travel modelling group

tmg

WORK PLAN 2022-23

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1. Introduction

This document presents the proposed work plan for Travel Modelling Group (TMG) operations for the fiscal year 2022-23 (April 1, 2022 through March 31, 2023). In addition, for the first time, this work plan is presented in the context of a projected multi-year "look-ahead" presenting proposed longer-term tasks for years 2023-24 and 2024-25. This three-year perspective facilitates undertaking tasks that may not be completable within TMG's normal one-year planning horizon. This enables TMG to be more ambitious in its plans and objectives. This is particularly important given the pandemic-induced delay in undertaking the "2021" TTS, now scheduled for the fall of 2022,[1] as well as supporting the planning for development of a "next generation" of TMG tools (in particular, GTAModel V5) that will be based on the 2022 TTS and that need to be designed to address the complex modelling and planning changes facing TMG member agencies in the coming post-pandemic years.

Section 2 of the report presents and discusses the major tasks to be undertaken by TMG during this time, with detailed focus on the 2022-23 tasks. Section 3 defines the deliverables and milestones associated with these tasks. Section 4 then presents the budget for the 2022-23 fiscal year, along with projections for near-term future budgets.

2. Major Tasks & Schedule

A series of discussions were held with the TMG Technical Advisory Committee (TMGTAC), leading to the development work plan presented below. Table 1 presents the proposed 2022-23 detailed schedule of tasks, along with a very preliminary projection for years 2023-24 and 2024-25. The primary focus of the overall three-year plan is the development and implementation of a "next generation" GTAModel V5 that will represent a significant leap forward in capabilities relative to the current GTAModel V4, which has been undergoing incremental improvements since the original V4.0 was introduced into operational practice with the City of Toronto in early 2016. GTAModel V5 will be based on TTS 2022 data, which is not expected to be available for use until sometime in the fall of 2023.[2] Given this, the plan is to undertake as many tasks as possible in the April 2022 – August 2023 time period that can both represent desirable incremental improvements to current TMG tools and models, while also representing significant preparatory work for the eventual GTAModel V5 development and implementation planned to commence in the fall of 2023. At the same time, TMG must be able to continue to support its existing tools and models and member agencies usage of same.

Given these considerations, the 2022-23 tasks can be grouped into four categories (colour-coded in Table 1):

1. Network modelling.
2. Travel demand modelling.
3. GTAModel V5 development.
4. On-going software development and maintenance, and other routine activities.

[1] Plans at the time of writing of this work plan are for 70-75% of the survey to be conducted in the fall of 2022, with the remaining 20-25% to be conducted in the spring of 2023.

[2] The current estimate is that weighted, final records might be available in December 2023. Our expectation, however, is that access to unweighted records will be possible earlier in the fall of 2023, which will be adequate for many preliminary modelling tasks.

Table 1: 2022-23 TMG Major Tasks & Schedule

TMG Three-Year Work Plan (2022-25)		2022-23												Days Allocated		2023-24												2024-25											
No.	TASK	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total[1]	%	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	NCS16 to NCS22 conversion tools	3	1	1										20	4.2%																								
2	VDF calibration tools				2	2	2							24	5.0%																								
3	2022 Emme base network development						1	2	2	2				28	5.8%																								
4	Transit travel time modelling										2	2	2	24	5.0%																								
5	PoRPoW modelling	2	2	2	1	1								32	6.7%																								
6	NWS destination choice modelling		1	1	1	1	1	1						24	5.0%																								
7	Emissions modelling integration							1	2	2				20	4.2%																								
8	HOV/Carpool modelling										2	2	2	24	5.0%																								
9a	Preparing for GTAModel V5		1	1	1	1	1	1	1	1	1	1	1	44	9.2%																								
9b	GTAModel V5 development, testing & implementation													0	0.0%																								
10	GTAModel V4 maintenance & incremental development	1	1	1	1	1	1	1	1	1	1	1	1	48	10.0%																								
11	TMG Emme & Aimsun Toolbox Development & Maintenance	1	1	1	1	1	1	1	1	1	1	1	1	48	10.0%																								
12	XTMF: Upgrades/ Maintenance & V2.0 Development	2	2	2	2	2	2	2	2	2	2	2	2	96	20.0%																								
13	Documentation of TMG products	1	1	1	1	1	1	1	1	1	1	1	1	48	10.0%																								
14	Outreach & Training (3 workshops)		W1				W2			W3				480	Total																								
15	Meetings: TMGSC (2) & TMGTAC (6)	TAC		TAC		TAC		SC	TAC		TAC	TAC	SC																										
	TMG Staff Average Weekly Time Allocation (Days)[2]	10	10	10	10	10	10	10	10	10	10	10	10	10.0																								

