ARLINGTON
VIRGINIA

DEPARTMENT OF MANAGEMENT AND FINANCE
Office of the Purchasing Agent

2100 Clarendon Blvd., Suite 501 Arlington, VA 22201
TEL 703-228-3410 FAX 703-228-3409 EMAIL purchasing@arlingtonva.us www.arlingtonva.us

February 14, 2020

VIA E-MAIL AND US MAIL
Mr. Jeremy Shaffer, Vice-President Mobility
Bentley Systems, Inc.
1501 Reedsdale Street
Suite 505
Pittsburgh, Pennsylvania 15233 USA

RE: Arlington County Sole Source Contract No. 20-811, entitled, "CUBIC Software and Support Services"

Dear Mr. Shaffer:

Enclosed for your files is a fully executed Contract for your file. Should you have any questions, please feel free to contact me at 703-228-3424 or via e-mail at stdiamond@arlingtonva.us.

Thank you for your assistance in this matter.

Sincerely,

Shirley Diamond
Procurement Officer

Enclosure

Attn: Shirley Diamond

ARLINGTON COUNTY, VIRGINIA
OFFICE OF THE PURCHASING AGENT
SUITE 600
2100 CLARENDON BOULEVARD
ARLINGTON, VIRGINIA 22201

CONTRACT No. 20-811

THIS AGREEMENT ("Agreement") is made on the date of execution by the County between the COUNTY BOARD OF ARLINGTON COUNTY, VIRGINIA ("County") and Bentley Systems, Incorporated, a Foreign Corporation, registered in Delaware with principal officer at 685 Stockton Drive, Exton, Pennsylvania 19341 ("Contractor").

1. The Contractor agrees to provide services in accordance with the Scope of Work as set forth in this Agreement. (Exhibit A)

2. The County will have no obligation to the Contractor if no services are required.

3. The Contractor's provision of services is subject to review and approval by the County's Project Officer.

4. The Contract Term shall be a Two (2) Year Base with Three (3) One-Year Option periods.

5. The County will pay the Contractor in accordance with Exhibit B and shall pay the Contractor net Forty-Five (45) days from receipt of an invoice the Project Officer approves for payment.

6. The Contract rates will remain firm through the Two (2) Year Base Period. To request price adjustment the Contractor or the County must submit a written request to the other party not less than Ninety (90) calendar days before the Base Year Period end date. Adjustment to the Contract rates will not exceed the percentage of change in the US Department of Labor Consumer Price Index, All Items, Unadjusted, Urban Areas (CPI-U) for the Twelve (12) month period ending at the Base Year(s) end date.

   Any rate adjustment that results from this Provision will become effective the day after the Price Adjustment date and will be binding for Twelve (12) months. The new Price Adjustment date will be Twelve (12) months after the rate adjustment.

   If the Contractor and the County have not agreed on a requested adjustment Thirty (30) calendar days before the Rate Adjustment Date, the County may terminate the Contract, whether or not the County has previously elected to extend the Contract term.

7. The Contractor is an independent contractor, and the County will not withhold from the Contractor's compensation any federal or Virginia unemployment taxes, federal or Virginia income taxes, Social Security tax or any other amounts for benefits to the Contractor or its agents or employees.

8. The Contractor is obligated to take one of the Two (2) following actions within Seven (7) days after receipt of amounts paid to the Contractor by the County for work performed by any sub-contractor under this Agreement:

a. Pay the sub-contractor for the proportionate share of the total payment received from the County attributable to the Work performed by the sub-contractor under this Agreement; or

b. Notify the County and the sub-contractor, in writing, of the Contractor's intention to withhold all or a part of the sub-contractor's payment, with the reason for nonpayment.

The Contractor is obligated to pay interest to any sub-contractor, on all amounts owed by the Contractor to the sub-contractor that remain unpaid after Seven (7) days following receipt by the Contractor of payment from the County for Work performed by the sub-contractor under this Agreement, except for amounts withheld as allowed in Section (b) above. Unless otherwise provided under the terms of this Agreement, interest shall accrue at the rate of One Percent (1%) per month.

