Consultant Work Program for the Transportation and Land Use Model Integration Program

22 June 1998

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Project Approach

The technical work program is broken into four task sets, as described in the Request for Proposal. A critical review of the progress to date will be carried out in Task Set 1, concluding with a peer reviewed general design of second generation models. The ability of the ODOT staff to creatively use the models will be required if this work is to be truly successful. To that end a comprehensive training program is described in Task Set 2. The design and implementation of the second generation models is described in Task Set 3. The ability to share the information gleaned from the modeling work with other analytical databases and packages is also important. These capabilities will be developed in Task Set 4. Each task is described in detail, to include the products that will emerge from each task; a list of the key deliverable items is presented in Exhibit 1.

Task Set 1: Refine Technical Work Program

The work in Task Set 1 will focus on a collaborative design of the second generation of integrated land use and transport models for the Oregon DOT. It will build upon the experience gained and the products developed in the current TLUMIP consultant contract. The frequent consultations with the Peer Review Panel and Modeling Steering Group have provided immeasurable benefits to the current work. We propose to continue both bodies, and to have them play an integral role in the refinement of the technical work program.

Task 1A: Reactivate Peer Review Panel and Model Steering Committee

The consulting team will contact the current members of both bodies to ascertain their willingness to continue in that role. To the extent possible, we propose to retain the composition and membership of both bodies as they presently stand. The reactivation will include providing the members

with a briefing of the current project status, reaffirmation of their commitment, negotiation of compensation for direct expenses and labor (jointly with the ODOT project manager), and the preparation and execution of necessary contractual documents. It is anticipated that some members of these oversight committees will not be able to continue in that role. The consulting team will prepare a revised membership roster of both organizations (including addresses, phone numbers, and email addresses), and make written recommendations of suitable candidates for vacant positions on the Peer Review Panel.

A combined meeting of the Panel and Committee will be held during the first two months of the contract. We propose to retain the one and one-half day meeting schedule that proved successful in the past. The consulting team will report on the progress of all work to date, to include the preparation of data required for the historical validation of the first generation UrbanSim model. Two major topics will be addressed during this meeting. The first will deal with the presentation and defense of our technical approach for the historical validation of UrbanSim in the Eugene area (Task 3E), which we are proposing will begin immediately and will provide useful input to Task 1B (the review of the current model status). The idea for the historical validation came from the Peer Review Panel, but the details of the exercise have not been reviewed by the Panel. The second major topic will be a review of the lessons learned during the development of the current models. We would like to obtain a candid assessment from both groups about the direction taken to date, and their broad recommendations for further evolution of the models. Their input and recommendations on model form and structure will be important considerations in the design of the second generation models.

Product: The consulting team will make recommendations for the replacement of vacant positions on the peer review panel. The consulting team will organize and lead the oversight committee meeting, and will prepare meeting minutes from the meeting in the same format utilized for documenting the past meetings.

Schedule: The recommendations for the composition of the peer review panel will be submitted within one week after receiving the notice to proceed on this contract. The oversight committee meeting will be held within the first 60 days of the contract. The meeting minutes will be submitted within one month.

Task 1B: Review current status of the state, substate, and metropolitan models

Development of the prototype models has led to a much fuller understanding of the intricacies, strengths, and weaknesses of integrated land use-transport modeling at the statewide and substate levels. Several major conclusions may be drawn from this experience as well as many criteria and guidelines that will inform the second generation model development. It is critical that these be well documented to facilitate full discussion and to provide detailed input to upcoming model recommendations and specifications.

The current status of the statewide and substate models

Many aspects of the prototype statewide and substate models will be reviewed and discussed including, at least, the following:

- Spatial Structure: At the outset of the TLUMIP modeling program it was envisioned that a hierarchical, nested zoning system would be developed encompassing the full range of model

applications from statewide through metropolitan. Experience to date reinforces and clarifies this concept. For example, it is clear that economic modeling works best at a more aggregate level whereas network modeling works best at a more disaggregate level. The economic modeling component would benefit from more sectoral detail and less geographic detail than employed in the prototype. Network modeling would benefit from a considerably finer level of spatial detail than employed in the prototype, especially in the MPO areas. Large zones encompassing small urban areas have also been problematic because economic flows and related transport flows are entirely intrazonal.

- Network Design: Use of highly abstracted networks employed in the statewide and substate models should be reconsidered. The high degree of network abstraction in the prototype created problems related to accuracy of travel times within metropolitan areas, representation of capacities, and analysis and presentation. This experience suggests networks be modeled at a level of detail much closer to the real world, a level much closer to that of the MPO transport models. It is quite easy to average zone-to-zone travel times and costs from a detailed network and zone system for use at a higher level of aggregation; whereas, it is difficult to abstract the network and achieve similar results directly at the more aggregate level. Accuracy of intrazonal travel times and the time between adjacent zones would be substantially improved by more detailed networks. Analysis and presentation would also be facilitated since the networks would coincide closely with actual facilities. Another aspect of network design to be reviewed is the provision for external flows. It is necessary to provide for the different external trip lengths associated with freight (truck and rail) transport compared to passenger (primarily auto) travel. The prototype network has employed artificial capacity-restrained links at the external cordon to deal with this problem but a better solution should be considered. Possibilities include extending the model area to adjacent states at a highly aggregate level and/or providing separate external centroid connectors in the network by mode and category.
- Economic Transactions: Economic transactions in an input-output model are typically expressed in annual dollar terms. For the prototype statewide and substate models, this convention was carried through the application of the TRANUS model. While this had some benefit related to tying TRANUS results back to the base input-output table, it also complicated preparation of inputs and made interpretation more difficult in some respects. All things considered, it is probably better to break with the input-output table convention and work directly in units such as households and workers. A related aspect to be reviewed is if and how to reflect the variations in productivity throughout the state. The way this was handled in the prototype resulted in troublesome imbalances in production and demand on a regional basis. This in turn led to economic flows and activity being more dispersed than in reality which, when translated into related travel demand, produced trip lengths considerably longer than those observed.
- Land Market Simulation: Data problems have been most prevalent here. Availability, consistency, and accuracy of land quantities and prices have been extremely elusive, especially outside the Portland and Eugene metropolitan areas, for a single year much less over time. This is an area that should receive careful review and consideration. What is possible? In what time frame? What can be done in the time frame of second generation models? What steps can be taken with a view to the longer term? Other aspects of the land market simulation need to be reviewed also. For example, the way in which production sectors and land sectors are

defined should be reconsidered to facilitate specification of land consumption functions and appropriate land consumption patterns. Economic sector definitions such as AGFF (Agriculture, Forestry and Fishing) create problems in land market simulation. Very large land areas of different types are involved in such definitions and demand for agricultural land for farming, say, is hard to separate from the demand for commercial office land by office workers in the agriculture industry.