Suggested Workshops[3]

W1	York Region Activity-Based Model System
W2	Network & Demand Modelling Upgrades
W3	XTMF 2.0

Legend

n	Lighter, on-going effort (TMG staff)
n	Heavy, focussed effort (TMG staff)
	Network modelling & tools
	Demand modelling
	GTAModel V5 work plan
	GTAModel V5 development
	Student/PDF-led work with TMG staff support
	TMG maiintenance, support, etc.

n = approximate, average number of TMG days per week for this task

Notes:

1 Estimated total days of staff time allocated to the task, assuming 48 working weeks per year (staff take 2 weeks vacation and the University closes for 2 weeks/year during the Christmas Break).

2 5 days/week for Williams Diogu & AmitSandhel. Student & postdoc time not included in this table. James Vaughan time also not allocated in this table.

3 Provisional. Topics may change.

As indicated in Table 1, the work plan consists of 15 tasks. Dark shaded boxes in Table 1 indicate a primary work area in the given month, while more lightly shaded boxes indicate lower-level, more "background" levels of effort on an on-going basis. The number in each box indicates the approximate number of person-days per week anticipated to be allocated to the given task in the given month by TMG staff. These sum to 10 days per week.[3] These numbers should be taken as representative of the level of effort assigned to the task, but the actual amount of time will inevitably deviate to varying degrees from these forecasts. Assuming effectively 48 working weeks in the year (2 weeks vacation per staff member and the University shuts down for two weeks of the Christmas Break), yields the total number days per year per task shown in the second-last column in the table, with the last column indicating the percentage of total staff time allocated to each of these tasks. Tasks have been sequenced in the schedule so as to balance staff workload as best as possible, as well as to respect the logical interconnections among certain tasks. Other tasks requiring sustained by lower weekly levels of staff commitments are then sequenced around the major tasks. The following sub-sections discuss each of the 15 tasks in detail.

2.1 NCS16 to NCS22 Conversion Tools

The TMG 2016 Network Coding Standard (NCS16) has been updated to NCS22 in preparation for the next major round of model system upgrades and development within the region that will be based on the 2022 TTS. Significant effort went into NCS22 to ensure maximal consistency between TMG/GTAModel and GGH Model (GGHM) coding conventions, as well as other necessary updates to the standard. As a result, the need exists to develop a set of tools for agencies to be able to update there NCS16-based networks to NCS22 (as desired/needed) in as automated and error-free manner as possible.

Deliverables: Tested and documented set of conversion tools by July 31, 2022.

2.2 Volume-Delay Function (VDF) Calibration Tools

New methods for developing road volume-delay functions (VDFs) were explored by MASc student Mohammad Amin Abedini in 2021-22. In addition, member agencies have been acquiring new traffic count and speed data from a variety of sources that may provide the basis for improved VDF calibration. In this task new, VDF specifications, calibration methods and calibration datasets will be tested in detail.

Deliverables: Report documenting task activities, findings and new methods developed by October 31, 2022.

2.3 2022 Emme Base Network Development

As in the past, TMG will develop a base EMME road and transit network for fall, 2022 conditions to support travel demand modelling using 2022 TTS data. Also as usual, TMG agency partner staff assistance will be required to help in updating and error-checking the 2022 network in their regions.

Deliverables: Validated 2022 Emme base network by January 31, 2023.