The Contractor shall include in each of its sub-contracts a provision requiring each sub-contractor to include or otherwise be subject to the same payment and interest requirements as those contained in this Agreement with respect to each lower-tier sub-contractor.

The Contractor's obligation to pay an interest charge to a sub-contractor pursuant to the above Provisions may not be construed to be an obligation of the County. A Contract modification may not be made for the purpose of providing reimbursement for such interest charge. A cost reimbursement claim may not include any amount for reimbursement for such interest charge.

9. The County may terminate this Agreement by Thirty 30) calendar days' written notice whenever the Purchasing Agent determines that termination is in the County's best interest. The Contractor will be entitled to receive compensation for all goods the County accepted before the termination notice.

10. The County may terminate this Agreement within Forty-Eight (48) hours' written notice if the Contractor fails to provide satisfactory goods in the determination of the Project Officer. The notice will be effective upon receipt by the Contractor or Three (3) calendar days after the County mails the notice, whichever is sooner.

    The Contractor will be entitled to receive compensation only for goods the County accepted before the County mailed the above referenced notice. The Contractor will be liable to the County for all costs the County incurs after the termination takes effect to complete the Work covered by the Contract, including delay costs and costs to repair or replace any unsatisfactory work. The County may deduct these costs from any amount it owes the Contractor or require the Contractor pay the costs on demand.

11. Time is of the essence and the Contractor agrees that failure to provide timely service will render this Agreement null and void.

12. The Contractor must provide a certificate of proof of the insurance coverages before the start of the Work:

    - Workers Compensation-Standard Virginia Workers Compensation Policy.

    - Commercial General Liability (CGL)- $500,000 combined single limit with $1,000,000

aggregate coverage to include Personal Injury, Completed Operations, Contractual Liability and, where applicable to the services, Products and Independent Contractors. "The County Board of Arlington County, Virginia, and its officers, employees and agents" must be additional named insureds on the CGL policy.

- Automobile Bodily Injury and Property Damage Liability - $500,000 Combined Single Limit (Owned, non-owned, or hired, as applicable)

13. The Contractor agrees as follows:

    a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, sexual orientation, national origin, age, disability or on any other basis prohibited by Virginia or federal law and must post in this non-discrimination clause in conspicuous places, available to employees and applicants for employment.

    b. The Contractor must state that it is an Equal Opportunity Employer in all solicitations or advertisements for employees that it places or causes to be placed.

    c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall meet the requirements of this Section.

    d. The Contractor must include the provisions of the foregoing paragraphs (a), (b), and (c) in every sub-contract or Purchase Order in excess of $10,000.00, so the Provisions will be binding upon each sub-contractor and/or supplier.

14. The Contractor must comply with the provisions of the Americans with Disabilities Act of 1990, which prohibits discrimination against individuals with disabilities in employment and mandates their full participation in publicly-and-privately-provided services and activities.

15. The Contractor must provide the following:

    (i) A drug-free workplace for the Contractor's employees;
    (ii) Post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of marijuana or any other controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;
    (iii) State in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace; and
    (iv) Include the provisions of the foregoing clauses in every sub-contract or purchase order in excess of $10,000.00, so that the provisions will be binding upon each subcontractor or supplier.

    For the purposes of this Section, "drug-free workplace" means a site for the performance of work done in connection with this Agreement.

16. The Contractor acknowledges that it does not, and will not during the performance of this Agreement, knowingly employ an unauthorized alien as defined in the federal Immigration Reform and Control Act of 1986.

17. This Agreement is governed by the Arlington County Purchasing Resolution, which is incorporated by reference. The time limit for decision by the County Manager in Contractual Disputes, as that term is used in the Purchasing Resolution, is Thirty (30) calendar days.

18. This Agreement is not effective until the County issues a valid County Purchase Order covering the amount of the Agreement.

19. All payments by the County to the Contractor pursuant to this Contract are subject to the availability of an annual appropriation for this purpose by the County Board of Arlington County, Virginia ("Board").