- Activity-Transport Interface: In TRANUS this interface converts economic flows (in annual dollars) by economic sector to daily transport demand in appropriate units. For example, economic flows from households to industries are converted to commute trips. Based on experience with the prototype, there are several areas that warrant review and potential modification to provide greater flexibility. One such area is the level of specificity at which conversion factors may be applied. In the current version of TRANUS, these may be specified only by sector not on a sector-to-sector basis. Experience suggests the ability to deal separately with industry-to-household flows, household-to-industry flows, industry-to-industry flows, and household-to-household flows is essential. Similarly, the ability to deal separately with internal-to-internal flows versus internal-to-external flows is essential.
- Model Convergence: This has been another area where severe difficulties have been experienced. And, while substantial progress has been made, further refinement and flexibility in this area should be considered. There are three interrelated convergence mechanisms involved, namely: convergence within the economic activity and land market models, convergence within the transport model, and overall convergence between the two. Experience indicates it is necessary to have more robust dampening algorithms, especially between land use and transport, to achieve overall convergence.
- Model Formulation: Overall the nested logit structure of the prototype statewide/substate models has worked well and the need for a nested structure is reinforced by the above comments related to spatial structure. At the same time, review of experience to date and consideration of refinements is appropriate. Fundamental considerations include the implied sequencing of decision making and the use of scaled logit utilities. Do households first decide where to live then what type of housing to choose in that area or is the type decision made first? How do we deal with non-linear utility functions? These are among the questions that need to be considered. There is a perceived problem with the so-called ‘scaled logit’, used in TRANUS, where each alternative’s utility value is divided by the maximum utility (actually minimum disutility) value for the set of alternatives. The rationale for using ‘scaled logit’ in TRANUS is that it reflects the non-linear nature of perceptions (where the difference between $1000 and $1010 is not the same as the difference between $10 and $20). This departs from the standard logit formulation and its theoretical underpinnings and its impact on model calibration will be reviewed. An alternative approach within standard logit is the use of non-linear transformations in the utility expressions.

The current status of the metropolitan model

The current version of the metropolitan prototype model represents a useful first stage in the development of a metropolitan land use and transport model. It shows considerable promise in many regards. Much has been learned about possible approaches and techniques. It is very impor-

tant that this valuable learning by experience is documented and reviewed, in order to realize the maximum benefit in the further modeling work.

This review of the current state of the metropolitan model will include, but not be limited to, consideration of the following issues:

- The approach used for location choice in UrbanSim, where there is an area-wide location choice process influenced by general accessibilities, contrasts with the approach used in TRANUS, where there is a consumption-based allocation of production influenced by specific interaction costs. It would appear from a conceptual level that the approach used in UrbanSim is more consistent with the trip chain and activity-based representations of household travel behavior currently under development. And it seems likely that it more closely represents the actual nature of the behavior of households. This makes the UrbanSim approach appealing for households. However, it would appear from a conceptual level that the approach used in TRANUS is closer to the actual nature of spatial interaction in industrial activity, making the TRANUS approach more appealing for at least some sectors of employment. This suggests that a hybrid framework using elements of both of these approaches may be appropriate and should be explored. Along with possibly improving the representation provided, such a hybrid framework would work towards the objective concerning integration of the statewide and metropolitan models. The performance of both the metropolitan model and the statewide model need to be reviewed in this regard to see what can be learned about a suitable hybrid framework.
- The metropolitan model has yet to be tested regarding its performance through time. The vast bulk of the empirical work has concerned cross-sectional distributions at just one point in time. The historical validation process will help in this regard. Still, there are specific elements of the metropolitan model that relate to its temporal dynamics that need to be reviewed, as follows:
  - Developer responses, and associated temporal lags in floorspace changes;
  - Employment and household location choice, and the associated time delays in the influences of accessibilities; and
  - Price adjustments where the model works towards but does not reach equilibrium, and the resulting need to specify the extent of the step towards equilibrium in each case.

  Leaving aside equilibrium, as is done in UrbanSim, is appealing from a theoretical level; but it does make it necessary to specify and estimate the parameters of the functional forms for each of these elements. In the strictest sense these are calibration matters, but they will have a direct bearing on the historical validation. It is anticipated that the results of the historical validation will aid in the further adjustment of these elements of the model.
- The current version of the Metropolitan model uses an average price for each zone. It would be more consistent at a theoretical level to use a logsum price. The potential to do this using the existing data needs to be reviewed. It may be that a logsum price would provide a better model fit.
- The current version of the Metropolitan model considers the location choice of firms in terms of industrial (SIC) categories. Yet employment location issues relate primarily to occupation (SOC) categories. This was done because of data availability problems. The effectiveness of this approach needs to be reviewed, and the potential for an augmented approach that recog-

nizes data availability problems.

- The Metropolitan model in its current state uses tax assessment values as a proxy for willingness-to-pay amounts, primarily because of data availability problems. The effectiveness of this approach needs to be reviewed, and the potential for the use of some other survey method, such as stated preference surveys, as a means to observe willingness-to-pay amounts needs to be reviewed.

The review of the Metropolitan model will be done using a systematic approach, where the current state of the model will be set against the current TLUMIP objectives. This will allow both an assessment of the current state and a consideration of the potential alternative courses for the next stage and subsequent stages of development. There will also be a review of items according to the following headings:

- What has gone well;
- What has not gone well, and with hindsight should have been done differently;
- What are the practical constraints regarding data and computing resources;
- What are the greatest opportunities; and
- What are the most appropriate directions for the next stage of development and for subsequent development?

Product: The review of both modeling systems will be carried out by the consulting team, and documenting in a working paper on the topic.

Schedule: A draft working paper will be submitted by 1 October 1998. The final report, incorporating comments from the oversight committees and ODOT, will be completed by 1 November 1998.

Task 1C: Draft recommendations for development of second generation state and substate models and first generation metropolitan model

Based upon the insights gained from the review of the current models, feedback from ODOT staff and the oversight committees, and recent literature on the topic, the consulting team will prepare a set of draft recommendations for the development of the second generation models. It will pay particular attention to the concepts of horizontal and vertical integration of the statewide, substate, and metropolitan models, and our strategies for achieving them. The recommendations will include charts and illustrations to help convey the principal features of the recommended models.

Product: The recommendations will be submitted as a technical report, and will include material from the review of the current models, as appropriate. This report will describe the proposed modeling approach in general, along with its strengths and weaknesses. We will point out areas of potential risk, either in terms of lack of suitable data or for techniques that have not been previously tested elsewhere, either in the first generation models or in work in other locations. Finally, this document will describe any data requirements that have not already been met in the work to date.

Schedule: The draft recommendations will be submitted by 1 January 1999. The final recommendations, incorporating comments from the oversight committees and ODOT, will be completed by 1 February 1999.

Task 1D: Discuss recommendations with oversight committees

The draft recommendations in Task 1C will be distributed to the oversight committees for their review and comments. The second joint meeting of the committees will be scheduled for approximately two to three weeks after the recommendations have been distributed, allowing them ample time to review the material. The meeting will last one and one-half days, and will follow the same general format as the meetings held to date. The consulting team will provide a brief review of the recommendations, which will lead into discussions on the various aspects of model design. The consulting team will lead each discussion session. At the conclusion of the meeting, the consulting team will prepare a summary of the meeting, in the same format used for previous meetings.

Products: The consulting team will organize and lead the oversight committee meeting, and will prepare meeting minutes.

Schedule: The oversight committee meeting will be held during the first half of February 1999. The meeting minutes will be submitted within 15 days after the meeting.

Task 1E: Finalize recommendations

The consulting team will revise their recommendations based upon the comments received from the oversight committees (Task 1D), as well as less formal feedback received from attendees at the Symposium (Task 2A).

Products: The finalized recommendations will be submitted in the form of a technical report.

Schedule: This task will be completed within one month from the second oversight committees meeting (Task 1D). A draft report will be distributed to members of the oversight committees to ensure that their concerns and comments were properly reflected. Given the importance of this document and its key role in the development of the detailed model specifications (Task 3A), we believe that it is prudent to incur this additional review time. The report will incorporate the comments of the oversight committees and ODOT, and will be completed within 45 days.