2.4 Transit Travel Time Modelling

A major continuing theme in TMG activities over the years has been to improve our transit network modelling capabilities within Emme. This work will continue in 2022-23 with a focus on improving the

[3] 5 days each for the two TMG staff members, Williams Diogu and Amit Sandhel; time allocations for students, postdocs and the Senior Software Architect – all funded from other sources – are not shown.

origin-destination (O-D) travel time calculations with the Emme transit assignment procedures. This will include several components:

1. Investigating improved representation of "congestion/crowding" effects at transit stops/stations and onboard transit vehicles. The current GTAModel method simply uses a conical "delay" function analogous to a roadway VDF to capture these effects. While we are confident that use of this function has significantly improved GTAModel model transit assignments from both a behavioural and policy sensitivity point of view, we also believe that improvements in this procedure are possible. Among other options, the current GGHM procedure for dealing with these effects will be examined.
2. The reliability of transit vehicle schedule adherence (and hence expected wait times / delays in travel times) is not explicitly represented in the current model. Capturing reliability effects in a static assignment model such as Emme is a non-trivial problem, but options for addressing this issue will be investigated.
3. Potential improvements in the current fare-based assignment method, walk access/egress calculations and modelling of transit route headways will all be investigated.

As indicated in Table 1, developing improved travel time calculations is a significant task, which is expected to continue into the 2023-24 work year.

Deliverables: An interim report documenting progress to date, preliminary findings and recommendations for further work in 2023-24 will be submitted by February 28, 2023.

2.5 Place-of-Residence-Place-of-Work (PoRPoW) Modelling

The COVID-19 pandemic has highlighted the need for much improved modelling of "working from home" (WfH), on both a full-time and a part-time basis. In GTAModel V4, identification of workers in the WfH category is done during the population synthesis stage, and so is not directly sensitive to policies and is not easily adjustable on a scenario basis. The "C19" version of GTAModel developed during 2021-22 has rectified this somewhat by improving analysts' ability to adjust WfH rates on a scenario basis, but this is not a long-term solution. What is required is to remove WfH determination from population synthesis entirely and to make it an integral part of the PoRPoW model that is endogenous within the main GTAModel model system.

In addition, currently GTHA workers employed outside the GTHA and GTHA jobs filled by non-GTHA workers are similarly determined during population synthesis. This should similarly be changed to include the modelling of these work linkages within the main PoRPoW model.

Both of these significant improvements to the PoRPoW model will be implemented. This work will be significantly assisted by the work sponsored by ARTM to transfer GTAModel to Montreal, which will involve this same update to the PoRPoW model.

Deliverables: Updated, documented PoRPoW model by September 30, 2022.

2.6 Non-Work/School (NWS) Destination Choice Modelling

Non-works/school (NWS) activity purpose destinations choices historically have arguably been one of the weaker links in activity/travel demand model systems. Three typical challenges associated with these models are:

1. The development of well-defined destination choice sets.
2. Availability of strong explanatory variables characterizing competing destinations attractiveness for various NWS activities.
3. The interconnections between tour-based mode choices and NWS activity location choices.

With the assistance of a UTTRI PhD student working in this area, TMG will investigate alternative approaches for addressing these issues and test their effectiveness in improving the prediction of NWS activity locations (trip destinations) within the GTAModel/TASHA modelling framework.

Deliverables: A report documenting this task's activities, findings and recommendations for further work by November 30, 2022.

2.7 Emissions Modelling Integration

Extensive, well-calibrated models of air pollution and greenhouse (GHG) gas emissions for the GTHA have been developed by Prof. Marianne Hatzopoulou's TRAQ research group.[4] These have been "loosely coupled" to GTAModel for various studies by simply exporting GTAModel travel times and volumes to the TRAQ models. This is a very inefficient process. The TRAQ model system also currently is not as computationally efficient as it might be (thereby reducing its "nimbleness" in responding to policy questions) and could benefit from refactoring and recoding. In this task, this recoding of the TRAQ models within XTMF will be undertaken, thereby significantly facilitating improved transportation emissions modelling for both TMG partners agencies as well as other TRAQ partners.

Deliverables: Upgraded emissions models integrated and documented within XTMF by December 31, 2022.