    In the event that the Board does not appropriate funds for the goods or services provided under this Contract, the County will terminate the Contract, without termination charge or other liability to the County, on the last day of the fiscal year or when the previous appropriation has been spent, whichever event occurs first.

20. This Contract incorporates by reference Article 9 of the Arlington County Purchasing Resolution, as well as all state and federal laws related to ethics, conflicts of interest or bribery, including the State and Local Government Conflict of Interests Act (Code of Virginia § 2.2-3100 et seq.), the Virginia Governmental Frauds Act (Code of Virginia § 18.2-498.1 et seq.) and Articles 2 and 3 of Chapter 10 of Title 18.2 of the Code of Virginia, as amended (§ 18.2-438 et seq.).

    The Contractor certifies that its proposal was made without collusion or fraud; that it has not offered or received any kickbacks or inducements from any other offeror, supplier, manufacturer or subcontractor; and that it has not conferred on any public employee having official responsibility for this procurement any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.

21. No Arlington County employee may share in any part of this Contract or receive any benefit from the Contract that is not available to the general public.
22.
23. The County does not discriminate against faith-based organizations.

24. The Contractor and its employees, agents and subcontractors will hold as confidential all County Information that they obtain under this Agreement. Confidential Information includes, but is not limited to, nonpublic personal information; personally, identifiable health information; security numbers; addresses; dates of birth; information pertaining to products, operations, systems, customers, prospective customers, techniques, intentions, processes, plans and expertise. The Contractor must take reasonable measures to ensure that all of its employees, agents, and subcontractors are informed of and abide by this requirement.

25. The Contractor must comply with the provisions of Chapter 11 of the Arlington County Code covering business licenses as applicable.

26. The Contractor must remain authorized to transact business in the Commonwealth of Virginia during the term of this Agreement.

27. This Agreement is governed in all respects by the laws of the Commonwealth of Virginia, and the jurisdiction and venue for any litigation is in the Circuit Court for Arlington County, Virginia, and in no other court.

28. The Contractor covenants for itself, its employees and its subcontractors to save, defend, hold harmless and indemnify the County and all of its elected and appointed officials, officers, current and former employees, agents, departments, agencies, boards and commissions (collectively the "County Indemnitees") from and against any and all claims made by third parties for any and all losses, damages, injuries, fines, penalties, costs (including court costs and attorneys' fees), charges, liability, demands or exposure resulting from, arising out of or in any way connected with the Contractor's acts or omissions, including the acts or omissions of its employees and/or subcontractors, in performance or nonperformance of the Contract. This duty to save, defend, hold harmless and indemnify will survive the termination of this Contract. If the Contractor fails or refuses to fulfill its obligations contained in this section, the Contractor must reimburse the County for any and all resulting payments and expenses, including reasonable attorneys' fees. The Contractor must pay such expenses upon demand by the County, and failure to do so may result in the County withholding such amounts from any payments to the Contractor under this Contract.

29. Notices will be effective when made in writing and either (a) delivered in person, (b) delivered to an overnight delivery service or (c) deposited in the United States mail, certified or registered. Notices should be addressed as follows:

TO THE CONTRACTOR:
Jeremy Shaffer, Vice-President Mobility
Bentley Systems, Inc.
1501 Reedsdale Street
Suite 505
Pittsburg, Pennsylvania 15233 USA
Telephone: 412-708-0088

TO THE COUNTY:
Christine Baker, Principal Planner
Arlington County Government
Office of the Purchasing Agent
2100 Clarendon Boulevard
Suite 500
Arlington County, Virginia 22201
Telephone: 703-228-3780

AND

Shirley Diamond, Procurement Officer
Arlington County Government
Office of the Purchasing Agent
2100 Clarendon Boulevard
Suite 500
Arlington County, Virginia 22201
Telephone: 703-228-3424

30. The Contractor must retain all books, records and other documents related to this Contract for at least Five (5) years after the Final Payment and must allow the County or its authorized agents to examine the documents during this period and during the Contract Term. The Contractor must provide any requested documents to the County for examination within Fifteen (15) calendar days of the request, at the Contractor's expense.

