Design Report submitted in February 2004. The philosophy used in the development of these plans was to keep the costs as low as possible. The design is targeted to achieve costs comparable to streetcar systems.

Significant characteristics include:

- Single-track with short passing tracks

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- Use of diesel light rail vehicles
- Short, simple stations that accommodate single unit operations ("single-car trains")
- Maximize the use of existing UPRR tracks
- Minimize reconstruction of UPRR tracks but provide sufficient improvements necessary to assure safe passenger operations
- Generally utilize at-grade operations with no newly constructed bridges for the project. Use existing bridges for grade separation of crossings where available.
- Minimum right-of-way acquisition by using existing public rights-of-way to the extent available.
- Relocation of only the utilities that are directly impacted by construction
- Private utilities in publicly owned rights-of-way anticipated to be relocated by the utility owner
- Impacted roadways will only be repaved in the area of the tracks, not curb to curb
- No improvements to adjacent right-of-way
- No corridor landscaping (a landscape allowance has been provided at station locations)

For the U-City Light Rail Alternative, several options were also priced including:

- Alternative locations for the Light Rail Operations and Maintenance facility:
  - STA's Fleck Service Center
  - STA's parcel "B", north of the existing UPRR yard

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- Electrified version of the light rail segment
- Alternative downtown terminus locations:
  - Riverside Avenue
  - Wall Street

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The preferred alternative decision may select a more expensive version of the base options. For example the final decision might be to electrify the system instead of using diesel powered vehicles. Or the decision might be to provide more passing tracks to reduce headways and enable the project to provide more frequent service with more vehicles, thereby providing a higher passenger capacity. Of course, with each enhancement would come a corresponding higher cost.

2. BRT Assumptions

The philosophy used to develop the BRT system options was to create a recognizable premium bus service that will be seen as efficiently using available facilities. The assumptions relating to the BRT design include the following:

- Buses usually share general purpose lanes on existing streets
- Queue bypasses will be provided around selected congested intersections
- The stations will be "light rail-like" stations as opposed to traditional bus stops
- Premium vehicles will be used with distinctive appearance
- Designed to be upgraded to LRT in the future
- Only a single short segment of new bus roadways is included as per the conceptual design plans
- BRT facilities don't conflict with future LRT facilities or track alignment
- New park and ride construction is usable for future LRT system
- Minimized "throw-away" facilities, for example: some station components could be relocated and BRT buses could be re-deployed if the system were upgraded to LRT

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III. Capital Cost of Alternatives

The "base price" for the U-City Light Rail MOS alternative includes two segments: a light rail segment and a BRT segment. The base price includes use of DMU vehicles, the terminus on Riverside and the Fairgrounds location for the light rail operations and maintenance facility. The summary table below includes capital costs for the light rail segment of this alternative. The details of all estimates are provided in the appendices.

Table 2 - U-City Light Rail MOS Segment Cost (Base Price)

Project Component	Amount ($ Millions)
Civil Construction	20.2
Utilities	5.7
Structures	0.4
Stations	1.4
Park & Rides	1.6
Operations/Maintenance Facility	4.7
Traction Power System	-
Signal System	9.7
Communications	1.1
Fare Collection	0.5
Right of Way	12.7
Vehicles	20.8
Engineering & Administration	21.4
Contingencies	14.0
WA State Sales Tax	5.0
Escalation	20.2
TOTAL (2008 $)	**139.4**

Selected options for components of the light rail segment were also priced. The options and associated prices are shown below. These are also shown in year 2008 dollars:

- Wall Street Terminus (2-track) — Adds $1.1 M
- Electric instead of Diesel LRT — Adds $29.3 M
- Fleck Location for O&M Facility — Adds $0.4 M

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The additional cost for the "Wall Street Terminus" option includes differences in track construction, station construction and associated items. The "Electric Instead of Diesel" option includes costs for the traction electrification system, maintenance facility, and considers the difference in costs between diesel and electric light rail vehicles.

The capital costs for the BRT Segment of the U-City Light Rail (MOS) Alternative are summarized below. A similar breakdown of costs as illustrated for the light rail segment is shown.

Table 3 - U-City Light Rail Alternative - BRT Segment Cost

Project Component	Amount ($Millions)
Civil Construction	3.6
Utilities	-
Structures	-
Stations	1.1
Park & Rides	0.2
Operations/Maintenance Facility	1.8
Traction Power System	-
Signal System	-
Communications	1.1
Fare Collection	0.6
Right of Way	1.4
Vehicles	6.0
Engineering & Administration	3.7
Contingencies	2.2
WA State Sales Tax	1.1
Escalation	3.9
TOTAL (2008 $)	**26.7**

The following table illustrates costs for the light rail segment and the BRT segment together for the U-City Light Rail (MOS) Alternative. The costs for the light rail segment are the base costs, not including the options that were priced for this alternative.

Table 4 - Total Costs for the U-City Light Rail (MOS) Alternative

Project Component	LRT DMU COST	BRT SEGMENT	TOTAL LRT/BRT
Civil Construction	20.2	3.6	23.8
Utilities	5.7	-	5.7
Structures	0.4	-	0.4
Stations	1.4	1.1	2.5
Park & Rides	1.6	0.2	1.8
Operations/Maintenance Facility	4.7	1.8	6.5
Traction Power System	-	-	0.0
Signal System	9.7	-	9.7
Communications	1.1	1.1	2.2
Fare Collection	0.5	0.6	1.1
Right of Way	12.7	1.4	14.1
Vehicles	20.8	6.0	26.8
Engineering & Administration	21.4	3.7	25.1
Contingencies	14.0	2.2	16.2
WA State Sales Tax	5.0	1.1	6.1
Escalation	20.2	3.8	24.1
TOTAL (2008 $)	**139.4**	**26.7**	**166.1**

The capital costs for corridor-length pure-BRT alternative are shown below. Both of the options for this alternative entering downtown Spokane, Sprague Option and Trent Option are shown. As with the other estimates, these are reported in year 2008 dollars.