2.8 HOV / Carpooling Modelling

GTAModel V4.2 generates within-household shared-ride trips, auto passenger trips with (implicit) non-household drivers and combined taxi/TNC trips. These "2+ HOV" trips, however, are not assigned as such to the network, and so HOV lane usage is not currently modelled in road assignment. This task involves extending and testing the current road assignment procedures used in GTAModel to assign these trips as an explicit mode within the network, including usage of HOV lanes where available. This task is viewed as an important first step towards the eventual more explicit modelling of mobility services such as TNCs, as well as, at some point, autonomous vehicles in GTAModel V5. Points to note about this task include:

- HOV lanes and mode definitions are already coded in the TMG 2016 base network.
- The currently modelled trips do not include non-resident taxi/TNC usage by visitors to the region.
- The model system also is not currently capable of modelling "no-passenger" trip links for inter-household carpool and taxi/TNC trips.

[4] University of Toronto Transportation and Air Quality Research Group (https://www.facebook.com/traqresearch/).

2.9 GTAModel V5

GTAModel V5 is intended to be a major extension and upgrade of GTAModel V4 across virtually all components of the model system, including the addition of a number of capabilities not currently present in V4. It will be implemented in XTMF V2, which is itself a "next generation" rewrite and reconfiguration of XTMF V1 (within which GTAModel V4 is implemented) that has been underway within TMG for the past two years. It will be developed using TTS 2022 data, taking fall, 2022 as its base year, but will also use TTS data from previous years where possible to improve and demonstrate the temporal transferability of the model system.[5] Road and transit networks will be coded based on NCS22. Among the expected features of GTAModel V5 are:

- Complete update of the TASHA core procedures and software for activity episode generation and scheduling, including greater sensitivity to transportation level-of-service changes.
- Improved integration between mode choice and activity location choice.
- Explicit modelling of parking supply and demand at both residential and non-residential trip ends.
- Explicit modelling of a range of mobility services (ridehailing, demand-responsive transit, etc.).
- Improved modelling of household auto ownership and other "mobility tool" choices (driver's licences, mobility service memberships, etc.).
- Incorporation of the network and demand modelling improvements to be undertaken in the 2022-23 work plan, as described in Sections 2.1 – 2.8.
- Improved modelling of active transportation (walking and bicycling) mode choice.
- Improved representation of the trip-making population's socio-economic attributes to support improved mobility equity analyses.[6]
- Improved modelling of urban freight / goods movement.

This is a major undertaking – the largest since TMG's development of GTAModel V4 in 2014-15. It will require additional resources beyond the current TMG staff to accomplish. At a minimum, several of Prof. Miller's PhD students will be heavily involved in the work, as will at least one postdoctoral fellow (PDF). These will be supported by additional research funds from a variety of sources outside of the base TMG budget. Additional funding for this work to enable additional resources to be brought to bear on the problem will also be sought.

As indicated in Table 1, formal work on GTAModel development, testing and implementation will begin in the fall of 2023, once at least preliminary TTS 2022 data are available. During the period April, 2022 – August, 2024 (spanning the 2022-23 work year and the first 5 months of the 2023-24 work year) preliminary research and testing of many of the new components will be undertaken, principally by the PhD students and PDF(s), with the strong support of James Vaughan, UTTRI's Senior Software Architect and the direct supervision and guidance of Prof. Miller, but also with TMG staff support where appropriate and feasible, given their other commitments to the 2022-23 work plan. The students' work will align closely with their individual PhD thesis topics, all of which are related to different components of "next generation agent/activity-based microsimulation modelling.

As is also clear from Table 1, detailed work plans for both the students' work and for the eventual GTAModel V5 development activities are not included in this document. The students' work plans are under development, and TMGTAC will be updated on these as they evolve. Similarly, results from their

[5] This is particularly important given the possible "lingering effects" of the COVID-19 pandemic on travel behaviour in the fall of 2022. A major research challenge will be to ensure, as best as possible, that the post-pandemic "new normal" is captured in GTAModel V5.

[6] TTS 2022 is expected to include an extended set of personal and household characteristics

work will be reported to TMGTAC as these become available. It is currently anticipated that the GTAModel V5 development, testing and implementation will take approximately a year and a half, involving the second half of the 2023-24 work year and all of the 2024-25 work year.[7] The detailed work plan for this work will be developed as a major work year 2023-24 task during the summer of 2023 (indicated by the hatched cells for the months of June-August, 2023 in Table 1), based of the preceding extensive R&D work described above, and given the much clearer understanding of the TTS 2022 data availability that should be available at that time.