    Should the County's examination reveal any overcharging by the Contractor, the Contractor must, within Thirty (30) calendar days of County's request, reimburse the County for the overcharges and for the reasonable costs of the County's examination, including, but not limited to, the services of external audit firm and attorney's fees; or the County may deduct the overcharges and examination costs from any amount that the County owes to the Contractor.

    If the Contractor wishes to destroy or dispose of any records related to this Contract (including confidential records to which the County does not have ready access) within five years after the final payment, the Contractor must give the County, at a minimum of Thirty (30) calendar days' notice and must not dispose of the documents if the County objects.

31. The Contractor shall not assign or transfer this Agreement, or any of its rights or interests, without the County's prior written consent.

32. This Agreement may be modified only by written amendment.

33. All remedies available to the County under this Agreement are cumulative, and no remedy is exclusive of any other that is available to the County at law or in equity.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE AFFIXED THEIR SIGNATURES.

THE COUNTY BOARD OF ARLINGTON COUNTY, VIRGINIA

SIGNED: _____
PRINTED NAME: SHIRLEY DIAMOND
PRINTED TITLE: PROCUREMENT OFFICER

DATE: 2-13-20

CONTRACTOR'S NAME

SIGNED: _____
PRINTED JEREMY SHAFFER
PRINTED TITLE: VICE-PRESIDENT, MOBILITY

DATE: 2/13/2020

EXHIBITS AND FORMS

EXHIBIT A

SCOPE OF WORK

TASK 1 - DESCRIPTION OF PROFESSIONAL SERVICES

1. MODEL DEVELOPMENT

Contractor will use the data developed in the previous tasks to calibrate the model, step by step. Contractor will create the model using the Simplified Tour-Based Model (STM) structure that Contractor have developed for other areas.

The structure of STM is very straightforward. The records created by the HH Synthesis step are processed to estimate the number of tours by HH and purpose and then each tour is processed individually to determine its destination, mode, intermediate stops, and time period. Contractor propose the following trip purposes: work (HBW), school (SCH), university (HBU), shop (HBS), other (HBO), at-work (ATW), resident external (I/X), non-resident work external (XIW), non-resident non-work external (XIN). The tour's purpose is determined based on the activity at its main destination. Note that there is no NHB trip purpose because all NHB travel is accounted for in terms of intermediate stops on another type of tour. All tours are assumed to begin/end at home, except for ATW, which begin/end at work. Additional processing is necessary to handle group quarters residents, which includes military bases.

Each of the main models is a logit model. Each model estimates the probabilities of selecting one option from among the available choices. The choices are as follows:

- Tour Frequency: 0 - 10 round-trip tours per HH (the exact maximum number varies by purpose)
- Destination Choice: all possible destination zones (some basic logic is applied – if a zone has no school enrollment, it obviously cannot be a SCH destination)
- Mode Choice: some breakdown of travel modes (see below).
- Intermediate Stop: 0 - 7 stops for each half-tour by purpose
- Stop Location: all possible stop location zones (some logic is applied to restrict the possible zones to the most feasible candidates), for each half-tour by purpose
- Time Period: AM, MD, PM, NT (probably defined consistent with the MWCOG model), for each half-tour by purpose

The tour records are then converted into conventional trip tables by mode, time period, and type, for assignment to the roadway and transit networks.

The logit models are determined by their utility equations. For example, the Tour Frequency (TF) model for Work uses the number of workers, HH income, HH size, and area type. In addition, the models for different purposes are connected. For example, in the TF model, the SCH, HBU, and HBW models are applied first, since these are considered *mandatory* trips. The *discretionary* trips (HBS, HBO, ATW) are applied afterwards and are conditioned on the results of the mandatory trips. So, the number of Shop

trips a HH makes depends on its number of Work trips. This is another feature of STM that improves its accuracy compared to the four-step process.