Task 1F: Establish university research linkages

The desire to establish formal university research linkages was an objective in the current contract, and is listed as a TLUMIP second stage objective in the RFP. We share ODOT's belief that research links with universities can add significant value to the research and development effort. The challenge will be to develop linkages that will facilitate the stated objectives while at the same time providing timely and useful contributions to the project.

The consulting team will re-assess the recommendations made during this contract, and examine new ideas for establishing such relationships. One avenue of collaboration that can be immediately implemented is to invite selected academics from Oregon and regional universities to join the Modeling Steering Group. Their input on this topic will be particularly valuable. If there is sufficient interest on the part of several universities, ODOT may wish to consider the formation of a third oversight committee, devoted to university collaboration. This committee could provide ODOT with a better perspective on the opportunities for and obstacles to university involvement in the project, and to help formulate and supervise such efforts once they are identified.

PB prepared a call for applications that was distributed to professors and colleagues via email in January 1998, as part of the current contract. A printed call for applications was widely distributed at the annual meeting of the Transportation Research Board that same month. This position was to commence in July 1998, at the start of the proposed contract. This will enable one or two graduate students or post-doctoral fellows to work directly with the consulting team and ODOT staff, under the supervision of one or more professors. The fast pace of the project, coupled with frequent attempts at alternative approaches and methods, makes this type of relationship more beneficial to the universities, ODOT, and the consulting team than a more traditional subcontract for specific products. We were unable to fill the position based on that solicitation, although we did secure commitments from two academics serving on the Peer Review Panel to supervise the chosen fellow.

Paul Waddell's affiliation with the project from his post at the University of Washington provides another opportunity to fill this position with a colleague or student in a manner that would be mutually beneficial to both the university and to the project.

Products: These and other options will be examined as part of a set of formal recommendations for this task, which will be submitted in the form of a technical memorandum on the topic.

Schedule: The recommendations will be completed within the first three weeks of the contract. The university linkages put in place will extend over the life of the contract.

Task Set 2: Training

The requirements for staff training are addressed through a variety of programs. The consulting staff will assist ODOT in the organization and conduct of a Symposium on Integrated Land Use-Transportation and Activity-Based Travel Modeling. This forum is designed to acquaint Oregon planners with the progress to date in the TLUMIP, and plans for further work. It will also permit researchers from other areas to both contribute their experiences and gain from ours. A training plan will be developed and carried out that will provide in-depth instruction in the modeling tools developed during this contract as well as the first generation work, from the theoretical underpinnings of the models to their real-world application. Lastly, provision is made for ongoing coaching of ODOT and MPO staff in the use of the models.

Task 2A: Conduct a state conference on integrated transportation and land use models

The consulting team has assisted ODOT in the planning of the conference, to include the development of the technical program and preparation and dissemination of advance notices. The consulting staff will play a key role in the presentations, along with ODOT staff and selected members of the oversight committees. It has been organized as a symposium, which differs somewhat from a conference in that the former is generally more of a one-way exchange of ideas. It will provide an excellent overview of integrated land use-transportation models and activity-based modeling for Oregon planners and engineers, and inform them of the pioneering work in these areas that have been conducted by ODOT and other planning agencies in Oregon.

Products: The consulting team will continue to work closely with ODOT staff to organize and conduct the Symposium, which will include the following tasks:

- Continued publicity of the event, to include electronic notification of interested parties;

- Organizing each session, to include the preparation of handouts if appropriate and the scheduling of presenters;
- Arranging for the presenters and panelists in each session to attend the Symposium; and
- Preparing the Symposium Proceedings.

The consulting team will appoint a person to lead their efforts in this Task, who will be on hand at all times during the Symposium to handle contingencies and problems.

Schedule: The Symposium will be held on 30 September-1 October 1998. The draft Proceedings will be submitted on 15 October 1998. The final Proceedings, incorporating ODOT comments, will be completed by 15 November 1998.

Task 2B: Develop a training plan

The consulting team will develop a course-based training program for ODOT staff covering the fundamentals of land use and transport modeling and the specifics of the operation of the statewide and metropolitan models. The economic, land use and transport theory underlying the models will be covered, and a range of alternative modeling frameworks will be presented, with a particular focus on the theory and application of the TRANUS and UrbanSim frameworks and their specifics in the statewide model and metropolitan models respectively. This course-based training program will include classroom lectures, question and answer tutorials, assignments, and laboratory exercises. It is recognized that the course will be most effective if it is limited to a small number of ODOT staff participants. A formal written examination may also be conducted if deemed appropriate.

Product: A training plan will be developed that includes identification of participants; a detailed listing of topics to be covered during lectures, tutorials, and exercises; and the schedule.

Schedule: A draft of the training plan will be completed by 1 August 1998. The final training plan, incorporating ODOT comments, will be completed by 1 September 1998.

Task 2C: Prepare training materials

The course materials for this training program will include lecture notes and overheads, problem assignments with worked solutions, and examples of use of the statewide TRANUS model and the UrbanSim metropolitan model. They will be prepared drawing upon the extensive experience in previous courses given at both the undergraduate and graduate levels at universities.

Set assignments will include worked examples designed to reinforce concepts and techniques covered in the lectures and tutorials. A small (3 to 5 zone) hypothetical study area will also be considered using a number of different land use and transport modeling frameworks in order to help develop an appreciation of relevant concepts and methods. Students will be taken through the operation of the TRANUS and UrbanSim models through a series of tutorials. The treatment of this hypothetical study area using other frameworks may also be considered if deemed appropriate. The intention is to facilitate learning by example to augment the material covered in lectures.

All the course materials will be drawn together into a coherent package so that those taking the course can take away with them after the training is completed to act as a reference for further work.

Product: A training package will be prepared for each course, including lecture notes and copies of audiovisual aids, supplementary reading materials, problem assignments with worked solutions, and examples of the use of the statewide and metropolitan models.

Schedule: Training courses are proposed at several points throughout the project; training materials appropriate for each session will be developed two weeks prior to each course.

Task 2D: Conduct classroom-training sessions on models

We anticipate including the several lectures in the classroom training:

- Introduction (2 hours)
  - Organization of course
  - Course objectives
  - Students involved
  - Required student background (e.g., familiarity with certain topics)
  - Outside reading and remedial preparation
- General Issues in Land Use and Transport Modeling (3 hours)
  - Why do it?
  - Reasons for the lack of integrated land use-transport modeling in the USA
  - The role of modeling in planning
  - Theory versus expedience in modeling
  - Data issues
  - The range of approaches and frameworks
- Review of Alternative Approaches (20 hours)
  - Classical theory (Wingo, Alonso, bid-rent)
  - Lowry-Type Models (Lowry)
  - Microsimulation choice behavior models (MASTER)
  - Mathematical programming (Herbert-Stevens)
  - Econometric (EMPIRIC)
  - Urban systems models (NBER, CAM)
  - Spatially disaggregated input-output models (TRANUS, MEPLAN, DELTA)
  - Bid-choice (Ellickson, Martinez, UrbanSim)
- Operation of TRANUS (6 hours)
  - Software design
  - Modules
  - Inputs and outputs
- Statewide Model (6 hours)
  - Components of model
  - Operation
  - Inputs and outputs
- Operation of UrbanSim (6 hours)
  - Software design
  - Modules
  - Inputs and outputs

- The Second Generation Models (18 hours)
  - Components of models
  - Operation
  - Inputs and outputs

Tutorial sessions will be interspersed with the lectures, in particular starting after the review of alternative approaches. These will be used to consider assigned problems concerning the alternative approaches, with the intention of reinforcing the concepts covered, and the operation and particular aspects of both the Statewide model in TRANUS and the metropolitan model in UrbanSim. Laboratories will also be conducted concerning the representation of the hypothetical 3-5 zone study area using TRANUS and using UrbanSim, where the focus will be more hands-on operation and understanding of the model representation, inputs and outputs.

