

## Active Traffic Management through Adaptive Signal Control on Midtown Manhattan Grid Network – System Expansion

September 7, 2011

Greenman-Pedersen, Inc. with KLD Associates, Inc.  
PIN: 84105MBTR001, Registration # 20090019128, Assignment #36

This scope of work is prepared as part of the NYCDOT ESA held by the GPI Team, with GPI as the prime contractor and KLD as the relevant subcontractor. This particular assignment will be done by KLD. KLD will be supported by its affiliate, KLD Engineering, P.C.

As detailed in this document some of the tasks require the support involvement of TransCore. The associated cost estimate is not included herein.

### BACKGROUND

Mayor Bloomberg announced in July 2011 the New York City Department of Transportation (NYCDOT) project titled "Midtown in Motion" (MIM) that was focused on series of measures to improve mobility in midtown Manhattan within the zone bounded by 42<sup>nd</sup> Street to 57<sup>th</sup> Street, and 2<sup>nd</sup> Avenue to 6<sup>th</sup> Avenue. These measures included active traffic management through adaptive signal control, turn lane designations, and parking restrictions. As part of this project NYCDOT deployed a network of microwave sensors and E-ZPass tag readers tightly integrated into NYCDOT traffic control system (NYC\_TCS) at the Traffic Management Center (TMC) along with advanced solid state traffic controllers (ASTC). This effort was completed under Assignments 27 and 33 of the PIN cited above.

The initial phase of MIM is operational and is under a six month evaluation period. Preliminary results suggest that in general travel times along the arterials have improved within the zone due to the active control, and that the system recommendations on when to invoke active control are logical. NYCDOT is interested in expanding this to other parts of midtown Manhattan. Figure 1 presents the existing zone with the proposed expansions in two phases:

- A. Phase A To the east (to 1<sup>st</sup> Avenue) and to the west (9<sup>th</sup> Avenue)
- B. Phase B To the south to 34<sup>th</sup> Street

The existing zone includes 119 signalized intersections. Phase A of the proposed expansion includes 77 signalized intersections, and Phase B includes 111 signalized intersections.

This document presents the tasks related to support the *initial expansion* (phase A).

The document is outlined as follows: the first section is a description of the tasks, followed by the schedule, and the last section is the labor/budget.

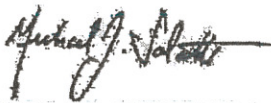
New York City Department of Transportation  
 Engineering, Design and Inspection Services Citywide for Intelligent Transportation System (ITS)  
 Related and Planning Projects  
 Contract No. 84105MBTR001  
 Reg. No. 20090019128

**Assignment No. 36**  
**Midtown In Motion-- System Expansion**  
**Cost Summary Sheet**

Description of Tasks	COST (\$)
Additional Tasks to be performed as part of the Midtown In Motion project. Includes system analysis/modification of the active traffic management system being developed as part of Midtown In Motion.	\$317,499.05

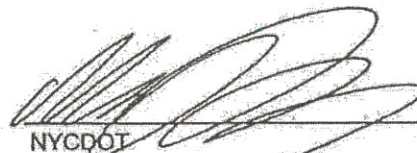
**Assignment Grand TOTAL \$ 317,499.05**

Agreed to:



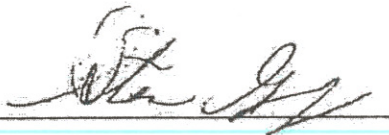
GREENMAN-PEDERSEN, INC.  
 Michael J. Salatti, P.E.  
 Vice President

Approved:



NYCDOT  
 Mohamad Telas, P.E., PTOE  
 Deputy Director Systems Engineering  
 Traffic Operations Division

Approved:



NYCDOT  
 Steve Galgano, PE  
 Executive Director Traffic Operations  
 NYC Department of Transportation

Approved:

Office of Management & Budget

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Assignment No. 36  
 Summary Midtown In Motion  
 Midtown In Motion-- System Expansion  
 Cost Summary Sheet