Model estimation consists of the following steps, repeated for each model component:

- A model structure and some initial key variables must be hypothesized. These are based on our experience with other similar models.
- The accuracy of the hypothesized model is tested by applying a statistical analysis program that includes logit analysis, such as ALOGIT. The program estimates the coefficient on each variable and produces certain goodness-of-fit measures. These measures are evaluated, and additional variables are tested in an iterative fashion. As part of this step, it may be necessary to constrain certain coefficients to specific values. This is sometimes necessary to overcome problems associated with a low sample size for certain choices or to be consistent with external guidance (e.g., FTA New Starts practice).
- At some point, the analyst concludes that the model has reasonable variables with logical signs, values, and t-scores for the coefficients.
- The estimated model is then applied to the base year data and the results compared to the survey. This usually indicates additional validation adjustments to improve accuracy.

Most of the logit models will be adapted from our work in Brunswick, Charlotte and Cape Town. This includes the following model components: Tour Frequency, Destination Choice, Intermediate Stop, Stop Location, and Time Period. The Mode Choice step will be handled differently, as discussed below. In addition, our new autonomous vehicle feature will be included. This estimates the AV penetration rate by forecast year (or lets the user specify a rate) and estimates how AV ownership and usage (including TNC/shared AVs) affects each model step.

1.1 HH Synthesis

This step is the discrete analog to the typical four-step model's task to split zonal HHs by size and income. This is one step of STM that is not a logit model and is typically not transferred between areas. It is necessary to customize this step for each area, in order to obtain local information on the key socioeconomic variables.

The main difference between this step in STM and the analogous step in the MWCOG model is that in STM, it is a discrete process. That is, instead of calculating average numbers of HHs by attributes in each zone, Contractor calculate the attributes of each individual HH. This is done by applying a Monte Carlo process that uses probabilities to assign attribute data to a HH in such a way that when the HHs are summarized for the region, the marginal percentages match the data from the Census (typically, 2013-17 ACS PUMS data).

The key HH characteristics Contractor propose are: size (1-5+ persons/HH), income (regional quartiles), workers (0-3+), life cycle (1=any retirees, 2=no retirees, any kids, 3=no retirees or kids), vehicles (0-3+), and AVs (0-3+). The size and income dimensions would be adopted from existing MWCOG practice, while the worker and life cycle dimensions would be created from the most recent ACS PUMS data for the Washington region. The worker model is based on a 3-way tab of HHs by size, income, and workers. The life cycle model is based on a 4-way tab of HHs by size, income, workers, and life cycle. The vehicle model would either be adopted from current MWCOG practice or newly created from ACS PUMS data. The AV

model is based on our analysis and research into AVs. The HH Synthesis model would be created for the entire Washington region, with special emphasis on accuracy within Arlington County.

The output of this step is a list of HHs in the region (around 2 million), with the above-listed attributes and zone number for each HH.

1.2 Network Processing

Several steps are necessary to develop zone-zone travel time information from the networks and to calculate other necessary variables. The most important of these is the network skimming process. This step uses the roadway network to estimate initial peak and off-peak travel times for each zone-zone pair, as well as other impedance values such as distance and toll. This is done separately for SOV and HOV paths (and possibly for HOV2 and HOV3+ paths, if necessary). A similar process is performed for the transit system. The transit network is used to create AM peak and midday paths with the components of time by sub-mode path (walk, initial wait, transfer wait, ride time by sub-mode, number of transfers, fare). The exact nature of this process will depend on how the mode choice model is developed (see section 7.5). But it is likely to be based closely on the MWCOG process.

Other related variables include parking cost, accessibility, the distance of each zone to the DC CBD, the distance of each zone to the cordon boundary, and the retail employment within 3 mi of each zone's centroid. Contractor will create scripts to calculate these variables.

In addition, it will be useful to create separate walk and/bike paths, for subsequent use in mode choice (see below). This will incorporate the County's data on bikeways, which identifies the existing bike paths, stratified by type of path.

1.3 Tour Frequency

The Tour Frequency (TF) model is a logit model where the choices are how many tours a household makes on a weekday, by purpose. The number of choices (0, 1, 2, 3, ...) depend on the trip purpose and are determined from the survey. A hierarchy of purposes is established, based on their priority within the household: 1. School, 2. University, 3. Work, 4. Shop, 5. Other, 6. At-Work. The higher priority tour models are estimated first and then the models for the lower priority purposes are conditioned on the choices made for the higher-priority purposes.