Deliverables: Periodic reports by UTTRI students and PDFs on findings from their GTAModel V5 preparatory R&D efforts. A full work plan for the GTAModel V5 development, testing and implementation program will be submitted by August, 2023 (part of the 2023-24 work plan).

2.10 GTAModel V4 Maintenance

Various versions of GTAModel V4 are now being used or are in the process of being adopted by the Cities of Toronto, Mississauga, Brampton and Vaughan, Regions of Durham, Halton, Niagara and Peel, and the Town of Bradford. As usage of the model system increases, so does the need for TMG staff to provide technical support to the agencies and their consultants using the software and to continuously update/fine-tune the software as usage identifies weaknesses in the code that can be incrementally improved. Continuing increment improvements to the model system will be implemented in parallel to the planning for and development of GTAModel V5. Version 4.3 will include an update to the NCS22, and the integration of new models developed during the 2022-23 year.

Deliverables: On-going maintenance and support for GTAModel implementations and usage. GTAModel V4.3 release, including an update of the TMG documentation, will be produced by end of March 2023.

2.11 TMG Emme & Aimsun Toolbox Maintenance

A primary rationale for the TMG is to develop standard tools, procedures and templates for general use by member agencies. These tools are primarily of two types: XTMF-based modules and Emme/4 Modeller procedures. In 2021-22 an Aimsun Toolbox was added as well. Tool development will be an on-going, primary activity of the TMG throughout its existence, as it evolves an ever-increasing suite of tools for members' use. Tool development occurs in two primary ways. First, TMG staff are constantly refining/extending existing tools and developing new tools through the course of their on-going model system development, network coding and testing and other work tasks. Second, recommendations for tool development are regularly generated by the TMGTAC on an on-going basis. A major focus of this work is upgrading the Emme Toolbox to be fully compatible with Python 3, which is needed to run the most recent releases of Emme.

Deliverables: On-going maintenance and expansion of the Emme and Aimsun Toolboxes.

2.12 XTMF Upgrades/Maintenance & V2.0 Development

Similarly, XTMF, as a primary software system for TMG work, is constantly being upgraded. It needs to be maintained, and technical support needs to be provided for its use by member agencies, their consultants, etc. Incremental additions and improvements (and associated updating of documentation) will occur as needed and as they are generated by continuing development of the TMG Toolbox and other TMG

[7] We hope that this is a conservative estimate of the timeline. If delivery of V5 can be accomplished before March, 2025, this, of course would be all to the good.

modules and models. The current release of XTMF is Version 1.9. A significantly upgraded and redesigned V2.0 has been under design by TMG over the past two years, and work on V2.0 will continue through 2022-23. This new version involves a major redesign of XTMF and will require a new version of the TMG Toolbox for Emme. V2.0 is also essential to support the expected major upgrade of GTAModel to V5 (see Section 2.9). XTMF 1 will have continued development until XTMF 2.0 is ready for production use.

Deliverables: Demonstration of an XTMF 2.0 prototype in a TMG workshop in December, 2022.

2.13 Documentation of Software & Models

Continuous updating of documentation of XTMF, GTAModel and TMG Toolbox software and procedures is an on-going task on TMG. As indicated in the discussions in the preceding sections and in Table 3 below, documentation of all TMG activities and products is an integral component of all tasks and deliverables. All documentation is available on the TMG website.

2.14 Outreach & Training

A critical component of TMG activities in all phases of its work must be training, technology transfer and outreach. In order to succeed, TMG must be responsive to its collaborating partners' needs. It must also get the tools that it is developing into the hands of its partners for their use. The TMG's role is intended to be one of tool developer, not to be the user of these tools on behalf of its partners in operational applications (except in special cases). These activities in 2022-23 will include:

- On-going updating and elaboration of the TMG web site.
- Documentation of all procedures, etc. developed by the TMG (Task 13).
- Regular (approximately every other month) meetings will be held with TMGTAC to discuss work in progress, next steps in the work plan and to disseminate work plan results (see Section 2.15).
- Training workshops will also be organized providing the opportunity to present and discuss in greater detail recent TMG work and products. As shown in Tables 1 and 2, three workshops are proposed for 2022-23. These workshops generally are held 10:00-12:00 Wednesday mornings. Workshop topics will be finalized in consultation with TMGTAC, but at time of writing of this work plan, the proposed topics are:
    - W1: Region of York Activity-Based Travel Demand Forecasting System.[8]
    - W2: Network & Demand Modelling Upgrades.[9]
    - W3: XTMF 2.0.