Labor

Greenman-Pedersen, Inc.	Subtotal	\$ 3,104.00
	Multiplier	2.464
	Total	\$ 7,648.26

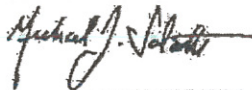
Direct Non-Salary Expenses

Travel	\$ -
Reproduction, Mailing, Postage	\$ -
Supplies	\$ -
Other	\$ -
Outside Services (KLDTRip Consultant's USA, Inc.)	\$ 309,850.79

Subtotal \$ 309,850.79

Assignment TOTAL	\$ 317,499.05
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Agreed to:



GREENMAN-PEDERSEN, INC.  
 Michael J. Salatti, P.E.  
 Vice President

Approved:

NYCDOT  
 Mohamed Talas, P.E., PTOE  
 Deputy Director Systems Engineering  
 Traffic Operations Division

Approved:

NYCDOT  
 Steven Galgano, PE  
 Executive Director  
 Department of Transportation

Approved:

Office of Management & Budget

## TASKS

### Task 1 Specify Detectors, Procure, Install, and Test

This task is devoted to scoping the locations for the sensors and developing an installation plan to cover the expanded study area shown in Figure 1. It is expected that there will be an intense period of discussions with NYCDOT during the first six weeks of the project regarding the deployment of sensors to meet overall project objectives. Sensors will include microwave and ETC readers, and consider needed measurements (a) within the expanded zone, (b) near the 4 critical areas named in Task 3, (c) on the approaches to the expanded zone, including from east and west. A preliminary plan will be developed and presented to NYCDOT. This will be revised as needed, during the course of installation by NYCDOT. NYCDOT will implement and oversee these processes in accord with its standard practices and complete acceptance testing of the installation. The deliverables under this task is an installation plan provided in a format specified by NYCDOT (ArcGIS, Google Earth, Google Maps, etc.).

### Task 2 Adapt Data Analysis Tools to Expanded Study Area

Under the current phase of MIM a range of data analyses were performed to support activities such as fine tuning of sensor deployment, development/refinement of algorithms, and evaluation of the control, etc. These were completed using three tools: Firstly, by post processing of the real time data in MS Excel; secondly, using the web services interface; thirdly, using traffic simulation to evaluate proposed signal control plans. These three tools will be enhanced to facilitate all of these data analyses and will be adapted as needed to support this proposed phase.

As part of adaptation, the existing database created for the current phase of MIM, will be expanded and enhanced to support the expanded study area and converted to a GIS based format (ESRI ArcGIS<sup>1</sup> will be the primary platform). Storing it in a spatial format such as GIS will not only support visualizations of the field data but also a range of valuable data analyses such as cluster analysis of the sensor data based on spatial locations.

The web services interface used in the decision support system (DSS) is a powerful tool for moving data from detectors and controllers to the control algorithm that will select plans, and for moving the new control settings to the field. The interface requires an inventory of the detector and controller codes, and the links to the control algorithm, as well as the related generalized coding that will identify detectors and controllers with zones and subzones. Based upon lessons learned to date, adaptations may be needed related to controller firmware, conditions under which control is dropped, and related issues. TransCore will be involved in some of the items under this task, namely the system integration and testing.

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<sup>1</sup> NYCDOT currently has licenses to ESRI ArcGIS

This task also includes effort related to coordination with the Data and Modeling Group of the NYCDOT Planning and Sustainability Division in order to apply the Manhattan Traffic Model. This model covers portions of the study area at Micro level and all of it under a Meso level. It is anticipated that NYCDOT will complete the simulation runs and provide results based on the scenarios/control plans that need to be evaluated. KLD will coordinate and interact with NYCDOT regarding analyzing the results and developing a framework to adapt the model to meet the needs of this effort.

The deliverables under this task include the set of adaptations as discussed above, resulting in the necessary integrated system to support the control.

### **Task 3 Update Control Algorithms**

This task involves updating the algorithms developed under the current phase of MIM – Level 1 and Level 2 – to meet the needs of the expanded study area.