The key variables are the HH attributes and data describing the area surrounding each HH. In some cases, accessibility may play a role and Contractor will specifically look for transport-related factors that might induce tours to be made. This step also examines whether the tour stays within the region or leaves it (I/X).

The output of this step is a set of HH records, showing the number of tours for each HH, by purpose (except for the ATW purpose, which is calculated in the next step).

1.4 Destination Choice

The Destination Choice (DC) model is a logit model where the choices are all feasible destination zones for each tour. Each round-trip tour begins at home and this model computes the utility ("goodness") of each of the traffic analysis zones in the region. It accounts for certain constraints – for example, no Work tour is sent to a zone that has no employment. The destination utility of a zone is typically a function of

the natural logarithm of some key "size" variables such as employment, population, and school enrollment, as well as the travel time and other impedances to that zone, by various modes. Density, accessibility, and some HH attributes (e.g., income) also play a role. Separate DC models are estimated for each trip purpose.

The logit estimation software calculates the coefficients that indicate the relative sensitivity of destination choice to different attributes and the resulting model is then validated using the typical methods of comparing the estimated and observed average tour length, tour length frequency distributions, and intrazonal tour share. The output of this step is a list of tours with their destination zones.

In addition, this step includes the estimation of tour frequency for the At-Work tours, which are made by workers from their workplace. Separate models are used for workers who live in the region and workers who commute from outside the region. This step also includes the estimation of tour patterns for residents who leave the region (I/X), external commuters (XIW), and external non-workers (XIN).

1.5 Mode Choice

The mode choice (MC) model is a special case. Actually, it is the one step in the existing four-step model that requires the least change for the tour-based structure. MWCOG has invested significant resources into its MC process and it would be helpful to leverage that investment for this model. In addition, MWCOG has recently conducted research into changing its approach from the "US" approach: complex mode choice (nested logit with 15 choices) + simple transit assignment to the "European" approach: simpler mode choice (multinomial logit with 5 choices) + more complex transit assignment that includes the sub-mode/path choice. There is some evidence that in transit-rich environments, the European approach works better. Contractor have used both methods but would like to review MWCOG's work and results, and then carefully consider which approach would be best for the new model.

In any case, it will be necessary to make certain modifications to the MWCOG MC process, such as:

- MWCOG's v2.3 model removes walk/bike trips within the trip generation step, so that mode choice considers only "motorized" modes. Contractor think the County would prefer that walk/bike trips not be eliminated early in the model but carried into mode choice. This allows a more sophisticated split process for those trips and also allows for more specific modal tradeoffs.
- The MWCOG v2.3 model does not include metered taxi or Transportation Network Companies (TNCs: Uber, Lyft) as modes. Contractor propose to include these modes. The TNC mode is not included in the 2007 survey and it is unclear if observed data on taxi or TNC usage is available under any circumstances. So, the variables and coefficients will be established from the literature and subjected to reasonableness testing.
- It is unclear if the MWCOG model uses coefficient values that are recommended by the Federal Transit Administration for New Starts analysis (v2.3 does not; v2.5 might). Contractor suggest the use of these coefficients, as this improves model credibility and makes the model more suitable for fixed guideway analysis and New Starts studies.
- Contractor will review the model's handling of complex mode trips, such as bike-rail, TNC-rail, and drive-bus-rail, to ensure that these are handled in reasonable fashion.

Of course, the major difference from the existing MWCOG model is that the new MC model is applied in discrete fashion: a single mode is assigned to each tour (note that "drive to transit" is considered a single mode in this context). The output of this step is a list of tours with their mode.

1.6 Intermediate Stops

The Intermediate Stop model has two components: Intermediate Stops (IS), which estimates the number of stops made by purpose and half-tour, and Stop Location (SL), which estimates the locations (zones) of those stops. The IS model is similar in form to the TF model, but the variables are different. The key variables are tour travel time, income, area type, density of the tour origin and destination zones. Also, the model for the second half-tour (destination to home) includes the number of stops made on the first half-tour (home to destination).