2.15 Meetings

In addition to the TMGTAC meetings discussed in Section 2.14, regular meetings with TMGSC will be held to discuss work plan progress, budget, overall TMG directions for work and other administrative and supervisory matters.

An important role of the TMGTAC meetings will be to monitor work plan progress and to identify and recommend "mid-course" changes to the approved work plan as might be warranted by either work progressing much more slowly or more quickly than originally anticipated or by new priorities, needs or opportunities emerging during the course of the work. Given the research nature of the TMG work plan,

[8] The Region of York has requested to use this workshop to "unveil" their new modelling system, which has been under development for the past two years.

[9] Summaries of key results to this point in the year from Tasks 1, 2, 5 and 6.

it is important to maintain "nimbleness" in the work plan in order to maximize its effectiveness as conditions and opportunities evolve over time.

It is proposed that 6 TMGTAC and 2 TMGSC meetings be held during 2020-21. Each meeting is generally 2 hours in length and is usually held on a Wednesday morning (10:00-12:00). The proposed schedule for these meetings (including the workshops discussed in Section 2.14) is shown in Table 2.

Table 2: 2022-23 Meeting & Workshop Schedule

TMGTAC Meetings	Workshops	TMGSC Meetings
April 6, 2022	May 4, 2022	October 5, 2022
June 1, 2022	September 14, 2022	March 1, 2023
August 3, 2022	December 7, 2022	
November 2, 2022		
Janaury 18, 2023		
February 1, 2023		
Notes:		
1. All meetings and workshops 10:00-12:00, unless otherwise posted.		

3. 2022-23 MILESTONES & DELIVERABLES

Table 3 lists the primary deliverables and milestones for the 2022-23 work plan. The GTAModel V5 work plan, discussed in Section 2.9, is not included in this table since it lies outside the 2022-23 work year.

Table 3: Summary of 2022-23 TMG Deliverables & Milestones

Task	Deliverable	Due Date
1	NCS16 to NCS22 conversion tools	July 31, 2022
5	PoRPoW modelling	September 30, 2022
2	VDF calibration tools	October 31, 2022
6	NWS destination choice modelling	November 30, 2022
7	Emissions modelling integration	December 21, 2022
3	2022 Emme base network	January 31, 2023
4	Transit travel time modelling (Interim report)	February 28, 2023
8	HOV/Carpool modelling (interim report)	March 31, 2023
9a	Preparing for GTAModel V5	Periodic reports to TMGTAC
10	GTAModel V4 Maintenance	On-going
10	GTAModel V4.3	March 31, 2023
11	TMG Toolbox Improvements	On-going
12	XTMF Maintenance	On-going
13	Documentation of TMG products	On-going
14	Outreach & Training (3 workshops)	See Table 2 for dates
15	Meetings: TMGSC (2) & TMGTAC (5)	See Table 2 for dates

4. 2022-23 BUDGET

Table 4 presents the proposed budget for 2022-23 TMG operations, based on agreed contribution levels for each participating agency. The majority of the budget (62.3% total; 88.5% of direct expenditures) is for TMG staff. In addition to the usual budget item for Emme and Aimsun software licences essential to TMG operations, a modest budget for upgrading computer hardware has been added to support updating TMG computational capabilities, which are also essential to its on-going operations.

University of Toronto cash and major in-kind contributions are also explicitly shown in Table 4 in order to make clear the full costs of the project and the University's significant contribution to TMG operations. Although these represent an under-estimation of the full University in-kind contributions, they significantly exceed the total project overhead paid by the member agencies to the University as part of their contributions.