Doug Hunt will lead this task and coordinate all of the instructors. He will also cover the Introduction and General Issues lectures. He will also give some of the Review of alternative approaches lectures and some of the lectures concerning TRANUS and its application in the Statewide model. Pat Costinett will give some of the lectures concerning TRANUS and its application in the Statewide model. Paul Waddell will give some of the Review of alternative approaches lectures and the lectures concerning UrbanSim and its application in the Metropolitan model. All three will participate in the tutorial and laboratory sessions as appropriate.

Products: A series of lectures, tutorials and laboratories will be conducted at different points in the project. A total of 21 days of training will be provided under this contract.

Schedule: This task will begin upon ODOT approval of the training plan (Task 2B), and will last the duration of the contract. Training sessions will be scheduled at times and locations mutually agreed upon between ODOT and the consulting team.

Task 2E: Coach staff in model applications

As ODOT and MPO staff transition from the classroom and laboratory environment into practical applications of state, substate, and metropolitan models, complex issues and problems will undoubtedly arise that could not have been adequately foreseen in the training preparation. These problems will range from errors and shortcomings in available data, to details in the operation of the software, to interpretation of model output — their significance and meaning. In order to provide a bridge between the classroom and practical application of the model, the consultant team will reserve 20 days of time to assist ODOT and MPO staff in this regard.

Determination as to the appropriateness and timing of this continuing support will be at the discretion of the ODOT project manager. This assistance could take one of many forms including, but limited to, telephone assistance, on-site guidance and direction, to “hands-on” problem solving. To the maximum extent possible, this assistance will be provided in the context of actual case studies or projects throughout the state. Experience seems to dictate that a much deeper understanding of the models and their supporting software is facilitated when faced with real data and analysis problems. The upcoming I-5 corridor study would assuredly represent the most complex and challenging application of the first generation models.

Product: The consulting team will provide assistance at a time and in a manner prescribed by the ODOT project manager. A total of 20 days of assistance will be provided under this contract.

Schedule: The assistance can begin with a notice to proceed on the contract, but will most likely begin after the development of the training plan (Task 2B). The assistance will be provided throughout the life of the contract.

Task Set 3: Development of Second Generation Models

The consulting team will develop a detailed model specification that encompasses these elements and many others that will emerge from the general model design in Task Set 1. The detailed specification will include the identification of data requirements, which will be discussed separately. We will develop the application platform and carry out model calibration, and will develop recommendations for further research and development. Each of these tasks are described below.

Task 3A: Develop detailed model specifications

A detailed model specification will be developed, drawing heavily from several sources of information:

- The draft recommendations for second generation models developed during Task Set 1;
- The comments of the oversight committees, both from formal meetings and email communications;
- Feedback from attendees at the Symposium (Task 2A);
- What we learn from the historical validation of the prototype metropolitan land use model (Task 3E);
- Recent literature on integrated land use-transportation modeling; and
- The capabilities and requirements of ancillary models and data, such as geographic information systems and transportation system performance packages (Task 4A).

Product: The model specification will be presented in the form of a technical report, and will contain the information necessary to begin the development of the application platform, data collection, and model estimation.

Schedule: The draft technical report will be submitted by 21 March 1999. The final technical report, incorporating comments from the oversight committees and ODOT, will be completed by 15 April 1999.

Task 3B: Enhance data to satisfy model architecture and specifications

Many of the data developed during the first generation modeling work will be directly usable in the second generation model as well. We will seek to maximize the continued use of the existing data. Indeed, one objective of this task will be to make better use of the existing data. One area is which this can be done is the application of robust regression techniques to minimize the influence of outliers in the housing price data, a continuing source of frustration in model calibration. Many of the problems with calibration have been traced to these outliers. Robust regression techniques will provide a systematic means of testing the data to identify outliers; in general these techniques are more appropriate for messy data than estimation based on ordinary least squares regression. They offer considerable promise for models with more than one independent variable,

where visual identification of suspect data points is not possible. Another example of making better use of existing data will be in the geocoding and analysis of the travel survey data. These are presently coded at the zonal level. Some zones are very large, resulting in loose estimates of average trip length. By recoding these observations to the grid system described earlier we can obtain much better precision in our analyses of these data.

The grid system described earlier will facilitate the fusing of data from heterogeneous sources. For example, a Census tract might cover several grid cells; each cell would assume the value of mean or median statistics from the tract above it, and would receive its proportional share of total statistics for that block. In instances where the border between tracts falls within a cell, a weighted average of the values from each tract is used. Other data, such as employment inventories, are typically available by zip code. Using a similar overlay technique, the values can be "pushed down" to the grid cell level. We anticipate combining data from several sources in this manner, obviating the need to massage them into a common zone structure. The zones will still be used, but the necessity for forcing all data to conform to their boundaries will be considerably reduced. It should be emphasized that almost all of the data on hand can be used with a grid approach with little modification; in most instances some improvement can be gained by changing the locational attributes to most accurately place them in individual cells (e.g., recoding the survey data to points rather than polygons). The consulting team will develop the grid system during this task, as well as determining which data (if any) should be reworked to take advantage of the finer grid system.

The consulting team will develop recommendations for the representation and rendering of transportation networks. An important element of this task will be to review the association between their representation in GIS coverages elsewhere in the Department, in order to facilitate the linkage of the model with other analytical tools (as described in Task Set 4).

A final major element in this task will be the identification of new data requirements. We proposed using the 1995 American Traveler Survey in the development of the first generation models. These data have just recently become available, and will be acquired and analyzed for the second generation modeling work, particularly with respect to the visitor models. A lack of data on trips entering and leaving Oregon at the external stations is a major deficiency in the model; the collection of such data would significantly improve the operation of the model, especially in the Upper Willamette Valley. The consulting team will prepare recommendations for new data collection, including a discussion of the sample frame and methodology. The team will work closely with ODOT to design, conduct, and analyze the survey results, as directed by ODOT.

Products: A technical report will be prepared describing the data required to satisfy the model architecture and specifications developed in Task 3A. It will include, but not be limited to, the geographic referencing systems to be used, transportation networks, polygon data (such as Census tracts and zipcodes), and travel behavior data. The required data will be collected or synthesized, as appropriate, and provided in electronic format. Data dictionaries and a summary of the data collection methodology will also be provided.

Schedule: The activities in this task will begin not later than 1 October 1998, and will be completed not later than 1 February 2000.

Task 3C: Develop application platform

The vision we outlined for our second generation models above will necessitate some fundamental changes from the platforms developed for the first generation models. As before, we envision using a hybrid of custom written software and the ArcView and ARC/INFO platforms. The custom software will be written using the Java programming language, perhaps with certain aspects written in the C programming language.[1] The target operating system will be Microsoft Windows NT 5.0, which is available now in beta format and will be finalized within the first year of this project.