The SL model is conceptually similar to the DC model. A zone is determined for each stop that the IS model estimates. Typically, the stop zones are located between the tour origin and destination zones, but not always. The key variable here is the detour time, which is the time required to reach each candidate stop zone. The mode is also important, since transit users make significantly fewer stops than auto users. This model is validated by comparing the total tour time (including stops) between the model and the survey. The output of this step is a list of tours with the number of stops and their locations by half-tour.

1.7 Time of Day

Contractor will consider alternative structures for the ToD model. This will be either a logit model or a look-up table based on tour purpose, half-tour, and directionality. The look-up table is simple and runs quickly, but the logit model allows different variables to be considered, such as congestion level and geography. Contractor will use four-time periods and will probably copy the current MWCOG period definitions. The output of this step is a list of tours with the departure period for each half-tour.

This step includes the Trip Accumulator step. That involves breaking the tour records into their component legs, with the origin, destination, and time period of each leg. The vehicle records also include the vehicle type (autos by occupancy, truck) and the transit records include the access mode (walk, drive). These records are then used to create conventional trip tables for assignment.

1.8 Truck Trips

Contractor propose to adopt the MWCOG truck model mostly as-is. This uses a conventional aggregate model to estimate trips by three categories: light-duty commercial, medium duty truck, heavy duty truck. Contractor will pay special attention to the truck assignment validation within Arlington Co.

2. TRAFFIC ASSIGNMENT

Our approach to traffic assignment is generally similar to that of MWCOG, but it differs in a few key aspects. Contractor would use a similar multi-class, capacity-restrained process with mostly the same parameters and options as the MWCOG process. The key differences in our approach include:

- MWCOG codes a different toll rate on each link. Contractor prefer to maintain a standard toll rate (cents/mile) for all links within a certain section, as Contractor believe this is closer to the way in which tolls are actually assessed. Contractor will also investigate the potential for having tolls

vary automatically with demand during the assignment phase, in order to balance supply and demand.

- MWCOG uses the equilibrium volume averaging method of assignment. This is a commonly used method, but it often suffers from instability in a highly congested network and illogical results when relatively small roadway changes are made. Such results could make the model perform in counterintuitive ways. Our preference is to use a fixed number of iterations with fixed weights. An equilibrium test run is used to determine the iterations and weights, but these are then held constant for all scenarios for a given horizon year. Our experience is that this produces more stable results, with reduced run times.
- Contractor will include a speed feedback step, as MWCOG does. However, Contractor believe it should be possible to achieve acceptable results using fewer iterations, which will save run time.
- Contractor will incorporate assignment summary reports that are created automatically with each model run, that summarize the main results of each assignment.
- Contractor will investigate the value of stratifying the assignment process by income, so as to improve the modelling of toll facilities.
- The normal assignment produces volumes by four-time periods and daily. One-hour volumes can be estimated from the AM and PM peak 3-hour link volumes.
- Contractor will include a bicycle assignment step.

3. TRANSIT ASSIGNMENT

As noted above, the details of the transit assignment process will depend on the approach chosen for mode choice. For future year model application, Contractor propose to use the Cube Voyager Public Transport module (the one used by MWCOG v2.5), which includes many more capabilities than the previous Voyager TRNBUILD module (MWCOG v2.3), including transit capacity restraint. If the European method is chosen, the PT assignment will be more complex and run longer, since it is effectively doing a combined sub-mode and path choice process. In either case, Contractor will write scripts to summarize the results of each PT assignment.

4. VALIDATION

The roadway assignment will be validated by comparing the daily link traffic volumes from the model against the weekday traffic counts, most likely as provided by VDOT. Contractor will also check VMT by jurisdiction. This effort will focus on roads in Arlington Co.

The mode choice model and transit assignment will be validated by comparing the daily transit boardings against the available boarding count data. The level of detail will depend on the availability of ridership data. If suitable data on bike counts is available, that will be used to help validate the bike model.