Level 1 is strategic and implemented along arterials, to rebalance the traffic being delivered to the zone by changing the signal plan on the avenue approach to the zone. Level 2 is more tactical, in that it is designed to look at shorter-term fluctuations of "severity" on competing approaches (avenues and crosstown streets) at certain key intersections, and fine tune the allocation of traffic signal green time to alleviate a localized problem that is developing.

As part of the update, there could be additional constraints considering the key cross streets along the expanded study area that will feedback into Level 1. Also, sub-zones around critical areas such as the 59<sup>th</sup> Street/Ed Koch Queensboro Bridge, the Queens Midtown tunnel, Columbus Circle, and Lincoln Tunnel, will likely provide additional constraints for both levels of control. Such revisions to the algorithm will be prepared, discussed with NYCDOT, and implemented.

Test plans will be developed to evaluate these control concepts and offline analysis will be performed to refine the control parameters. There will be field visits as part of the refinements and at least 2 meetings with NYCDOT.

The last subtask will be the development of software modules that incorporate the revised algorithms into the system.

The deliverables under this task include the set of discussions/presentations with NYCDOT on the control concepts for the revised algorithms and the software modules for integration into the MIM decision support system.

#### **Task 4 Update Decision Support System Displays**

The current graphical user interface (GUI) of MIM is deployed at the TMC and is being used by NYCDOT. The displays and features are largely based on discussions with TMC staff and continued feedback during system operation. With the proposed expansion in the study area, this task will be focused on updating the displays to best serve the NYCDOT staff.

Additionally, automated reporting tools will be added to provide summaries of control decisions, and field data being used in the decision support process. These summaries will be tailored to assist in the evaluation of the system operation.

There are to be multiple visits and working sessions with TMC staff to update the displays. The deliverables under this task will be the revised DSS GUI and user documentation.

#### **Task 5 Base Plan Development**

The current MIM DSS system assists TMC staff to select one of the four signal control plans – base plan (CTOD), Network balancing plan (NBP), and Access control plans (AC1/AC2) based on network conditions. As part of this task, for the expanded study areas 4 sets of plans will be developed, discussed with NYCDOT. These plans will be provided to NYCDOT in their preferred format – excel file or blk files for the ASTC.

These plans will be the deliverables under this task.

#### **Task 6 System Testing and Refinement**

The system testing will be performed at two levels. The plans developed in Task 5 will first be field tested and evaluated for refinement as needed. During this testing the plans will be implemented as part of the time of day control, without the DSS.

Next, the DSS will be run in real time mode and TMC staff will make decisions based on the DSS recommendations. This testing will help refine the system and will involve TransCore and NYCDOT. The results of the testing will be documented and presented.

The deliverables under this task are the two sets of test plans and the results of the tests.

#### **Task 7 Reporting**

A final project report in the form of a technical memorandum will be developed for the project. This will include the base plans developed, the algorithms and decision displays, and the results of the field tests. A draft memo will be provided to NYCDOT for review and revisions will be made as needed. This final project report will be deliverable under this task.

## **SCHEDULE**

The overall project schedule is estimated to be 30 weeks. During the first eight weeks Task 1 (sensor deployment plan), Task 2 (adapt tools), Task 3 (algorithm development), and Task 5 (base plan development) are planned concurrently. This is followed by another 8 weeks for the installation of the sensors in the expanded study area, with an overlap with Task 4 (update system displays). By week 16, the system is ready for testing and in the ensuing 8 weeks, testing and system refinement is planned (Task 6). The last 6 weeks is to finalize the final project report and other deliverables (Task 7). This is shown in Figure 2.

A total of 10 meetings are planned as part of this effort. Support will be provided to NYCDOT in presentation materials needed for use by the NYCDOT project director and executive management.

## **BUDGET AND STAFFING**

The KLD staffing and budget is shown in Table 1 and Table 2 respectively. The required 4T1 form is attached.

There is no labor cost escalation factor included in this proposal, because of the project duration and the expectation that the SI-2000 rate schedule will not be resubmitted for late 2011 review, due to completion of the overall ESA.