One important part of the detailed model specification (Task 3A) will be the description of the application platform and its components. The first step in this task will be to design a parallel (and complementary) application platform specification that will guide the project staff in the preparation of platform components. The specification will include, but not be limited to, programming conventions and acceptable practices, file and library naming and source control protocols, common utilities (such as sorting programs), and the overall class structure envisioned for the platform. This document will be a dynamic creation, undergoing revision as required on a periodic basis. A final version of this document will be delivered at the end of Task Set 3.

The application platform will be built in a modular fashion, from several perspectives. There is an obvious benefit to having different parts of the platform (e.g., economic model, database manager, geographic information systems interfaces, network assignment models) in an object-oriented format. Early versions of each object can be updated and replaced without disrupting work in other areas of the platform. We propose to also organize the platform in such as way as to reduce its dependence upon the host operating system, segmenting the code into cross-platform (XP) and front-end (FE) components. This is much easier to do in an object-oriented environment such as Java, but still requires conscious decisions to ensure it will be incorporated into the design of the platform. We recognize ODOT's commitment to the Windows operating system, and will orient our efforts towards it. However, the first generation models are heavily computationally intensive, and the second generation models might be even more so. There may be benefits from implementing it on other platforms. While we do not anticipate doing so in this contract, we feel it is imperative that ODOT retain that option without a substantial rewriting of software. Separating the XP components from the FE ones will reduce the effort required to do so.

We propose to orient the software from the outset towards eventual availability outside of ODOT. To that end we suggest using the Open Software Foundation's General Public License, under which ODOT would copyright the software but then make the source code available to other users with the provision that any changes to it must be contributed back to ODOT. This will facilitate the sharing of the program with other agencies, as well as permitting it to be extended by others in ways that would be beneficial to both parties. This has important implications for the application platform specification, as it implies that no proprietary components can be included in the application platform that would prevent its dissemination under the General Public License.

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1. Java makes provisions for what it calls native interfaces with the C programming language, enabling mixed language programs. While it is generally not an optimal software design, there are some instances where it might make sense from a performance standpoint. Java is much slower at matrix operations than C, for example, and might be a more suitable tool for instances where large arrays are handled (e.g., network assignment).

The application platform specification will conclude with standard for documentation, both with respect to comments in the programs themselves as well as user documentation. This is an essential element of software design that often goes neglected. We will make effective use of software design and development tools, including the javadoc utility, to generate and update the user documentation.

Products: A technical report will be prepared describing the specifications for the application platform, to include standards for software development and documentation. A functional application platform will be developed that will enable the development, testing, and implementation of the models specified in Task 3A. The application platform components, including source code, data, and other resources, will be provided in electronic format. A users manual will be completed that describes the installation and use of the application platform components. Third party components that may form part of the platform (licensed copyright programs such as ArcView or EMME/2) will not be included in these deliverable items.

Schedule: The draft technical report will be completed by 15 April 1999. Work on the platform will begin not later than 1 April 1999, and will be completed by 1 April 2000.

Task 3D: Develop second generation state/substate models

As noted in the introduction to this task set, we propose to not only develop second generation statewide and substate models, but to implement them in a common, scalable framework with the metropolitan models. The development and implementation of the unified model will be carried out in this task. The work activities in this task will focus on the estimation and calibration of the second generation model. In many instances, the model development work will make extensive use of the work carried out in the first generation models. For example, the average number of tons per truck by commodity classification derived from the truck intercept survey data will not change, and therefore not be estimated again (unless a change in the sector definitions dictates it). It is anticipated that a large number of these previously calibrated relationships will continue to be used in the second generation models.

An important and significant input to this process will be the economic forecasts developed during the first generation modeling work. We wish to return to the original 27 sectors specified in the first generation model, for we feel that the effects of sectoral aggregation have reduced the power and accuracy of the resulting models. The required input-output table and supporting data are already assembled. However, we anticipate that the economic modeling work will need to be revisited in order to include an explicit representation of the economies of the surrounding states. Collaborative work has already begun to revise the economic forecasting methodology used in the first generation, through working with economists from the Department of Administrative Services and other state agencies. We believe that this is important work that needs to continue in order to keep the second generation models consistent with statewide economic forecasts promulgated and used by other state agencies.

Because the activity location and transportation models are based upon an extension of the input-output matrices, the structure and specification of the economic forecasting elements must precede most of the other model development work.

We anticipate that the majority of this task will begin once the final model specifications (Task 3A) and application platform specifications (Task 3C) have been approved. Some of the work, particularly model estimation, can be done with statistical modeling packages such as SAS or S-Plus and can proceed without the application platform being in place. However, we anticipate using model estimation and calibration results obtained in the first generation models as a starting point in the second generation models, reducing the amount of original model estimation that will be done within the first six to nine months of the contract.

It should be emphasized that the work in this task will provide feedback to the model specification. As results are obtained from model development work it can be anticipated that a limited amount of revisions to the model specification will be carried out.

Products: Given that the design of the second generation models has yet to begin, it is somewhat premature to specify the products of this task in detail. However, the interaction of this task with others can be described, as well as our general approach to carrying out the work. We anticipate that four major steps in the development process will be:

- Estimation of selected model components, using the data developed in Task 3B as well as information and data from the first generation models;
- Calibration of individual model components, using the application platform developed in Task 3C;
- Testing of the overall model convergence between the activity location and transportation model components; and
- Application and testing of the model through time.

A technical report describing the development, estimation, and calibration of the second generation models will be prepared. The final models, including source code, data, and other resources, will be provided in electronic format. A users manual will be completed that describes the installation and use of the modeling components. Third party components that may be used in the modeling process (such as EMME/2 or STAN) will not be included in these deliverable items.

Schedule: The work in this task will commence not later than 1 April 1999, and will be completed by 1 May 2000. A draft technical report will be submitted by 1 May 2000. The final technical report, incorporating comments from the oversight committee and ODOT, will be completed by 30 June 2000.

Task 3E: Develop first generation metropolitan model

The Peer Review Panel, meeting in October 1997, suggested that a historical validation of the prototype metropolitan model should be a high priority. Work has been carried out this Spring to obtain the required data, with the goal of being ready to begin historical validation in mid-summer. We propose that this work be undertaken immediately as one of the first tasks in this contract. The information gained from the historical validation process will be invaluable for informing ODOT and the consulting team about the stability of such models for forecasting extended time series. The lessons learned from this exercise will be essential inputs to the design of the second generation models.

The procedure for historical validation is straight-forward. Data from 1980 onwards has been assembled, edited, and checked to ensure that it meets the requirements of the model. The first work element will be to prepare the datasets in the format required by the UrbanSim model. The model will then be run for at least a twenty year horizon, in one year intervals (the travel model will be run only on five year intervals, as the travel costs and accessibilities are not likely to change much from year to year). The resulting forecast of land use changes will be compared to observed changes from 1980 to 1995. The model should be capable of replicating the changes in land use and value over that period. The dynamic time series aspects of the model will be calibrated during this step.

We do not propose to conduct further work in this task beyond the historical validation. As noted earlier, we want to use the insights gained during this work to inform the design of the second generation models. The information gained from this task will be incorporated into the first generation model to the extent possible (without requiring changes to the underlying software). Because we envision folding the metropolitan model into the others to recreate a unified model, we do not wish to devote further resources to its development.

Products: A technical report will be prepared describing the historical validation process in detail (including sources and extent of data), steps taken to calibrate the model, findings and their interpretation, and their implications for design of the second generation models.

Schedule: This task will begin upon notice to proceed on the contract. Assuming a contract start date of 1 July 1998, the draft technical report will be submitted by 1 December 1998. The final technical report, incorporating comments from the oversight committees and ODOT, will be completed by 1 January 1999.