Table 5 - BRT Alternative Capital Costs

Project Component	Amount $ Millions	Amount $ Millions
	Sprague	Trent
Civil Construction	6.7	7.2
Structures	0.5	0.5
Stations	3.0	3.6
Park & Rides	1.0	1.0
Operations/Maintenance Facility	3.6	3.6
Communications	2.2	2.3
Fare Collection	1.5	1.8
Right of Way	2.8	2.9
Vehicles	16.8	18.0
Engineering & Administration	8.3	9.0
Contingencies	4.9	5.3
WA State Sales Tax	2.7	2.9
Escalation	9.2	9.9
TOTAL (2008 $)	**63.2**	**68.1**

In summary, total estimated capital costs for the alternatives are reported below.

Table 6 - Capital Cost Estimates Summary

Alternative			Total in 2008 $ (Millions)
Separate Track LRT - Double Track Electric to Liberty Lake			**658**
Shared Track LRT - Single Track Diesel to Liberty Lake			**408**
U-City LRT	**LRT**	**139**	**166**
	BRT	**27**	
BRT Alternative (Sprague / Riverside)			**63**
BRT Alternative (Trent)			**68**

IV. Operation and Maintenance Cost of Alternatives

In addition to preparing capital cost estimates the project team also estimated the operation and maintenance costs associated with the U-City Light Rail (MOS) Alternative and the BRT alternatives. Rail system operating and maintenance costs are grouped into four cost element categories:

- **Transportation:** Wages and benefits for train operators and operations supervisors, and propulsion power (electricity) or diesel fuel.
- **Maintenance of Equipment (vehicles):** Wages and benefits for vehicle maintainers and supervisors, parts, contract maintenance work, and shop utilities.
- **Maintenance of Way:** Wages and benefits for facility maintainers and supervisors, parts, and contract maintenance.
- **General and Administrative:** Risk management, and wages and benefits for general management and administrative personnel.

The following tables summarize operating and maintenance costs for the alternatives. For light rail, both the base U-City Light Rail alternative as well as the option for this alternative that utilizes electric instead of diesel light rail vehicles are estimated.

U-City Light Rail Alternative - Annualized O&M Costs

Vehicle Combinations	RVH (Revenue Vehicle Hours) per year (LRT + BRT)	Estimated Annual O&M Costs in 2010 $)
LRT = Diesel LRT + BRT	35,169	$8.35 Million

U-City Light Rail Alternative (Electric LRT Option) - Annualized O&M Costs

Vehicle Combinations	RVH (Revenue Vehicle Hours) per year (LRT + BRT)	Estimated Annual O&M Costs (in 2010 $)
LRT = Electric LRT + BRT	34,105	$8.84 Million

The BRT Alternative is estimated on the basis of current O&M costs for STA buses with a 10% premium added because of expected higher costs due to the more complex BRT vehicles.

BRT - Annualized O&M Costs

Vehicle – Route	RVH's per year	Annual O&M Costs (in 2010 $)
BRT on Sprague/Riverside or BRT on Trent	55,161	$6.44 Million

V. Synopsis

The project has considered both rail and bus alternatives and within each of these categories additional options. There are different alignment options for the BRT alignment and different power options, electric light rail transit and diesel light rail, for the U-City Light Rail (MOS) alternative. Several analyses regarding Operations and Maintenance Costs have been completed since 2001 on various options for light rail in Spokane. The project has sought to craft a workable alternative, a balance between the level of service and investments, in both vehicles and facilities, which would enable regional objectives to be achieved. The current "low-cost" alternatives documented in this report seek to serve this requirement in terms of providing acceptable service frequency while optimizing the level of initial investment required.

Appendix A Conceptual Cost Estimate for BRT Sprague Alternative

Appendix B Conceptual Cost Estimate for BRT Trent Alternative

Appendix C Conceptual Cost Estimate for BRT Station

Appendix D Conceptual Cost Estimate for BRT Operations and Maintenance Facilities

Appendix E Conceptual Cost Estimate for BRT Queue By-Pass

Appendix F Conceptual Cost Estimate for DMU MOS Rail Alternative

Appendix G Conceptual Cost Estimate for Electrified MOS Rail Alternative

Appendix H Conceptual Cost Estimate for Wall Street Terminus – DMU and Electrified

Appendix I Conceptual Cost Estimate for Fairgrounds Operations and Maintenance Facility – DMU and Electrified

Appendix J Conceptual Cost Estimate for Fleck Center Operations and Maintenance Facility – DMU and Electrified

Appendix K Conceptual Cost Estimate for MOS BRT Operations and Maintenance Facility

Appendix L Conceptual Cost Estimate for LRT crossing Major and Minor Intersections

Appendix M Conceptual Cost Estimate for MOS Rail Station

Appendix N Conceptual Cost Estimate for Utility Relocation Unit Price – High

Appendix O Conceptual Operations and Maintenance Costs - DMU and Electrified

Appendix P Conceptual Operations and Maintenance Costs - Bus Rapid Transit