It is unlikely that data on actual usage is available from TNCs but it might be available from the taxi companies. School authorities will be contacted for school bus usage.

5. FORECASTING

5.1 2018 Forecast

Contractor will obtain networks and land use information from MWCOG that represent current conditions as closely as possible. Contractor will edit the networks and interpolate the land use to reflect conditions as of December 2018, in order to establish an existing scenario. Running the model with these inputs creates an existing base case, which is useful as a basis of comparison and as a way of further validating the model. Contractor will also compare the model results to the available observed data, as an additional validation and credibility check. Contractor will make any adjustments that are needed to improve model accuracy.

5.2 Future Year Runs

The model will be used to make a base forecast, for a horizon year selected by County staff. Contractor will work with the County Planning Dept. to create the future land use inputs. The networks will be consistent with those of MWCOG. The main purpose of this task is to ensure that the model is working properly.

Contractor will also hypothesize a number of scenarios for sensitivity testing. The response of the model to different kinds of changes will be tested as a check on reasonableness.

6. TRAINING

Contractor will create a complete model application process, including a basic user interface and recommended directory structure. This includes specifications for the computer to be used to run the model. Contractor will conduct two 8-hour on-site training sessions in the use of the model, including the development of input data and how to use model outputs.

7. DOCUMENTATION

Contractor will write a report documenting the input data, zone and network modifications, adaptation of MWCOG model components, development of the forecasting process, validation, sensitivity testing, and user interface. This will include a user's guide to the model.

TASK 2 - DESCRIPTION OF MAINTENANCE SERVICES

Customer previously purchased from Company a license to use the Company's Cube software ("**Software**").

During the term of the Agreement, Company will provide technical support for the Software to Customer via both telephone and electronic mail during the Company's prime period of maintenance ("**PPM**"), defined as 8:30 AM to 5:00 PM EDT, Monday through Friday, with the exclusion of US federal holidays.

During the term of the Agreement, Company will provide Customer with all maintenance releases for the Software that Company may, in its sole discretion, make generally available to its licensees at no additional charge. All maintenance releases, upon being provided by Company to Customer hereunder, are deemed to be Software and are subject to the same license terms as those that apply to the Software under the separate Software license entered into between Company and Customer.

Customer shall apply all maintenance releases received from Company in a timely fashion.

TASK 3 - DESCRIPTION OF ADVANCED SUPPORT SERVICES

Task 3.1 Training

Contractor will provide various types of training for County staff as required. This will include, but not be limited to, the following topics:

- the use of Cube software

- application of the County travel model to various scenarios

- creation of Cube Voyager scripts to perform various analyses

- specification of model input data for future years

- coordination with MWCOG (and potentially other agencies)

Task 3.2 Model Maintenance

Contractor will help County staff to maintain the model scripts. This includes fixing errors, adding new features as requested, and implementing improvements that Contractor discover based on work in other cities. This task includes assisting County staff in the development of model inputs for various scenarios and in interpreting model outputs as needed.

Task 3.3 Documentation

Contractor will prepare tech memos, reports, and other written guidance as requested by County staff to help users and customers understand the model.

Task 3.4 Presentations

As requested by County staff, Contractor will make public and private presentations on the model approach and results.

EXHIBIT – B

RATE SCHEDULE

Bentley
Advancing Infrastructure

Bentley Systems, Incorporated

February 6th, 2020

Ms. Shirley Diamond
Arlington County Department of Management and Finance
2100 Clarendon Blvd., Suite 501
Arlington, VA 22201

Re: Cube Software Maintenance

Dear Shirley:

This letter confirms that the maintenance fee that Bentley will charge Arlington County for its license for Cube Base, Voyager and Cluster will be $3,069.00 through the end of 2020. In addition, the billing rates for the travel model development services project are as follows:

Bill Allen	$210.63
Chris Simons	$245.74
Filippo Contiero	$118.77
Vu Dang	$87.77

These amounts may increase by up to 5% per year after 2020.

Very truly yours,

BENTLEY SYSTEMS, INCORPORATED

By: Katie Brinson

Name: Katie Brinson

Title: Account Manager