Task 3F: Make recommendations for model improvement

This task will be the final task completed under this contract. The consulting team will review the work completed to date on the second generation models, and will prepare recommendations for further research and development. This review will cover the design and theoretical aspects of the model, the model and data architecture, the application platform, its interaction with other models, and data requirements. The deficiencies of the model with respect to the TLUMIP objectives will be identified, and recommendations for addressing them with be provided. Lastly, the consulting team will explore opportunities for collaboration with other agencies and researchers for the continued evolution of the model.

Product: A technical report outlining the recommendations will be prepared by the consulting team.

Schedule: A draft technical report will be prepared by 15 May 2000. The final report, incorporating comments from the oversight committees and ODOT, will be completed by 30 June 2000.

Task Set 4: Integration of Model Outputs

The integrated modeling of economic interactions, land use, and transportation is an important step in the continued advancement of knowledge of the interactions between them. However, such modeling is only one part of the overall transportation planning process at the Oregon DOT.

The ability to combine the results of the modeling work with other analyses and data maintained by the Department is an important consideration in the design and implementation of the second generation models. The work to be completed in this task set includes an assessment of the data requirements of other packages with which the modeling results will be combined, and the development of automated linkages with these models and databases.

Task 4A: Identify data and data formats needed in analysis software

The consulting team will review the planning and performance monitoring systems used by ODOT, to include the Highway Performance Monitoring System Analytical Package (HPMS-AP), the Highway Economic Requirements System (HERS), and the Surface Transportation Efficiency Analysis Model (STEAM). The review will include the assumptions that each of these packages makes about the quality, scope, and extent of the data provided as well as the input data format. Recommendations will be provided for the automation of these linkages, both for the first and second generation models. The consulting team will also consider the opportunity for providing the same type of output and reports that these models provide, especially the STEAM package. It may be possible to replicate the analysis process within the second generation models as easily as it would be to establish an automated linkage with it.

Products: A working paper will be prepared describing the various packages for which data exchange are desired, as well as recommendations for the development and implementation of such linkages.

Schedule: A draft working paper will be prepared by 1 September 1998. The contents of the working paper, including ODOT comments, will become a part of the Task 1C recommendations.

Task 4B: Develop methods for combining model outputs

Once the recommendations developed in Task 4A have been approved, the process will be implemented in both the first and second generation models. The linkages from the first generation models will be post-processor programs that will directly access databases and files generated by the host package, formatting the data in the format required for the analytical packages. This work will begin immediately after approval of the recommendations, in order to place the tools into operation as quickly as possible.

Products: The linkages to the second generation model will be incorporated into the final model and application platform specifications (Tasks 3A and 3C, respectively). In both instances the development work will include the preparation of user documentation for using the linkage programs, as well as examples of their use. Custom data exchange tools developed during this task, including source code, data, and other resources, will be provided in electronic format. A users manual will be completed that describes the installation and use of the data exchange tools.

Schedule: The work in this task will begin upon ODOT approval of the recommendations from Task 4A. A draft of the deliverable items will be submitted by 1 May 2000. The final deliverable items, incorporating ODOT review, will be submitted by 30 June 2000.

Management and Planning

Parsons Brinckerhoff has a written *Project Management Manual* which is published and periodically updated by the firm's Office of Professional Practice and distributed to our project managers, engineers, planners, and construction specialists. This manual specifies the procedures we expect our professionals to implement during the course of any project they manage.

One of the basic tenets we stress for ensuring prompt response to a client's request is communication. Keeping team members apprised of every facet of a project ensures adherence to budget and schedule milestones. Thus, we require our project managers to issue a project procedures memorandum which includes:

- Summary of the scope of services;
- List of deliverables and responsible person(s) assigned;
- Project organization directory (names, addresses, telephone numbers of all key participants);
- Correspondence procedures;
- Job number and task numbering system;
- Time and expense report special instructions;
- Cost control reporting system;
- Technical criteria, practices, and procedures; and
- Billing instructions

Another management mandate is the requirement to schedule project reviews to ensure the proper coordination of project activities and deliverables. Typical subjects addressed at these review sessions include:

- Significant events, actions taken, and decisions made since last review;
- Project performance per contractual terms;
- Client and team relations;
- Project quality control and quality assurance program;
- Schedule status;
- Cost versus budget status;
- Labor requirements;
- Major problems — actual or anticipated — and remedial solutions;
- Decisions and actions required; and
- Review of deliverables and other data.

We propose conducting by-weekly teleconference sessions comprised of the ODOT and PB Project Directors and each of the Principal Investigators. In preparation for these sessions, each of the relevant subject topics identified above will be formulated into a meeting agenda. The presence of an agenda is an excellent mechanism to focus the discussion and achieve maximum results.

Periodic reviews with ODOT staff and the Modeling Steering Committee represents a second key method of communication. The frequency and timing of these meetings will be determined jointly by the PB and ODOT project managers. A concerted effort will be made to insure that these meetings contain substantive technical material content to encourage attendance and efficiently utilize the expertise and technical contributions of the committee. Finally, at key milestone points the

Peer Review Panel will be assembled to critically review, comment, and contribute ideas and concepts to each of the technical components defined in the project. In the current contract, contributions of the Modeling Steering Committee and the Peer Review Panel have been essential to the success achieved in the first generation model development.

A particularly successful component of the existing contract has been the extensive use of the Internet to exchange information, data, and ideas about technical project issues. This primarily involves continued use of the ODOT World Wide Web (WWW) page to quickly and efficiently provide public access to technical papers, working documents, and reports. The ODOT ftp server has also been essential to the sharing of data, GIS files, interim documentation. Professionals throughout the country have been able to monitor the progress and accomplishments of the project through these means.

Parsons Brinckerhoff also requires project managers to prepare a project management plan containing:

- Work breakdown structure;
- Budget;
- Project management and control systems;
- Project staffing and definition of responsibilities; and
- Quality assurance/quality control plan.

The project management plan is put together using a process which considers:

- The “best fit” of tasks, activities, time and budget targets, people, and performance milestones to achieve all project objectives;
- Resources: personnel, equipment, and space; and
- Back-up plans and alternatives to accommodate changing conditions.

Parsons Brinckerhoff stresses the use of management tools. Given the complexity and rapidly changing conditions that are sure to permeate this phase of the TLUMIP project, we have identified placed Bob Brannan, Portland Area Manager and Principal-In-Charge of this project, in a role that is intended to keep an objective view of the progress of the project both in resource and budgetary terms, and assist the ODOT and PB Project Directors in resolving whatever problems or issues arise. We feel that this emphasis on project management will contribute to the most efficient and effective use of project funds and resources.

Quality Control Plan

The basic idea of the quality control activity is to have an independent person reviewing the work. This person should not be “wrapped up” in the day to day technical operations of the study nor should the person have any responsibility for producing deliverables in the study. Yet this person should possess a technical understanding of the project and be looking for “opportunities” for what can go wrong and develop procedures to either identify these “mistakes” or, better, prevent them from happening. We will place this responsibility in the hands of our Project Director, Bill Davidson. Bill will have the responsibility to work closely with the ODOT Project Manager, Bob Brannan, and each of the Principal Investigators to invoke quality control procedures and manage the project resources in a manner consistent with the goals and objectives of the second generation models.