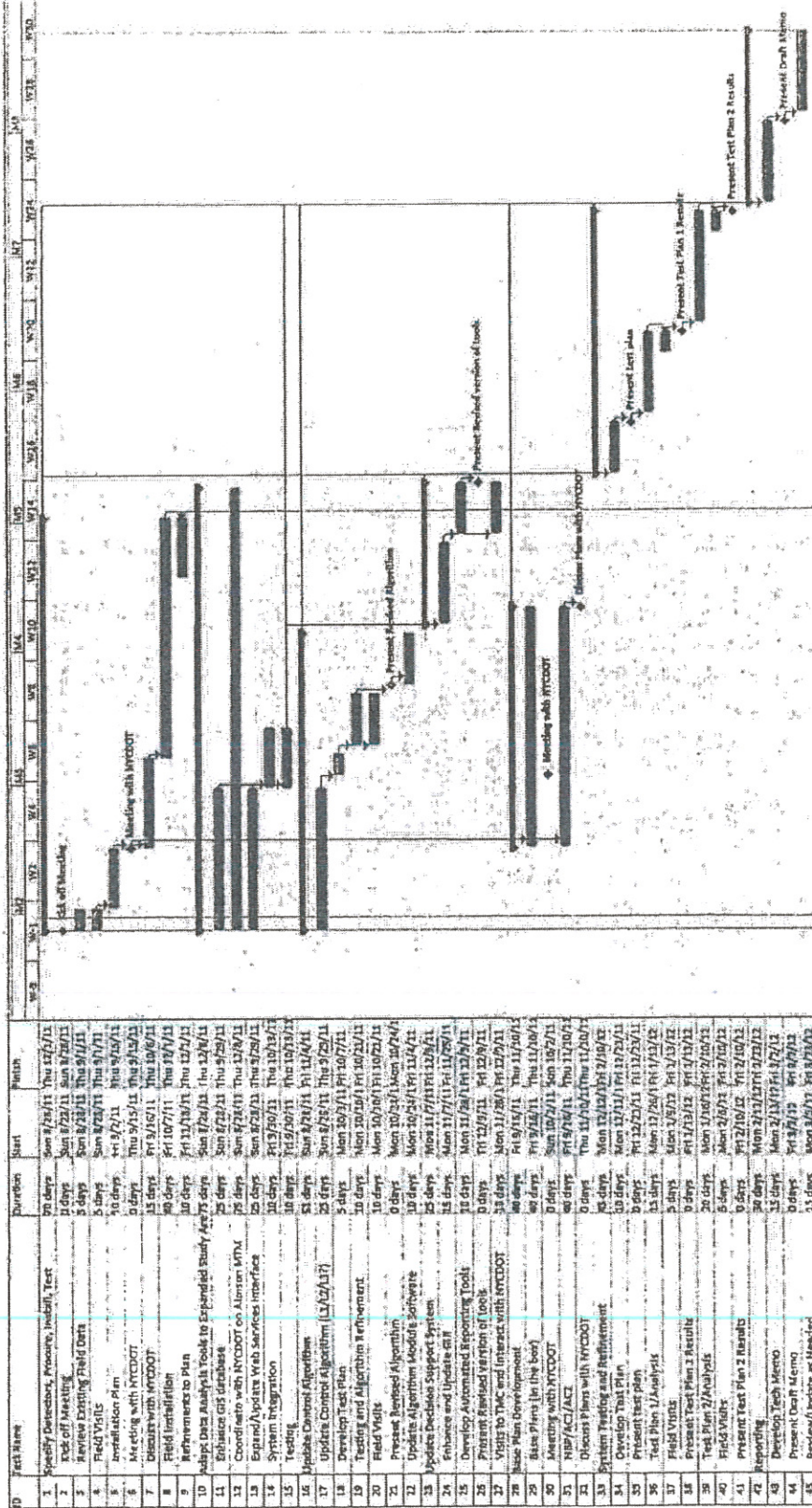


Figure 2 -- Proposed Schedule