Projections of the budget for the next four years (2022-26, inclusive) are also provided in Table 4. Note that, based on current assumptions, the 2022-23 and projected future agency contributions over this planning period are projected to remain at the 2020-21 levels.

Table 4: TMG 2022-23 Budget

TMG Budget	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**2026-27**
Expenses	**Amount**	**Amount**	**Amount**	**Amount**	**Amount**
Salaries[1]	$161,640.88	$167,865.89	$173,120.20	$178,132.45	$183,293.51
Computer Hardware	$15,000.00	$15,000.00	$15,000.00	$5,000.00	$5,000.00
Software Licences (Emme, Aimsun, misc.)	$6,000.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
Contingency	$0.00	$0.00	$0.00	$0.00	$0.00
Overhead (@40%)	$76,857.14	$76,857.14	$76,857.14	$76,857.14	$76,857.14
Total Expenses	**$259,498.02**	**$265,723.04**	**$270,977.34**	**$265,989.59**	**$271,150.66**
Percent increase in expenses over previous year	-2.88%	2.40%	1.98%	-1.84%	1.94%

Revenues	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**2026-27**
Member Contributions	**Amount**	**Amount**	**Amount**	**Amount**	**Amount**
Metrolinx	$66,000.00	$66,000.00	$66,000.00	$66,000.00	$66,000.00
MTO	$34,000.00	$34,000.00	$34,000.00	$34,000.00	$34,000.00
City of Toronto	$34,000.00	$34,000.00	$34,000.00	$34,000.00	$34,000.00
City of Hamilton	$21,000.00	$21,000.00	$21,000.00	$21,000.00	$21,000.00
Region of Durham	$21,000.00	$21,000.00	$21,000.00	$21,000.00	$21,000.00
Region of Halton	$21,000.00	$21,000.00	$21,000.00	$21,000.00	$21,000.00
Region of Peel	$21,000.00	$21,000.00	$21,000.00	$21,000.00	$21,000.00
Region of York	$21,000.00	$21,000.00	$21,000.00	$21,000.00	$21,000.00
City of Brampton	$7,500.00	$7,500.00	$7,500.00	$7,500.00	$7,500.00
City of Mississauga	$7,500.00	$7,500.00	$7,500.00	$7,500.00	$7,500.00
City of Vaughan	$7,500.00	$7,500.00	$7,500.00	$7,500.00	$7,500.00
Toronto Transit Commission	$7,500.00	$7,500.00	$7,500.00	$7,500.00	$7,500.00
Total Member Contributions	**$269,000.00**	**$269,000.00**	**$269,000.00**	**$269,000.00**	**$269,000.00**
Carry-Forward from Previous Year [3]	$0.00	$9,501.98	$12,778.95	$10,801.60	$13,812.01
Additional Revenue (UofT Subsidy)	$0.00	$0.00	$0.00	$0.00	$0.00
Total Revenues[2]	**$269,000.00**	**$278,501.98**	**$281,778.95**	**$279,801.60**	**$282,812.01**
Percent Increase in contributions over previous year	0.0%	0.0%	0.0%	0.0%	0.0%
Total Revenues - Total Expenses	$9,501.98	$12,778.95	$10,801.60	$13,812.01	$11,661.36
Contributions-Actual Expenses	$9,501.98	$3,276.96	-$1,977.34	$3,010.41	-$2,150.66

Notes:

1. 2 full-time TMG staff salaries + benefits + 1 undergraduate summer research assistant.
   TMG staff salary increases based on current salary schedule for USW employees at UofT.
   This may change in the future.
2. "Total Revenues" include carry-forward from the previous year.
3. Estimated.

University of Toronto In-Kind Contributions	
Principal Investigator Time	$50,000.00
Senior Software Architect Time	$52,000.00
Post-Doctoral Fellow Time	$15,000.00
Graduate Research Assistants Time	$40,000.00
Office Space & telephones	$6,000.00
Total	$163,000.00
UofT In-Kind - Total Overhead Contribution	$86,142.86

This excludes other UofT in-kind contributions to TMG that are very difficult to quantify. These include:

- Data Management Group support of TMG
- Internet access
- University of Toronto library access
- Administrative support
- UTTRI computers & software in addition to explicit TMG equipment & software.