For each major task set of quality control procedures will be established. These procedures could be fairly simple checks to more complex specifications of how to evaluate data, model development and estimation results, and software development. For example, the quality control plan should identify the summary tabulations of the calibration data that are required to insure that errors in the base data are identified prior to performing a significant amount of calibration work. The Quality control plan will also require that software standards be developed, for the software to be written in the project, and that these standards will be adhered to. Part of these standards will be that a high level program design that will be written prior coding the program. This design should identify the input data, the output data, the parameters and options for the program, and the major algorithms used in the program

Progress Report Procedures

Progress reporting will occur in two areas, management reports and technical reports. Management reports will include detailed monthly progress reports, submitted to ODOT each month. These reports describing the current status of the project will be prepared to:

- Highlight significant accomplishments;
- Target potential problem areas needing special attention or points of coordination;
- Compare actual work progress with contractual obligations; and
- Show the current period and cumulative financial status.

The reports will include updated output from Microsoft Project, indicating all progress to date and resources expended. This update will include any changes in schedule, sequence, or resource loading. If any schedule slippage has occurred, a plan for bringing the work back on schedule and completing the work within schedule and budget will be included.

The progress report will be distributed to ODOT and to all key team members to maintain effective exchange regarding the project status, budget, and schedule. Keeping the project on schedule is one of the elements that will be given constant attention by the Project Director to ensure that individual staffing and completion commitments are met by the consulting team.

Resources and Scheduling

A 24 month schedule has been established for the project, with the possibility of a contract amendment for additional time and funding. We have structured the work elements to meet the 24 month project timeline. Our work plan and schedule includes each of the tasks described in the RFP. However, we do not propose to complete the work plan sequentially in the order listed. We propose to begin some tasks in Task Sets 3 and 4 immediately, so that they can inform the overall design of the second generation models. Our proposed schedule for completing the work, as well as the resources we will devote to it, are described in this chapter.

The RFP states that the contract may begin as early as May, 1998. In the discussion and exhibits that follow, we assume that our work on this contract will begin in July, 1998. We are retaining the same team from the first generation modeling work, who are committed to completing that work by the end of June, 1998. While some tasks could begin before the end of the current contract, we feel that both parties would be much better served by not stretching the resources between the two contracts.

The overall project calendar is shown in Exhibit 2, and a description of each task in Exhibit 3. Our

proposed commitment of principal staff by task is shown in Exhibit 4. As shown in the calendar (Exhibit 2), we believe that several tasks can begin immediately in parallel:

- Rick Donnelly will lead the team's efforts on Task Set 1. We propose to reassemble the oversight committees quickly, holding our first meeting with them to discuss the progress made in the first generation modeling work. We plan to elicit their comments and feedback on what went right and what did not, as the starting point for our review of the current status of the models (Task 1B). There will be a time lag in the preparation of this report, during which time all team members will be preparing materials and presentations for the Symposium. Once the Symposium is over, attention will turn back to the finalization of the review of the current status and preparation of the draft recommendations for the second generation models (Task 1C).
- We believe that there will be substantial benefit to conducting the first training course before the fall Symposium (29 September-1 October 1998), and thus will work hard to complete the antecedent work before then. Doug Hunt will lead our efforts in this area, assisted by Paul Waddell and Patrick Costinett. Rick Donnelly and Bill Davidson will devote their attention during this time to preparations for the Symposium.
- We propose to begin the historical validation of the prototype metropolitan land use model (Task 3E) immediately. Doug Hunt and Paul Waddell will lead this work, and be assisted by Sam Seskin and Larry Conrad of PB's Portland office. We believe that the knowledge gained from this task will be essential in order to properly design the second generation models. Carrying out the design without this knowledge may result in a specification that will perform satisfactorily in a cross-sectional sense (such as calibrating to a trip length frequency distribution from a single year) but not well from a time series perspective. The dynamic qualities of these models are as important as the static relationships embodied within them; a proper design requires all participants to understand the emergent dynamic behavior of the first generation models.
- We also propose to conduct the review of the data and formats required for the integration of model outputs (Task 4A) early in the project, in order to allow it to also inform the design of the second generation models. Susan Hendricks of KJS Associates will organize and lead this work.

The coaching of ODOT and MPO staff in the application of the models will begin after the first class session, and will continue as needed throughout the contract. Pat Costinett will lead this effort. We have specified a level of effort that will permit our staff to conduct several coaching sessions over that time, for a total of 20 days of effort. We will combine these sessions with other work at ODOT during the same time so as to permit this work to be spread out as needed rather than in discrete one-day units.

The development of the general design for the second generation models do not begin until the fifth month of the contract. The primary reason for this is its dependency upon Task 3E, the historical validation of the prototype metropolitan land use model. As stated earlier, we believe that the knowledge gained from the historical validation will be invaluable in the second generation model design process. This activity will be followed by review by the oversight committee and finalization of the draft model specification. This second meeting of the committees will permit them to review both the general design and the historical validation work. We anticipate that the

review and finalization of the general design will take approximately six weeks. Once these tasks are complete, several major tasks will begin:

- We believe that certain data requirements will become obvious early in the review and design process, and that work can commence on them in advance of the final model specification. Rick Donnelly and Susan Hendricks will supervise these activities. An example is the collection of data at external stations around the state. It is hard to envision any model specification that will not require better data on trips flowing through these external points. Like the model coaching work, this task will continue through much of the life of the project, although it is very unlikely to be done so continuously over that period.
- The design and construction of the application platform will commence once enough of the salient elements of it are specified. We believe that many aspect of the application platform specification will not require as much review by the oversight committees as the models themselves, and we have thus shown this work beginning before the final model specification is completed. Bill Davidson will coordinate this work, which will be jointly supervised by Rick Donnelly and Paul Waddell.
- The final model specification will be completed and presented to the oversight committees (the third joint meeting). Once reviewed by all parties, it will be quickly finalized so that work can begin as quickly as possible. Rick Donnelly will oversee this task.
- We anticipate beginning the development of the second generation models (Task 3E) by the tenth month of the contract. This is the largest and most challenging of the tasks in the contract. This work will be directed by Rick Donnelly, with substantial contributions of each Principal Investigator and supporting staff. The fourth and fifth meetings of the oversight committees will be scheduled at the midpoint and conclusion of this task.
- The second and third training sessions will be presented. The second session will continue where the first left off, covering the theoretical aspects of integrated land use-transport modeling and the use of the first generation models. The third and final session will cover the use of the second generation models, and is slated for late in the contract. Doug Hunt will continue to lead these efforts.

The project will conclude with the final implementation of the model output integration (Task 4B) and the preparation of recommendations for further work (Task 3F).

Our goal is to specify a robust model that can be completed within the schedule and budget given. There is obvious uncertainty at this point about the final specification of the model, although we have described our vision of it in general terms in this proposal. Because we are blazing new trails with this type of model, a review of the detailed model specification may reveal that certain components cannot be completed within the schedule and budget remaining in the project, either because of data requirements or dependencies on the completion of other components. We therefore propose that a review of the remaining budget and schedule be carried out immediately after the oversight committee review of the draft model specifications. While we will present a model specification that can be completed with the remaining resources, there may be sound theoretical or operational considerations that both parties will need to consider in order to reach the best decision in light of the TLUMIP goals and objectives.

Exhibit 1: List of Project Deliverables

Description	Associated Task(s)	Draft Due	Review Time
Critical review of first generation models (working paper)	1B	September 98	1 month
Draft and final recommendations for development of second generation models	1C, 1E	January 99	1 month
Transportation and land use modeling conference proceedings	2A	October 98	1 month
Training plan	2B	July 98	1 month
Training materials	2C	Varies[a]	2 weeks[b]
Detailed model specifications	3A, 3B	April 99	6 weeks
Application platform specification	3C	April 99	1 month
Model applications for implementing statewide, substate and metropolitan models	3C, 3E	May 99	1 month
Documentation and source code for model applications	3C	October 99	1 month
Second generation statewide, substate and metropolitan models	3D	May 00	1 month
Metropolitan area model[c]	3E	November 98	1 month
Recommendations for future model improvements	3F	June 00	1 month
Working paper on data and formats required for integrating of model outputs	4A	August 98	2 weeks[c]
Applications for combining model outputs including documentation and code	4B	June 00	2 weeks[c]

a. Training classes are proposed at several points throughout the project. For example, training on the second generation models are deferred until the end of the project. The training materials appropriate for each session will be developed two weeks prior to each course.
b. Review by the oversight committees is not anticipated for this deliverable item, reducing the amount of time required for review.
c. We propose to carry out historical validation of the prototype metropolitan model (UrbanSim), and then to fold its continued development into a unified second generation model, as described in Task 4E.

Exhibit 2: Project Calendar

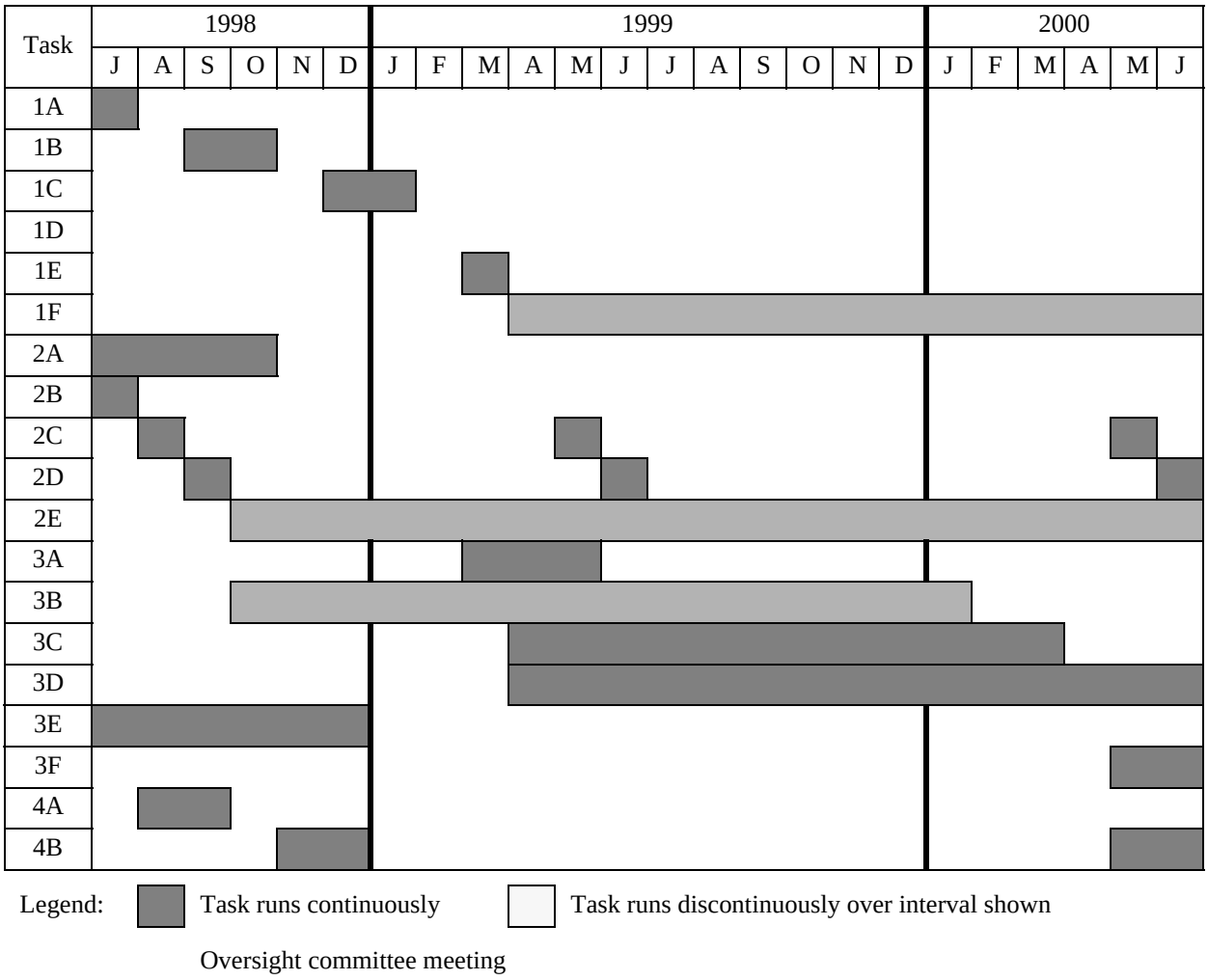

Exhibit 3: Project Schedule

Task	Description	Begin	End	Draft Due
1A	Reactivate Peer Review Panel and Model Steering Committee	1 Jul 98	1 Aug 98	10 Jul 98
1B	Review current status of the state, substate, and metropolitan models	1 Sep 98	1 Nov 98	1 Oct 98
1C	Draft recommendations for development of second generation models	1 Dec 98	1 Feb 99	1 Jan 99
1D	Discuss recommendations with oversight committees	1 Feb 99	1 Mar 99	15 Feb 99
1E	Finalize recommendations	15 Feb 99	15 Mar 99	1 Mar 99
1F	Establish university research linkages	1 Apr 99	30 Jun 00	10 Jul 98[a]
2A	Conduct a state conference on integrated transportation and land use models	1 Jul 98	15 Nov 98	15 Oct 98[b]
2B	Develop a training plan	1 Jul 98	1 Sep 98	1 Aug 98
2C	Prepare training materials	1 Aug 98	30 Jun 00	Varies[c]
2D	Conduct classroom training on models	1 Sep 98	30 Jun 00	Varies[c]
2E	Coach staff in model applications	1 Jul 98	30 Jun 00	
3A	Develop detailed model specification	1 Mar 99	15 Apr 99	21 Mar 99
3B	Enhance data to satisfy model architecture and specifications	1 Oct 98	1 Feb 00	TBD[d]
3C	Develop application platform	1 Apr 99	1 Apr 00	15 Apr 99[e]
3D	Develop second generation models	1 Apr 99	30 Jun 00	1 May 00
3E	Develop first generation metropolitan model	1 Jul 98	1 Jan 99	1 Dec 98
3F	Make recommendations for model improvement	1 May 00	30 Jun 00	15 May 00
4A	Identify data and data formats needed in analysis software	1 Aug 98	1 Oct 98	1 Sep 98
4B	Develop methods for combining model outputs	1 Nov 98	30 Jun 00	1 May 00

a. Recommendations for establishment of the linkages will be provided on this date, although they are expected to begin once the research needs are identified in the draft general design (Task 1E) and will continue through the remainder of the project.
b. Denotes submission of draft proceedings from the Symposium.
c. Training classes are proposed at several points throughout the project. For example, training on the second generation models are deferred until the end of the project. Training materials appropriate for each session will be developed two weeks prior to each course.
d. To be determined based upon requirements identified in the general model design (Task 1E) and model specifications (Task 3A).
e. Denotes submission of draft application platform specification.